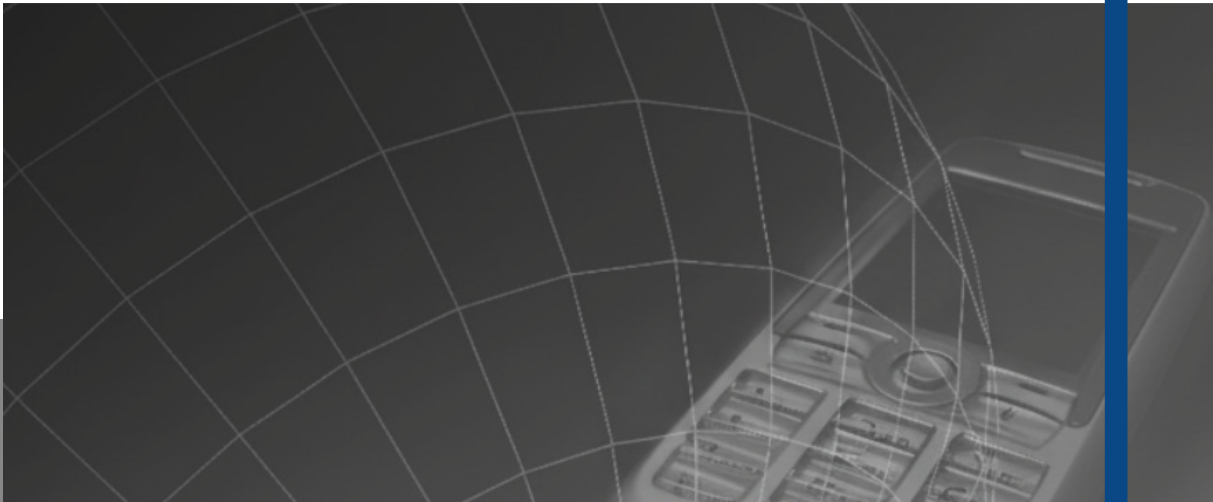




15th International Conference on Recent Challenges in Engineering and Technology ICRCET-2026



22nd-23rd April, 2026



Bangalore, India

**Organized by: Primus School of Management Studies, India
IFERP Academy, India**





15th International Conference on Recent Challenges in Engineering and Technology
(ICRCET 2026)

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Conference Theme



“Engineering for a Changing World: Creating Sustainable Solutions for the Future.”

Preface

We cordially invite you to attend the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026) on 22nd-23rd April, 2026. The main objective of ICR CET-2026 is to provide a platform for researchers, students, academicians as well as industrial professionals from all over the world to present their research results and development activities in relevant fields of Recent Challenges in Engineering and Technology. This conference will provide opportunities for the delegates to exchange new ideas and experience face to face, to establish business or research relationship and to find global partners for future collaboration.

These proceedings collect the up-to-date, comprehensive and worldwide state-of-art knowledge on cutting edge development of academia as well as industries. All accepted papers were subjected to strict peer-reviewing by a panel of expert referees. The papers have been selected for these proceedings because of their quality and the relevance to the conference. We hope these proceedings will not only provide the readers a broad overview of the latest research results but also will provide the readers a valuable summary and reference in these fields.

The conference is supported by many universities, research institutes and colleges. Many professors played an important role in the successful holding of the conference, so we would like to take this opportunity to express our sincere gratitude and highest respects to them. They have worked very hard in reviewing papers and making valuable suggestions for the authors to improve their work. We also would like to express our gratitude to the external reviewers, for providing extra help in there view process, and to the authors for contributing their research result to the conference.

We would like to extend our appreciation to all participants in the conference for their great contribution to the success of ICR CET-2026. We would like to thank the keynote and individual speakers and all participating authors for their hard work and time. We also sincerely appreciate the work by the technical program committee and all reviewers, whose contributions made this conference possible. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard work.

About ICRCET - 2026

Emphasizes the critical role of engineering and technology in addressing today's global challenges while shaping a resilient tomorrow. As the world faces rapid urbanization, climate change, and technological disruption, ICRCET 2026 provides a platform for researchers, academicians, industry leaders, and innovators to collaborate on transformative ideas. The focus is on developing sustainable infrastructure, advancing digital technologies, and fostering interdisciplinary research that aligns with the United Nations Sustainable Development Goals (SDGs). By uniting diverse perspectives, the conference aims to inspire forward-thinking solutions that ensure a more sustainable, inclusive, and technologically empowered future.

Conference Objectives – ICRCET 2026

Objectives of 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET-2026)

- **Foster Knowledge Exchange:** Provide a global platform for researchers, academicians, industry experts, and practitioners to share innovative ideas, research findings, and best practices in engineering and technology
- **Promote Interdisciplinary Collaboration:** Encourage collaboration across diverse engineering disciplines to address current and emerging global challenges through integrated and sustainable solutions.
- **Highlight Emerging Technologies:** Explore advancements in areas such as Artificial Intelligence, IoT, Renewable Energy, Smart Infrastructure, Robotics, and Sustainable Materials that are shaping the future of engineering.
- **Encourage Research and Innovation:** Inspire participants to present novel research outcomes, prototype developments, and innovative approaches that contribute to industrial growth and societal development.
- **Focus on Sustainable Development:** Align engineering solutions with global sustainability goals to create technologies that balance economic growth, environmental protection, and social well-being.
- **Provide Networking Opportunities:** Facilitate meaningful interactions, collaborations, and partnerships among participants for future research, publications, and professional growth.

Scope of the Conference

The scope of ICRCET-2026 covers a wide range of topics and disciplines within engineering and technology, including but not limited to:

- Emerging Technologies: Artificial Intelligence, Machine Learning, Internet of Things (IoT), Robotics, Blockchain, and Cloud Computing.
- Sustainable Engineering Solutions: Renewable Energy Systems, Smart Grids, Green Manufacturing, and Sustainable Materials.
- Civil & Structural Engineering: Smart Cities, Urban Infrastructure, and Disaster-Resilient Design.
- Electronics & Communication Engineering: 5G/6G Networks, Embedded Systems, Wireless Communication, and VLSI Design.
- Mechanical & Automotive Engineering: Advanced Manufacturing, Mechatronics, and Automotive Technologies.
- Computer Science & IT Innovations: Cybersecurity, Data Science, Human-Computer Interaction, and Software Engineering.
- Interdisciplinary Approaches: Engineering Education, Technological Entrepreneurship, and Cross-Disciplinary Research.

The conference also provides opportunities for networking, industry-academia collaboration, and exploring global partnerships that promote innovation-driven growth.

About IFERP

The IFERP Academy is a committed professional organization that advances engineering, science, and technology. IFERP anticipates a global scientific community brought together by digital innovation. This organization puts a great emphasis on promoting research activities, communicating the newest insights, and driving industrial trends.

IFERP has built strong networks throughout Asia, the Middle East, Europe, and countries such as Iraq, Malaysia, Australia, and more. They have incorporated networking, research support, publications, and worked in other scientific areas.

IFERP excels in organizing **International Conferences** that connect researchers worldwide. It holds important **international webinars**, publishes journals and publications that are indexed by Web of Science and SCOPUS, and provides thorough **research assistance and guidance**. Engaging in Youth Empowerment projects and encouraging Industry-Institute Interaction are key components of IFERP's goal. The organization is committed to enabling professionals through faculty advancement, skill development, and persistent research and publication initiatives.

- **Global Community Building:** IFERP exerts a lot of effort in building new communities all over the world. As community organizers, we control the conversations & inculcate passion for innovation amongst diverse groups.
- **Promoting Innovation Schemes:** IFERP has several schemes for students, professionals, researchers & organizations to being distinct innovators across all technology streams & sub disciplines.
- **Publicizing Research Publication:** Publication of research is the crucial aspect of IFERP's activities. IFERP also serves as a support center for early - career researchers aspiring to publish world-class research papers.
- **Our Origin:** Established by the Technoarete Research & Development Association (TRADA), IFERP was meant to serve as an accelerant for technological innovation worldwide.
- **Facilitating Multi-Disciplinary Collaborations:** IFERP encourages networking & collaborative partnerships on all fronts to result in a diverse collaborative atmosphere to gain abundance knowledge.
- **Access To Critical Funding & Resources:** IFERP has dedicated itself to fund for various efficient projects & activities to make it achieve successful outcomes beyond just meeting expectations.

What IFERP Does

IFERP is committed to improving the professional experience by providing a world-class platform to professionals. Their dedication extends to the following activities:

- **Academic Resource Accessibility :** They make academic resources and support available to aspiring scholars in both rural and urban locations.
- **Diverse Educational Program :** They organize a wide range of educational events such as workshops, conferences, webinars, seminars, guest lectures, short-term training programs, and faculty development programs.
- **Drive Innovation:** They work hard to foster curiosity and creativity, and stay up to date on the newest trends and advancements in the dynamic field of Engineering, Science, and Technology.
- **Knowledge Sharing and Collaboration:** They believe in the strength of the exchange of knowledge and actively collaborate with institutions, organizations, and associations to contribute to our shared objective of a better future.
- **Publication & Recognition:** They also provide opportunities for research articles to be published in reputable journals and actively promote and encourage transdisciplinary research activities.

IIFERP Mission & Vision

IIFERP's Mission: Upskilling the knowledge hub through technological innovation & excellence for the benefit of humanity.

IIFERP's Vision: A Digitally equipped robust, dynamic & swift professional community integrating academics & industry for upgraded technical implementation.

IIFERP's Value: IIFERP values the restoration of high level technological research, learning, collaboration, resource sharing & community-building traditions.

IIFERP's Goal: To serve as the foundation for all technological progress and advancement activities around the world.

Managing Director, IFERP



Mr. A. Siddh Kumar Chhajer

Managing Director & Founder, IFERP
Technoarete Group, India



Message:

On behalf of IFERP & the organizing Committee, I express my hearty gratitude to the Participants, Keynote Speakers, Delegates, Reviewers and Researchers.

The goal of the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026) is to provide knowledge enrichment and innovative technical exchange between international researchers or scholars and practitioners from the academia and industries in various fields of academics. This conference creates solutions in different ways and to share innovative ideas in the field of Recent Challenges in Engineering and Technology. ICR CET-2026 provides a world class stage to the Researchers, Professionals, Scientists, Academicians, and students to engage in very challenging conversations, assess the current body of research and determine knowledge and capability gaps.

ICRCET-2026 will explore the new horizons of innovations from distinguished researchers, scientists and eminent authors in academia and industry working for the advancements in Recent Challenges in Engineering and Technology from all over the world. ICR CET-2026 hopes to set the perfect platform for participants to establish careers as successful and globally renowned specialists in various fields of Academics.

Chief Executive Officer, IFERP



Mr. Rudra Bhanu Satpathy

Chief Executive Officer & Founder, IFERP
Technoarete Group, India



Message:

IFERP is hosting the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026) this year in month of April. The main objective of ICRCET-2026 is to grant the amazing opportunity to learn about groundbreaking developments in modern industry, talk through difficult workplace scenarios with peers who experience the same pain points, and experience enormous growth and development as a professional. There will be no shortage of continuous networking opportunities and informational sessions. The sessions serve as an excellent opportunity to soak up information from widely respected experts. Connecting with fellow professionals and sharing the success stories of your firm is an excellent way to build relations and become known as a thought leader.

I express my hearty gratitude to all my Colleagues, Staffs, Professors, Reviewers and Members of organizing committee for their hearty and dedicated support to make this conference successful. I am also thankful to all our delegates for their painstaking effort to make this conference successful.

Principal & Director, PRIMUS



Dr. Shaista Banu Harris

Principal & Director
Primus School of Management Studies
Bengaluru, India



Message:

It gives me immense pleasure to welcome all distinguished delegates, researchers, academicians, industry professionals, and students to the 15th International Conference on Recent Challenges in Engineering and Technology (ICRCET 2026), held on 22nd and 23rd April 2026 in Bangalore, India.

We are living in a time of unprecedented transformation. Technologies such as artificial intelligence, automation, and advanced data systems are rapidly reshaping industries across the world. Recent developments in the global technology sector, including reports of large organizations restructuring their workforce while simultaneously increasing investments in AI infrastructure, highlight the speed and scale at which businesses are evolving. Roles are being redefined, traditional job structures are changing, and new opportunities are emerging at the intersection of technology and innovation.

This reality sends a clear message to all of us in academia and industry: education can no longer remain static. We must continuously redesign our teaching, learning, and research approaches to prepare individuals for a future where adaptability, digital capability, and innovative thinking are essential.

In this context, the theme "Engineering for a Changing World: Creating Sustainable Solutions for the Future" becomes highly relevant. It challenges us to move beyond conventional thinking and develop solutions that are not only technologically advanced but also sustainable, ethical, and inclusive.

ICRCET 2026 provides a valuable platform for exchanging ideas, presenting cutting-edge research, and building meaningful collaborations between academia and industry. It is through such collective efforts that we can respond effectively to global challenges and drive impactful innovation.

At Primus School of Management Studies, we are committed to nurturing future-ready professionals who can thrive in an AI-driven world. We believe that conferences like this play a vital role in encouraging critical thinking, interdisciplinary collaboration, and global engagement.

I extend my sincere appreciation to the organizers, speakers, and participants for their valuable contributions. I am confident that the discussions and interactions during this conference will be insightful, inspiring, and transformative.

I wish you all a productive and enriching conference experience.

Thank you.

Invited Keynote Speaker



Prof. Dr. Nagendra Kumar Sharma

Chandra Shekhar Azad University of
Agriculture & Technology
india



Biography:

Dr. Nagendra Kumar Sharma is a Professor, Dean, and Head of the Department of Electronics & Communication Engineering at the College of Agricultural Engineering & Technology, Etawah, a constituent faculty of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, India. He has over 30 years of teaching and research experience and has held several administrative positions, including Dean of the College of Fisheries Science & Research Centre and Chairman of the Board of Faculty of Technology. Dr. Sharma completed his M.Phil and Ph.D. in Physics from Aligarh Muslim University. His research interests include cosmic rays, space physics, and the application of electromagnetic energy in agriculture. He has published numerous research papers, delivered invited talks, and chaired sessions at national and international conferences. He has received several prestigious awards, including the International Best Teacher Award (2023) and Outstanding Achievement Award (2024).

Invited Keynote Speaker



Dr. Nagaraju L. G.

REVA University
india



Biography:

Dr. Nagaraju L G is an accomplished academican and Assistant Professor and IQAC vertical Head at REVA University, with over 14 years of teaching and research experience. He has successfully completed his Ph.D. in Social Entrepreneurship and is NET qualified, JRF and KSET cleared, reflecting strong academic and research credentials. Dr. Nagaraju specializes in integrating Artificial Intelligence with business strategy, social entrepreneurship, and sustainable development, aligned with Industry 5.0. He holds postgraduate degrees in M.Com and MTTM and has completed advanced certifications in Generative AI, Prompt Engineering, and AI for Business from Google, IBM, and be10x. He has published research in reputed journals and actively contributes to academia as a reviewer, editorial board member, and associate editor. His editorial and reviewing roles include associations with the Journal of Agriculture and Ecology Research International, Asian Journal of Current Research, International Journal of Creative Research Thoughts (IJCRT), Journal of Scientific Research and Reports, Journal of Small Business and Entrepreneurship Development, and publications under BP International. He serves on the editorial boards of REST Publisher's Trends in Finance and Economics Journal and the Asian Journal of Agriculture and Rural Development, and is an Associate Editor of the International Journal of Economics, Finance and Management Sciences (IJEFM). He is also associated with Eastasouth journals covering Management, Accounting & Finance, Economics & Entrepreneurship, and Social Sciences & Humanities. A recipient of the IMRF Skill India Award and former NAAC Coordinator, Dr. Nagaraju is a sought-after speaker on AI in Business, Digital Transformation, Social Entrepreneurship, Research Methodology, and Bibliometric Analysis.

Keynote Speaker



Assoc. Prof. Dr. Abdul Halim Abdullah

Associate Professor
Universiti Teknologi MARA
Malaysia



Biography:

Abdul Halim Abdullah is an Associate Professor and the Deputy Dean (Research & Industrial Linkages) at the Faculty of Mechanical Engineering, Universiti Teknologi MARA (UiTM), Malaysia. He is also a member of the Biomechanical and Clinical Engineering (BioMeC) Research Group. He obtained his Doctor of Engineering (Dr.Eng.) in Biomechanical Engineering from Kyushu University, Japan, a Master of Engineering (M.Eng.) in Mechanical Engineering from Universiti Teknologi Malaysia, and a Bachelor of Engineering (B.Eng.) from Universiti Sains Malaysia. Dr. Abdul Halim's research focuses on orthopedic engineering and the development of adaptive assistive devices for rehabilitation management. His expertise includes biomechanics, computational analysis, and 3D printing technology, particularly in integrating mechanical engineering principles with medical and biological sciences. He actively leads collaborative research and industrial partnerships to promote innovation in biomedical and rehabilitation engineering.

Keynote Speaker



Prof. Dr. Ramachandra C G

Professor
Presidency University
India



Biography:

An accomplished Academic Professional with over 25 years of experience in Academics, Training, Research & Development, and Academic Administration, holding qualifications of B.E., M.Tech., Ph.D., and Post-Doctorate. Proficient in building visionary teams and motivating students and faculty toward excellence, with strong interpersonal skills to maintain cordial relations with parents, educators, industry professionals, and academic experts. Recognized by the Guinness World Records for authoring the "Thickest Book in the World" (5.8 meters / 19 feet 0.34 inches, 100,100 pages) titled World 2023 (Wide Outcomes on Research & Latest Development), published by ESN Publications and LOSD (London Organization of Skills Development). Recipient of 8 patents and 19 academic excellence awards from national and international professional bodies. Authored 27 books and 33 book chapters, published 128 research papers in reputed journals, and presented 124 papers at international and national conferences. Serves as a member of the Editorial Board for over 100 reputed journals and as a Reviewer for 35 journals. Holds memberships in 59 international/national advisory committees and is a life member of 32 professional societies. Actively contributes as a Global Executive Committee member, Scientific Committee member, Advisory Board member, and Organizing Committee member for numerous international conferences. Has delivered several technical talks and keynote addresses, served as Guest of Honour, Jury Member, and Session Chairperson at academic events, and organized various workshops, FDPs, and seminars. Currently serving as a Ph.D. Guide at Presidency University, Bengaluru and Visvesvaraya Technological University, Belagavi, having guided 9 Ph.D. scholars with 4 ongoing, and supervised numerous UG and PG projects. Also serves as a Panel Examiner for multiple reputed universities including Presidency University, VTU, Anna University, JSS STU, Shivaji University, Nitte University, and Reva University.

Keynote Speaker



Prof. Dr. J. Sathik Basha

International Maritime College Oman
National University of Science &
Technology (IMCO), Sohar, Oman



Biography:

Prof. Dr. J. Sathik Basha obtained his Doctorate Degree in Mechanical Engineering at the NIT, Trichy, India in the year 2011. He is currently working as a Professor & Head @ NU-IMCO, Sohar. Dr. Basha is an experienced educator and researcher for more than two decades. His current research interests include water-diesel/biodiesel emulsions, thermal desalination, carbon capture techniques, and renewable energy. He has received various research projects totaling over \$1,00,000 in the fields of thermal desalination, waste plastic oil synthesis, etc. He is an expert referee, editorial board member, and advisory board member for more than fifty reputed international journals in the fields of energy, combustion, and power engineering. He has more than ten patents, and published more than eighty research articles, and participated in several national and international conferences. Further, the contents of his research work have been cited more than two thousand times in various technical articles, magazines, and international journals. He is a Recipient of "Best Supervisor Award" by MEDRC & GPCA in the year 2021 & 2023 respectively, and "Best Researcher Award" by IMCO in the year 2021. He has won "Best Teaching Cash Awards" several times. He is one of the top 2% academically cited researchers as per the global Stanford University Ranking consecutively for the past four years. Dr. Sathik is currently working in the area of zero-emission techniques, Carbon capture techniques, and conversion of waste feedstock to potential feedstocks for alternative power generation.

Keynote Speaker



Prof. Dr. Balaji Prabhu BV

Professor
Malnad College of Engineering
India



Biography:

Dr. Balaji Prabhu BV is a Professor in the Department of Computer Science and Engineering at Malnad College of Engineering, Hassan, and a distinguished researcher in the domains of Artificial Intelligence, Machine Learning, Deep Learning, Data Science, Cloud Computing, and IoT. He holds a Ph.D. in Computer Science from Visvesvaraya Technological University and completed his Postdoctoral Research at the prestigious Indian Institute of Science (IISc), Bengaluru, where he worked under the Computational Intelligence Lab in the Department of Aerospace Engineering with a focus on AI and Remote Sensing. With extensive research contributions, Dr. Balaji Prabhu has authored more than 20 papers in SCI and Scopus-indexed journals, multiple international book chapters with Springer, and co-authored the book "IoT Technologies Application for Industry." His innovative work has led to three published patents and recognition through prestigious awards such as the Excellence in Research Award (2021) and Best Young Researcher in Data Analytics (2019). Dr. Balaji Prabhu is widely known for his national-level academic engagement and has delivered 80+ hours of training programs and expert sessions on AI, ML, DL, Data Science, Python, and Data Visualization. He is regularly invited as a resource person, keynote speaker, and session chair for IEEE and other global conferences, contributing significantly to the advancement of next-generation technologies and skill-based education.

Keynote Speaker



Dr. Kavitha A Karkera

Nagarjuna Degree College
India



Biography:

Dr. Kavitha A Karkera is Gold medallist and Rank holder from Mangalore University. She has been honoured with a Doctor of Philosophy degree in Management from University of Mysore. A seasoned academic and finance professional with over 21 years of teaching and 6 years of corporate experience. She has completed an Executive program in Applied Finance from Indian Institute of Management, Lucknow. She has worked in management colleges across India in Mumbai, Bangalore, Hyderabad and Mangalore. A dedicated researcher with a strong focus on finance, having presented papers at national and international conferences and published research in reputed UGC, Scopus, ABDC and Web of Science indexed journals. With 32 research papers published/presented, 2 patents published/ in process and reviewer of online journals, She contributes to advancement in academic knowledge. Actively engaged in academic development through participation in conferences, workshops, FDPs, and seminars. Completed Certificate programmes in Artificial Intelligence, reflecting a commitment to continuous learning and interdisciplinary growth. Served as a Member of the Board of Examiner (BOE) at Bengaluru City University (BCU) and Paper Setter for reputed colleges. She has convened Conferences, workshops, seminars and session chair in conferences. In administration activities she has played a key role in LIC, NAAC, IQAC, AICTE and UGC, coordinating the regulatory and quality assurance framework.

Keynote Speaker



Dr. Rakesh Kumar Donthi

Malla Reddy University
India



Biography:

Dr. Rakesh Kumar Donthi did my postdoctoral school at the School of Computer Science, University College Dublin, Ireland. I completed my Ph.D. in Computer Science Engineering at the National Institute of Technology Patna, India. I have achieved a gold medal in B.Tech Information Technology, the best state rank for admission in M.Tech Software Engineering and the Best International Conference Paper Award NIT. Trichy, given Foreign guest lecturer, Applies many government schemes project contributions, e.g., ANRF, DST, AICTE, ISRO. As a keynote speaker, I got appreciation from a foreign international conference.

Keynote Speaker



Prof. Dr. S.V.A.R.Sastry

Harcourt Butler Technical University
India



Biography:

Dr. S.V.A.R.Sastry has more than 20 years of teaching and research experience. He was B.Tech Gold Medalist from NIT Jalandhar, M.Tech Silver Medalist from IIT Delhi and got Best Ph.D Thesis Award from JNTU Kakinada. He has authored 15 Patents, 25 International Books in the area of Renewable Energy, Unit Operations & Heat Transfer. He has published more than 75 Research Papers and presented papers in more than 60 International Conferences. He is a Member Scientist of CORE GROUP of Scientists on Tree Borne Oil seeds for promotion, utilization and socio-economic linkages in Southern India. He is a Senior Member of Institution of Engineers, Indian Institute of Chemical Engineers, Indian Desalination Association, International Association of Computer Science and Information Technology and Institute for Engineering Research and Publication. He has been awarded Outstanding reviewer status by Elsevier, U.S. and granted full free access to Scopus by Elsevier, U.S. He is an Editor for five International Journals and Editorial Board member for six International Journals. His Biography has been published in Marquis Who's Who in the World, 31st, 32nd & 33rd editions consecutively. He got the Andhra Pradesh University Best Teacher Award from JNTU Kakinada for five consecutive years from 2008 to 2013. He is a Recipient of International Awards from IBC, Cambridge, England. He got selected for inclusion in "100 Best Educators of 2014"; "2000 Outstanding Intellectuals of the 21st Century"; "CAMBRIDGE CERTIFICATE for Outstanding Educational Achievement"; and the prestigious "Leading Professionals of the World-2014" by International Biographical Centre (IBC), Cambridge, England. He is giving consultation in the design and implementation of 'High Speed Industrial Vaporizer', 'Mixing Device for Chemical

Absorption Process’ and ‘Exploring Disruptions, Formulations, and Technologies in Lubricant Industry’ to Convetit, U.S. He has given more than 40 Keynote lectures in various International Conferences held at Brazil, Dubai, Spain, China, Canada, Germany, Italy, France and UK. He received the Pillars of the Nation Award for Excellence and Innovation in Education Sector from the Delhi Vidhan Sabha in 2023. He got the Outstanding Alumni Faculty Award from IIT Delhi in 2023. He got the University Research Excellence Award for 2023, 2024 and 2025 from Hon’ble Governor of Uttar Pradesh. He is selected as Fellow by Institution of Engineers (India) in 2024. He is appointed as ‘Regional Mentor of Change for Uttar Pradesh’ by Atal Innovation Mission, NITI Aayog, GOI, New Delhi in 2024. He was honored with the “Outstanding Leadership in Research and Innovation” Award in the 29 th World Education Summit, New Delhi on 5 th July, 2024. Presently, he is working as Professor and Associate Dean (Research & Development and University Counsellor at the Harcourt Butler Technical University, Kanpur, Uttar Pradesh, India.

Keynote Speaker



Prof. Dr. Nandini Prasad K S

Dean - Foreign Affairs and HoD
Dayananda Sagar Academy of Technology
and Management, Bangalore, India



Biography:

Dr. Nandini Prasad K.S is a Professor, Dean of Foreign Affairs, and Head of the Department of Information Science and Engineering at Dayananda Sagar Academy of Technology and Management (DSATM), Bengaluru. With over 22 years of experience in academia, research, and industry, she holds a Post-Doctoral Fellowship from City University of London (2023), a Ph.D. in Electronics and Communication Engineering (2014), an M.Tech in Computer Science (2005), and a B.E. in Computer Science (2002). Her academic and research expertise spans Compiler Design, Machine Learning, Big Data Analytics, System Modeling, and more. She has published 84+ papers in reputed journals, authored five books, filed 12 patents, and has received multiple national and international recognitions including the Bharat Jyothi Award, Women Researcher of the Year 2023, and NPTEL STAR awards. A Senior Member of IEEE, Dr. Nandini actively guides Ph.D. and post-doctoral scholars, serves as a research supervisor under VTU, and has secured research funding from AICTE and KSCST. She has delivered lectures across India and represented her work internationally in countries such as the UK, Singapore, and Thailand.

Keynote Speaker



Dr. Agughasi Victor Ikechukwu

Assistant Professor
Maharaja Institute of Technology
Mysore, India



Biography:

Good morning/afternoon, everyone. It is a pleasure to introduce Dr. Agughasi Victor Ikechukwu, keynote speaker for this session and Assistant Professor in the Department of Computer Science and Engineering with a specialization in Artificial Intelligence at Maharaja Institute of Technology, Mysore. He earned his Ph.D. from the University of Mysore in 2024, where his research focused on machine learning algorithms for the diagnosis of chronic obstructive pulmonary disease from chest X-ray images. His areas of expertise include medical imaging, explainable AI, deep learning, computer vision, multimodal machine learning, data science, and agentic AI." Dr. Victor has established a strong research profile through publications in respected Scopus- and SCI/SCIE-indexed journals and conferences, with notable work in AI-driven healthcare, medical image analysis, and intelligent systems. He has also served as a reviewer for leading international journals, including International Journal of Computer Vision, Computers in Biology and Medicine, Information Sciences, Machine Learning: Science and Technology, and Applied Soft Computing. In addition, he holds two patents in Medical Imaging, reflecting his growing contribution to innovation in intelligent healthcare technologies." His academic excellence has been recognized with multiple Best Paper Awards, including awards in 2021 and 2024, and earlier in his career he was honored as a Gold Medallist and Best Outgoing Student in PG Science in Computer Science from St. Joseph's University Bangalore. Beyond research, he has actively contributed as a resource person and speaker in workshops and faculty development programs on artificial intelligence, deep learning, research methodology, blockchain, and mobile application development. Please join me in warmly welcoming Dr. Agughasi Victor Ikechukwu.

Keynote Speaker



Dr. Mohd Natashah Bin Norizan

Associate Professor
Universiti Malaysia Perlis (UniMAP)
Malaysia



Biography:

Associate Professor EUR ING Ir. Ts. Dr. Mohd Natashah Bin Norizan is an accomplished researcher, educator, and industry collaborator in electronic engineering and renewable energy. He holds a Ph.D. in Sustainable Energy and Environmental Engineering from Osaka University, Japan (2019), an M.Sc. in Microelectronics from Universiti Kebangsaan Malaysia (UKM), and a B.Eng. (Hons) in Electronic Engineering from Universiti Malaysia Perlis (UniMAP). With over a decade of academic experience, he has significantly contributed to scientific discovery, interdisciplinary collaboration, and engineering education. Currently serving as an Associate Professor at UniMAP, Dr. Mohd Natashah is actively engaged in research related to solar cells, nanomaterials, embedded systems, IoT, FPGA, and thermoelectric technologies, with a strong focus on sustainability. His work has led to numerous publications in high-impact journals and presentations at international conferences. His research excellence is reflected in his H-index scores across Web of Science, Scopus, and Google Scholar. Dr. Mohd Natashah holds the prestigious title of EUR ING (European Engineer), awarded by the European Federation of National Engineering Associations (FEANI), recognizing his high level of expertise, competence, and contributions to the engineering field. He is also a Chartered Engineer (CEng) of the Engineering Council UK, an ASEAN Chartered Professional Engineer (ACPE), a Professional Engineer (P.Eng.) registered with the Board of Engineers Malaysia (BEM), and a Professional Technologist (P.Tech.) under the Malaysia Board of Technologists (MBOT). Additionally, he is a Senior Member of IEEE and an International Professional Registration Advisor for The Institution of Engineering and Technology (IET), UK.

Furthermore, he holds several management positions at the university, demonstrating his leadership capabilities and commitment to academic and institutional development. He is also actively involved in industry collaborations, securing various research grants, and receiving numerous innovation awards. With a strong passion for renewable energy, engineering innovation, and academic excellence, Dr. Mohd Natashah continues to contribute towards a more sustainable and technologically advanced future.

Keynote Speaker



Prof. Dr. V. J. K Kishor Sonti

Pro Vice-Chancellor
Jeppiaar University
India



Biography:

Dr. V. J. K. Kishor Sonti is a distinguished academician and administrator with over 20 years of experience in teaching, research, and academic leadership. He currently serves as the Pro Vice Chancellor of Jeppiaar University, Chennai. He has published over 60 research papers, authored multiple books and book chapters, and holds several patents. Dr. Sonti is actively involved in mentoring students and fostering innovation ecosystems, with significant contributions to institutional development, research guidance, and international academic collaborations.

Session Speaker



Prof. Dr. Budi Nurani Ruchjana

Professor
Padjadjaran University
Indonesia



Biography:

Budi Nurani Ruchjana is a full professor in the Department of Mathematics at Universitas Padjadjaran, Indonesia. She received her B.Sc. in Mathematics from Universitas Padjadjaran in 1987, a Master's degree in Applied Statistics from Institut Pertanian Bogor in 1992, and a Doctorate in Mathematics and Natural Sciences from Institut Teknologi Bandung in 2002. Her research focuses on spatiotemporal modelling, stochastic processes, time series analysis, spatial analysis, geostatistics, and ethnomathematics. She was a Dean of Faculty of Mathematics and Natural Sciences Universitas Padjadjaran and a President of the Indonesian Mathematical Society (IndoMS) at 2012-2016. She was a member of the Commission of Developing Countries International Mathematical Union (CDC IMU) period 2015-2018. She was a coordinator from Universitas Padjadjaran in the International Consortium of Research Innovation and Staff Exchange Social media Analytics (RISE_SMA) year 2019-2024, on H2020 Schema funded by the European Union, with Coordinator Prof. Stefan Stieglitz from Potsdam University. Until now, she was a member of IAENG, European Women in Mathematics (EWM), Association Women in Mathematics (AWM), CWM IMU Ambassador for Indonesia, and EC member of Asian Oceanian Women in Mathematics (AOWM).

Session Speaker



Prof. Dr. Murad Mohammed Al-Nashmi

Arab Academy for Management
Banking and Financial Sciences
Yemen



Biography:

Prof. Dr. Murad Mohammed Al-Nashmi is a distinguished academic and researcher with a Ph.D. in Business Administration from Universiti Utara Malaysia (UUM). He currently serves as the Director of the Yemen Branch of the Arab Academy for Management, Financial, and Banking Sciences, where he is also a faculty member in the Department of Administrative Sciences. Dr. Al-Nashmi has played a key role in developing and evaluating academic programs in administrative sciences for several higher education institutions, including the Arab Academy, the Lebanese University, Al-Rasheed University, and the University of Science and Technology. Renowned for his significant contributions to scientific research, Dr. Al-Nashmi has earned numerous certifications and awards. He has authored over forty-five published research papers, many of which appear in high-impact international journals classified under Q1 and Q2 categories. Additionally, he has written three books on administrative sciences and has supervised numerous master's and doctoral theses. He has also served as Editor-in-Chief of two peer-reviewed journals and has actively participated in various international conferences. Dr. Al-Nashmi is an expert in strategic and institutional development and has contributed to designing organizational structures and strategic plans for various institutions, companies, and banks. He has also worked as a consultant for several organizations, companies, and universities. Furthermore, he is a certified trainer in governance, strategic, and institutional development and has developed multiple training modules and programs.

Session Speaker



Prof. Dr. Beulah Soundarabai P

Professor
CHRIST (Deemed to be University)
India



Biography:

Dr. Beulah Soundarabai P is a Professor in the Department of Computer Science at Christ (Deemed to be) University, Bangalore. She holds an MCA, MPhil, and PhD, with academic and research expertise in Distributed Systems, Machine Learning, Artificial Intelligence, and Data Analytics. Her teaching and research focus on applying advanced computing techniques to solve real-world problems, including IoT-based healthcare systems for the elderly, quantum-inspired optimization, and deep reinforcement learning for keyphrase generation. Dr. Soundarabai has published extensively in reputed journals such as Multimedia Tools and Applications, Advances in Computers, and the International Journal of Intelligent Engineering and Systems. Her recent works explore cutting-edge topics like 5G communication paradigms, portfolio optimization using quantum models, and intelligent text generation. In addition to her research, she actively mentors MPhil and PhD scholars in domains such as semantic keyphrase generation and quantum machine learning. Dr. Soundarabai also conducts workshops and training sessions on data visualization using Power BI and advanced analytics tools, bridging academia and industry needs. Through her publications, projects, and academic leadership, she continues to contribute significantly to the growth of computational intelligence and applied data science education at Christ University.

Session Speaker



Dr. Karthikeyan Dinesh Kumar

University of Jyväskylä
Finland



Biography:

Dr. Karthikeyan Dinesh Kumar is currently a Postdoctoral Researcher at the University of Jyväskylä, Finland, with over a decade of combined experience in academia and industry. His teaching portfolio spans Software Engineering and Artificial Intelligence, and he is supervising several Master's and Ph.D. students in these areas. Dr. Dinesh is actively involved in a Business Finland-funded project, "6G Software for Extremely Distributed and Heterogeneous Massive Networks of Connected Devices," focusing on developing energy-efficient EdgeAI frameworks for computation and communication across distributed edge environments. His research interests include Software Engineering for Edge Intelligence, Cyber-Physical Systems, and Sustainable EdgeAI, with a focus on low-power, green, and context-aware computing for next-generation intelligent systems.

Session Speaker



Dr. V. Harini

Assistant Professor
Vardhaman College of Engineering
India



Biography:

Dr. V. Harini is currently working as an Assistant Professor in the Department of Electronics and Communication Engineering (ECE) at Vardhaman College of Engineering, Hyderabad. She serves as the Faculty Advisor for the IEEE Antennas and Propagation Society under the IEEE Vardhaman Student Branch. She is also actively leading the Industry-Institute Interaction Cell (IIIC) as Convener and serves as an Innovation Ambassador for the Institution Innovation Council (IIC) at Vardhaman College of Engineering. She was awarded her Ph.D. in Millimeter-Wave Antennas from Jawaharlal Nehru Technological University, Kakinada (JNTUK), Andhra Pradesh, India, in January 2024. She completed her B.Tech in Electronics and Communication Engineering from JNTU Hyderabad, Telangana, in 2008, and her M.Tech in Communication Engineering from VIT University, Vellore, Tamil Nadu, in 2010. Her research interests include Wireless Communications, 5G Communications, Femtocells, and Millimeter-Wave Microstrip Antennas, with a special focus on fractal, log-periodic, aperture-coupled, and CPW-fed array antennas. She has published five SCIE-indexed papers along with several publications in Scopus-indexed journals, and has received the Best Paper Award twice at international IEEE conferences held in 2024 and 2025.

Session Speaker



Dr. Sandeep Kumar .R

Associate Professor & Research Head
Faculty of Management
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Bangalore, India



Biography:

Dr. Sandeep Kumar R has completed BBM (HR) from Bangalore University, MBA (MARKETING) from Visvesvaraya Technological University, Ph.D from University of Mysore. He has qualified KSET and UGC-NET (Management), PGDMM from Jain University and M.com From Madurai Kamaraj University. He has handled MBA, M.COM & PGDBA courses. He has 09 years of Corporate Experience having served positions like HR & Marketing Manager, Senior Associate, Associate and 11 years of experience in teaching profession at PG Level. Currently pursuing his teaching career as Associate Professor & Research Head in the Post Graduate Department of Management Studies, Primus School of Management Studies, Bengaluru City University, Singanayakanahalli, Bengaluru- 560064. He has profound knowledge in the subjects of his expertise. Guided several MBA & M.COM final year students in successfully completing their university projects affiliated to Bangalore University & Bengaluru City University (formerly known as Bengaluru Central University). Chaired as the honorable member of the judging committee to judge the papers presented in the National Conference on "Emerging Trends in Business Management", Bangalore. Actively participated in several National Level and International Level Conferences, Seminars, Endowment Lectures, Faculty Development Programmes, Management Development Programmes, Workshops, Symposiums and Faculty Orientation Programme at university level on the research methodology for the guidance of MBA dissertations. He is the Lifetime Member of Management Teachers Consortium (MTC) Global Trust, Lifetime Member of Institute of Scholars (INSC), Bengaluru, Karnataka., Lifetime Member of Inspira Research Association (IRA), Jaipur,

Rajasthan & Member of Indian Academicians and Researchers Association (IARA), Guwahati, Assam. He is an eminent scholar and has authored several research papers at national and international conferences which have been presented and included in the book of proceedings and also in journal publications bearing ISSN and ISBN numbers. Published 23 research papers in several National and International research journals recognized by UGC, UGC-CARE and Scopus indexed journals of international repute and standards. His area of expertise includes Talent and Knowledge Management, Entrepreneurship and Ethics, Organizational Behaviour, Commodity Markets, Human Resource Management, Business Ethics and Corporate Governance, Business Marketing, Services Marketing, Strategic Brand Management, International Marketing Strategy, Advertising and Integrated Brand Management, Talent Management and Employee Engagement, Consumer Behaviour and Neuro Marketing, International Business Dynamics, Management and Organizational Behaviour, Marketing Management and Strategic Management and Business Ethics.

Session Speaker



Assoc. Prof. Dr. Javed Alam

Associate Professor
Chandigarh University
India



Biography:

Dr. Javed Alam is an Associate Professor in the Department of Computer Applications at Chandigarh University, India, bringing over 18 years of experience across academia, research, and industry. He holds a Ph.D. in Computer Application (Artificial Intelligence) and specializes in machine learning, deep learning, fuzzy Logic and AI applications for healthcare and industrial systems. Dr. Alam has around 5 years of industrial experience, during which he led AI-driven healthcare projects at Digibionics LLC and Quantlase Lab LLC in the UAE. He has published widely in Scopus and SCI-indexed journals, serves as a reviewer for journals by Elsevier, Springer, and IOP Science etc. Dr. Alam is also member of professional bodies including the Royal Statistical Society, Royal Society of Chemistry, and others. Beyond research and teaching, he has contributed as a mentor, curriculum designer, and research group coordinator, and has been recognized with appreciation letters for expert sessions and academic contributions. His commitment to advancing AI in real-world applications, combined with his dedication to teaching, research and mentoring, underscores his vision of leveraging technology for societal benefit.

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Prof. Dr. G.P. Ramesh

Conference Convenor
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Biography:

Dr.G.P.Ramesh is a distinguished academician, visionary technologist and ambitious researcher with over 26 years of multifaceted experience spanning higher education, advanced research and industry leadership. His career reflects a seamless integration of academic excellence and technological innovation, positioning him as a transformative force in engineering education and applied research. A dynamic leader and passionate educator, Dr.G.P.Ramesh has served as Professor and Head of Electronics and Communication Engineering at prestigious institutions across India and abroad. He has mentored undergraduate, postgraduate and doctoral scholars, successfully guiding Twenty-Two Ph.D. candidates and nurturing a culture of inquiry and excellence. His academic expertise encompasses artificial intelligence, machine learning, embedded systems, VLSI design and antenna technologies. With more than 125 publications in Scopus-indexed journals, his scholarly influence is evidenced by an H-index of 32 and an i10-index of 70, marking him as a prominent contributor to global research discourse. He has also organized Twelve International and Six National conferences, publishing proceedings with Springer and ensuring global visibility through Scopus and Web of Science. A pioneer in Outcome-Based Education and a strategic advisor for NAAC, NBA and Autonomous frameworks, Dr.G.P.Ramesh continues to shape future-ready engineers and scalable, tech-driven solutions for India and beyond.

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Detecting Brain Tumor Using Deep Learning Techniques

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Abstract

Detection of brain tumors is one of the most important medical imaging tasks that can have a great impact on patient outcomes. An accurate and fast diagnosis is needed to increase treatment success rates and patient's survival. CNNs (Convolutional Neural Networks), where a deep learning techniques, have been very effective in automated tumor classification with MRI scans in recent years. These programs are able to very exactly detect cancers and also help the radio logists by analyzing huge volume of medical pictures with their effective. This work base donkey factors like preprocessing of data, model selection and metric for assessment provides the entire approach eg for identifying brain tumors through deep learning methods. By performing automatically the tumor detection process, this approach will help medical doctors in making more faster and more accurate diagnoses, therefore, patient care will be improved. The proposed method is a good chance for application in real the scenario of medicines inceit can bring down the errors in diagnosis and also increase efficiency in clinical settings. Future investigations might concentrate on the expansion of datasets, enhancement of model generalization, and integration of explainability techniques to build trust in AI-assisted medical decisions.

Keywords

Brain Tumor, Convolutional Neural Networks (CNNs), Medical Imaging, MRI (Magnetic Resonance Imaging), Tumor Classification, Image Preprocessing.

Detecting and Enhancing the Operational Efficiency in ADAS During Wraithgloom

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Abstract

This paper presents an Advanced Driver Assistance System (ADAS) that is intended to improve the safety of vehicles in various harsh weather conditions like fog, snow, heavy rain, and darkness, collectively known as 'Wraithgloom.' By combining YOLOv8 object detection models tailored for specific weather conditions with a real time weather classification and conditional model-switching framework, the system demonstrates excellent detection performance for vehicles, pedestrians, animals, and road potholes. Further complementing the system, various video processing methods such as dehazing and monocular distance estimation offer visual and auditory alerts for unsafe proximity. The experimental results demonstrate a high detection mAP of 85-88 accuracy of weather classification above 90 its efficacy for real-time driver assistance.

Keywords

ADAS, YOLOv8, Weather Classification, Dehazing, Distance Estimation, Conditional Model Switching.

AI-Enabled Autonomous Unmanned Ground Vehicle for Vision and Sensor Fusion-Based Anomaly Detection

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Abstract

Continuous surveillance in defense zones and sensitive areas is often constrained by human risk, operational fatigue, and limited situational awareness. To address these challenges, this work proposes an **AI-enabled Autonomous Ground Patrol Vehicle (UGV)** capable of intelligent patrolling and **multi-modal anomaly detection**. The system combines **real-time vision-based object detection** with proximity sensing to achieve reliable perception in dynamic environments. A **YOLO-based deep learning model**, trained on a custom dataset derived from real surveillance scenarios, enables accurate identification of humans, vehicles, animals, and unidentified objects. Ultrasonic sensors provide complementary spatial awareness for obstacle detection and autonomous navigation. High-level intelligence is executed on a **Raspberry Pi**, while an **ESP32 controller** manages motion control and low-level sensing. The fusion of visual and distance-based information significantly reduces false alarms and enhances detection of confidence. The developed UGV demonstrates effective autonomous movement, real-time anomaly recognition, and flexible operation modes, offering a **cost-effective and deployable solution** for defense surveillance, border patrolling, and security monitoring tasks.

Keywords

Autonomous Ground Vehicle (UGV), Sensor Fusion, Autonomous Patrolling, Defense Surveillance, Deep Learning, YOLO-based Object Detection.

IOT - Enabled Smart Vision Analyzer and Retinal Screening System for Global Health Partnership

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Abstract

The number of world-related vision disorders is rapidly growing, and it concerns persons of any age. The retinal diseases that cause the cases of irreversible blindness include diabetic retinopathy, glaucoma and macular degeneration that cannot be reversed especially when they are not early detected. The availability of ophthalmologists and diagnostic facilities is limited in most of the rural and semi-urban regions; hence, they are usually diagnosed late and their sight is lost forever. Several models of classical retinal screening require manual inspection by experts, which is not only time-consuming but also expensive and highly reliant on the availability of specialists. Convolutional Neural Networks (CNN) can be used to detect the patterns of particular diseases, whereas Internet of Things (IoT) enables the transmission of data in real-time and remote monitoring. In this work, a portable retinal screening system, based on AI and IoT, is suggested, which consists of retinal image capture, OpenCV-based retina image preprocessing and classification of the disease severity on the scales of Normal, Mild, Moderate or Severe based on a trained CNN model. Its results are represented on a web dashboard and sent to an ESP32-based IoT device to provide immediate notifications and have doctors access it remotely. The suggested system is a low-cost, fast and easy-to-use solution that could be implemented in clinics, health camps and rural health facilities and help people to detect early and prevent the occurrence of permanent vision loss.

Keywords

Deep Learning, Convolutional Neural Network, Image Processing, ESP32 Microcontroller, LCD Display.

Electrical Fault Detection in Underground Cables using Arduino UNO and IoT-Based Wi-Fi Module

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Abstract

This project aims to identify fault distortion and classify the type of fault in underground cables using an IoT-based Micro Arduino. Typically, underground cable circuits often experience earth faults or leakage currents, leading to unnecessary power loss. The design detects the occurrence of earth faults, open circuits, and short circuits, providing alerts for each. Using this technique, the exact fault location and type can be easily determined. The voltage passing through the system is continuously monitored by a microcontroller-based system. In such cases, the system sends alerts via text messages on an LCD and mobile notifications through the Cadio App, indicating the type of fault. Additionally, a buzzer alarm provides an audible alert. This approach enhances the efficiency and speed of fault detection.

Finance Tracker

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Abstract

In an era of economic turbulence, effective Personal Financial Management (PFM) is essential; however, many individuals lack organized, real-time tracking tools necessary to succeed. This paper presents the foundational architecture and impact framework for an intelligent and secure Finance Tracker application designed to foster financial discipline and self-efficacy, functioning as a digital financial manager that records, categorizes, and analyzes transactions via reliable automated data synchronization from bank APIs and payment gateways, with advanced features like real-time alerts, customizable budgets, and machine learning-driven predictive analytics. Critically addressing the behavioral paradox of automation reducing self-awareness, it integrates 'active tracking' checkpoints—such as manual verification prompts and gamified reviews—to boost user engagement, mental accounting, and decision-making. Featuring multi-layered security with end-to-end encryption and biometric authentication, a scalable microservices backend, and React Native for cross-platform use, the app supports IoT expense logging; preliminary studies show 25 percent better savings adherence. By promoting financial stability, it advances Sustainable Development Goal 8 (SDG 8): Decent Work and Economic Growth, especially in emerging economies.

Keywords

Component, formatting, style, styling, insert.

Intelligent Smart Footwear with AI-Powered Object Detection and Emergency Alert System for the Visually Impaired

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Abstract

Blind people face a lot of difficulties in moving around safely and getting help in emergencies quickly when the environment keeps changing. Most of the current assistive devices do not have the ability to understand the environment intelligently and also cannot communicate reliably. This paper proposes an AI powered smart shoe system that brings together real time environmental sensing, vision-based perception and emergency notification using IoT. A small camera and ultrasonic sensors take pictures and measure the environment. Data processing is performed on an external computer using a YOLO based object detector, a Haar Cascade based face detector and OCR with text to speech conversion. Processed information is sent to an ESP32 microcontroller via UDP communication over a wireless link, and the user receives real time feedback through vibrations and buzzer alerts. During emergencies, location aware notifications are sent via Arduino IoT Cloud and internet-based SMS support is optional using cloud services. The prototype of such a system has been developed as a proof of concept and it has been tested for remote and instant monitoring, user feedback and obstacle detection functionalities that can help visually impaired users to be more mobile, independent and safe.

Keywords

Assistive Technology, Smart Footwear, Object Detection, YOLO, IoT, ESP32, Visually Impaired Navigation.

Mechanical Behaviour and Characterization of Hot Isostatic Pressing in Inconel 740H

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Abstract

In this work, Inconel 740H is selected due to its excellent high-temperature creep resistance compared with commonly used Inconel alloys such as 625 and 718, making it suitable for next-generation power plant and gas turbine components. To enhance its mechanical properties and creep performance, a powder metallurgy route will be adopted. Based on literature reports highlighting the effectiveness of advanced consolidation techniques in achieving refined microstructures, Prior to HIP, Inconel 740H powder will be subjected to ball milling to improve powder homogeneity. The rapid heating rates and enhanced densification characteristics of HIP are expected to promote porosity reduction, grain refinement, and improved interparticle bonding. The planned work aims to investigate the influence of HIP processing on densification behavior, microstructural evolution, and mechanical properties of Inconel 740H. This includes tensile testing and fatigue analysis to quantitatively validate the anticipated ~10% improvement in mechanical performance including an approximately 7% increase in Tensile strength, compared with conventionally processed Inconel alloys. These evaluations are essential to confirm the suitability of HIP-processed Inconel 740H for long-term high-temperature service.

Keywords

Inconel 740H, Nickel-based Superalloy, Hot Isostatic Pressing, Ball milling, Densification Behavior, Microstructural evolution, Grain Refinement, Mechanical Properties, Tensile Testing.

Analyzing the Thermal Behaviour of Additive Manufacturing of Inconel 740h with Reinforced Graphene

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Abstract

In this investigation, Inconel 740H was selected owing to its superior high-temperature creep resistance and exceptional thermal stability relative to conventional Inconel alloys, rendering it highly suitable for advanced ultra-supercritical power plants and gas turbine applications. To further augment its high-temperature thermal performance, a powder metallurgy approach incorporating graphene as a nanoscale reinforcement was employed within an additive manufacturing framework. Drawing upon prior studies emphasizing the efficacy of advanced consolidation techniques in mitigating thermal gradients and residual porosity, Hot isostatic pressing (HIP) was adopted as the principal densification strategy. Prior to HIP processing, Inconel 740H powder was subjected to high-energy ball milling with controlled graphene additions of up to 10 wt.% to achieve homogeneous dispersion and enhanced interfacial interaction. The synergistic influence of elevated temperature and isostatic pressure during HIP is anticipated to facilitate near-full densification, porosity annihilation, microstructural refinement, and improved matrix-graphene interfacial bonding, thereby enhancing thermal transport characteristics. This study systematically evaluates the influence of graphene-assisted HIP processing on sintering kinetics, thermal behaviour, and microstructural evolution of additively manufactured Inconel 740H, with an anticipated enhancement of approximately 10% in thermal conductivity compared to conventionally processed counterparts.

Keywords

Inconel 740H, Additive Manufacturing, Hot Isostatic Pressing (HIP), Graphene Reinforcement, Thermal Behaviour, Thermal Conductivity, Powder Metallurgy, Sintering Kinetics, Microstructural Evolution, High-Temperature Stability.

Multimodal Industrial Predictive Maintenance using Graph Neural Networks and Large Language Model Fusion

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Abstract

Unanticipated failures in industrial equipment can lead to substantial operational disruption, increased maintenance expenditure, and reduced system reliability. Consequently, the development of intelligent predictive maintenance frameworks has become essential for modern industrial environments. This study introduces a multimodal predictive maintenance methodology that integrates data-driven machine learning, graph-based relational modeling, and Large Language Model (LLM) assisted interpretation to support accurate failure forecasting and actionable maintenance planning. Multivariate time-series sensor measurements from the NASA CMAPSS turbofan engine dataset are utilized to estimate the Remaining Useful Life (RUL) of machinery across operational cycles. The proposed workflow begins with systematic preprocessing, including feature normalization, sensor selection, and RUL target formulation. A supervised learning model is trained to capture degradation behaviour from historical observations, while interdependencies among sensor variables are represented through a graph structure processed by a Graph Neural Network. To enhance interpretability, prediction outputs are further translated into human-readable maintenance insights using an LLM-based reasoning module. The framework is designed to improve predictive reliability while simultaneously providing explainable decision support for industrial monitoring and maintenance scheduling applications.

Keywords

Predictive Maintenance, Graph Neural Networks, Multimodal Industrial Analytics, Remaining Useful Life Prediction, Sensor Time-Series Modeling, Explainable Industrial AI, Large Language Models.

Developing an End-to-End Quantum Network

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Abstract

Many classical cryptographic schemes such as RSA, Diffie Hellman, and Elliptic Curve Cryptography can be broken by quantum computers using Shor's algorithm which can efficiently factorise large integers and solve discrete logarithm problems. Even Grover's algorithm weakens symmetric key cryptography by speeding up brute force key search reducing the security level of schemes like AES, DES and Hash (SHA). To overcome this problem we use a Quantum One Time Pad (QOTP) which encrypts information using random Pauli operations and provides security based on the laws of quantum physics rather than mathematical difficulty. This encrypted data is sent using Free Space Optical (FSO) communication where the information that is transmitted is done via a narrow laser beam through free space and polariser rotating at different angles making the communication fast and difficult to intercept. By combining QOTP based quantum encryption with FSO transmission, the proposed approach offers a quantum-safe end-to-end communication framework.

This can be used in various fields in our day to day applications such as military applications where information security is critical so in our scheme intercepting the signal is almost impossible because we have used Line-of-Sight communication, hence any interception by a 3rd party can be easily detected as it causes a signal disturbance or loss of signal at the receiver, after which the receiver can stop the transmission or take any necessary action. Another application can be space communication where laser light can be used as a form of optical wireless communication between spacecraft, satellites, and ground stations. Let us assume satellite A has to communicate with satellite B. Our satellite A will be the source of green laser (FSO) and our satellite B will have a photoresistor. Knowing that the signal disturbance in vacuum/space is non-existent there will be 100% accuracy in sending across the data.

To add an extra layer of security we have also designed our own encoding and encryption scheme hence, even if the signal is intercepted the cipher text is pretty much useless without the decoding and decryption key.

Keywords

Quantum-Inspired Cryptography, Free-Space Optical Communication (FSO), Quantum One-Time Pad (QOTP), Polarization-Based Optical Modulation, Embedded Optical Communication Systems.

A Cross Format Solar Filament Detection using Enhanced Memory Optimized ResNet Framework

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Abstract

Solar filaments, dark thread-like structure on the surface of sun, are essential for understanding the varying nature of Earth's magnetic field dynamics. The behavioural changes that occurred in the stellar magnetic field due the eruptions in filaments are a major problem, so it is crucial to identify the emission and explosion of these plasma features, as it is vital in predicting atmospheric and geographical changes. Despite various manual detection methods that deliver satisfactory accuracy, it is impractical in processing high-resolution spectroscopic data, especially the Chinese H-alpha Solar Explorer. Extracting heterogeneous features from these massive solar scale observations was time consuming and labour intensive. In this work we have introduced a memory optimized U-Net with ResNet-50 for extracting complex features from the high-resolution solar imagery. Also the model pre-process the raw data by creating an automated mask generation pipeline using K-means clustering. The distinct intensity populations of solar data can be efficiently separated with fewer annotations. In order to ensure cross-format applicability, we have standardised the PNG H-alpha images from ground-based observatories. The experimental results show that our model achieves an average Intersection over Union of 0.9683 with a high precision and obtained a strong generalization across diverse datasets.

Keywords

Solar Filaments, Chinese H-alpha Solar Explorer (CHASE), ResNet-50, IoU, U-Net, Cross Format.

An Intelligent Self Learning Quantum Neural Model for Multi- Horizon Stock Price Forecasting - Stage 1

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Abstract

This work introduces an artificial intelligence-driven multi-timeframe trading system leveraging MetaTrader 5 (MT5) and an ensemble of machine learning models to improve trade signal accuracy. Leveraging higher timeframes (15M, 30M, 1H, 1D) for signal validation, the system runs on a 5-minute Heikin-Ashi (HA) candlestick chart. To create buy/sell signals, it combines SVM, Random Forest, XGBoost, Catboost, MLP, LSTM, RNN models taught on HA OHLC values and technical indicators. While daily automated retraining updates parameters without interfering with ongoing trading, a dynamic weighted ensemble changes model weights depending on real-time accuracy. Through alignment of short-term predictions with more general trends, a multi-timeframe signal aggregation module filters false signals. The system also supports live trading integrated with the MT5 application and Paper trading for demo and backtesting purposes.

The system enhanced the trading accuracy by using HA candlesticks, ensemble learning, and adaptive retraining, thus providing an efficient artificial intelligence-based trading solution.

Keywords

AI-driven trading system, Heikin-Ashi, Ensemble learning, Multi-timeframe analysis, Algorithmic trading.

Exploring Intrinsic Vocal Characteristics through Unsupervised Density-Driven Learning

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Abstract

Human voices differ in pitch, tone, frequency distribution, and overall vocal texture, reflecting complex acoustic and physiological differences across individuals. Previous research focused on traditional speaker diarization systems that rely on supervised identity labels, this study shifts attention towards clustering speakers based on intrinsic vocal characteristics in a fully unsupervised setting. We propose a label-independent framework that groups speakers according to inherent acoustic characteristics rather than predefined identities. A set of pretrained speech encoders, including WaveLM, Wav2Vec 2.0, and OpenSMILE, were employed to extract high level embeddings from raw audio, eliminating the need for manual annotation.

The resulting embeddings are projected into a lower-dimensional space using UMAP to preserve structural relationships within the feature space. Subsequently HDBSCAN is applied for density-based clustering, enabling adaptive cluster discovery without requiring prior specification of the number of clusters. By integrating self-supervised representation learning, manifold learning, and density-based clustering, the proposed framework facilitates structure-preserving exploratory analysis of vocal characteristics. The resulting clusters are evaluated using internal validation metrics such as Silhouette Score and Cluster stability analysis. Experiments conducted on publicly available speech corpora investigate whether the discovered clusters naturally correspond to tonal quality, age-related variation, or speaking dynamics. This work positions speaker clustering as a tool for exploratory acoustic profiling beyond conventional diarization systems.

Keywords

Unsupervised Learning, UMAP, HDBSCAN, Silhouette Score, Cluster Stability Analysis, Speech Representation Learning.

Design and Development of Agentic AI Driven Decision Support Platform for Startups and MSMEs

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Abstract

Startups and Micro, Small, and Medium Enterprises (MSMEs) constitute a fundamental component of economic development by fostering innovation, generating employment opportunities, and contributing to industrial growth. To support entrepreneurial development, governments and financial institutions introduce numerous welfare schemes, subsidies, and financial assistance programs aimed at strengthening the MSME ecosystem. Despite the availability of these initiatives, many entrepreneurs experience significant challenges in identifying suitable schemes due to limited awareness, complex eligibility conditions, and insufficient guidance regarding application procedures and documentation requirements. This project presents the Design and Development of an Agentic AI Driven Decision Support Platform for Startups and MSMEs, which aims to facilitate the discovery and accessibility of relevant government support programs. The proposed system adopts an intelligent decision support approach by analyzing business related attributes and recommending schemes that align with the specific requirements of entrepreneurs. The platform collects essential information such as business type, industrial sector, geographical location, investment capacity, and the stage of enterprise development to construct a comprehensive contextual business profile. To generate accurate recommendations, the system employs advanced artificial intelligence techniques including semantic similarity analysis and vector-based information retrieval methods. These techniques enable the platform to analyze scheme descriptions and identify programs that closely correspond to the user's business profile. A ranking mechanism is further applied to prioritize and present the most relevant schemes, thereby supporting informed and efficient decision making for startups and MSMEs. The proposed platform incorporates an Agentic Artificial Intelligence architecture, in which multiple intelligent agents collaborate to perform specialized tasks such as profile interpretation, eligibility filtering, semantic matching, and recommendation ranking. In addition to recommendation capabilities, the system integrates an interactive Scheme Assistance Chatbot that provides step-by-step guidance on scheme application procedures, including detailed information regarding eligibility conditions and required documentation. Furthermore, the platform includes an AI-based document validation module, which allows users to upload application documents and verifies their completeness and validity through automated text extraction and verification techniques. This functionality reduces errors in document submission and enhances the reliability of the application process. Overall, the proposed platform improves accessibility to government welfare schemes and simplifies the process of identifying and applying for appropriate support programs. By integrating AI-driven recommendations, conversational assistance, and automated document verification, the system serves as an intelligent decision support tool that empowers startups and MSMEs to effectively utilize available opportunities for sustainable business growth and development.

Sustainable Power Flow Optimization in Renewable-Driven Microgrids Using Population-Based Multi-Objective Meta-Heuristics

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Abstract

Optimal Power Flow (OPF) is a critical challenge in the efficient and sustainable operation of modern smart grid technologies, particularly in microgrids, where diverse energy resources and fluctuating demand patterns complicate decision-making processes. The increasing penetration of renewable energy sources has introduced significant variability and uncertainty, necessitating advanced optimization techniques to balance competing objectives. In this paper, the OPF problem is formulated as a Multi-Objective Optimal Power Flow (MOOPF) problem, with objectives including minimization of operational costs, voltage stability, and emissions, as well as maximization of renewable energy utilization and grid reliability. To address the complexity of this problem, population-based metaheuristic algorithms such as Non-Dominated Sorting Genetic Algorithm-II (NSGA-II) and Multi-Objective Particle Swarm Optimization (MOPSO) are employed as they effectively explore the solution space, handling the nonlinear, multimodal, and constraint-heavy nature of the MOOPF problem while providing a set of Pareto-optimal solutions that capture trade-offs among conflicting objectives. The proposed approach is validated through simulations in microgrid test systems with diverse renewable energy profiles, demonstrating its ability to handle high levels of renewable penetration. The results highlight significant improvements in operational efficiency, renewable energy integration, and computational performance. This work emphasizes the potential of population-based metaheuristic algorithms and highlights the critical role of multi-objective OPF in enabling the sustainable and reliable integration of renewables in smart grids, paving the way for a greener energy future.

Keywords

Optimal Power Flow, Microgrids, Renewable Energy Integration, Multi-Objective Optimization, Population based Meta-Heuristics.

RakshaNetra: Securing Intelligent AI-Powered Framework for Vigilance and Cyber Awareness

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Abstract

Cybercrime complaints have shot up lately, and honestly, the old reporting systems just can't keep up. Most websites only collect complaints and leave investigators to sift through everything by hand. It's slow, and cases often get stuck in limbo or aren't prioritized the right way. That's where RakshaNetra comes in. It's a secure, practical setup that actually helps with reporting and investigating cybercrimes using AI. The system sorts complaints automatically, figures out how risky they are, and puts together quick summaries so investigators can get the gist of each case right away. Access and permissions are handled with a three-tier, role-based model, so everything stays secure and accountable. Anyone can use RakshaNetra—victims can report anonymously or register if they want, and there's a mobile app for them, plus a web dashboard for investigators. In tests, even in a simulated setup, RakshaNetra made everything faster: cases got handled sooner, the important ones got flagged first, and investigators had a much clearer view of how things were moving along.

Comprehensive AI-Powered Mental Health Analysis and Crisis Prevention System with Multi-Modal Behavioural Intelligence and Predictive Risk Assessment

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Abstract

Mental illnesses are on the rise and are mostly unaddressed because they are based on subjective scores and accounts and are late in administering clinical care. The study introduces a machine learning-driven predictive system related to analyzing mental health behavioural aspects and satisfying treatment needs with the help of structured behavioural and demographic information. The system combines the preprocessing steps of data, categorical encoding of data, scaling of the features and supervised learning models to categorize mental health cases and determine whether they require treatment assistance or not. Two analysis pipelines are introduced, one is devoted to predicting behavioural risks, and the other to classifying the outcomes of the treatment. To measure model performance, proper classification measures are used so that reliability and generalizability is achieved. The suggested approach proves the adequacy of the data-based mental evaluation systems in detecting patterns of psychological risks at their initial stages. The framework will help healthcare practitioners anticipate intervention planning and tailored mental health care thus enhancing the accuracy of early detection and efficiency in decision-making during clinical and digital health situations.

Keywords

Mental Health Prediction, Machine Learning, Behavioural Analysis, Treatment Classification, Supervised Learning, Data Preprocessing, Feature Engineering, Classification Models, Psychological Risk Assessment, Digital Health Analytics.

Experimental Validation of an IoT-Based Dual-Tank Water Monitoring System

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Abstract

In homes and community water management systems, ensuring continuous, effective, and automated water distribution continues to be a major difficulty. The design and implementation of an Internet of Things (IoT)-based Dual-Tank Water Monitoring and Management System that uses intelligent sensing and control to handle these issues is presented in this study. The suggested system uses a DS18B20 temperature sensor to monitor water temperature across two connected tanks, an ESP32-S3 microcontroller combined with ultrasonic and capacitive level sensors for precise water-level measurement, and a YF-S201 flow sensor for flow-rate monitoring. In the created architecture, a secondary backup tank automatically sustains the system when the water level drops below predetermined thresholds, while the primary tank provides water to nearby homes. Through a Flask-based API, real-time sensor data is concurrently stored in a MySQL database for historical recording and analytical insights, and it is sent to a Blynk IoT dashboard for live viewing. A relay-controlled pump mechanism enables autonomous tank switching, and integrated alarm modules offer email and optional SMS warnings in the event of anomalous operating conditions. Reliable connectivity, accurate level estimate, efficient pump management, and seamless tank changeover were all shown by experimental assessment. The findings verify that the suggested system offers a reliable, scalable, and economical solution for intelligent water distribution in residential complexes, smart homes, and community-level water resource management applications.

Keywords

IoT, Dual Tank Automation, Water Level Monitoring, Blynk Cloud Dashboard, Smart Water Management.

Energy-Efficient, Scalable, and Secure Routing Protocols for Wireless Body Area Networks: A Comprehensive Survey and Future Directions

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Abstract

Wireless Body Area Networks provides constant health monitoring using wearable and fixed sensors. These nodes work with batteries of one hundred to five hundred mAh and often transmit dynamic data every one to five seconds. Routing plan directly distresses network lifetime, suspension, and patient security. Many present protocols progress one metric but damage others. Energy sanitations quickly due to frequent retransmissions, thermal things in implanted nodes, and flexibility caused by body movement. Safety adds upstairs that further decreases lifetime. This work shows a complete review of routing protocols for Wireless Body Area Networks with concentration on energy efficacy, scalability, and security. We analysis more than 70 papers published between 2015 and 2025. We categorize protocols into flat, ranked, cross-layer, thermal-aware, QoS-aware, and trust-based categories. We compare them using quantifiable metrics such as network lifetime, packet delivery ratio, end-to-end delay, output, and energy per bit. According to the results, frivolous encryption increases energy consumption by 5 to 15%, while cluster-based routing can extend network lifetime by 20 to 35% when compared to flat routing. Scalability beyond 20 nodes is addressed by rare protocols. Flexibility and dynamic circulation cause the majority to fail. We categories deficiencies in adaptive routing, lightweight security integration, and thermal management under mobility. We concentrate on practical approaches such as federated learning for dispersed optimization, AI-driven routing, energy harvesting support, and frivolous cryptanalysis. These insights direct researchers toward reliable, implementable routing outcomes for healthcare structures of the future.

Keywords

Wireless Body Area Networks, Safe Routing Protocols, Network Scalability, Thermal-Aware Routing, Energy- Efficient Routing.

An Interpretable Cross-Modal Attention-Based Deep Learning Framework for Multimodal Cancer Detection

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Abstract

Early and accurate cancer diagnosis remains one of the most critical challenges in modern healthcare. Traditional unimodal diagnostic approaches—such as radiology, histopathology, or genomics—offer valuable but fragmented insights, often resulting in incomplete clinical interpretations. This research proposes an interpretable cross-modal attention-based deep learning framework for multimodal cancer detection, designed to integrate heterogeneous data sources including radiological images, histopathology slides, genomic profiles, and structured clinical records. Each modality is processed through a dedicated deep encoder—3D CNNs for imaging, Vision Transformers (ViTs) for histopathology, transformer-based sequence models for genomics, and MLPs for clinical data—to extract high-level feature representations. These are fused using a cross-modal attention mechanism that dynamically learns inter-modality relationships and gracefully handles missing data. The attention weights further serve as an intrinsic interpretability feature, revealing the contribution of each modality to the final diagnostic decision. Experimental validation on benchmark multimodal datasets demonstrates that the proposed framework achieves superior accuracy, robustness, and generalization compared to unimodal and existing fusion-based models. Moreover, a Clinical Decision Support Dashboard provides transparent visual explanations through saliency maps and modality importance scores, fostering clinician trust and practical usability. The results highlight the potential of interpretable multimodal AI to transform diagnostic precision, reduce uncertainty, and advance personalized cancer care.

Keywords

Multimodal Deep Learning, Cancer Detection, Cross-Modal Attention, Explainable AI, Medical Imaging, Genomics, Clinical Decision Support.

Multi-Keywords Searchable Attribute-Based Encryption with Verification and Attribute Revocation Over Cloud Data Using Python and Cloud Computing

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Abstract

With the exponential rise in cloud storage usage, ensuring the security, privacy, and efficiency of data retrieval has become a critical concern. Traditional encryption methods often fall short in providing fine-grained access control and secure searchability over encrypted data. To address these limitations, this project introduces a Multi-Keywords Searchable Attribute-Based Encryption (MK-ABE) system, a novel approach that synergizes attribute-based encryption (ABE) with secure multi-keyword search functionality.

The proposed MK-ABE system allows users to perform search queries using multiple keywords without compromising data confidentiality, significantly enhancing usability and flexibility. It incorporates fine-grained access control based on user attributes, ensuring that only authorized users can decrypt and access specific data. A standout feature of this system is attribute revocation, which enables dynamic modification of access rights, addressing scenarios where users' roles or permissions change over time. Another critical component is data integrity verification, which ensures that search results are both accurate and unaltered, building trust in the retrieved data. The system will be developed using Python and deployed on cloud platforms, aiming to deliver a scalable, high-performance, and cost-effective solution suitable for both academic and enterprise environments.

Keywords

Cloud Storage, Data Security, Multi-Keyword Search, Attribute-Based Encryption (ABE), MK-ABE, Attribute Revocation, Access Control, Secure Searchable Encryption, Data Integrity Verification, Python, Cloud Computing, Encrypted Data Retrieval, Fine-Grained Access Control, Scalable Solutions, Privacy-Preserving Search, Dynamic Access Management, Secure Cloud Applications, High-Performance Encryption, Cryptography in Cloud, Confidential Data Access.

Statistical Mix Proportion Optimization of Sustainable Geopolymer Binder Systems using Taguchi Methodology

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Abstract

This study presents the parametric optimization of fly ash–GGBS based geopolymer concrete (GPC) using the Taguchi L25 orthogonal array design. Geopolymer concrete provides a low-carbon alternative to ordinary Portland cement; however, its mechanical properties are highly dependent on mix proportions and alkaline activator characteristics. In this work, four key parameters—fly ash content, GGBS percentage, NaOH molarity, and alkaline activator-to-binder ratio—were investigated at five levels to determine their influence on compressive strength. The experimental effort was significantly reduced by applying the Taguchi optimization technique, wherein only 25 cubes were cast instead of the 625 cubes required in a full factorial design, while still enabling prediction of compressive strength. Cube specimens (70.6 × 70.6 × 70.6 mm) were prepared, cured under controlled conditions, and tested at the designated age. The results were analyzed using signal-to-noise (S/N) ratios and analysis of variance (ANOVA), which identified GGBS content and NaOH molarity as the most significant factors affecting strength development. The optimum mix consisting of 40% fly ash, 60% GGBS, an A/B ratio of 0.5, and 12M NaOH achieved an average compressive strength of 45.31 MPa, outperforming all other trial combinations. The findings validate the effectiveness of Taguchi-based optimization for geopolymer mix design and highlight the potential of optimized GPC formulations for sustainable and high-performance construction applications.

Keywords

Geopolymer Concrete, Fly ash, Taguchi, ANOVA, Mix Design, GGBS.

Evaluating Data Augmentation Strategies for Fine-Tuned Language Models

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Abstract

Despite being widely used, little is known about data augmentation techniques for large language models (LLMs) beyond basic accuracy metrics. Although back-translation is often preferred due to its high classification accuracy, simultaneous optimisation of ranking performance, computational efficiency, and calibration quality is required for real-world deployment. A multi-evaluation framework that goes beyond single-metric tests is presented in this paper. Baseline, back-translation, masked language modelling, and T5 paraphrasing are the four augmentation techniques that are systematically compared across two different architectures: GPT-2 (decoder-only) and DeBERTa (encoder-only). Eight model variants are evaluated using nine metrics, with a focus on BoolQ dataset. These metrics cover classification performance (accuracy, precision, recall, F1), calibration quality (ROC-AUC, Brier score, Expected Calibration Error), and ranking quality (MRR, nDCG@5). Important conclusions show that the effectiveness of augmentation is strongly influenced by architectural design. Across all methods, the bidirectional attention of DeBERTa consistently performs better than the unidirectional constraint of GPT-2. More significantly, a surprising finding contradicts the norm: when efficiency and calibration are taken into consideration, masked language modelling is the best approach, even though back-translation has the highest accuracy (87.69%). It performs at an excellent balance in both. Although masked-LM with DeBERTa has a lower weighted composite score (0.9437) than back-translation with DeBERTa (0.9705), masked-LM is a more reliable option due to its consistent performance across both architectures.

Keywords

Data augmentation, large language model, calibration, multi-metric evaluation, BoolQ.

Broadband Absorption in a Symmetric Resonator-Based Metamaterial Absorber via Geometric Modulation

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Abstract

Metamaterial Microwave Absorbers have emerged as promising candidates for radar cross-section reduction and electromagnetic interference shielding applications due to their engineered electromagnetic response. Conventional resonant MMAs give high peak absorption but suffer with narrow bandwidth. The designed structure consists of a metallic ground plane, a dielectric substrate, and a frequency selective metallic resonator fabricated on the top surface. In contrast to traditional uniform-thickness resonators, the top metal layer is deliberately patterned with two distinct thickness values, arranged symmetrically inside the unit cell. This intentional thickness variation alters the effective inductance and capacitance, as well as the surface current paths, resulting in several closely spaced resonance modes. The impedance matching condition between free space and the absorber is improved due to the resonance behaviour, thereby enhancing absorption bandwidth while maintaining high peak absorption. The symmetric design ensures polarization insensitivity, making the structure suitable for stealth and EMI shielding applications in the microwave regime. In this work, a broadband microwave metamaterial absorber is proposed by introducing a multi level thickness and length variation in a symmetric top resonator configuration. We design a structure that offers an efficient way to surpass the narrowband constraint without substantially raising structural complexity while still preserving a greater than 90% absorbance and increasing the bandwidth to nearly 2X in 8-20 GHz.

Electronics and Logic Development for Grasping Objects using Sensor Array on Robotic Gripper

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Abstract

Reliable grasping with minimal force is critical for safe and efficient robotic manipulation, particularly when objects exhibit diverse geometries and structural compliance. Stable grasping requires timely slip detection and adaptive force-control while avoiding object damage and maintaining a secure hold. This paper describes a tactile feedback-based slip detection and regrasping control framework for a three-finger gripper equipped with 3x3 PDMS-based piezoresistive sensor arrays. Unlike conventional methods, the proposed approach is generalized for all objects possessing defined geometric forms without explicit object models or material properties. Slip is detected by analyzing temporal and spatial variations in sensor resistance patterns. They were arranged on a 3-finger robotic gripper to test grasping, slip detection, and re-grasping of multiple objects. Upon slip detection, a closed-loop controller adaptively increases gripping force in discrete increments ($rFR=+50$) until the spatial tactile response stabilizes to ensure a secure hold. The gripper employs a minimum-force strategy, achieving a user-specified initial normal force by closing fingers until feedback matches a target normalized response. A precision impact tester was used to characterize the sensor to ensure consistent force estimation and the resulting force-resistance mappings were then integrated into the control loop using a Random Forest Regression model. System logic is partitioned between an Arduino Mega 2560 R3 for slip-detection and a Python environment for gripper actuation and force regulation. Experimental validation on diverse objects, including a fragile egg, demonstrates robust slip-detection and stable grasp maintenance, highlighting the effectiveness of spatial tactile sensing for adaptive, model-free manipulation in sensitive environments.

An Efficient XGBoost Approach for Cervical Cancer Risk Assessment in Women

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Abstract

Cervical cancer are a huge cause of multiple cancer fatalities worldwide, especially in progressing regions. Predicting risk early and acting accurately is important for lowering these rates. In this study, we present a learning module through a machine adjective that uses the XGBoost Approach Algorithm to identify cervical cancer risk at an early stage. The model analyses clinical and risk factor to find high-risk patterns. The dataset includes medical details such as age, male sexual behavior, medical history, smoking etc. It also specifies various sexually transmitted diseases. We improved the missing data by handling the procured values, selecting important features, and neutralising the provided information. The procured data was divided into testing and training sets. XGBoost had been selected because it works well with structured clinical data and is more accurate than other machine learning methods. We measured the performance of the provided model using the specified accuracy, recall score, F1-score etc. The results obtained showed that XGBoost algorithm provides better identification of the accuracy provided and also provides generalized algorithm compared to other classification algorithms. The system is meant to support, not replace, professional medical diagnosis. It acts as a first step to highlight possible risks and encourage people to seek medical advice promptly; by analyzing multiple clinical and lifestyle factors simultaneously. The model helps reveal various arcs that may not be adaptable in traditional medical assessment. Such intelligent decision-support systems can reduce the burden on healthcare facilities by prioritizing patients who are at higher risk. When seen in long term prospects, the procured model could be improved by co-assisting through larger and more diverse datasets, additional medical parameters, and real-time clinical data through which it can further enhance prediction, accurate values and reliability among algorithms.

Keywords

Cervical Cancer Prediction, XGBoost Algorithm, Machine Learning, Medical Data Analysis, Early Cancer Detection Classification Models, Clinical Decision Support System.

A Portable Optical Biosensing System for Real-Time Hemoglobin Monitoring with Quantitative Validation

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Abstract

Reliable and rapid evaluation of hemoglobin concentration is fundamental for diagnosing and managing numerous clinical conditions, yet existing approaches largely depend on invasive sampling and centralized laboratory infrastructure. Such constraints limit their effectiveness in decentralized, resource-limited, and field-based settings. In response, this study introduces a compact optical biosensing platform engineered to enable non-invasive and near real-time estimation of hemoglobin levels.

The system operates on multi-wavelength photoplethysmographic sensing, exploiting wavelength-dependent optical absorption characteristics of blood. A high-sensitivity acquisition module, built around the ADPD4100 sensor, facilitates stable signal capture under diverse physiological and environmental conditions. A key contribution of this work is the implementation of a dynamic wavelength selection mechanism that adaptively prioritizes optimal spectral bands based on signal quality indices, improving robustness under varying skin tones and perfusion levels. The collected signals are processed through an embedded computational pipeline incorporating adaptive filtering, calibration modeling, and supervised learning algorithms, enhancing estimation fidelity while mitigating motion-induced disturbances and ambient interference. In addition, a hybrid calibration framework combining physics-based modeling with data-driven regression is introduced to improve cross-subject generalization without requiring extensive recalibration.

Performance evaluation was conducted on a hybrid dataset consisting of controlled prototype measurements and simulated variations across a hemoglobin range of 8–18 g/dL. The proposed model achieved a **mean absolute error (MAE) of 0.68 g/dL**, a **root mean square error (RMSE) of 0.91 g/dL**, and a **mean absolute percentage error (MAPE) of 5.2%** relative to reference values. The system demonstrated a strong **correlation coefficient (R^2) of 0.93**, with a **Bland–Altman analysis indicating limits of agreement within ± 1.8 g/dL**, confirming consistency with standard clinical measurements. Furthermore, the proposed adaptive wavelength selection improved signal-to-noise ratio by approximately **18%**, while reducing motion artifact impact by **~22%** compared to fixed-wavelength configurations. The average processing latency was maintained below **10 seconds per reading**, with an operational power consumption under **120 mW**.

The compact and energy-efficient design enables deployment in rural healthcare environments, emergency response scenarios, and defense applications. Wireless communication support further facilitates remote monitoring and integration with digital health infrastructures.

Overall, the results validate the effectiveness of integrating adaptive optical sensing with intelligent signal processing for non-invasive hemoglobin estimation. This device demonstrates strong potential as a scalable, real-time diagnostic solution, contributing to the advancement of accessible healthcare technologies through interdisciplinary innovation.

Keywords

Non-invasive Hemoglobin Estimation, Photoplethysmography (PPG), Optical Biosensing, Adaptive Wavelength Selection, Machine Learning in Healthcare, Point-of-Care Diagnostics, Real-Time Monitoring, Hybrid Calibration Model, Defense Application.

Improving Diagnostic Accuracy and Patient Outcomes through AI-Driven Early Detection of Brain Tumors

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Abstract

In this paper, an AI-based system of automated brain tumor detection, segmentation, and multi-class classification of multi-modal MRI is described to enhance the accuracy of diagnostic and clinical efficiency. The system manages to combine a self-configuring convolutional backbone with transformer-based attention mechanisms and transfer-learning-based classifiers to detect the local and global characteristics of tumors and include explainability and uncertainty estimation as a way of achieving clinical transparency. The proposed method was tested on cross-validation of patients and traditional benchmarking metrics, demonstrating better results than both popular CNN and U-Net baselines, high Dice scores of tumor subregions, and high classification accuracy on glioma, meningioma, and pituitary tumors. The methods of optimization also facilitated the opportunity to practically implement it, and it was proven that hybrid models of deep learning can be used to assist with early intervention and lessen the load of radiologists.

Keywords

Brain tumor detection, MRI; Deep learning, Vision transformer, Medical image segmentation, Tumor classification, Explainable AI, Clinical decision support.

Cybersecurity Protection Mechanisms for Critical Power Sector

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Abstract

The increased integration of Information and Communication Technologies (ICT) in critical power infrastructure has enhanced efficiency and automation in power systems as well as real-time monitoring systems. However, this increased reliance on digital systems has also created a number of vulnerabilities that make power systems more susceptible to cyber threats. Threats such as Denial of Service (DoS), Man-in-the-Middle (MITM), and false data injection can compromise power system operations and potentially cause huge losses through power outages.

This paper focuses on cybersecurity protection mechanisms in critical power infrastructure systems through an analysis of existing vulnerabilities and research gaps as well as the existing defense mechanisms in the power sector. The paper identifies a number of challenges that make cybersecurity a significant issue in the power sector. These challenges include the inability of power systems to detect threats in real-time, insufficient protection mechanisms for legacy systems, as well as the inability to integrate physical and cybersecurity mechanisms in a cohesive manner.

The study highlights the importance of a comprehensive and dynamic approach to cybersecurity for the safeguarding of critical power infrastructure. This includes a multi-layered approach that incorporates the use of sophisticated detection systems, strong protection for both contemporary and traditional systems, and effective cyber-physical security systems. This not only makes the systems more robust but also allows for the secure and effective operation of contemporary power systems.

Keywords

Cybersecurity, Cyber-attacks, Power system.

A Privacy-Preserving Federated Learning Framework for Real-Time Cryptocurrency Fraud Detection Using Hybrid Machine Learning Models

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Abstract

The exponential increase in the incidence of criminal activity relating to cryptocurrencies has been as a result of the rapid advancement of cryptocurrencies in the currency market. thus there are more challenges towards financial institutions and also towards the consumers who use it. This document describes a Blockchain-based Federated Learning (BCFL) System that allows the check for the occurrence of cryptocurrency fraud in a safe, scalable fashion while maintaining the privacy of the consumer. By using federated learning in combination with Blockchain technology, organizations like banks and cryptocurrency exchanges can collaborate to develop a fraud detection algorithm without the involvement of consumer's transaction data. Key features of this system are secure training of local models, encrypted sharing of model updates, decentralized aggregation of model updates and prediction of fraud. The use of Blockchain enables all parties involved to have some level of transparency and trust amongst each other, that is due in large part to the use of a lightweight consensus algorithm that helps to increase the efficiency of this system and reduce the processing burden. Also, the combination of hybrid Random Forest and Convolution Neural Network model generates additional accuracy improvement over detection based on pure statistical methods and those based on pure deep learning methods as it is capable of modelling statistical and deep transactional behaviours. The system was implemented using a real-world dataset; and the results achieved using our system achieved greater accuracy, precision, recall and ROC-AUC than traditional model-based methods. By marrying together scalable, privacy preserving and intelligent fraud detection, we believe that our system has the ability to provide a traditionally robust platform enabling effective protection against current challenges surrounding cryptocurrency-security.

Keywords

Cryptocurrency Fraud Detection, Blockchain, Federated Learning, RF-CNN, Privacy Preservation, Distributed Learning, Cybersecurity.

Real-Time Health Insights Pipeline Using Big Data Streaming and Machine Learning

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Abstract

Modern healthcare systems generate large amounts of patient information in the form of prescriptions, laboratory reports, and clinical notes. However, because most of this data is unstructured and processed using conventional batch methods, it is challenging to use right away. The real-time healthcare analytics pipeline presented in this work is intended to transform clinical documents into practical insights for quicker medical decision-making. The suggested system uses OCR techniques to process medical documents, then continuously ingests the extracted data via Apache Kafka. The data is cleaned, key features are extracted, and patient-level records are prepared for analysis using Apache Spark Structured Streaming. Predictive models are used to categorize glucose risk levels, identify aberrant laboratory conditions, and assess the severity of diseases. Processed records are stored in MongoDB, and real-time patient insights visualization is made possible by a dashboard interface. The system consistently detects significant clinical risk patterns from streaming healthcare data, according to experimental results. The study shows how scalable and useful healthcare monitoring systems for early risk detection and enhanced clinical decision support can be supported by combining real-time data streaming with machine learning.

A Pipeline-Based Approach for Summarizing Long Legal Judgments Beyond Transformer Input Limits

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Abstract

Legal judgments are often lengthy, unstructured, and complex, making them difficult to summarise using standard transformer-based models due to input length limitations. This work focuses on developing a scalable pipeline-based approach for summarising long legal documents using token-level chunking and hierarchical aggregation. The proposed approach segments documents into overlapping chunks, processes them using a LongT5 model, and combines intermediate summaries into a coherent final output. The system also integrates document validation and a case-type classification module based on TF-IDF feature extraction and a Logistic Regression classifier trained on 4,905 labeled cases. The approach is evaluated on 500 Indian Supreme Court judgments exceeding standard input limits. In addition to detailed summarisation using LongT5, a BART-based model is used for short summary generation to enable comparative analysis. Experimental results show that LongT5 achieves ROUGE-1, ROUGE-2, and ROUGE-L scores of 0.1592, 0.0269, and 0.1230, respectively, with a BERTScore (F1) of 0.7608, outperforming BART, while the classification module achieves an accuracy of 0.89, weighted F1-score of 0.90, and macro F1-score of 0.61. These results demonstrate that the proposed approach effectively generates structured and coherent summaries for long legal documents, making it suitable for real-world legal applications.

Design and Analysis of Solar Powered Eco-Friendly and Efficient Coir Moisture Removal System

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Abstract

The objective of this research work is to develop and test an automatic system for removing moisture from coir and compare its drying efficiency with the existing conventional drying method through statistical analysis. In this study, the existing conventional drying process is compared with automatic moisture control. Process. The proposed automatic coir moisture removal system, in which a rotating drum mechanism, hot air flow, and microcontroller-based moisture sensor feedback control are employed. A total sample size of 03 coir samples was taken for each group with similar initial moisture content ranging from 54% to 58%. The variables taken for analysis are final moisture content and drying time. Statistical analysis was done using mean, standard deviation, and independent sample test. The results obtained clearly depicted that the speed of the drums has a major impact on the removal of moisture content in the proposed system for automatic coir drying. At an initial moisture content of 57% and a blower temperature of 138°C, it was indicated that the final moisture content of the coir material reduces with an increased speed of the drums. At 110 rpm, the final moisture content was found to be 19%, which reduced to 16% when the speed increased to 130 rpm and further reduced to 11% at a speed of 150 rpm. It has been affirmed from this study that the proposed automatic coir moisture removal system indeed works properly at various higher rpm. In addition, out of all the conditions tested, 150 rpm results in minimum moisture content and therefore optimal drying. It is inferred from this study that the rpm of the drum plays an important role in drying, and this proposed system is applicable to efficient coir processing.

Keywords

Automatic coir moisture removal system, Coir drying, Moisture content, Drying time, Hot air drying, Microcontroller-based control, Statistical analysis, independent sample t-test.

An IP Based Login System for Enhanced Security

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Abstract

In today's digital era, ensuring the security of online accounts is of paramount importance. Traditional password systems often fall prey to unauthorized access due to static credentials and predictable patterns. To address this, this paper introduces a novel approach of "Fourth Login" for dynamic password generation. This approach leverages a user's IP address to generate unique, time-sensitive passwords for every login attempt. The generated password is automatically sent to the registered user via secure channels, ensuring seamless and secure authentication. By incorporating dynamic password generation, the system mitigates risks associated with static passwords, such as brute-force attacks and credential theft. The paper focuses on implementing robust Heuristic (Rule-Based) Algorithm algorithm to ensure IP-based password uniqueness and uses encryption to maintain password confidentiality during transmission. This innovative solution offers a user-friendly and scalable authentication mechanism, contributing to enhanced cybersecurity for applications requiring high-level protection.

Detecting Fake Users Over Online Social Networks Using Social Graph Analysis

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Abstract

In recent years, social media platforms have become popular spaces for people to connect and share information. However, some groups or users on these platforms are created with fake or misleading identities to spread false information, manipulate opinions, or conduct fraudulent activities. Detecting such fake users is important to maintain trust and safety online. This project aims to identify fake users by analyzing social network data, such as user connections, and interaction behaviours. Using techniques from Social Network Analysis (SNA) and Graph Theory, the system can detect unusual patterns like tightly connected groups with low individual credibility or automated activity. We will be Using Graph Theory based Algorithm as Jaccard Similarity, Degree Centrality, Betweenness Centrality. By identifying these fake users early, this work helps improve the security and reliability of social media platforms.

Early detection of fake users helps to prevent the spread of false information, reduce coordinated manipulation, and protect genuine users. This research strengthens the reliability and security of social media platforms and demonstrates that social graph analysis is an effective approach for maintaining trustworthy online environments.

Performance Analysis of Polymer-Enhanced Bitumen in Flexible Pavement Applications

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Abstract

In recent times, improving the strength and durability of flexible pavements is a key concern for engineers. The present study investigates the performance characteristics of polymer modified bitumen (PMB) in flexible pavement mix design with the objective of enhancing durability and load-bearing capacity. Different proportions of polymer additives were blended with conventional bitumen, and a series of laboratory tests were conducted to evaluate their influence on material properties. Standard tests such as penetration, softening point, and ductility were carried out to assess the basic characteristics of the modified binder. In addition, Marshall mix design tests were performed to determine stability, flow, and volumetric properties of the bituminous mixtures. The experimental results, analyzed using spreadsheet-based tools, reveal that the inclusion of polymers significantly enhances the performance of bituminous mixes. An increase in Marshall stability and softening point indicates improved resistance to deformation and temperature variations. Meanwhile, penetration and ductility values showed controlled changes, suggesting better flexibility and cohesion of the binder. The study also identifies an optimum polymer content that provides maximum performance benefits without adversely affecting workability. Overall, the novelty of the proposed findings demonstrate that polymer modified bitumen can effectively improve the mechanical behavior and service life of flexible pavements, making it suitable for use in high-traffic and challenging environmental conditions.

Keywords

Flexible pavements, cohesion, binder, polymer modified bitumen, polymers.

Influential User Detection Using Centrality Measures of Social Network Analysis

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Abstract

Influential users are those users over online social networks that are acting as the mover and shakers in the given social networks. To detect these influential users in online social networks is the need of the hour and their detection using the novel approaches will be having many real world implications. In this project we are going to detect these influential users using centrality measures of Degree Centrality, Betweenness Centrality, Eigenvector Centrality, Closeness Centrality Social Network Analysis Techniques and then will be going to lay a comparative study. All the experimentations will be done in Python and proposed approach will be tested on real work social network datasets from opensource dataset repositories. The proposed approach will be having many real world implications.

Community Detection in Online Social Media Using Social Networks Analysis: A Comparative Study

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Abstract

Group of users that are intra densely connected with each other are termed as the community over an online social network. People over an online social network group together in these communities and most of the times they share the similar interests. In this project we are going to detect these communities over these online social networks using the techniques of Social Network Analysis (SNA) such as clique percolation method, random walks and Louvain methods. The proposed approach will be tested on real social network datasets and the experimentations will be done in python. The empirical venture will show the best results and can have best implications in real world situations.

Keywords

Clique percolation method, Community Detection, Influential user, Louvain methods, Online Social Networks, random walks Social Graphs, Social Network Analysis.

A Study on Burhwal - Gonda Kacheri Fourth Line for Economic & Financial Viability of Railway Capacity Augmentation by using Cost - Benefit Analysis

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Abstract

The Indian economy has witnessed rapid growth in recent decades, with railway infrastructure playing a crucial role in supporting passenger and freight movement. However, inadequate freight capacity has led to delays, reduced line efficiency, and increased operating costs. This study evaluates the economic and financial viability of adding an additional railway line to the existing triple-line section between Burhwal to Gonda Kacheri. A cost-benefit analysis approach is adopted to assess feasibility, incorporating key parameters such as project cost, traffic forecasts, revenue generation, operating expenses, and detention savings. These inputs are used to estimate the Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR). The results indicate FIRR and EIRR values of 10.36% and 16.17%, respectively, demonstrating both financial and economic feasibility. The proposed additional line is expected to significantly enhance operational efficiency and accommodate future traffic demand. Freight volume is projected to reach 11.39 million tonnes, while overall traffic capacity is anticipated to increase by 50%. Additionally, freight travel time is expected to reduce by 0.08 hours and route distance by 2.1 km. The project is also likely to contribute to broader economic benefits, including a 30% increase in employment, tourism, and secondary market activities. Overall, the findings confirm that cost-benefit analysis is an effective tool for evaluating railway infrastructure projects.

Keywords

Railway Capacity Augmentation, Cost-Benefit Analysis, Railway Feasibility Study, Traffic Forecast.

Detection of Overlapping Communities in Online Social Networks by Using Graph Analysis

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Abstract

Whenever people use the online social networks they tend to mix and collaborate with each other, as a result of which they are creating the groups of users called as communities. These communities are more intradensely connected. The different users with a community are having the similar interests and properties. The detection of these communities is of utmost importance as per their implications are concerned. In this project we are going to detect the overlapping communities using the different approaches and tools of graph theory. The datasets of online social networks will be utilized from the open dataset repositories that are available over the internet. The experimentation of this project will be done on google colab using the python language. The results on experimentation will be of best standard and the project will be having many real world implications.

Exploring High Performance Composites for Efficient Automobile Application

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Abstract

The aim of this research work is to design and analyze hybrid natural fiber-reinforced epoxy composites using bamboo, hemp, and ramie fibers, and to determine which combination of fibers provides the best mechanical properties. The mechanical properties of the composites were affected by the type of composition of the fibers. The tensile strength varied from 8.27 N/mm² to 12.27 N/mm², flexural strength from 892.5 N/mm² to 1819.9 N/mm², and impact strength from 2.94 J to 3.92 J. Among the samples, R1 provided the best results in terms of tensile strength, impact resistance, and less water absorption. The experiment has confirmed that the combination of bamboo, hemp, and ramie fibers enhances the mechanical properties of epoxy composites. The R1 mixture showed the best combination of properties and can be regarded as a sustainable and eco-friendly material.

Keywords

Bamboo fiber, Hemp fiber, Ramie fiber, Epoxy resin, Mechanical properties, Tensile, composite materials.

A Hybrid Multi-Model Deep Learning Framework for Proactive Vehicular Engine Fault Diagnosis

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Abstract

The vehicles we drive today are really complex. That's why we need systems to monitor the engines condition and alert us to potential problems. People usually check their vehicles regularly do a diagnosis. This may not help us detect issues early and that can cause the vehicle to break down suddenly. This paper is a way to analyze the health of a vehicular engine using a deep learning model. This model combines one- convolutional neural networks and artificial neural networks. It looks at data from sensors that measure temperature, pressure and speed to find patterns that might indicate the engine is not working properly. The one-dimensional convolutional neural networks help find features in the data and the artificial neural networks classify and identify the engines condition. So it is important to use systems like this in vehicles to make smart vehicles and intelligent transportation systems and also it save a money on maintenance. Our aim is to reduce the unexpected failures of the vehicle by identifying the problems at an early stage. The proposed system can be used for identifying the problems related to the vehicle at an early stage. This work is mainly focused on the health of the vehicle's engine and the predictive maintenance of the vehicle. For this, the proposed system is utilizing advanced techniques such as deep learning, which include 1D CNN and ANN. The main aim of this system is fault prediction, which increases the reliability of the vehicle and reduces the maintenance costs.

Keywords

Vehicular Engine Health, Predictive Maintenance, Deep Learning, 1D-CNN, Artificial Neural Networks, Fault Prediction.

Performance Analysis on CFD and Sustainable Implementation of Telescopic Rectangular Blade Wind Turbine for Low-Wind Regions

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Abstract

The primary aim is to come up with a Telescopic rectangular blade Wind Turbine (TBWM) to have high efficiency when the wind is low (10 m/s). The design, through altering the area of the blade, minimizes the problem of high cut-in speeds and weight, common to fixed-blade HAWTs. This research focused on comparing the conventional fixed-blade turbine with the proposed TBWM. The TBWM is analysed in ANSYS Workbench with three different materials: Steel, ABS and UPVC (Unplasticized Polyvinyl Chloride). The analysis was done and the results shows TBWM was much more effective in the conditions of low wind (5 to 12 m/s). The TBWM produced an average of 0.174 kW of power with a system efficiency of 71.8% while the traditional fixed-blade system recorded 0.092 kW of power output with an efficiency of 45.1%. The average power output of 0.108 kW and standard deviation of 0.046 kW were proven by using statistical analysis. It is evident that the TBWM is more efficient in low winds (10 m/s), where TBWM could produce 0.174 kW with the efficiency of 71.8. These improvements have been proven by statistics with an average power output of 0.108 kW.

Keywords

Telescopic Blade Windmill, Low-Wind Regions, Finite Element Analysis, Structural Dynamics, UPVC Material, Variable Geometry, Aerodynamic Efficiency, Sustainable Energy.

Automated Difficulty Estimation and Simplification of Academic Texts: Narrative Review

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Abstract

The rising digital content rate is an effect that has enhanced the necessity to explore automated ways of textual content summarisation, simplification, assessment and evaluation. This is a review of findings of fifteen current research studies in four related fields, viz., text summarisation, text simplification, text difficulty prediction and question-based evaluation. It also looks at trending papers on extractive, abstractive and hybrid summarisation models, and emphasises the rise of transformer models such as Bidirectional Encoder Representations from Transformers (BERT), Text-to-Text Transfer Transformer (T5) and Bidirectional and Auto-Regressive Transformers (BART). It also addresses simplification strategies grounded in lexical substitution and deep-learning systems optimised based on the readability level. In addition to this, we also discuss linguistic and machine learning based approximations of text difficulty, text factual consistency and document understanding assessments based on QA systems. Comparison of the works demonstrates that hallucination during abstractive summarisation, lack of datasets to streamline the process and poor generalisation during difficulty prediction exist. However, there are opportunities to integrate the four areas. Future research directions involve unified pipelines that combine, simplify and quantify text using multi-task transformers and QA-based factual verifiers.

A Conceptual Framework for Fine-Grained Aspect-Based Sentiment Analysis in Hinglish Smartphone Reviews

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Abstract

The extraction of granular consumer information on e-commerce platforms where consumers often talk about various product attributes in the same review has become a necessity of Aspect-Based Sentiment Analysis (ABSA). But, in the case of the Indian smartphone market, the use of codemixed and informal transliteration makes the Hinglish language appear very noisy and it is this “linguistic noise” that causes the poor performance of the typical Natural Language Processing (NLP) models. Although previous studies have obtained a high accuracy in monolingual or coarse-grained sentiment analysis, a common set of tasks in this area has not been reached in terms of the fine-grained triplet extraction in low-resource Indian languages. The proposed paper introduces a concept framework that can deal with these shortcomings by introducing a dedicated Hinglish-to-English normalization layer and a hybrid XLM-RoBERTa system. The framework, based on the Appraisal Theory, operationalizes the extraction of triplets of informal consumer feedback consisting of the aspects, opinion and sentiment, which are operationalized as (Aspect, Opinion, Sentiment) triplets (bootstrapped to structured domain-specific taxonomies). Our hypothesis is that this modular design will enhance aspect boundary detection and sentiment mapping by reducing sparsity in vocabulary due to transliteration. The work gives an extensive architectural plan upon the implementation in the future and gives great implications to the multilingual NLP research and the automated processing of consumer feedback in the expanding Indian e-commerce industry.

Keywords

Aspect-Based Sentiment Analysis, Hinglish, Code-mixing, XLM-RoBERTa, Conceptual Framework, Smart-phone Reviews.

A Critical Review of Diagrid and Hexagrid Tubular Systems in the Context of IS 1893 (Part 1): 2025 Seismic Provisions

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Abstract

The development of India's urban landscape with super-tall structures faces concerns in selecting effective Lateral Load Resisting Systems (LLRS). While diagrid and hexagrid structures are widely accepted for efficiency, a research gap exists in applying international codes (ASCE/Eurocode), which have limited applicability to the proposed draft of IS 1893 (Part 1): 2025 draft, specifically regarding the transition to Zone VI and PEHA. This paper reviews 24 studies on the shift from axial-dominated diagrids to flexure-dominated hexagrid structures. A critical focus is missing design link between IS 800:2007 and updated 1893:2025 (Draft) regarding structural ductility and force redistribution. Practical feasibility of these systems is also examined through Indian case studies, including the UIIC Headquarters and Palais Royale. Findings show that while diagrids provide superior stiffness, hexagrids offer enhanced ductility and a 10–15% reduction in structural steel. However, the nonlinear performance of both diagrid and hexagrid systems under the proposed extended 10-second spectral acceleration (S_a/g) range, revised hazard factors (Z), and Soil-Structure Interaction (SSI) and near-fault ground motion conditions remains insufficiently addressed for structures exceeding 40 stories in high-density urban zones. This research identifies these gaps to support mechanism-based evaluation under evolving Indian seismic provisions.

Sustainable Dynamic Wireless Charging System for AGVs & AMRs

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Abstract

Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs) play a critical role in modern smart factories and warehouse automation, where uninterrupted operation is essential for maintaining productivity. Conventional charging methods require vehicles to stop for recharging, leading to operational downtime and reduced system efficiency. This work proposes a solar-assisted dynamic wireless charging system for AGV applications, validated using a prototype robotic platform. The system utilizes resonant inductive wireless power transfer to enable contactless energy transmission while the vehicle is in motion. A hybrid power architecture integrates solar photovoltaic (PV) energy with an auxiliary DC supply through a common DC bus. The received power is rectified and regulated to charge a 12 V battery managed by a Battery Management System (BMS). An ESP32 controller supervises system operation and battery monitoring. Experimental validation demonstrates the feasibility of renewable-assisted dynamic wireless charging, improving operational continuity and efficiency in industrial automation environments

Keywords

Dynamic Wireless Power Transfer (DWPT), Automated Guided Vehicle (AGV), Solar Photovoltaic (PV), Resonant Inductive Coupling, Battery Management System (BMS).

A Hybrid Enhancing and Localizing Ocular Tumor Diagnosis using Dual-Attention FusionNet Framework

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Abstract

Ocular tumor is a rare but serious eye disease that may lead to severe defect in the eye vision unless the tumor is detected at the initial stage of its occurrence. Retinal fundus image is not easy to identify the tumors in the eye since they are irregular in shape, small and low in contrast to the other areas of the retinal image. Determining the ocular tumors using retinal fundus images based on the eye and vision expert using his or her bare eye might be a tedious exercise and might lead to variation in identification of ocular tumors using retinal fundus images. In this project, A Hybrid Enhancing and Localizing Ocular Tumor Diagnosis System using Dual Attention FusionNet Framework has been suggested with the aim of identifying ocular tumors using retinal fundus images. ResNet50 and EfficientNet convolutional neural networks have been utilised in the proposed system to enhance the detection of ocular tumors in the images of retinal fundus. It has been trained through different methods which include normalization, contrast enhancement and retinal fundus image data augmentation on the RFMiD database towards the enhancement of ocular tumor recognition in retinal fundus images. The suggested model has an accuracy of about 96.5 in the detection and localization of ocular tumors, which proves its effectiveness and reliability in the early determination of the same using retinal fundus images. The suggested system is actually excellent at recognizing tumors using eye back image. It is possible to detect ocular tumors with the help of this system. It comes in handy with the vision and eye workers. The system is effective in locating tumors at an early stage by images of the back of the eye. This is a system that assists in the detection of tumors in retinal fundus image.

Keywords

Ocular Tumor Detection, Fundus Image Analysis, Deep Learning, Dual-Attention FusionNet, Transformer Encoder, Explainable AI.

Hybrid CNN-Transformer Framework for Real-Time IoT Device Identification Using Full Packet Data

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Abstract

The fast emergence of devices on the Internet of Things (IoT) has introduced the situation when highly heterogeneous networks are being formed in which correct identification of the device is paramount to the enforcement of the security, access control, and traffic regulation. Traditional flow-based machine learning models are based on statistics, like size of packets or interarrival time, and fail to provide finer-grained contextual information, with failure exhibiting whenever packets are encrypted or the domain alters. In a bid to overcome these constraints, this paper presents a hybrid convolutional neural network (CNN)-transformer system that can be used to identify real-time IoT device identifications using full packet data. The CNN layers are able to find local patterns in the form of the byte, whereas the Transformer encoder captures the long-range temporal relationships with the help of self-attention. As evidenced by experimental evaluation on two benchmark datasets: CICIoT2023 and IoT-TON, the proposed framework on benchmarks allows better precision, precision, recall, and F1 score than CNN-only baselines, RNN / LSTM based and Transformer-only. In addition, it has almost real time inference latency and can be robust in partially encrypted and noisy traffic settings. The findings rise to the usefulness of hybrid deep learning system to support scalable, precise, and deployable IoT security systems.

Keywords

IoT Security, Device Identification, Deep Learning, CNN, Transformer, Full Packet Data.

Design and Implementation of a Custom Flight Controller for a Quadcopter Using ESP32 and Low-Cost Sensors

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Abstract

This paper presents the design and development of a custom flight controller for a quadcopter using EP32 microcontroller and a set of low cost sensors. The objective of the work is to explore whether an affordable hardware can be implemented and designed. The focus of this work is to achieve reliable parameters, sensor integration and wireless system which is suitable for academic and experimental UAV applications. The proposed system integrates BME280 barometric sensor, ADXL245 accelerometer and Neo-6M GPS module in order to keep a track on the expected parameters which are essential for attaining stability in a flight.

Keywords

Quadcopter, Flight Controller, ESP32, Sensor Fusion, Wireless telemetry, ADXL345, BMP280, Neo-6M, UAV, PID Auto-Tuning.

Predicting Hospital Stay Length

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Abstract

The Efficient management of hospital resources is important for improving patient care, reducing operational costs, and ensuring optimal utilization of healthcare facilities. One of the most important factors affecting hospital efficiency is the length of stay (LOS) of patients. Predicting the duration of hospital stay at the time of patient admission can help in healthcare providers in planning bed allocation, scheduling treatments, and managing hospital workflows effectively. However, accurately estimating hospital stay length is a challenging task due to the complexity of patient health conditions, varying treatment procedures, and the large volume of healthcare data generated in hospitals.

This study proposes a machine learning-based predictive framework for estimating the hospital length of stay using electronic health records (EHR). The system checks things like age, medical conditions, test results, admission details and treatments. It uses machine learning algorithms such as Random Forest, Logistic Regression and XGBoost to figure out how to predict how long a hospital stay will be. The system looks at all the information about hospital stay length to make a prediction. It uses Random Forest and Logistic Regression and XGBoost to help make these predictions about hospital stay length. First the system cleans up the data to work with these models. This means fixing the missing information and making the formats consistent and removing the data. Then the system checks these models to see how well they work using things like accuracy and precision and predictive power. The results show that using all these models together gives results than using just one model for hospital stay length. This way the system can make predictions about hospital stay length. A system like this can help hospitals and the people, in charge manage the beds better and use the resources in a way and provide good patient care. Also if the hospital puts these models into their system it can help the people make decisions based on the data and this can make the patient outcomes better.

Keywords

Hospital Length of Stay Machine Learning, Healthcare Analytics, Electronic Health Records, Predictive Modeling, XGBoost.

Smart Path Following Robot: A Systematic Literature Review

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Abstract

Autonomous mobile robots capable of following predefined paths are widely used in industrial automation, educational robotics, and intelligent transportation systems. This project presents the design and implementation of an Arduino based path-follower robot that utilizes infrared (IR) sensors and a Proportional-Integral-Derivative (PID) control algorithm for accurate path tracking. The proposed system detects a black line on a contrasting surface using IR sensors and dynamically adjusts motor speed and direction through a PID controller to minimize deviation from the path. The hardware architecture consists of an Arduino Nano microcontroller, L293D motor driver, DC motors, and IR sensor modules, ensuring cost effectiveness and ease of implementation. Experimental evaluation demonstrates that the robot can successfully navigate paths of varying complexity while maintaining stability and consistent performance at different speeds. The results indicate that the integration of PID control significantly improves tracking accuracy and reduces oscillations compared to basic control methods. This work provides a reliable and scalable solution for autonomous navigation applications and serves as an effective learning platform for robotics and embedded systems research.

Keywords

Autonomous mobile robot, Path-follower robot, PID control, Arduino Nano, Infrared sensors, Line following robot, Embedded systems, Motor control.

Next-Gen CCTV: Real-Time Gesture Detection with Geolocation Alert

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Abstract

In order to protect the public efficiently, effective Surveillance Systems play an important role in detecting possible Threats prior to becoming Problems. Traditionally, CCTV Surveillance is based on Human Operators using a Simple Motion Detection System that has limitations in detecting High-Risk Gestures such as Aggressive or Distressed Behavior or Silent Calls for Help. The Study being presented in this Paper will focus on Gesture Alert, an AI-based, Intelligent Surveillance Framework, that incorporates MediaPipe and OpenPose for Real-time Hand Gesture Identification and Risk Assessment. Gesture Alert will review Real-time CCTV Video to identify Critical Gestures (indicating Distress/Aggression) and Generate a Geo-located Notification to Emergency Responders within Programmed SMS, Email, or App Notification Programs. A Non-Disruptive Automated System for Security Monitoring by using Computer Vision and Deep Learning Models to extract Features and Classify them. Gesture Alert achieves High Detection Rates with Multi-Level Accuracy with a Significant Reduction in Human Reliance and Delayed Response Times. Experimental Tests of the Gesture Alert Approach, Clearly Demonstrate Real-time Identification of Critical Gestures with Minimum False Positive Rates, therefore Providing an Effective, Proactive, Scalable Solution for Smart Surveillance.

Keywords

Gesture Recognition, Deep Learning, MediaPipe, OpenPose, Surveillance Systems, Geolocation Alerts, Real-time Threat Detection.

Lung Cancer Detection from CT Images Using Deep Learning Based Model EfficientNet-B4 and DenseNet121

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Abstract

Fast observation of Lungs Cancer significantly increases the patient's chances of recovery and help to doctors for treatment on time. Generally Computed Tomography (CT) scans use for test the Lungs Cancer, But the analysis of CT scans depends on the Radiologist. Therefore, different doctors may understand the same CT scans differently. To reduce this problem and help doctors, this study introduces an interpretable Deep Learning framework to identify Lungs Cancer risk based on CT images. This model of deep learning used two Convolutional Neural Network (CNN) EfficientNet-B4 and DenseNet-121, which help in differentiating Benign (Normal) and Malignant (Cancerous) nodules in CT scans. Parameters such as Accuracy, Precision, Recall, F1- Score, Confusion Matrix and Receiver Operating Characteristic- Area Under the Curve (ROC-AUC) have been used to measure the performance of the Model. To make the model understandable, the Gradient weighted- Class Activation Mapping (Grad-CAM) technique has been used, which shows which parts of the CT image most influence the model decision. Experimental results show that DenseNet-121 produce more stable and better classification results than EfficientNet-B4. Although the (ROC-AUC) results showed slight variations due to uncertainty of some levels in the proved effective in predicting and visually explaining Lungs Cancer risk. Therefore, this model may be useful for AI-Assisted Medical Diagnosis in the future.

Keywords

Lungs Cancer, Deep Learning, Convolutional Neural Network (CNN), DenseNet-121, EfficientNet-B4, Receiver Operating Characteristic (ROC), Area Under the Curve (AUC).

CFD Analysis of Trapezoidal Shaped Manifold Arrangement in Micro - Channel Heat Sink

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Abstract

Heat sink is engaged and evaporates heat from other devices by using radiant or direct contact. Heat sink is a device which increases the heat dissipation capacity from a device to open environment. Application of a heat sink has to adjust the temperature of hot body which is being under the process of heat dissipation within prescribed conditions as defined by the constructor of that device. In the present research investigation is done on three different shape test pieces are designed having aluminum as the base material. These test pieces are consisting small scale fluid channel. The channels are surrounded by the solid walls and with heating source. The testing is done with a variable input of heat and flow rates. As to resolve the instability difficulties of manifolds flow section and channels are needs to be design for effective shape of the entrance and exit manifold. The CFD analysis is carried out to analyze the effective shape of the manifold arrangement from three different shapes. These will show that the manifold with upward and downward taper flow arrangement having more rate of heat transfer coefficient then another.

Keywords

Heat Sink, Micro channel, Heat Transfer, Reynolds Number, Computational analysis.

Fault Impact Footprint Mapping in Power Networks

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Abstract

In the given paper, the author describes a fault impact footprint mapping framework to investigate disturbance propagation in radial power distribution systems. The proposed method does not only rely on fault-detection or fault-localization, but on the impact that a fault has on the behavior of voltages in the network of nodes that are interconnected. A radial distribution network model of 20 nodes and lateral branches is developed that incorporates a distance-related variation of voltage in the normal operating cases. Simulation of fault scenarios is carried out at the desired nodes, and the relative voltage deviation is then determined as an indicator of the level of disturbance. The magnitude of deviation is used to categorize the nodes into levels of impact to produce a spatial footprint of fault influence. It has been shown by simulation that faults in different locations lead to different disturbance patterns across the network. The available approach is computationally sparse and can be used to do analytical evaluation of voltage disturbances induced by faults without having to use training sets or machine learning regressions.

Keywords

Radial distribution network, fault impact analysis, voltage deviation, disturbance propagation, impact classification, simulation-based modeling.

A Hybrid Deep Learning Framework for EEG-Based Epileptic Seizure Detection using CNN and Pre-Trained Transfer Learning Models

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Abstract

Epilepsy is a neurological disorder characterized by abnormal electrical brain activity causing recurrent seizures. Electroencephalogram (EEG) is a safe, non-invasive technique for detecting epileptic seizures, but expert training and long hours are required for the manual interpretation. Existing methods fail to represent both fine-scale cross-region spatial organization and temporal dynamics of the signals, risking a decreased classification performance. This study presents a hybrid deep learning framework with two parallel branches for a fully automated five-class neurological EEG classification. In the spatial branch, 1D signals are transformed into log-scaled spectrogram images, allowing pre-trained CNNs (VGG16 and ResNet50) to extract spatial features. At the same time, the spatio-temporal component processes normalized sequences through stacked one-dimensional convolutional layers and a Bidirectional Long Short-Term Memory (Bi-LSTM) network for a precise representation of the seizure temporal dynamics. These features are then fused through regularized dense layers to classify five clinical states (seizure activity, tumor area, healthy area, eyes closed and eyes open). On the classical UCI Epileptic Seizure Recognition dataset with 11,500 samples, the architecture achieves an outstanding 98.25% F1-score, 98.68% precision and 97.83% recall specifically for the detection of ictal seizure states. On the highly complex five-class classification task, distinguishing inter-ictal tumor and healthy brain regions, the model equips a sound overall test accuracy of 83.83% with macro-average precision, recall and F1-scores of 84.26%, 83.83% and 83.87%, respectively. By using multi-dimensional feature extraction, the model transcends standard 1D baselines, offering a solid foundation for automated diagnostics.

Intelligent Prognostics and Predictive Maintenance of Power Cables Using Machine Learning

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Abstract

Underground power cables are essential components of modern electrical distribution systems, yet they remain highly vulnerable to faults caused by insulation degradation, thermal stress, and environmental factors. Traditional monitoring techniques often rely on manual inspections, leading to delayed detection and increased downtime. This paper proposes an intelligent monitoring system, Monitoring Cable Protector, which integrates Artificial Intelligence and IoT for real-time fault classification. The system utilizes an ESP32 microcontroller for multi-sensor data acquisition, tracking parameters such as voltage, current, temperature, and insulation resistance. A Random Forest Classifier is employed to analyze these inputs and identify fault patterns, including short circuits and insulation failures. Data is transmitted via Wi-Fi to the ThingSpeak cloud platform for remote visualization and early warning alerts. Experimental results demonstrate high detection accuracy and system stability. By enabling predictive maintenance, the MCAP system enhances power grid reliability and supports sustainable infrastructure development by significantly reducing maintenance costs and operational risks.

An Explainable AI-Based Clinical Decision Support System for Early Diabetes Risk Detection Using XGBoost, SHAP, and LLM-Generated Personalised Recommendations

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Abstract

Diabetes mellitus is one of the most prevalent and silently progressing chronic health conditions that continue to be prevalent globally. Therefore, the timely detection of diabetes is of critical importance to prevent the development of serious and severe complications. Most of the prevailing machine learning-based risk prediction systems for diabetes detection also face various challenges and restrictions. Thus, the main purpose of the proposed research is to develop an Explainable Artificial Intelligence (XAI)-based Clinical Decision Support System (DSS) for the early detection of diabetes risk using the XGBoost gradient boosting algorithm and the resampling method SMOTETomek. Feature engineering techniques were also employed in the proposed research to develop the most accurate and discriminative risk prediction system. To perform the experiments and validate the proposed system, the PIMA Indians Diabetes dataset was employed. The proposed system was compared with the baseline Logistic Regression, Support Vector Machine, and Random Forest-based risk prediction systems. The proposed XGBoost gradient boosting algorithm-based risk prediction system outperformed the baseline systems in all the performance metrics. Therefore, the proposed system was considered the most accurate and reliable risk prediction system. To address the black-box nature of the proposed gradient boosting algorithm-based risk prediction system, the SHAP (SHapley Additive exPlanations) TreeExplainer method was employed. To validate the proposed system, it was compared with six different configurations. The proposed risk prediction system outperformed the baseline systems in the most critical performance metric. The proposed research was conducted on the PIMA Indians Diabetes dataset. Therefore, the proposed risk prediction system was considered most accurate and reliable. However, the proposed risk prediction system needs to be tested on the population dataset to validate the proposed risk prediction system.

Keywords

Diabetes Risk Prediction, XGBoost, SMOTETomek, Explainable Artificial Intelligence, SHAP, Clinical Decision Support System, Class Imbalance, Feature Engineering, Gradient Boosting, Machine Learning in Healthcare.

LinkPulse: An Autonomous Web-to-Knowledge AI Platform Using Retrieval-Augmented Generation and Hybrid Retrieval

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Abstract

The exponential growth of digital information on various websites, software repositories, and multimedia content has created a bottleneck for efficiently integrating this information from various sources into a unified and queryable “knowledge base.” The paper describes LinkPulse, an autonomous web-to- knowledge AI platform for ingesting and processing information from various sources such as web pages, GitHub repositories, PDF files, and video transcripts using a unified seven-layer pipeline. LinkPulse is based on a Retrieval-Augmented Generation (RAG) model using LangChain-based pipelines and vector storage using Pinecone, FAISS, and ChromaDB. A *hybrid retrieval engine* is proposed that combines the results of internal vector database search and real-time web search results using Reciprocal Rank Fusion (RRF) of all ranked lists. Experimental results on a 5,000 pair benchmark using Wikipedia, arXiv, and GitHub as data sources show that LinkPulse achieves 97.2 time, which is superior to various keyword-based, TF-IDF-based, and vector- based retrieval methods by up to 16.9 percentage points in terms of F1-score. The modular structure of LinkPulse is highly scalable as each component of the pipeline can be scaled individually, making it suitable for large-scale enterprise-level knowledge management applications.

Keywords

Retrieval-Augmented Generation, Knowledge Ingestion, Vector Databases, Large Language Models, Hybrid Retrieval, Semantic Embeddings, Reciprocal Rank Fusion, AI Knowledge Systems.

AI-Driven Career Guidance System Using Hybrid Assessment and Machine Learning for Personalized Career Planning

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Abstract

In today's rapidly evolving world, choosing the right career path has become increasingly complex due to the abundance of educational options, technological advancements, and changing job market demands. The AI-Based Career Guidance System aims to provide personalized career recommendations to students based on their academic performance, interests, skills, and personality traits. By leveraging Artificial Intelligence techniques such as machine learning, natural language processing (NLP), and data analytics, the system analyzes user data collected through assessments, questionnaires, and academic records.

The model predicts suitable career domains and suggests educational paths, skill development courses, and potential job roles aligned with the user's profile. The system continuously learns from user feedback and market trends to refine its recommendations, ensuring adaptability to future industry needs. A user-friendly web or mobile interface enables students to interact with the system, receive AI-generated insights, and plan their career progression effectively.

This project not only assists individuals in making data-driven career decisions but also serves as a valuable tool for educational institutions and counselors to guide students efficiently. The integration of AI in career counseling bridges the gap between student potential and market opportunities, fostering informed and confident career choices.

Real-Time Anomaly Detection in IoMT Networks Using Stacking Model and a Healthcare- Specific Dataset

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Abstract

Internet of Medical Things (IoMT) facilitates real-time patient monitoring via interconnected medical devices, but it also increases the risk of sophisticated cyber-attacks, compromising data integrity and service reliability. Conventional anomaly detection techniques show low flexibility in dealing with diverse IoMT traffic and specific types of attacks in the healthcare sector. For addressing these issues, an anomaly detection framework is proposed, relying on datasets obtained from UNSW-NB15 and BRFSS2015. The dataset is processed by means of label mapping, feature encoding, recursive feature elimination via XGBoost, dataset concatenation, SMOTE-based balancing, and standard scaling. Various classifiers, including Logistic Regression, Random Forest, XGBoost, KNN, SVM, ANN/MLP, and Isolation Forest, as well as ensemble classifiers, are implemented. The stacking classifier consists of XGBoost, Random Forest, and ANN as base classifiers, with XGBoost as the final classifier, whereas the voting classifier comprises XGBoost, Random Forest, and MLP as base classifiers with a soft voting mechanism. The voting classifier produces the highest classification accuracy of 95.5%, whereas XGBoost classifier produces 96% accuracy in multi-class detection, and the voting classifier produces 99.9% accuracy in binary classification. Model interpretability is enhanced using LIME and SHAP, and a Flask-based interface supports real-time prediction, demonstrating improved robustness and practical applicability for IoMT anomaly detection.

Keywords

Internet of Medical Things (IoMT), Anomaly Detection, Healthcare Cyber security, Machine Learning, Distributed Denial of Service (DDoS), UNSW-NB15, Gini Index, IGRF-RFE, XGBoost, Random Forest, AdaBoost, Voting Classifier, Ensemble Learning, XGBoost, Intrusion Detection System (IDS).

Parameter-Efficient Continual Learning for Scientific Text Classification: A LoRA-Based Approach with and without Replay

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Abstract

Scientific literature has been spreading widely in almost every area and this has raised a dire necessity of automated classification systems that can be used with efficiency in the same area without devastating memory lapses. The paper explores parameter-efficient continual learning (CL) of text classification in science based on Low-Rank Adaptation (LoRA), a generalization of previous studies on full fine-tuning of pre-trained language models. We evaluate four models—BERT, SciBERT, BioBERT, and BlueBERT—trained sequentially on three Web of Science datasets (WoS-5736, WoS-11967, and WoS-46985) in curriculum order, under two CL configurations: LoRA-CL (without replay) and LoRA+Replay-CL (with 10% experience replay). LoRA adapters are applied to query and value projection matrices with rank $r=8$ and $\alpha=16$, reducing trainable parameters to approximately 5% of the full model. A novel third input strategy combining keywords and abstracts is introduced alongside the two strategies from the baseline. We report four CL metrics—Average Accuracy (ACC), Backward Transfer (BWT), Forward Transfer (FWT), and Forgetting Measure (FM)—alongside per-task accuracy and F1 scores. Results show that LoRA-CL matches or exceeds full fine-tuning baselines on WoS-46985 while reducing trainable parameters by approximately 95%. SciBERT achieves the best overall performance across all input strategies with a peak accuracy of 87.93% on WoS-46985; BlueBERT exhibits the most severe catastrophic forgetting. The combined input strategy outperforms keywords alone on larger datasets, establishing LoRA-CL as a viable, resource-efficient alternative for scientific text classification in continual learning settings.

Keywords

Catastrophic forgetting, continual learning, experience replay, LoRA, parameter-efficient fine-tuning, scientific text classification, BERT, SciBERT, BioBERT, BlueBERT, Web of Science.

CryptEase – Secure Message Encryption & Decryption System with Expiry and QR Integration

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Abstract

CryptEase is a secure, web-based encryption and decryption system designed to ensure confidential communication through advanced security mechanisms. The system integrates Triple DES encryption, expiry-based message access, QR code-enabled sharing, and downloadable encrypted files, offering a complete privacy-focused messaging workflow. Each message is encrypted with a unique ID and secret key, ensuring authenticity and security before allowing access.

The project's backend is deployed on AWS EC2, providing a scalable, reliable cloud infrastructure for encryption logic, secure storage, and user authentication. The frontend is developed using React.js, enabling a modern, responsive, and intuitive interface. Additional support for QR code generation using qr.js enhances accessibility by allowing users to quickly scan, view, and decrypt messages using secret keys.

CryptEase is ideal for time-sensitive communication, secure file sharing, and temporary message access. By combining cryptography, cloud deployment, and modern web technologies, the system offers a secure, efficient, and flexible platform for encrypted data exchange.

Keywords

Triple DES Encryption, AWS EC2, Django Backend, React.js Frontend, QR Code Generation, Expiry-Based Message Access, Secure Web Application, Encrypted Message Sharing.

Performance Assessment of Angular Air Distribution System for Operation Theatre using Numerical Simulation and Experimental Approach

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Abstract

The present work concern with the analyses of air flow and thermal pattern in an Operation Theatre (OT). The effect of Angular Air Distribution (AAD) system with 90°, 30°, 45°, 60° inlet air flow angle on the air flow and thermal pattern were investigated in presence of surgical staff and patient. The effectiveness of air distribution system is commonly evaluated by the removal of heat from occupant and room to accomplish air temperature, air velocity at prescribed level to attained human comfort condition and indoor air quality. The study is carried out on scale model of OT. The scale model dimension is calculated with the help of geometrical similarity concept. Initially the scale model of OT is examined by numerical simulation by varying inlet angle at constant inlet velocity and temperature. For numerical simulation Computational Fluid Dynamics (CFD) technique with fluent software is used. The CFD modelling technique solved the continuity, momentum and energy conservation equation in addition to standard k-ε model equation for turbulence closure. The boundary conditions of numerical results are tested with grid independency test. The numerical results are validated with the help of experimental readings of scale model of OT. The air flow pattern of AAD system in OT with various inlet angles are tested with the help of smoke test. The flow pattern obtained by smoke of AAD system is capture by Camera Target Method (CTM) and it is validated with streamline results of CFD. To check the human comfort and effectiveness of air distribution system, the obtained result is compared with the international standard parameter for ventilation system such as Air Diffusion Performance Index (ADPI). During the investigations, numerical validation is carried out by method of comparisons of numerical and experimental results. Good agreement is found between numerical and experimental results.

Keywords

Angular Air Distribution, Operation Theatre, CFD, ADPI, CTM, Smoke test.

Lingoflix: A Browser Extension for Contextual Language Learning Through Netflix

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Abstract

A Chrome extension called Lingoflix was created to assist users in learning new languages while they watch Netflix. Users can choose a practice language and watch dual subtitles—one in their native tongue and one in the language they wish to learn—by integrating the extension directly with the Netflix web player. When a user is watching a show, Lingoflix automatically recognizes it and adds personalized subtitle controls. A popup menu allows users to change the practice language, and the extension instantly updates the availability of dubbing and subtitles. One important feature is that you can click on specific words in the subtitles to get instant definitions, examples of sentences, parts of speech, and, for some languages, pinyin or romanization. To do this, Netflix's subtitle data is intercepted and processed inside the extension. Additionally, the extension offers quick links to other shows in the chosen language and determines whether dubbing or subtitles are available. Chrome's storage API is used to save all user preferences, including the selected practice language and extension on/off state, so settings are maintained between sessions. The process is simple: after installing Lingoflix, the user launches Netflix, chooses a language from the menu, and begins to watch. The extension overlays learning tools, controls subtitle switching, and reacts to user input such as word lookups while the show is playing. Without interfering with the viewing experience, the design attempts to make language learning feel organic and incorporated into regular entertainment.

Keywords

Content script, Service worker, Chrome storage, Popup UI, Subtitles overlay, Word lookup, Event listener, Custom event, XMLHttpRequest interception, AngularJS.

Detection of Disjoint Interest Groups Over Online Social Networks and Analysis

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Abstract

Online social networks like's Facebook, Twitter and Instagram are really important for how people talk to each other, share ideas and make groups. As these websites are highly scalable, with each day generating huge amount of data the complexity of the interactions becomes hard. Finding these interested groups, it is important for making recommendations in order to have effective and purpose full social processes such as advertisement, edutainment and entertainment etc.

This study focuses on finding groups of people who are of similar interests and do not overlap with other groups. To uncover this, we will model social networks as graphs. In the proposed study we use different methods to analyses how people interreact to each other and how they share ideas. These methods are uncovering the interest groups a that are densely connected together.

The different datasets have been used in this study that are taken from open dataset repositories like the SNAP repository, Kaggle social network datasets, and the UCI Machine Learning Repository. On experimentation we have found the best results and we have laid down a comparative study.

Centrality measures are used to evaluate the importance of users with in the network. Degree, betweenness, closeness and eigenvector centrality provide different perspectives on user influence. A comparative analysis is performed to examine variations in influential user ranking across these measures.

The approach is evaluated using multiple real-world and synthetic datasets obtained from standard repositories. The results demonstrate effective identification of disjoint communities and detection of influential users across different networks.

Keywords

Social Network Analysis, Community Detection, Disjoint Communities, Graph Theory, Centrality Measures, Clustering, Online Social Networks, User Interaction Networks.

AI-Powered Decision Support System for Gallbladder Cancer Diagnosis and Prognosis Assessment

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Abstract

Gallbladder cancer is a rare but highly aggressive malignancy, often diagnosed at an advanced stage due to its nonspecific symptoms and rapid disease progression. Early identification of risk factors and timely intervention can significantly improve patient prognosis, yet conventional diagnostic methods and clinical judgment may fall short in complex or ambiguous cases. To address these challenges, this study proposes an AI-powered decision support system for gallbladder cancer diagnosis and prognosis assessment using machine learning. The system utilizes a structured dataset containing 21 features, including patient demographics, lifestyle habits, medical history, clinical symptoms, tumor characteristics, biomarker levels, treatment details, and survival rates. The system groups patients according to the severity of the disease, predicts survival chances, and identifies key risk factors using contemporary data analysis and machine learning tools. The integration of this system into clinical workflows aims to support healthcare professionals in making timely, data-driven decisions, improve diagnostic precision, and personalize treatment strategies, thereby enhancing overall patient care and survival rates.

Keywords

Machine Learning (ML), gallbladder Prediction, Artificial Intelligence (AI), Data Analysis, Predictive Modelling.

A Comprehensive Review on Solar Powered Cloth Drying System

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Abstract

This review paper compiles insights from twenty research articles addressing the design, performance, and sustainability of domestic and industrial clothes dryers, including gas, electric, and heat-pump systems. Key parameters such as moisture extraction rate (MER), specific moisture extraction rate (SMER), specific thermal energy consumption (mSPC), energy efficiency, and primary energy efficiency were compared across different dryer configurations. Studies highlight the superiority of heat-pump dryers in energy conservation, while gas dryers provide higher drying rates. However, environmental concerns remain due to fossil-fuel dependency and electricity-intensive operation. The review emphasizes the growing research interest in waste-heat utilization, advanced control systems, and exergy-based optimization. A critical gap identified is the **absence of solar-assisted charging or hybrid renewable integration** in these systems, limiting long-term sustainability. Future work must explore solar-thermal and photovoltaic hybridization with dryers to reduce reliance on conventional energy and minimize carbon emissions.

Keywords

Clothes dryer, Energy efficiency, Moisture extraction, Renewable integration, Solar-assisted drying.

Performance Analysis of Hybrid Natural Fiber Reinforced Composite Using Prosopis Juliflora, Aegle Marmelos and Mimusops Elengi for Automobile Applications

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Abstract

The aim of this research work is to develop and compare the mechanical and physical properties of a hybrid natural fiber reinforced epoxy composite made from Prosopis juliflora, Aegle marmelos and Mimusops elengi natural fibers. Which fiber combination is the best in composite materials. From the experimentation process it was found that Hybrid Composite exhibited a higher mean for different mechanical properties, Tensile strength varied from 5.07 N/mm² to 8.13 N/mm², Flexural strength varied from 660 N/mm² to 1026 N/mm², Compressive strength varied from 1.47 N/mm² to 2.66 N/mm², Impact Energy varied from 3.43 J to 3.92 J and Hardness varied from 49 HD to 66 HD. Among the samples R2 provided the high results in terms Tensile strength, Flexural strength, Compressive strength. R2 provided less water absorption from the tests. Also, R2 provided the SEM images clearly show the epoxy layer was well bonded with the composites. The results obtained from this research work have confirmed that hybridization of natural fibers has a significant effect on improving the mechanical properties of epoxy composites. The proposed hybrid natural fiber reinforced epoxy composite material has been found to be a sustainable alternative to the existing single-fiber composites.

Keywords

Hybrid natural fiber composite, Prosopis juliflora fiber, Aegle marmelos fiber, Mimusops elengi fiber, Epoxy resin, Mechanical properties, Water absorption, Compression molding, SEM analysis.

Advances in Charge Pump Technologies for Low-Power and High-Frequency Electronic Systems: A Comprehensive Review

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Abstract

This research investigates design methodology for charge pump circuits using nano-scale MOS transistors. The design differs from the classic Dickson charge pump architecture since it uses MOS transistors driven by anti-phase pumping clocks that improve both voltage gain and output performance. Active components such as the phase frequency detector (PFD) and charge pump within the phase-locked loop (PLL) were studied using RF simulation tools. The design was found to accurately and efficiently work in low voltage and low power circuit applications during simulations. The design results in a system with improved phase margin and high loop gain, providing for the possibility of more efficient electronic systems. This study also provides a basis for alternative designs of charge pump circuits that are compact, high performance, and low leakage. This was achieved by design parameter optimization, the use of advanced design tools, modern fabrication techniques, and the anticipation of potential uses of the charge pumps in communication and power management integrated circuits.

Keywords

Charge Pump, Phase Frequency, Phase-Locked Loop.

Comparative Evaluation of Transfer Learning-Based Convolutional Neural Networks for Automated Plant Disease Detection

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Abstract

Plant diseases represent a critical threat to agricultural productivity and food security. Therefore, there is a significant need to develop plant disease detection systems. In this paper, we propose a comparative framework for plant disease detection using advanced and hybrid transfer learning-based convolutional neural networks (CNNs), namely EfficientNet-B4, DenseNet121, Vision Transformer, and a proposed Hybrid CNN-Transformer. We have implemented these models using the publicly available Plant Village dataset, consisting of over 50,000 labeled leaf images. To make the proposed models robust, we have also implemented data augmentation techniques. We have evaluated the performance of the implemented models using key performance metrics. Experimental results show that the proposed Hybrid CNN-Transformer model has achieved the highest accuracy of 99.12%, followed by EfficientNet-B4 with 98.76%, DenseNet121 with 98.34%, and Vision Transformer with 97.89%. In terms of computational efficiency, EfficientNet-B4 has achieved a balanced trade-off between accuracy and inference time, whereas the proposed Hybrid CNN-Transformer model has slightly higher computation time of 35 ms/image due to the complexity of the model.

Keywords

Plant disease detection, Transfer learning, Convolutional neural networks, Deep learning, Computer vision, Smart agriculture, Image classification.

RetailGuard: LangChain-Enhanced AI Platform for Predictive Demand Forecasting & Security Analytics

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Modern retail sectors often struggle with operational lapses caused by imprecise demand forecasting, poor inventory control, and persistent security risks. Conventional surveillance setups typically act as passive recording devices, offering minimal analytical depth for strategic business operations. This research presents RetailGuard, a LangChain-powered artificial intelligence framework developed to merge computer vision metrics, predictive inventory modeling, and security oversight into one cohesive system. By processing CCTV streams alongside transaction logs and environmental data, the platform evaluates customer dynamics and identifies irregular patterns within the retail space. We utilize a multi-agent architecture, managed via LangChain, to synchronize specialized modules for behavioral tracking, time-series forecasting, and anomaly detection. Our approach combines deep learning for visual interpretation with machine learning for trend prediction. Empirical testing indicates that merging behavioral cues with traditional sales records markedly boosts forecasting precision and real-time threat detection. Finally, the RetailGuard system serves as a powerful decision-support system with the ability to optimize business processes, prevent loss of revenues, and enhance security measures.

Keywords

Artificial Intelligence, Retail Analytics, LangChain Agents, Computer Vision, Demand Forecasting, Smart Surveillance.

CERAS – Cognitive Efficiency Reasoning Alignment System

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Abstract

AI based educational framework generates solutions without adapting to a learner's cognitive state, resulting in limited personalization and shallow conceptual understanding. To address this limitation, a cognitive aware and explainable AI framework CERAS (Cognitive Efficiency and Reasoning Alignment System) is designed to enhance conceptual learning through adaptive inference and behavioral modeling. CERAS explores the explainability in AI. CERAS implements a dual pipeline architecture which consist of an offline cognitive processing module and an online reasoning engine. In the offline pipeline, Cognitive Efficiency Prediction Model (CEPM) calculates the Cognitive Efficiency (CE) score dynamically using the user's live data, while the Convolutional Neural Network (CNN) performs intent modelling. These results are then fused with a Response Engine which generates personalized feedback which is aligned with learner's cognitive profile. The online pipeline utilizes Large Language Models with a customized Tree of Thoughts (ToTs) data structure to store and break complex problems into structured, step by step explanations, ensuring transparency and deeper conceptual engagement.

Deep Learning Architectures for Early Detection of Rheumatoid Arthritis from Clinical Data

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Abstract

Timely therapeutic intervention during the first ninety days following initial symptom presentation remains crucial for preventing permanent joint damage in Rheumatoid Arthritis patients. Unfortunately, current clinical pathways demonstrate significant diagnostic latency—patients typically wait twelve to twenty months before receiving definitive diagnosis, largely due to symptom non-specificity and inadequate access to specialized rheumatological care. We developed a machine learning framework incorporating three neural network variants: a Feature Tokenizer Transformer, tabular-optimized Residual Networks, and standard Multi-Layer Perceptrons. Our approach integrates laboratory biomarkers—specifically Erythrocyte Sedimentation Rate, C-Reactive Protein levels, and Rheumatoid Factor seropositivity—with free-text physician notes processed through TF-IDF vectorization. Testing across forty-five thousand patient records yielded classification performance between 99.5% and perfect accuracy. We deployed these models via Flask web infrastructure, enabling real-time risk assessment in clinical settings. Results confirm that modern neural approaches can successfully capture the complex, nonlinear biomarker interactions characteristic of autoimmune disease presentation.

Keywords

Rheumatoid Arthritis, Deep Learning, FT-Transformer, ResNet, tabular data classification, medical diagnosis.

Small Business Management System Enhancing Productivity through Automation using AI

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Abstract

Small and Medium Businesses (SMBs) often struggle to adopt artificial intelligence due to limited data availability, high infrastructure costs, and lack of technical expertise. This paper presents a lightweight, plug-and-play AI suite designed to deliver essential business decision support under such constraints. The system integrates three core modules: customer churn prediction using a Random Forest model, demand forecasting based on weighted moving averages with trend and seasonality analysis, and invoice data extraction using optical character recognition. The proposed framework emphasizes simplicity, modularity, and local deployment, enabling practical adoption of AI-driven insights without reliance on expensive computing resources or complex architectures.

Keywords

Lightweight Artificial Intelligence, Small and Medium Businesses, Decision Support System, Customer Churn Prediction, Demand Forecasting, Optical Character Recognition, Resource-Constrained Environments, Modular AI Framework.

AI-Based Black Sigatoka Prediction and Management Systems for Banana Plants

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Abstract

Banana plants are affected by several serious diseases, including Black Sigatoka, Yellow Sigatoka, Panama disease, and Moko disease, which primarily attack the leaves, causing them to weaken, turn streaky or yellow, and deteriorate over time. These infections lead to significant reductions in both the yield and quality of bananas, directly affecting the income and livelihood of farmers, especially in rural areas. Early identification of these diseases is critical to prevent extensive damage, but many small-scale farmers lack access to plant disease experts or laboratory testing facilities, which often results in delayed treatment and higher losses. To overcome this challenge, an AI-based system built on the ResNet50 architecture has been developed. This system allows farmers to upload images of their banana leaves, enabling accurate identification of whether the leaves are healthy or infected with any of the four diseases. In addition to detection, the system provides actionable advice for disease management, including recommended fertilizers, proper fungicide applications, and irrigation adjustments. The tool is designed to be fast, user-friendly, and cost-effective, allowing farmers to regularly monitor their plants without specialized knowledge. By combining image-based disease detection with practical guidance, the system helps reduce losses, improve the quality and quantity of bananas, and supports sustainable farming practices. It provides a reliable technological solution that empowers farmers to take timely action and maintain healthier plants.

Keywords

Banana Disease Detection, ResNet50, Black Sigatoka, Yellow Sigatoka, Panama Disease, Moko Disease.

Advanced Neuro-Inspired Deep Learning Paradigm for Adaptive Employee Stress

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Abstract

In the workplace these days the connection between how stressed-out employees are, how they feel emotionally has a big impact on how much work they can do and how healthy they are overall. This study is about something called RtPES, a system that is used in time to look at how employees are feeling and how stressed out they are. RtPES will use computers to look at peoples' faces and figure out how they are feeling. It uses something called deep learning to understand what peoples' faces are telling us about their stress levels. RtPES is a real-time system, for employee emotion and stress. The system uses Haar Cascade Classifiers to enable reliable face detection, which allows for the precise calculation. For the purpose of emotion recognition, a bespoke Mini-XCEPTION convolutional neural network (CNN), classifies seven different emotions (Angry, Disgust, Fear, Happy, Sad, Surprise, Neutral). Stress levels are determined through an emotion-stress mapping, coupled with Exponential Moving Average (EMA) smoothing, to furnish stable, temporally aware assessments, which categorize stress as Low, Medium, or High. RtPES is integrated with Google Gemini 1.5 Flash. It uses Python FastAPI for backend, React.ts for Frontend and MongoDB for data storage. This approach ensures the workplace will be healthier. It also helps in keeping track of health. In this way people can be able to manage stress better at work. It helps to monitor health. This leads to managing stress in a way, in offices.

Explainable AI for Multimodal Fake Profile Detection: An Integrated Framework with Trust Scoring

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Abstract

AI is aimed at combating the distribution of fake identities created by AI on the social internet, staffing sites, and dating websites, where the anonymity of users and the credibility of the site harm user safety and platform credibility. The minor project uses an explainable multimodal pipeline which scores authenticity out of images, text, and metadata and combines the signals into one Trust Score. YOLOv8 is used to localize the face areas and a fine tuned ResNet 18 model is used to discriminate between real faces and synthetic faces. A fine tuned DistilBERT model is applied to classify profile biographies, to differentiate the human written text and AI generated text. PyExifTool is used to perform metadata forensics and investigate the EXIF fields and identify missing or inconsistent capture data. Final score = Trust Score = $wI + wT + wM = M = 0.4$ $wT = 0.3$ and $wM = 0.3$. Image decisions can be explained using Grad CAM, and textual cues using SHAP and LIME, whereas metadata signals can be interpreted. Use of a Flask backend and React dashboard. Accuracy of 85 percent and F1 of 0.82 were attained in experiments, meaning that the system is dependable in terms of real world verification.

Keywords

Fake profile detection, explainable artificial intelligence, deep learning, natural language processing, metadata forensics, multimodal fusion, trust scoring, Grad CAM, SHAP, LIME.

Enhancing Glycemic Condition Diagnosis Using CNN Architecture and Automated Learning

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Abstract

Glycemic is a chronic condition that affects millions worldwide, necessitating timely and accurate diagnosis to prevent severe complications. This study presents an advanced diagnostic framework integrating Convolutional Neural Networks (CNNs) and machine learning algorithms to enhance the detection and prediction of glycemic. CNNs are employed to analyze medical images, such as retinal scans, for identifying glycemic-related complications like glycemic retinopathy, leveraging their ability to extract complex features automatically. Simultaneously, machine learning models are trained on structured patient data, including glucose levels, BMI, and age, to predict the likelihood of diabetes. The proposed hybrid approach combining CNN extracted image features with structured data enhances diagnostic accuracy and robustness. The model development incorporates data preprocessing techniques, such as image augmentation and feature normalization, and employs optimization algorithms like Adam with regularization strategies to prevent overfitting. Evaluation metrics, including accuracy, precision, recall, and validate the model's reliability and performance. The proposed framework is deployed through user-friendly web applications, enabling healthcare professionals to access predictions seamlessly. This study underscores the potential of artificial intelligence to transform diabetes care by improving diagnostic efficiency, supporting early intervention, and facilitating personalized treatment strategies. Future work aims to incorporate explainable AI techniques and real-time monitoring systems to enhance transparency and adaptability in clinical practice. This method not only improves diagnostic efficiency but also underscores the potential of AI in transforming healthcare.

Heart Disease Prediction Using Machine Learning Algorithm

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Abstract

Disease diagnosis and prediction is one of the major aspects in the healthcare sector. Heart disease remains a leading cause of mortality worldwide, necessitating accurate and early prediction methods to facilitate timely intervention. This study explores the application of machine learning algorithms to predict heart disease by analyzing medical data such as age, blood pressure, cholesterol levels, and other relevant features. Various supervised learning algorithms, including Logistic Regression, Random Forest, Support Vector Machine (SVM) and SVM-PCA were employed to develop predictive models. A set of heart disease data containing various parameters of the tests conducted along with their results are fed to various machine learning algorithm for training. Then the pre-trained models are used for the prediction of new input data of new patients. The results of these algorithms are summed up to get one output for any patient's heart disease prediction. The results indicate that SVM-PCA achieved the highest accuracy, demonstrating the potential of machine learning in enhancing heart disease prediction and contributing to improved healthcare outcomes.

Multi Disease Prediction Using Ensemble Machine Learning on Health Data

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Abstract

Early detection of chronic diseases is essential for improving healthcare outcomes and reducing long-term complications. This study aims to develop a reliable and scalable multi-disease prediction system using ensemble machine learning techniques to estimate the risk of Diabetes, Heart Disease, Kidney Disease, and Liver Disease based on structured clinical data collected from multiple publicly available datasets. The proposed methodology integrates multiple supervised learning models, including Random Forest, XGBoost, Logistic Regression, K-Nearest Neighbors, and Naive Bayes, which are combined using a soft voting ensemble approach to enhance predictive accuracy, stability, and robustness across different disease categories. Data preprocessing plays a critical role in improving model performance and includes handling missing values, label encoding of categorical features, feature scaling, and the application of Synthetic Minority Oversampling Technique (SMOTE) to effectively address class imbalance issues commonly found in medical datasets. The models are evaluated using standard performance metrics such as accuracy, precision, recall, and F1-score, demonstrating consistent improvement over individual classifiers and better generalization capability. Furthermore, a lightweight and user-friendly web-based application is developed to provide real-time disease risk prediction, enabling improved accessibility and practical usability for early screening. The results highlight that ensemble learning offers an efficient, reliable, and scalable solution for early disease detection and supports informed healthcare decision-making processes in real-world scenarios.

The Smart Medical Appointment Booking System

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Abstract

In modern healthcare systems, patients and medical staff often face difficulties such as delayed appointment updates, missed consultations, and inefficient scheduling processes. Many existing medical appointment booking platforms lack intelligent decision-making support, leading to inefficiency in healthcare delivery. To address these challenges, this project proposes SmartSymp-Loc – a Smart Medical Appointment Booking System using Symptoms and Location. The proposed system enables secure user authentication to ensure that only authorized users can access the platform. A role-based access control mechanism is implemented to provide separate functionalities for Patients, Doctors, and Administrators. Patients can register and log in to select their symptoms, which are analyzed using anTF-IDF (Term Frequency-Inverse Document Frequency) vectorization to recommend suitable medical specialists. For location-based doctor and hospital identification, a predefined seed dataset containing hospital details, doctor information, and geographical data is utilized to efficiently match patients with nearby healthcare providers. An urgency-based priority mechanism ensures that emergency cases are handled promptly. The system supports both online and offline consultations. Furthermore, role-based dashboards allow patients to track their appointments, doctors to manage daily schedules and priority cases, and administrators to monitor overall system activities through summary views and analytics. By integrating secure authentication, role-based access control, symptom-based intelligence, structured location data, and priority handling, SmartSymp-Loc enhances healthcare efficiency, reliability, and user experience.

Keywords

Medical Appointment Booking System, Symptom-Based Disease Prediction, Healthcare Scheduling, Role-Based Access Control, Location-Based Hospital Recommendation, Priority-Based Appointment Management, e-Health Systems.

Strategic Engineering Management and Generative AI Driven IoT Framework for Smart and Sustainable Precision Agriculture

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Abstract

The rapid transformation of agricultural ecosystems due to climate variability, resource scarcity, and increasing global food demand necessitates intelligent, adaptive, and scalable technological interventions. This research proposes a Strategic Engineering Management (SEM) driven Generative Artificial Intelligence (GenAI) enabled Internet of Things (IoT) framework for smart and sustainable precision agriculture, focusing on data centric decision optimization and autonomous system coordination. The proposed architecture integrates heterogeneous IoT sensor networks to continuously capture multidimensional agro-environmental parameters including soil moisture, nutrient levels, temperature variability, humidity gradients, and crop health indicators. The acquired data streams are processed through cloud-enabled distributed computing infrastructure supporting real-time data aggregation, feature engineering, predictive modelling, and performance analytics using advanced machine learning algorithms.

A Generative AI decision layer synthesizes context-aware agronomic recommendations, adaptive irrigation scheduling strategies, crop disease risk insights, and scenario-based yield forecasting under dynamic environmental uncertainties. Strategic Engineering Management principles ensure lifecycle optimization, interoperability governance, risk mitigation, scalability planning, and techno-economic feasibility evaluation. The framework leverages edge computing, modular microservices architecture, and secure communication protocols to enhance responsiveness and resilience. The proposed approach improves water efficiency, optimizes fertilizer utilization, enhances yield predictability, and establishes a sustainable digital agriculture paradigm aligned with Industry 4.0 objectives.

Leveraging Artificial Intelligence for Climate Forecasting and Carbon-Neutral Future

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Abstract

Growing intricacies surrounding climate change call for emerging strategies to forecast environmental trajectories and develop sustainable responses. This research explores the application of Artificial Intelligence (AI) to climate forecasting, underlining its importance in scrutinizing vast environmental datasets, predicting extreme weather events, and supporting policy decisions in reaching carbon neutrality. With the integration of machine learning algorithms, satellites, and sensor-climate monitoring, AI allows realistic simulations of atmospheric and ecological phenomena. The study further explores how knowledge drawn from AI can support renewable energy options, emission reduction plans, and climate-resilient infrastructure planning. Despite advances in technology, data integrity, algorithmic biases, and governance remain challenges, necessitating responsible AI deployment. The study traces a pathway from predictive analytics to practical climate action plans, providing an outline for governments, business organizations, and environment institutions to accelerate transformation to a carbon-neutral future.

Keywords

Artificial Intelligence, Algorithmic biases, Carbon Neutrality, Ecological.

Green Innovation as a Driver of Sustainability and Organizational Performance in Emerging Economies: Evidence from India

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Abstract

Sustainability and green innovation have emerged as critical strategic imperatives for organizations operating in an increasingly environmentally conscious and resource-constrained global economy. Green innovation refers to the development and application of eco-friendly products, processes, and technologies that minimize environmental degradation while enhancing economic performance. This study explores the role of green innovation in promoting organizational sustainability, focusing on its impact on environmental performance, financial outcomes, and long-term competitive advantage.

The research synthesizes existing literature to examine the drivers, mechanisms, and outcomes of green innovation within firms. It highlights the influence of environmental regulations, stakeholder pressure, and Environmental, Social, and Governance (ESG) frameworks in encouraging firms to adopt sustainable innovation practices. Empirical evidence suggests that green innovation contributes not only to reduced emissions and resource efficiency but also to improved firm value, reduced operational risk, and enhanced corporate reputation.

Furthermore, the study emphasizes the growing integration of technological innovation and sustainability strategies, where green operational practices act as a bridge between ESG initiatives and corporate sustainability outcomes. Despite the increasing adoption of green innovation, organizations face challenges such as high implementation costs, uncertain returns, and lack of institutional support.

The paper concludes that green innovation is not merely an environmental responsibility but a strategic necessity for achieving sustainable development and long-term organizational resilience. It provides insights for policymakers, managers, and researchers to foster sustainable innovation ecosystems, particularly in emerging economies like India.

Keywords

Green Innovation, Sustainability, ESG (Environmental, Social, Governance), Sustainable Development, Corporate Performance, Environmental Management.

Real-Time AI Pose Estimation for Markerless Physiotherapy Assessment Using a Mobile Camera

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Abstract

Post-operative lower limb rehabilitation requires continuous monitoring of patient movement quality to ensure safe and effective recovery. Conventional physiotherapy assessment relies heavily on therapist supervision and subjective observation, limiting scalability and accessibility. This work presents an AI-based, markerless pose estimation framework for real-time tracking and analysis of human movement during physiotherapy exercises using a single RGB camera. A deep learning-driven pose tracking model identifies and tracks major body joints without the need for wearable sensors or physical markers. The system generates a skeletal representation of the patient's posture and movement, enabling objective assessment of exercise execution. Experimental results demonstrate reliable joint detection and real-time performance during common lower limb rehabilitation exercises. The proposed approach highlights the potential of artificial intelligence to support intelligent, accessible, and remote physiotherapy monitoring.

Keywords

Rehabilitation, Physiotherapy, Pose estimation, Pose tracking model, Joint detection.

Corporate Ethics, Responsibility, and Liability: Pillars of Sustainable Business

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Abstract

Following the systemic crises of the world in the form of environmental destruction as well as the high-profile financial misconducts, the traditional doctrine of the primacy of stockholder in enterprise is being challenged as an inadequate approach to enterprise in the present day. The underlying conflict on modern business research is balancing the fiduciary obligation to make profit with the ethical and legal relationships of the globalized society. The study fills the current gap of how vital a multidimensional framework of governance is beyond elective philanthropy.

This study examines Corporate Ethics- Responsibility- Liability convergence as the new frontier of "Sustainable Business" paradigm. The paper will examine the interactions of the three components that make up the TBL and the Stakeholder Theory towards lessen the systemic risk effect and increase the long-term resiliency of the organization. By conducting a comparative qualitative study of multi-industry case studies between those firms that have adopted these pillars and those that have exhibited systemic governance failures; this research concludes that the three pillars cannot be taken as an addition but synergetic to each other. The evidence implies that those companies that actively coordinate their internal ethics with their external obligations and legal protection experience much lower volatility and greater growth rates caused by innovations.

The study concludes that the Sustainable Business is a business that manages to combine the theory of moral philosophy with that of strategic management and legal rigor. The result is a contribution to the sphere of corporate governance since it suggests a holistic approach in which Ethics offers the purpose, Responsibility offers the action, and Liability offers the accountability. Its results indicate that such tripartite approach is the sole possible way of the 21st century corporation to retain social license to operate.

Keywords

Corporate Governance, Ethics, Sustainability, TBL Theory, Corporate Liability.

IoT and AI-Based Smart Monitoring System for Industrial Applications

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Abstract

Internet The Internet of Things and Artificial Intelligence are really changing things now that Industry 4.0 is here. This project is about creating an Internet of Things and Artificial Intelligence-Based Smart Monitoring System, for Industrial Applications. The goal is to make monitoring, prediction and decision-making better. The system will use Internet of Things-based sensors to collect and monitor time industrial equipment data from the Internet of Things. This will help with making decisions and the Internet of Things and Artificial Intelligence will be a part of it.

This system also has automated alerts and real-time dashboards that help us maintain equipment proactively and reduce downtime. The Machine Learning and Deep Learning help us make sense of the data. The cloud and edge computing make it happen quickly. We get alerts. See the dashboards in real-time. This helps us fix things before they break. It also helps us avoid shutdowns. The goal is to use data to keep things running smoothly. The Machine Learning and Deep Learning are key, to that. They help us understand and act on the data.

This study shows that using Internet of Things and Artificial Intelligence together is a way to make things work better reduce the money spent on maintenance and make systems more reliable. The idea they came up with could be really useful in factories, automated industries and systems that combine physical and computer parts. This research helps create industries that use data to make decisions and fits with what people want to achieve with modern technology changes. The of Things and Artificial Intelligence are important, for making this happen so the Internet of Things and Artificial Intelligence will be used to improve the way things work.

Keywords

Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning, Industrial IoT (IIoT), Smart Monitoring System, Predictive Maintenance, Real-Time Data Processing, Anomaly Detection, Deep Learning, Edge Computing, Cloud Computing, Industry 4.0, Smart Manufacturing, Industrial Automation, Cyber-Physical Systems, Sensor-Based Monitoring, Data Analytics, Big Data Processing, Fault Detection, Performance Optimization, Decision Support Systems.

Psychological Influences on Digital Purchase Decisions: Examining the Effects of Cognitive Processing, Risk Perception and Trust in Online Consumers

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Abstract

The digital marketplace has transformed the way consumers evaluate information and make purchase decisions, highlighting the growing importance of psychological factors in online consumption. This study investigates the influence of key psychological constructs—cognitive processing patterns, perceived risk, and consumer trust—on online purchase decision-making. Grounded in consumer psychology and behavioural decision-making theories, the research adopts a quantitative approach using survey data collected from active online consumers. Advanced statistical techniques, including factor analysis and structural modelling, are applied to examine the relationships among psychological variables and purchase intention. The results indicate that cognitive processing significantly affects consumer judgment, while higher levels of perceived risk tend to reduce purchase likelihood. Trust in digital platforms emerges as a critical factor that mitigates uncertainty and enhances decision confidence. By integrating multiple psychological dimensions into a unified framework, this study contributes to the theoretical advancement of consumer psychology and offers practical insights for e-commerce platforms and digital marketing strategies. All stages of the research strictly comply with international ethical standards, including voluntary participation, informed consent, and data confidentiality.

Keywords:

Consumer Psychology, Digital Consumer Behaviour, Cognitive Processing, Perceived Risk, Online Trust and Purchase Decision.

Managing Technology for Sustained Innovation: A Strategic and Organizational Perspective

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Abstract

The increasing pace of technological advancement has fundamentally reshaped the competitive landscape of modern organizations. In such an environment, sustained innovation has become a critical capability for long-term survival and growth. This research paper examines how organizations can strategically manage technology to foster continuous innovation. The study adopts a conceptual and integrative research approach grounded in theoretical frameworks such as dynamic capabilities, resource-based view (RBV), and organizational learning theory. It identifies key determinants of sustained innovation, including strategic alignment, leadership vision, organizational culture, human capital, and governance mechanisms. Through an in-depth analysis supported by contemporary industry examples, the paper demonstrates that sustained innovation is not merely the result of technological investment but a systemic organizational capability. The findings highlight the importance of long-term orientation, adaptability, and continuous learning in achieving innovation sustainability. The study contributes to the literature by presenting a comprehensive framework that integrates strategic management and technology management perspectives. It also provides actionable insights for managers aiming to leverage technology as a strategic asset for continuous value creation and competitive advantage.

Keywords

Technology Management, Sustained Innovation, Strategic Capability, Organizational Learning, Competitive Advantage.

Behavioural Bias of Investors Toward Investment – A Study

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Abstract

The traditional paradigm of rational decision-making in finance is increasingly challenged by behavioural insights that highlight the pervasive influence of psychological biases on investor behaviour. The present study examines the impact of behavioural biases—namely overconfidence, loss aversion, herd mentality, anchoring, recency, and information bias—on investment decision-making and financial risk tolerance among individual investors. The study is based on primary data collected through a structured questionnaire and to test the proposed relationships, multiple regression analysis and Karl Pearson's correlation were employed. The findings reveal that behavioural biases significantly influence investment decision-making, with loss aversion and information bias emerging as the most dominant predictors. Additionally, a positive and statistically significant relationship was observed between behavioural biases and financial risk tolerance, indicating that investor psychology plays a crucial role in shaping risk perception and tolerance levels. The study contributes to the growing body of behavioural finance literature by providing empirical evidence from the Indian context, where such integrated analysis remains limited. The findings offer practical implications for investors, financial advisors, and policymakers by emphasizing the need for behavioural awareness and structured decision-making frameworks to mitigate irrational investment behaviour and enhance financial outcomes.

Keywords

Behavioural Finance, Behavioural Biases, Investment Decision-Making, Risk Perception, Financial Risk Tolerance, Investor Behaviour, India.

Influencer Marketing: Shaping Brand Perception in the Digital Age

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Abstract

The rapid expansion of social media platforms has significantly transformed marketing communication, positioning influencer marketing as a dominant strategy in the digital era. This study examines the role of influencer marketing in shaping brand perception, with a focus on long-term brand outcomes rather than short-term engagement metrics. Grounded in Social Influence Theory and Source Credibility Theory, the research analyses how influencer attributes such as credibility, authenticity, and audience engagement influence consumer attitudes and brand perception. A qualitative and conceptual research design is adopted, supported by an extensive literature review and case-based insights. The findings suggest that influencer marketing plays a critical role in building trust, enhancing emotional connection, and strengthening brand identity. However, existing literature reveals key gaps, including the absence of integrated frameworks and limited focus on long-term brand perception. This study addresses these gaps by proposing a comprehensive perspective linking influencer marketing strategies with brand perception. The research offers practical implications for marketers and contributes to the academic understanding of digital marketing strategies.

Keywords

Influencer Marketing, Brand Perception, Social Media Marketing, Consumer Behaviour, Brand Equity, Digital Marketing, Social Influence.

Browser-Based Unified Approach for Vulnerability Detection and Endpoint Discovery

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Abstract

The dynamic nature of web application attacks is becoming an emergent difficulty to the antiquated security evaluation methodology that can be described as excessive infrastructural and invasive examination. To fill this gap, this paper proposes a lightweight and online based, vulnerability assessment platform that introduces security testing into the world of development to offer an immediate expansion of the development environment. The tool employs a two-way endpoint discovery method, whereby, passive scanning of the HTTP traffic and passive scanning of the HTML and JavaScript text is being employed to identify both the static and dynamically generated API endpoints. Security analysis is performed by a hybrid detection engine which makes use of both safe and pattern-matching heuristics as well as limited and non-destructive active probes in order to find out high-impact vulnerabilities known as SQL Injection (SQLi) and Local File Inclusion (LFI). The results are interconnected and presented in a developer-oriented interface through which they can be triaged and remediated in a short time. This paper demonstrates that non-invasive browser-based testing can be made possible and it also provides a scalable template to implement security detection at an earlier phase of the software development life cycle (SDLC) and to improve an ongoing security posture.

Keywords

Endpoint Discovery, Local File Inclusion (LFI), SQL Injection (SQLi), Dynamic Application Security Testing (DAST), Browser Extension.

Towards Effective Detection and Mitigation of DDOS Attacks in IoT Environment

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Abstract

This work presents a comprehensive multi-layer DDoS attack detection and mitigation system specifically designed for Internet of Things (IoT) devices. As IoT devices become increasingly prevalent in critical infrastructure, they represent attractive targets for Distributed Denial of Service attacks due to their limited computational resources and often inadequate security measures. The proposed system implements a three-tier defence architecture combining NGINX-based rate limiting at the network edge, application-level intelligent filtering, and real-time monitoring with automated threat response. The system successfully detects and mitigates various DDoS attack vectors including HTTP floods, SYN floods, and keep-alive abuse attacks. Experimental results demonstrate that the system blocks approximately 95% of malicious traffic while maintaining service availability for legitimate users. The implementation includes a real-time security dashboard for visualization and analysis of attack patterns, providing security analysts with actionable insights. This research work contributes to the growing field of IoT security by providing a practical, deployable solution that balances robust protection with minimal performance overhead.

Keywords

DDoS mitigation, IoT security, intrusion detection, network security, NGINX, real-time monitoring, threat intelligence, cyber defence, attack detection.

Multimodal Deep Neural Network for Diabetic Retinopathy Severity Classification and Referral Risk Prediction

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Abstract

Diabetic retinopathy (DR) is a significant cause of preventable vision loss, often progressing without noticeable symptoms until advanced stages. Most existing automated screening approaches rely solely on retinal fundus images and ignore systemic clinical factors that influence disease severity and referral decisions. This paper proposes a multimodal deep-learning framework that integrates fundus images with clinical and metabolic data for joint DR severity classification and high-risk identification. A convolutional neural network (CNN) is used to extract visual features from retinal images, while a multilayer perceptron encodes clinical variables including age, duration of diabetes, glycemic control, blood pressure, body mass index, lipid levels, and smoking status. The learned representations are fused and optimized using a multi-task learning strategy with dual output heads for severity grading and binary high-risk prediction. Experimental results demonstrate that the proposed multimodal model outperforms image-only baselines in severity classification and achieves strong performance in clinically referable DR screening ($\geq$ moderate DR), with high sensitivity, specificity, and ROC-AUC. These results highlight the effectiveness of multimodal learning for clinically relevant DR screening and risk stratification.

Keywords

Diabetic Retinopathy, Multimodal Deep Learning, Fundus Imaging, Clinical Data Fusion, Multi-task Learning, Risk Stratification, Referral Screening, Convolutional Neural Networks.

PosePal: Real-Time Yoga Pose Detection, Estimation, and Personalized Feedback System

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Abstract

Yoga is one of the oldest forms of exercise for physical and mental health, but depending on the situation, correct postures are very important. In this research, we created PosePal, a yoga pose detection and feedback system leveraging MediaPipe's pre-trained pose estimation framework, OpenCV, and Flask to provide real-time posture detection and feedback. PosePal detects 34 human body landmarks using MediaPipe Holistic and evaluates pose correctness using custom-built geometric modules—VectorCal, AngleCal, and DistanceCal.

So long as the user maintains their pose (correctly) for five seconds, PosePal will move to the next yoga asana. Posepal will then provide a performance score based on time and correctness. PosePal has a simple user webspace using Flask and HTML and is rather easy to use. PosePal is intended to be a bridge between an in-person instructor and self-practice situations for anyone wanting to practice yoga in their own home, with personal/personalized real-time feedback on how they are doing.

Keywords

Computer Vision, MediaPipe, Pose Estimation, OpenCV, Flask, Yoga Guidance System, Fitness Technology.

UVM-Based Functional Verification of Arithmetic Logic Unit Using Adaptive Coverage Method

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Abstract

Universal Verification Methodology (UVM) is a standardized methodology for functional verification of digital designs based on constrained-random stimulus, assertion-based verification, and functional coverage analysis. This paper describes a UVM-based verification environment for an 8-bit Arithmetic Logic Unit (ALU) with an adaptive coverage-driven approach that goes beyond the standard UVM methodology by adapting the stimulus generation process in real-time based on coverage feedback. In contrast to the standard static coverage-driven approach, which only uses constrained randomness, the adaptive feedback loop in this approach identifies under-covered functional bins and focuses the stimulus on those bins, thus improving the convergence of coverage without human intervention. Various phases of verification, such as directed, boundary, random, and adaptive verification, were performed to ensure the functional correctness and robustness of the design. Assertion-based verification was performed using 19 System Verilog properties to check the integrity of the data path and arithmetic operations. Experimental results show the functional correctness of the ALU with a functional coverage of 95.00%, which is an improvement over the 78.91% coverage achieved by the conventional constrained-random verification approach.

Keywords

UVM, functional verification, adaptive coverage, system verilog assertions, ALU verification.

TravelMate AI: Next-Gen AI-Powered Matchmaking & Seamless Itinerary Creation

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Abstract

Artificial Intelligence (AI) is no longer reactive but rather agentic, which means that systems can think, reason multi-step, and act proactively not only in relation to human beings but also other digital agents. Although AI is a disruptive technology in other industries, its application to social and collaborative purposes in the travel and tourism industry has not been extensively studied. The paper will present TravelMate AI, a platform based on Agentic AI that aims at intelligently matching travelers to people with similar destinations, budgets, dates, and interests and who receive personalized and intelligent daily itineraries automatically. Using n8n to automate workflows on the back-end and React.js to create a responsive front-end and Supabase to store data and provide authentication, TravelMate AI provides adaptive, data-driven, and real-time travel suggestions. Collaboration, automation, and adaptivity are the most crucial features of the system, allowing the users to create companionships during travels, get intelligent itinerary updates, and have socially engaging and stress-free travel experience. Therefore, TravelMate AI is the representation of further AI development in the context of the travel planning industry by means of intelligent matching and adaptable optimization of the itinerary.

Keywords

Agentic AI, TravelMate AI, Personalized Itinerary, User Matching, Workflow Automation, Supabase, n8n, Smart Travel Planning, Collaboration, Adaptive AI.

Beyond Static Retrieval: Designing and Evaluating Agentic Retrieval-Augmented Generation for Sales Intelligence

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Abstract

Rapid urbanization, market volatility, and accelerating digital transformation have intensified the need for intelligent engineering systems that support resilient and sustainable decision-making. In this context, Retrieval-Augmented Generation (RAG) has emerged as a powerful approach for enabling data-driven insights from large-scale enterprise knowledge bases. However, conventional RAG architectures—such as vector-based, graph-based, and hybrid retrieval—often rely on static retrieval strategies, limiting their adaptability, interpretability, and effectiveness across diverse analytical tasks.

This paper presents Agentic RAG for Sales Intelligence (ARSI), an engineering-driven framework that integrates autonomous agents with tool-based retrieval mechanisms to enable adaptive reasoning over structured, unstructured, and external data sources. Leveraging a ReAct-style reasoning-action loop, ARSI dynamically selects retrieval strategies based on query intent, enabling accurate quantitative analysis, contextual explanation, and causal reasoning within a unified pipeline. This adaptability supports more transparent and human-aligned decision processes, which are essential for sustainable digital infrastructures.

The proposed framework is evaluated using real-world sales intelligence scenarios, including quarterly revenue assessment, root-cause analysis of sales fluctuations, and cross-market performance evaluation. Comparative results demonstrate that while traditional RAG methods excel in isolated semantic or relational tasks, ARSI achieves superior performance in adaptability, multi-source evidence integration, and explainability. By improving the quality and reliability of enterprise intelligence, this work contributes to resilient digital systems that support informed decision-making, efficient resource utilization, and long-term organizational sustainability, aligning with the broader goals of smart infrastructure development and the United Nations Sustainable Development Goals.

Detection of Top Influential User within Each Interest Group Over an Online Social Network using Graph Analysis

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Abstract

Online social networks play a vital role in modern communication, enabling users to connect and form communities based on shared interests. These communities, known as interest groups, often exhibit strong internal connectivity among users with similar preferences. Identifying such groups and determining the most influential user within each group is essential for applications such as targeted marketing, recommendation systems, and efficient information dissemination. This project focuses on detecting interest groups in online social networks and identifying the top influential user within each group using graph analysis techniques. Users are represented as nodes and their interactions as edges, forming a graph structure. The Louvain community detection algorithm is used to identify interest groups, and multiple centrality measures including Degree Centrality, Betweenness Centrality, and PageRank are combined to determine the most influential user within each group. Publicly available online social network datasets are used for experimentation, and the implementation is carried out using Python with appropriate graph analysis libraries. The proposed approach aims to provide meaningful insights into social network behavior with strong real-world applicability.

Keywords

Online Social Networks, Community Detection, Interest Group Identification, Louvain Algorithm, Influential User Detection, Centrality Measures, Degree Centrality, Betweenness Centrality, PageRank, Graph Analytics, Social Network Analysis.

SCRIBEE: A Comprehensive App for the Detection, Intervention, and Aid of Dyslexia and Dysgraphia

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Abstract

Learning disabilities such as dyslexia and dysgraphia affect millions of children worldwide, often hindering their academic progress, self-expression, and confidence. Dyslexia impacts reading and comprehension, while dysgraphia affects handwriting and written communication, leading to frustration, disengagement, and low self-esteem. Despite the availability of tools like Text-to-Speech (TTS) and Speech-to-Text (STT) or gamified learning apps, most existing solutions remain fragmented—offering partial support without integrating real-time feedback, engagement, and personalized progress tracking. This gap creates difficulties for parents, teachers, and therapists in providing consistent intervention and guidance. Scribee addresses this challenge by combining assistive technology, gamified learning, and adaptive assessment within a unified, cloud-enabled platform. The mobile interface of the work engages children through interactive literacy activities, while the intelligent back-end dynamically adjusts difficulty levels and securely stores progress data. Tested modules like TTS and STT achieved high accuracy (95% and 92%), validating the system's reliability and responsiveness. By merging engagement, accessibility, and adaptive learning, Scribee delivers personalized, child-centered support that fosters confidence and sustained improvement. It transforms fragmented interventions into a seamless ecosystem—empowering children with dyslexia and dysgraphia to learn independently and joyfully while bridging the gap between technology, education, and inclusivity.

Hybridization of Online and Offline Payment Modalities through Dynamic Split-Transaction Orchestration in Contemporary Food Ordering Systems

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Abstract

The current food ordering medium only allows a single method of payment which makes them inconvenient to the customers who would like to use a mix of cash and electronic payments especially in shared food orders and low balance cases. The limitation is solved through this paper and is proposed to be adopted as a hybrid split-payment system which allows the effective settlement of transactions with the help of various payment means in one order. The methodology proposes an integrated payment orchestration framework through which the division of dynamic bill splitting between online payments like UPI as well as offline cash payments may be supported by a reconciliation and transaction validation framework to guarantee consistency and atomity. An HTML, CSS, JavaScript, PHP, and MySQL prototype web-based system were used to test feasibility in a simulated environment of transaction operations. The experimental data show that it allows having better payment flexibility, decreased cart abandonment, and achieve full-price payment reliability, and provides higher success rates with respect to transaction. The primary value of the work is the introduction of a lightweight and scalable practical hybrid of payment framework that can be deployed in the current food ordering and point-of-sale solutions, especially in the Indian digital payment landscape.

Keywords

Split payment, Hybrid transactions, Food ordering systems, UPI integration, Cash-on-delivery, Payment reconciliation.

Develop a Machine Learning Model to Predict Human Life Span

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Abstract

Life expectancy is widely used as an important measure of an individual's overall health and well-being. It is influenced by several factors, including medical conditions, lifestyle habits, and physiological characteristics. However, predicting human lifespan is not straightforward, as these factors interact in complex and non-linear ways. In the project, a machine learning-based approach is proposed to estimate life expectancy using the Gradient Boosting Regressor algorithm. The model is developed using a dataset that includes key health and lifestyle attributes such as height, weight, body mass index (BMI), cholesterol levels, smoking behavior, alcohol consumption, physical activity, and medical conditions like diabetes, hypertension, heart disease, and asthma. To improve data quality, preprocessing steps such as handling missing values and applying one-hot encoding for categorical variables are performed. The dataset is then divided into training and testing sets to evaluate the model's performance. The results, measured using Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared (R^2), indicate that the model provides reliable predictions. In addition, a Streamlit-based web application is developed to allow users to input their details and receive real-time life expectancy predictions. Overall, the system offers a practical tool that can help individuals better understand how lifestyle choices may influence their long-term health.

Keywords

Gradient Boosting Regressor, Machine Learning, Life Expectancy Prediction, Healthcare Analytics, Streamlit, Lifestyle Factors.

Corrosion Performance and Chloride Permeability of Lime Activated High-Volume GGBS and Ferrochrome Slag based Concrete

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Abstract

Chloride penetration and the subsequent corrosion of embedded steel are among the leading contributors to the early deterioration of reinforced concrete, highlighting the importance of developing durable and low-carbon alternatives to conventional concrete. The current study probes the combined influence of high-volume Ground Granulated Blast-furnace Slag (GGBS), hydrated lime, and ferrochrome slag (FS) aggregate on enhancing the corrosion resistance and chloride barrier performance of concrete. Six concrete mixes were formulated with a fixed 60% GGBS used as cement replacement, with and without 7% hydrated lime as a chemical activator, while natural coarse aggregates were substituted with FS at 0%, 50%, 75%, and 100% by volume. Durability was measured through the Rapid Chloride Permeability Test (RCPT) according to ASTM C1202, accelerated electrochemical corrosion testing via gravimetric mass loss of embedded HYSD steel bars, and measurement of compressive strength (CS) and ultrasonic pulse velocity (UPV) before and after corrosion exposure. The incorporation of 7% lime together with 75% FS resulted in the minimum charge passed value of 432 C, corresponding to an overall reduction of approximately 69% compared to the control mix (CM) with 1392 C. This was classified as "Very Low" chloride permeability category in accordance with ASTM C1202. The optimal mix (G60L7F75) also attained the highest pre-corrosion CS of 54.4 MPa and UPV of 5448 m/s, with minimal post-corrosion deterioration (1.1% UPV loss and 7.5% CS loss), and the lowest reinforcement mass loss of 8.7% which is 51.9% improvement over the CM. These enhancements are the effect of the additional C-S-H gel formation from GGBS hydration, alkaline activation by hydrated lime, and the impermeable compound microstructure of FS particles, collectively densifying the cementitious matrix and interfacial transition zone (ITZ). The findings confirm the viability of this ternary industrial by-product system for producing high-performance, corrosion-resilient, and sustainable concrete infrastructure.

Keywords

Ground granulated blast-furnace slag (GGBS), ferrochrome slag (FS), Rapid Chloride Permeability Test (RCPT), compressive strength, corrosion resistance, ultrasonic pulse velocity (UPV), sustainable concrete.

From Source to Shelf: A Transparent Product Tracking Solution

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Abstract

This paper presents an advanced transparent product tracking framework designed to ensure end-to-end traceability and trust across modern supply chain ecosystems. The proposed system addresses critical limitations of conventional supply chain management solutions, including centralized data control, limited visibility, and vulnerability to data manipulation. By employing a distributed tracking architecture that integrates unique product identifiers, immutable record management, and real-time event logging, the framework enables continuous monitoring of product lifecycle events from raw material sourcing to final retail delivery. The solution captures and verifies manufacturing operations, logistics movements, storage conditions, and ownership transfers through secure data validation mechanisms. Implemented using modern web technologies and scalable backend services, the system provides an interactive dashboard for real-time product status visualization, provenance verification, and compliance monitoring. Extensive experimental evaluation conducted on simulated multi-tier supply chain datasets comprising over 20,000 product transactions demonstrates traceability accuracy of 99.1%, an average update latency of 210 milliseconds, and a significant reduction in data inconsistency incidents. The proposed approach effectively mitigates counterfeit risks, enhances stakeholder trust, and establishes a scalable foundation for transparent, resilient, and intelligent supply chain management.

Keywords

Supply Chain Transparency, Product Traceability, Source-to-Shelf Tracking, Real-Time Monitoring, Data Integrity, Distributed Ledger, Smart Supply Chain.

Industry Power Consumption and Penalty Minimization Using Automatic Power Factor Correction (APFC) Unit

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Abstract

Escalating demand for economical and productive utilization of electrical energy across manufacturing industries has brought attention to the adverse consequences of suboptimal power factor resulting from widespread deployment of inductive equipment. A poor power factor elevates reactive power requirements, amplifies line currents, escalates distribution losses, induces voltage instability, and triggers financial penalties from electricity authorities. To overcome these limitations, this work proposes an Automatic Power Factor Correction (APFC) unit engineered to enhance industrial energy utilization and curtail penalty-related expenditures. The developed scheme continuously acquires real-time electrical measurements, including supply voltage and load current, and executes dynamic reactive power injection via selective engagement of capacitor banks. A dedicated microcontroller-driven APFC relay evaluates instantaneous load behavior and regulates the power factor toward near-unity conditions, consequently elevating system performance and supply quality. Deployment of the APFC scheme diminishes total apparent power drawn, strengthens voltage profile, decreases feeder losses, and ensures adherence to utility compliance thresholds. Through the convergence of automation, live data acquisition, and adaptive reactive compensation, the proposed APFC unit markedly reduces industrial power bills, extends service life of connected apparatus, and fosters energy-conscious sustainable manufacturing operations.

Keywords

Power factor correction, reactive power compensation, capacitor bank switching, microcontroller control, energy efficiency, industrial power quality.

DeepLeaf: Intelligent Disease Detection System for Tomato Crops

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Abstract

Identifying tomato leaf diseases in the early stage is important in order to minimize crop damage and improve overall crop productivity. Recently, deep learning based methods have been broadly used in automating plant disease identification because of their ability to classify images accurately and quickly. In this study, an integrated deep learning system is presented using two convolutional neural network models, VGG16 and MobileNet, trained on the open source Plant Village tomato leaf dataset containing 16,012 images which belongs to ten different categories. This work presents an efficient deep learning based system for automated tomato leaf disease classification by merging the strengths of deep convolutional feature extraction and lightweight model optimization. Transfer learning helps the models learn faster and achieve higher accuracy while keeping the system more efficient and easy to run. In Experimental findings shows that the hybrid learning strategy works better for classifying the data, converges more quickly, and better at generalizing, making it good choice for real time agricultural monitoring systems. The study talks about how important is that to balance the accuracy and efficiency for real world use in precision agriculture.

Keywords

Tomato leaf disease, VGG16, MobileNet, Transfer Learning, CNN, Precision agriculture.

Enhancing Student Engagement in Zoology Laboratory through QR Code-Enabled Specimen Management: A Machine Learning and Text Analytics Approach

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Abstract

This project employs an interdisciplinary methodology that combines QR code-enabled specimen management with machine learning and text analytics to improve student engagement in zoology laboratory education. The system was put into use with 85 undergraduate students, and the data collected was in CSV format and included both structured responses and open-ended input. We created and tested several supervised machine learning models, such as Random Forest, Support Vector Machine (SVM), Logistic Regression, K-Nearest Neighbors (KNN), and Decision Tree, to see which one could best predict engagement levels. The Random Forest model had the highest accuracy rate of 87%. The examination of feature importance found that simplicity of use, scan frequency, and time spent were the best indicators of engagement. Natural language processing methods, such as sentiment analysis and TF-IDF vectorization, were also used to look at student input. These methods showed that most of the feedback was favorable and that students had better learning experiences. K-means clustering divided students into different involvement groups, which gave us a better understanding of how they behave. Statistical analysis validated a notable enhancement in overall engagement scores subsequent to the intervention ($p < 0.01$). The results show that using QR code technology with advanced analytical methodologies is a scalable, cost-effective, and data-driven way to make experiential learning in zoology labs better.

Sign Language Recognition Using Deep Learning Algorithm: A Survey

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Abstract

The current survey will provide the in-depth overview of Sign Language Recognition (SLR) systems developed under the methodology of the deep learning study, with a focus on researches published in 2019-2025. Sign language recognitions are very important in alleviating the communication barrier between the hearing-impaired society and the rest of the society. As of recent, SLR has seen massive improvements in both isolated and continuous recognition problems, with the improved computer vision, deep neural networks, and cheap computational resources. This paper syntactically examines state-of-the-art deep learning to SLR application methods such as: Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Long short-term memory (LSTM) networks, attention-based, and Transformer architectures. Some of the modalities of inputs such as RGB video, depth, optical flow, and pose or landmark-based representations are all covered in the survey and are extracted through frameworks such as MediaPipe and OpenPose. State-of-the-art benchmark datasets, such as WLASL, RWTH-PHOENIX-Weather, PHOENIX-2014T, Chinese Sign Language (CSL), and some Indian Sign Language (ISL) datasets are covered as well as popular evaluation measures that can be considered accuracy. To bring into the limelight architectural options, data sets involved, and trends of performance 15 representative research papers have been compared.

Keywords

Sign Language Recognition, Deep Learning, Computer Vision, Multimodal Fusion, Continuous Sign Language Recognition and Human-Computer Interaction.

Verbo Vision AI: A Multimodal AI Framework for Image Understanding

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Abstract

With the rapid growth of images and multimedia content, there is an increasing need for intelligent systems that can effectively interpret visual information and present it in an accessible and meaningful form. This paper presents Verbo Vision AI, a unified multimodal artificial intelligence framework designed to enhance image understanding by transforming a single image into multiple informative outputs. The proposed system generates descriptive captions, performs object detection and localization, supports visual question answering, provides audio narration, and produces a simple video representation of the visual scene. The framework integrates deep learning-based computer vision techniques with natural language processing and multimedia generation methods. Vision-language models are employed for caption generation and question answering, while YOLO-based object detection is used to obtain object-level information from images. The resulting textual content is further converted into speech and visual sequences to improve accessibility and user interaction. Unlike traditional image understanding approaches that address individual tasks separately, the proposed framework combines all functionalities within a single processing pipeline, enabling comprehensive interpretation of visual content. Experimental evaluation conducted on real-world images demonstrates clear, consistent, and accurate outputs across different modules. The proposed system is particularly beneficial for visually impaired users and shows strong potential for applications in education, assistive technologies, and multimedia content creation.

Temple Architecture Analysis Using Deep Learning and Visual Interpretation

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Abstract

Indian temple architecture has developed over many centuries through the influence of religion, regional traditions, and historical conditions, resulting in distinct architectural styles such as Dravidian, Nagara, and Vesara. Identifying these styles has traditionally relied on expert observation and detailed visual study, which becomes time-consuming and difficult when a large number of temples need to be examined. This study focuses on classifying temple architectural styles using image-based analysis with deep learning, while also allowing the basis of each classification to be examined. Temple images are analyzed using a deep learning model trained on a curated dataset of 1,475 images, including 492 Dravidian, 492 Nagara, and 491 Vesara samples collected from different sources and visual conditions. The model learns structural patterns related to architectural elements such as towers, gateways, and sculptural regions that help distinguish between styles. To understand which parts of an image influence the classification result, Gradient-weighted Class Activation Mapping is applied to highlight relevant regions in the temple images. The system was evaluated on an unseen test dataset and achieved a classification accuracy of 89.19%, indicating consistent performance across all three architectural categories. The visual results show that the classification relies mainly on meaningful architectural features rather than background details. These findings suggest that combining deep learning with visual analysis can assist architectural study and support systematic recording and learning related to Indian temple architecture.

Keywords

Temple Architecture, Deep Learning, CNN, Grad-CAM, Image Classification, Visual Representation.

AI-Based Mock Interview Platform

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Abstract

Interview preparation remains a challenging process for job candidates due to limited access to realistic practice environments and objective performance evaluation. This paper presents an AI-based mock interview platform that simulates real-world interview scenarios through voice-driven human-AI interaction. The proposed system generates role-specific interview questions, conducts adaptive dialogue based on candidate responses, and evaluates performance using real-time scoring metrics. A voice-enabled conversational AI module is employed to emulate interviewer behavior, enabling natural and interactive communication. The platform further provides personalized feedback and performance insights to support continuous improvement in communication skills and interview readiness. Experimental usage analysis demonstrates that the system effectively enhances user engagement and confidence, offering a scalable and accessible solution for interview training.

Keywords

Artificial Intelligence, Mock Interview System, Conversational AI, Voice-Based Interaction, Automated Performance Evaluation, Interview Training.

Deep Learning-Based Plant Disease Recognition System Using Convolutional Neural Networks and Streamlit Web Application

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Abstract

It is critical to detect crop diseases in early stage to enhance food production and reduce losses due to diseases. Disease identification methods based on manual visual inspection are highly error prone, require a lot of time, and are not feasible for large scale farming. In this paper, we develop an end to end crop disease prediction system that combines deep learning-based image classification with a real time web based deployment framework. Automatic disease classification from plant leaf images is carried out by a convolutional neural network (CNN) based on the ResNet50 architecture. Transfer learning is used to facilitate feature extraction and to achieve better classification results. A publicly available PlantVillage dataset has been used for training and testing the system. It contains ten disease and healthy classes for tomato crops only. Testing accuracy of 96.5% has been achieved, whereas other performance metrics like precision, recall, and F1 score noted score higher than 96%. The confusion matrix analysis shows that the model performs well in each class and only a few samples have been misclassified. To facilitate real time image upload and prediction, the trained model is wrapped in a Streamlit web application. The proposed architecture provides early crop disease diagnosis in precision agriculture.

Adaptive Cyber Defence Using ML, Steganography, and Hacker Activity Analysis

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Abstract

The Intelligent Web Traffic Analyzer with Hacker Activity Tracking model comprises of a fully integrated system it is integrated based on real-time web application monitoring, analysis, and protection. Along with this the feature our system collects data on request and the next level includes a hybrid hacker detection pipeline that incorporates statistical anomaly detection, rule based signatures, automated alerts, and rate-based heuristics. The contents of our model includes an admin dashboard, IP management, and reporting to end user and to the admin, and this is built with ASP.NET/C#, Microsoft SQL Server, and Google Charts. From our test findings and from load testing and simulated assaults it is clear that the model shows high precision for unusual and third person login attempts, alerting latency of less than two seconds, and it also consists of a steady dashboard performance under all concurrent loads. The admin site manager can more effectively respond to attacks with the smart integrated systems involved in the model, they can also monitor and alert the subsequent user of the threats they might face due to suspicious activities taking place, make it a safer cloud environment compared to the other models.

Keywords

Hacker Detection, Anomaly Detection, Signature-Based Security, IP Management, Cybersecurity Analytics.

Automated Energy Management and Control using IoT

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Abstract

Energy efficiency and effective electricity management are at the center of major challenges as a result of the increasing power demand and the rising energy costs. The developed system equips advanced voltage and current sensors with IoT, enabled communication to perform continuous, real, time, and on, demand energy consumption data collection, transmission, and analysis. The users can have remote access to detailed energy usage information through a dedicated mobile application, thus enabling monitoring and control from anywhere and at any time. The implementation of the proposed solution leads to energy saving, user awareness, and the use of energy in a sustainable way in residential and commercial environments by giving them real, time visibility, intelligent analysis, and remote management.

Keywords

Internet of Things (IoT), Energy Management System, Smart Energy Monitoring, Real-Time Power Analysis, Remote Monitoring and Control, Energy Conservation.

Gen AI – Enabled Mentorship and Internship Support Platform

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Abstract

The growing need to have individualized career advice and internship programs has revealed the shortcomings of the traditional mentorship and placement assistance frameworks that tend to be manual, piecemeal, and hard to scale. The paper will recommend a Generative AI-Powered Mentorship and Internship Support Platform to overcome these obstacles by combining Artificial Intelligence, Natural Language Processing, and full-stack application development to create career mentoring and internship support platforms that are all smart enough to be realistic and relevant nowadays. The system uses a chatbot powered by GenAI to deliver automated advice, resume and skills analysis, mentor placement, and individualized internship and job recommendations. The modern AI models carry out profile analysis, skill verification, mentor-mentee matching, and opportunity ranking according to relevance and user requirements. Data privacy and system integrity are guaranteed by means of secure authentication, role-based access control, and token management. Cloud-based deployment is scalable, highly available, and available 24/7 to a multiuser, multi-server environment. The experimental assessment shows better response efficiency, user engagement, and minimal manual intervention as compared to traditional mentorship methods. The suggested platform will facilitate inclusive, scaled, and intelligent career development in accordance with the current digital education and workforce preparedness goals.

Keywords

Generative Artificial Intelligence, Mentorship Platform, Internship Recommendation System, Natural Language Processing, AI Chatbot, Skill Analysis, Career Guidance, Role-Based Access Control, Cloud Computing, Automated Decision Support.

Smart AI Based Solution for Traffic Management

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Abstract

Rapid urbanization and the continuous growth of vehicular population have made traffic congestion a major challenge in modern cities. Inefficient traffic management leads to increased travel delays, excessive fuel consumption, environmental pollution, and a higher risk of road accidents. Conventional traffic signal control systems operate using fixed-time or pre-programmed schedules, which are unable to adapt to dynamic and unpredictable traffic conditions. As a result, these systems perform poorly during peak hours, emergency situations, and irregular traffic patterns.

This paper presents a Smart AI-Based Traffic Management System that enables real-time adaptive traffic signal control using artificial intelligence techniques. The proposed system integrates computer vision and Internet of Things (IoT) technologies to continuously monitor traffic conditions at signalized intersections. Traffic parameters such as vehicle density, queue length, and waiting time are extracted from real-time video streams and sensor data. A reinforcement learning-based control mechanism is employed to dynamically optimize traffic signal phases by learning optimal control policies through interaction with the traffic environment.

The effectiveness of the proposed system is evaluated under dynamic traffic scenarios simulating peak and off-peak conditions. Experimental results demonstrate a significant reduction in average waiting time and improved traffic throughput compared to traditional fixed-time control systems. The proposed approach offers a scalable, cost-effective, and intelligent solution for urban traffic management and contributes toward the development of sustainable and smart city transportation systems.

Keywords

Smart Traffic Management, Reinforcement Learning, Computer Vision, IoT, Adaptive Signal Control, Smart Cities.

Detection of Abnormality in Endoscopic Image using Image Segmentation

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Abstract

With the advent of faster and accurate devices imaging in the field of Medical has been undergoing a revolution in the past decade. For such devices corresponding software is required which in turn has provided a major drive for new algorithms in signal and image processing. Digital image processing techniques are used in the medical images analysed, used as diagnostic tools and quite often provides insight into the inner working of the process under study. The commonly found abnormalities in endoscopic images are cancer tumours, ulcers, bleeding due to internal injuries, etc. The segmented method is used to segment the tumours, abnormal regions and cancerous growth in the human esophagus. In our proposed work, a method for detecting possible presence of abnormality in the endoscopic images is presented. An algorithm is developed to perform the segmentation, classification and analysis of medical images, especially the endoscopic images for the identification of commonly occurring abnormalities in it.

Keywords

Endoscopy, Tumors, Esophagus, Morphology, Segmentation.

Local Field Potential Study in Normal and Chemically Induced Epileptic Mouse Model

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Abstract

Neurological disorders cause electrophysiological changes of the Brain. Electrophysiological analysis can detect the status of the brain and has positive impact on treatment pattern and actual diagnosis. Different devices are available to study the brain status but the electroencephalography is a technique commonly used for diagnosis of different neurological disorder. With the development of bioengineering, use of LFP can be a promising step apart from EEG which have been continuously using in diagnosing and treating various type of neurodegenerative diseases. LFP provide a molecular level data as compared to superficial EEG record (1). Previous works on LFP in various neurodegenerative disorder have shown correlation of Beta wave oscillation (13–30 Hz.) in Parkinson's disease (2). Changes in local field potential observed in case of epilepsy patients before onset of epileptiform discharge (3). A significant local field potential was recorded in epilepsy patient in theta range as in the earlier work (4)

Present study is carried out to identify the association of LFP signal with neural disorder recorded in the subcortical regions of the PTZ treated seizure model of mouse brain. Insulation coated microelectrodes were stereotactically implanted in the specific regions of the brain to collect the signals. Signals are acquired with the help of BioPac Data Acquisition system from control, PTZ treated mouse groups. The recorded data were analysed using software acknowledge 5.0. changes in the amplitude of waveforms are evident in PTZ treated animals. This indicated alteration of intercellular environment locally.

Classification of Knee Osteoarthritis Using Transformer Based Vision Models

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Abstract

Knee Osteoarthritis (KOA) is a chronic degenerative joint disorder that significantly affects mobility and quality of life, particularly among the elderly population. Accurate assessment of disease severity plays a crucial role in clinical diagnosis and treatment planning. Conventional diagnosis relies on manual interpretation of radiographic images using the Kellgren–Lawrence (KL) grading system, which is subjective and prone to inter-observer variability. This paper presents a transformer-based vision framework for automated classification of Knee Osteoarthritis using X-ray images. The proposed approach leverages Vision Transformers (ViT) and their advanced variants to capture both local structural details and global contextual relationships through self-attention mechanisms. Experimental evaluation on KL-graded knee X-ray datasets demonstrates that transformer-based models achieve improved classification accuracy and robustness compared to traditional convolutional neural network approaches. The results indicate that transformer architectures offer a reliable and scalable solution for computer-aided KOA diagnosis in real-world clinical settings.

Keywords

Knee Osteoarthritis, Vision Transformer, Medical Image Analysis, Deep Learning, X-ray Classification.

Deep Learning-Based Predictive Maintenance Approaches for Intelligent Equipment Monitoring in Smart Manufacturing Industries: A Comprehensive Review

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Abstract

Predictive maintenance (PdM) is recognized as a critical enabler of Industry 4.0 through the provision of data-driven alternative solutions to traditional breakdown and preventive maintenance strategies. A systematic literature review of recent developments in PdM taking into consideration the application of sensor based data, Internet of Things (IoT) enabled monitoring and Artificial Intelligence (AI) based techniques in manufacturing. The literature findings suggest that PdM enhances equipment reliability and reduces downtime compared with conventional methods, moreover, industrial IoT (IIoT) and AI integration are shown to be key factors in the realisation of smart manufacturing. Other advances regarding the use of deep learning and multimodal sensor fusion improve fault detection and Remaining Useful Life (RUL) estimation. However, challenges persist including: slow real-time deployments, limited use of multimodal data sets, low model explainability, and unresolved issues with regard to data privacy. The majority of approaches reviewed were purely conceptual, i.e. they proposed ideas for realising PdM but were lacking both empirical investigations of the results and the performance of the solutions. Future research should focus on the development of solutions that comply with the tenets of explainable AI, lightweight real-time PdM systems, and the testing of solutions within an industrial context to provide a platform for scalable and dependable PdM solutions.

Keywords

Predictive maintenance, Machine learning, Deep learning, Industry 4.0, Smart manufacturing, Multisensory data, Industrial Internet of Things.

Explainable and Data-Efficient Machine Learning Models for Time-Series Risk Prediction: A Comprehensive Survey

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Abstract

The rapid proliferation of machine learning (ML) in risk-sensitive domains has surfaced two persistent challenges: the need for vast labeled datasets and the opacity of predictions made by complex models. This paper presents a comprehensive survey of explainable and data-efficient machine learning models applied to time-series risk prediction. We systematically review 35 studies spanning healthcare, finance, energy systems, and industrial applications, analyzing their methodologies, datasets, key findings, limitations, and research gaps. Our analysis reveals four dominant strategies for achieving data efficiency—transfer learning, data augmentation, active learning, and representation learning—and four primary explainability techniques: LIME, SHAP, attention mechanisms, and Grad-CAM. Synthesized results demonstrate that hybrid models combining data-efficient learning with explainable AI (XAI) outperform traditional approaches by up to 40% in data utilization while maintaining competitive accuracy. Open challenges including the absence of unified benchmarks, limited cross-domain generalization, and high computational cost in real-time settings are identified and a structured research roadmap is proposed.

Keywords

Explainable AI, Data-Efficient Learning, Time-Series Risk Prediction, SHAP, LIME, Transfer Learning, Healthcare AI, Financial Forecasting.

An Automatic Text Summarization Using Extractive ML

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Abstract

In the information overload era, it is essential to barrow the appropriate insights out of the vast volumes of texts in a manner as efficient as possible. The paper describes an automated text summarization system based on AI which utilizes a hybrid system based on extractive and transformer abstractive models. It generates key sentences with the assistance of statistical, positional, and semantic properties, such as TF-IDF, sentence location, named entities, and contextual embeddings, and undergoes refinement with the help of abstractive models to convert the content to corresponding summaries, coherent and written by a human end-user. It enables multi-document inputs, domain-specific adaptation, multi lingual texts and customizable summary preferences on length, tone, and format. The ability to create visualization creates infographics, charts, and slides in order to make the content more approachable and captivating. Assessed on benchmark collections using conventional performance measurements related to ROUGE-N, ROUGE-L, and ROUGE-SU, the system exhibits a high level of accuracy, coherence and readability. The solution is scalable, can be deployed using APIs or SaaS platforms and useful in education, journalism, business intelligence, and research.

Keywords

Automatic Summarization, Extractive, Abstractive, NLP, Transformer Models, Multimodal Summaries, Multi-Documnet.

SYNCURVE: A Real-Time Multi-Source Health Analytics Platform for Outbreak Prediction Using Machine Learning and Explainable AI

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Abstract

The SYNCURVE Health Analytics Solution provides an adaptive, near real-time capability for detecting and responding to outbreaks in a rapidly evolving urban environment. The SYNCURVE Health Analytics Solution integrates the most effective methods of analysis (e.g., machine learning, statistical modelling and explainable AI) with the goal of identifying potential health risks with minimal delay. The SYNCURVE Health Analytics Solution collects information from many different sources in the urban environment, including healthcare information and services, environment information, mobility patterns of the population, and health-related stories. In contrast to earlier alert systems that were solely threshold-driven or rule-driven, the SYNCURVE Health Analytics Solution uses models based on data to identify trends, detect anomalies, and classify risk. The SYNCURVE Health Analytics Solution uses time-series forecasts, probabilistic models, and graph analysis to describe interaction between locations, populations, and the environment. A module that provides decision support will rank alerts and recommendations for response by risk level and intensity. Geospatial analysis allows the SYNCURVE Health Analytics Solution to visualize the geographic expansion of an outbreak and identify high-risk areas.

Keywords

Public Health Surveillance, Outbreak Prediction, Multi-Source Data Integration, Machine Learning, Explainable AI, Anomaly Detection, Geospatial Analytics.

YouTube Transcript Summarizer: Using Mistral Gemini for Efficient Video Content Distillation

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Abstract

The fast increase of video content on networks like YouTube has posed a challenge to users who desire to extract the important information in lengthy videos within the shortest time. It may be time-wasting and ineffective to watch all videos to grasp the main ideas. To overcome this issue, this project will suggest a YouTube Transcript Summarization System that will automatically create succinct and meaningful summaries out of video transcripts. It is based on a hybrid architecture with two strong Large Language Models (LLMs): Google Gemini Pro and the Mistral-7B-Instruct with Low-Rank Adaptation (LoRA). The first step is to fetch the transcript of a video on YouTube with the help of the YouTube Transcript API that retrieves the time-aligned segments of the speech in the video. In case the transcript exists in a non-English language, it is automatically translated to English so that it can be processed the same way. The process of summarization is dynamic and it selects the suitable model based on the availability of the internet. In case there is an internet connection, the system operates on Gemini Pro which is a cloud-based model that produces highly fluent and context-relevant summaries. The offline system is based on the Mistral-7B-Instruct model fine-tuned with LoRA, which allows a local summarization process to be done effectively with privacy of data and lower computational cost. It is implemented in Streamlit, which is a simple and interactive system that allows one to enter the URL of a video in a YouTube player and get the summary of the video shown in bullet points or paragraphs immediately. The experimental assessment results indicate that the offered system generates the clear and informative summaries, as Gemini Pro demonstrates a somewhat higher fluency whereas Mistral is capable of generating the reliable offline performance. It enhances the availability of video information and can find use in education, research, and information retrieval.

Keywords

YouTube Transcript Summarization, Video Content Analysis, Natural Language Processing, Large Language Models, Google Gemini Pro, Mistral-7B-Instruct, Low-Rank Adaptation (LoRA), Automatic Text Summarization, Multilingual Translation, Streamlit Interface, Information Retrieval.

PSNA Assistant – AI-Powered Campus Support

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Abstract

The emergence of artificial intelligence in academic institutions is changing the face of communication through the creation of AI-based assistants aimed at helping students and staff in their quest to find accurate academic information and institutional support services. Students and staff in these academic institutions have always found it hard to get accurate academic information and institutional services. This project seeks to introduce a cutting-edge academic AI-based chatbot dubbed the “PSNA Assistant,” aimed at helping students and staff in their quest to find academic information in real time. The AI-based chatbot makes use of a cutting-edge technology dubbed Natural Language Processing (NLP) and Retrieval Augmented Generation (RAG) in helping students get accurate academic information. The chatbot also helps students get information regarding academic timetables, faculty information, exam updates, and academic cutoffs through the use of a Vector Database (VectorDB) and a Large Language Model (LLM).

Keywords

AI-powered chatbot, Natural Language Processing (NLP), Retrieval Augmented Generation (RAG), Large Language Model (LLM), and campus support system.

Deep Learning-Based Multi-Class Retinal Disease Detection Using DenseNet-121 with Explainable AI

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Abstract

The retinal conditions, namely diabetic retinopathy, glaucoma, and cataract, are among the major causes of preventable blindness. However, the asymptomatic nature of these conditions in the early stages, in addition to the shortage of ophthalmology specialists, has led to delayed diagnosis. This research was carried out with the aim of developing a computerized system for the classification and diagnosis of fundus images, where four classes, namely diabetic retinopathy, cataract, glaucoma, and normal retina, are distinguishable. This system is based on a two-stage transfer learning method using DenseNet-121, where the classification head is first trained on a frozen backbone, followed by the fine-tuning of some deeper convolutional blocks at a reduced learning rate. A total of 4,217 fundus images, each with a near uniform distribution, were used in the classification. On-the-fly data augmentation was applied to the images, and a weighted loss was used for handling the mild imbalance. Interpretability was also integrated in the system using Grad-CAM, where the class discriminative regions are identified and related to the anatomically significant areas, and LIME, where the significant regions in the images are identified by applying superpixel perturbations. The outputs from the system were also converted to a four-tier risk stratification framework. The system achieves 91% overall test accuracy with a macro F1-score of 0.885, where diabetic retinopathy achieved the highest detection accuracy of 94%.

Keywords

Retinal disease detection, fundus image classification, densenet-121, transfer learning, explainable AI, grad-CAM, LIME, risk stratification.

LEXA: An AI-Based System for Legal Assistant for Judgment Prediction, Summarization and Legal Text Simplification

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Abstract

Legal professionals and the general public face significant challenges in reading, understanding, and acting on legal documents. This paper presents **LEXA** (Legal Expert Assistant), a unified NLP-powered web application that brings together three essential legal AI capabilities: (1) binary judgment outcome prediction using a BERT classifier fine-tuned on a legal question-answering dataset; (2) abstractive summarization using a T5-small model trained on the BillSum legislative corpus, complemented by Sentence-BERT semantic case retrieval; and (3) plain-language rewriting of legal text using FLAN-T5 with a rule-based fallback, evaluated via the Flesch Reading Ease metric. All three modules are served through an interactive Flask web interface with a conversational dark-themed UI. Experimental results show prediction confidence reaching **81.63%**, readability scores above 90 for simplified outputs, and coherent abstracted summaries with relevant case references. LEXA bridges the legal accessibility gap by combining state-of-the-art transformer models in a single deployable pipeline accessible on standard CPU hardware.

Keywords

Legal NLP, BERT, T5, FLAN-T5, Judgment Prediction, Legal Summarization, Text Simplification, BillSum, Sentence-BERT, Flask.

An Inspection of Deep Learning-Based Image Restoration and Segmentation in Smart Manufacturing

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Abstract

Smart manufacturing relies on high-performance image processing for automatic inspection, defect detection, and quality control. The traditional image restoration and segmentation algorithms are adversely affected by noise, distortion, and missing data and hence are not suitable for industry. In recent years, new robust image restoration and segmentation methods based on deep learning have been introduced for smart manufacturing purposes. This survey provides a detailed review of deep learning-based approaches for industrial image quality improvement with focus on Generative Adversarial Networks (GAN), i.e., CycleGAN and GCN. Other segmentation techniques, e.g., U-Net, Attention U-Net, and Mask R-CNN, are also considered. Moreover, comprehensive analysis of the strengths and weaknesses of these models is considered, including the future research directions for improving accuracy, scalability, and real-time automation. With the inclusion of the latest developments, this survey is a valuable reference for researchers and practitioners in intelligent manufacturing, industrial automation, and smart factory systems.

Automated Bone Marrow Cell Classification Using Deep Learning with EfficientNet-B0 and Progressive Unfreezing

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Abstract

Morphological classification of bone marrow cells is extremely important for the diagnosis of hematological cancer; however, it is still a time-consuming and expertise-dependent process. In this research paper, an end-to-end hybrid deep learning architecture based on the EfficientNet-B0 and the Swin Tiny Transformer has been suggested to classify 15 types of bone marrow cells from a vast number of 1.72 million microscopic images. Our hybrid model has shown outstanding accuracy (94.12%), exceeding the performance of EfficientNet-B0 alone (87.52%). High F1-scores were obtained for Eosinophils (0.98), Erythroid Progenitors (0.96), and Neutrophilic Granulocytes Segmented (0.94), whereas Hairy Cells (0.70) and Rare Cells (0.45) had worse performance scores. Grad-CAM, t-SNE, and cosine similarity analysis have revealed that our hybrid model considers important morphological characteristics like the nucleus and cytoplasm during classification.

Keywords

Bone Marrow Classification, Microscopic Imaging Hematological Malignancies, Hybrid Deep Learning, EfficientNet-B0, Swin Transformer, Grad-CAM.

Emotion-Aware Autonomous Driving System Using EEG and Eye-Tracking-Based Cognitive State Analysis

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Abstract

In the case of autonomous and semi-autonomous cars, the main safety of drivers remains a key challenge, particularly in cases where the driver is exhausted, drowsy, or bored. Conventional car systems often disregard the emotional and mental condition of a driver in preference to environmental sensors. Emotion-Conscious Autonomous Driving System as suggested in this paper utilizes eye-tracking information and EEG to detect and quantify the state of drivers in real-time. Variables like blink rate, Eye Aspect Ratio (EAR) and gaze direction are classified by utilizing MediaPipe to extract eye tracking variables. The alpha, beta and theta EEGs are regarded as the brainwave bands, obtained either by using the wearable headsets or by simulated datasets. These signals are acquired by Face Mesh. A pre-trained Support Vector Machine (SVM) model is used to group the manner of drivers into five groups; normal, stressed, microsleep, distracted and drowsy. Depending on the rules of suspicion, the system will undergo a readjustment, such as putting the user into autonomous mode, providing visual and auditory warnings, and prescribing rest or soft music. Moreover, event logging is undertaken to analyze the session and a dashboard built on Streamlit to give live visualization of EEG bands, system actions, emotion status, and eye landmarks. The potential of the system to establish the mental states correctly and deliver timely interventions to boost driver safety and potentially have emotion-sensitive autonomous vehicles is demonstrated to be necessitated by experimentation.

Keywords

Autonomous Driving Systems, Driver Safety, Emotion-Conscious Driving, Eye Tracking, EEG Signals, Brain-wave Analysis, Eye Aspect Ratio (EAR), MediaPipe, Face Mesh, Support Vector Machine (SVM), Real-Time Monitoring, Streamlit Dashboard.

Automated Academic Evaluation and Student Outcome Prediction

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Abstract

The rapid growth of digital education platforms and web-based learning environments has increased the need for efficient and scalable academic assessment systems. Many Institutions conduct and evaluate assignments and quizzes online so the number of student submissions has grown notably. Evaluating large volumes of descriptive answers manually can be time-consuming, especially in courses with a high number of students. In addition, identifying textual similarity between submissions and analysing student performance data adds further challenges for instructors.

To help address these issues, this work proposes an Automated Academic Evaluation and Student Outcome Prediction System developed using the MERN stack along with Machine Learning, Natural Language Processing (NLP), and Data Analytics techniques. This system provides a secured role-based access for both faculty and students. Faculty can upload assignments, quizzes, deadlines, and model answers, while students submit their responses within the specified timeframe. Once the submission deadline is reached, NLP-based similarity techniques are applied to analyse the submitted answers. In particular, TF-IDF vectorization and cosine similarity are used to measure textual similarity between student responses and the model answer, as well as to identify similarities among different student submissions. This approach helps in automating the evaluation process and also supports in plagiarism detection. Based on the similarity results, this platform automatically assigns marks along with the plagiarism score for assignments, generates quiz results and submission patterns. Based on these indicators the predictive analytics are performed using supervised machine learning algorithms to predict whether the student is likely to pass or fail a specific subject.

Overall, integrating automated grading, similarity detection, and predictive analysis into a single system helps in reducing the workload and is also time saving for the faculty. It also allows institutions to monitor student performance more effectively and supports data-driven decision making in modern education systems.

Keywords

Automated Academic Evaluation, Machine Learning, Data Analytics, Natural Language Processing, Plagiarism Detection, TF-IDF, Cosine Similarity, Student Performance Prediction, Predictive Analytics.

Design Space Exploration and Optimization of Retinex-Based Low-Light Image Enhancement on FPGA – A Survey

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Abstract

Image improvement in low-light conditions is crucial in a variety of current imaging tasks, such as surveillance, automated navigation, and intelligent transport. The low-light images may have very low contrast, higher noise, and reduced visual signal, which can lower both how good they look and how well computer vision algorithms work. Retinex-based enhancement are well liked as they replicate the manual vision of individuals by separating an image in terms of light and shadow. However, traditional Retinex algorithms involve complicated procedures such as logarithmic transformations, spatial filtering, and multi-scale processing and so existent processors cannot run them in real time. This survey examines existing methods of low-light image enhancement by Retinex and the way it can be accelerated with Field-Programmable Gate Arrays (FPGAs). Some of the optimization methods that it explores include pipelining, fixed-point computation, loop unrolling, and memory restructuring that will make processing faster and hardware more efficient. The paper further details the advantages of using FPGAs in order to have real time execution whilst maintaining high quality of images, and proposes further researches to be done on how better hardware notion can be achieved in embedded vision systems.

Reliable RFID System for Monitoring and Verifying Expiry Dates of Pharmaceutical Products

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Abstract

The growing demand for transparency and safety in pharmaceutical supply chains has highlighted the urgent need for a secure, reliable method to authenticate medicinal products. This paper introduces an RFID-based system that accurately tracks pills and capsules, focusing specifically on monitoring their expiry dates. By embedding RFID tags into pharmaceutical packaging, the system ensures consistent identification and real-time validation throughout the product's life cycle. Through the use of cryptographic encryption, only authorized personnel can access or modify the stored data, thereby reducing the risk of counterfeit or expired medications. Each RFID tag holds encrypted expiry data that is verified upon scanning, offering immediate confirmation of product authenticity. This innovative solution enhances patient safety, simplifies inventory handling, and offers a scalable and cost-effective method for pharmaceutical authentication.

Keywords

RFID, healthcare, expiry tracking, authentication, pharmaceutical supply chain.

Design and Analysis of Low-Power Consumption Linear Feedback Shift Register Using a Combined Sleepy and Keeper Technique

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Abstract

Power reduction in digital systems has become a critical design priority, especially for portable devices and energy-constrained embedded applications. Conventional Linear Feedback Shift Registers (LFSRs), widely used in communication systems, cryptographic hardware, and Built-In Self-Test (BIST), consume significant leakage and dynamic power at advanced technology nodes. This work presents a low-power LFSR architecture based on an integrated Sleepy and Keeper transistor technique. The proposed hybrid method suppresses leakage during idle periods through sleep transistors while retaining logic state with keeper circuits to avoid performance degradation. A 16-bit LFSR was implemented and simulated using a CMOS process. Experimental results demonstrate a Leakage reduction in leakage power, 18% dynamic power savings, and minimal delay overhead compared to the conventional LFSR. The design therefore offers an efficient and stable solution for low-power applications requiring continuous state retention and high reliability.

Keywords

LFSR, low-power design, sleepy technique, keeper transistor, leakage reduction, CMOS VLSI, BIST, state retention, power gating, subthreshold leakage.

A Deep Analysis on Brain-Like Exploration: Thriving on Graph Giants with Tiny Memory

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Abstract

Although such classical techniques as Breadth-First Search (BFS) and Depth-First Search (DFS) have long been fundamental techniques owing to their simple concepts and well-known theoretical behavior, when used in large-scale networks with limited memory resources they are significantly problematic. In modern systems like social media networks, biological interaction graphs, and communication infrastructure memory availability can be the most important constraint instead of a speed limit. This paper provides solutions to these issues by empirically and theoretically analyzing memory constrained graph search algorithms, namely, Iterative Deepening Depth-First Search (IDDFS) and Beam Search in comparison with BFS and DFS baseline algorithms in synthetic networks of Erdos-Renyi and Barabasi-Albert networks (10,000 to 100,000 nodes). We also propose a Memory-Bound Execution Framework (MBEF) that achieves realistic edge device constraints based on explicit memory limits. We show that using IDDFS, the BFS-level is restored and memory consumption by about 70% (390 MB vs. 1,220 MB), Beam search, in turn, is more scalable, with memory consumption reduced by 85% (152 MB), the number of node expansions is reduced four times, and execution time is lower (8.2 s vs. 18.4 s running BFS). The results offer practical information on the selection of algorithms in the resource-constrained context, such as autonomous navigation, the recommendation system, network routing, and edge computing platforms.

Comparative Analysis of MTCMOS, Header-Switch, and Footer-Switch Sleep Techniques for Low-Power 2:1 Transmission-Gate Multiplexer Design

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Abstract

This paper presents the design and comparative evaluation of MTCMOS, header-switch, and footer-switch techniques for implementing a 2:1 multiplexer using Transmission Gate Logic (TGL) in 90 nm CMOS technology. The primary objective is to identify the optimal sleep-transistor configuration and sizing that minimize the overall area-delay-power (ADP) product, quantified through a Figure of Merit (FOM) metric. Simulation results obtained from cadence virtuoso at 1.0 V supply demonstrate that the Footer-Switch configuration achieves the highest FOM, approximately 18× higher than the Header-Switch and nearly 5.0 orders of magnitude higher than the MTCMOS configuration. These findings indicate that the Footer-Switch provides the most efficient trade-off between performance, power consumption, and silicon area. The proposed optimization framework offers a structured design methodology for achieving energy-efficient multiplexers for ALUs and other low-power communication systems.

Keywords

MTCMOS technology, Header-Switch, Footer-Switch, 2:1 Multiplexer (TGL), Sleep Transistor, Optimal Sizing, Figure of Merit (FOM).

Online Exam Cheating Detection with Cognitive Load Estimation

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Abstract

Online examinations are now a common phenomenon in modern education systems; however, the maintenance of academic integrity in online examinations is a big challenge. Traditional online proctoring systems are based on manual observation, which is often inefficient, time-consuming, and error prone. In this regard, an online exam monitoring system based on artificial intelligence is proposed to automatically detect suspicious activities during online examinations using computer vision and audio processing techniques. In this system, the webcam is used to examine the activities of students in real time by detecting the face, eyes, gaze, and movements of the mouth. In this regard, face detection models such as MTCNN (Multi-task Cascaded Convolutional Neural Network) and facial landmark detection models such as MediaPipe are used to detect the face and facial features of the students. This allows the system to detect the gaze of the students and abnormal movements of the eyes. In addition to this, the system is designed to detect multiple faces in the video frame to detect the presence of intruders in the room. In addition to the above, object detection techniques are employed to detect the presence of forbidden items like mobile phones and books within the video frame. Audio monitoring techniques are included in the system to detect the speech and whispering of the candidate using signal processing techniques like the detection of energy levels and zero crossing rate. The system is further designed to monitor the screen of the examinee to detect the use of unauthorized resources during the examination. Once the presence of such activities is detected, the system generates alerts in real time and voice messages to alert the candidate about the detected behaviors. All the detected behaviors are compiled into detailed visual reports for further analysis. The use of the proposed system in the examination environment using Python, OpenCV, MediaPipe, and deep learning techniques proves the effectiveness of the system in improving the reliability of the examination environment.

Keywords

Online Examination, Cheating Detection, Computer Vision, Artificial Intelligence, MediaPipe, Face Detection, Eye Tracking, Object Detection.

Early Detection of Osteoporosis using Dental X-Rays: A Deep Learning-Based Non-Invasive Diagnostic

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Abstract

Human bones are the calcified skeletal frame work that aids in support, movement of organs and protection. Bone density declines with age, putting people at risk for osteoporosis – a condition in which bones become fragile and prone to fractures. Even though there are scans to evaluate a person's bone health, most people could go undiagnosed for years with weak bones until a severe bone damage occurs. Dental panoramic X ray images, commonly taken in dental offices, offer an attractive chance for early detection of bone medicine-related diseases. In this work, we propose a structured pipeline for computer vision, U-Net-based masking, and deep learning to analyse dental X-rays for the early diagnosis of osteoporosis risk. This method starts by preprocessing the image and applying a masking technique to isolate the relevant bone areas. Then, the proposed method uses deep learning to identify discriminative patterns for the classification of the patient's condition as Normal, Osteopenia, and Osteoporosis. Experimental results on four architectures show high performance, with test accuracy ranging from 87.63% to 94.30%, while MobileNetV2 achieves the best accuracy of 97.28%. The lightweight nature of the proposed framework also makes it possible for efficient real-time clinical practice, making the proposed framework a cost-effective and non-invasive approach for early screening and preventive medicine.

Keywords

Osteoporosis, Deep Learning, MobileNetV2, Computer vision, U-Net masking, Dental X-ray.

REACT (Resilient Environment Attack and Counter-Measure Testing)

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Abstract

Traditional security testing often falls short because it relies on static scans and pre-set attack scripts. These methods struggle to keep up with modern, adaptive defense systems that change in real-time. While AI has helped automate some of these attacks, most current tools focus strictly on whether an exploit "works" rather than explaining how the defense actually behaved.

To bridge this gap, this paper introduces REACT an AI driven framework designed to evaluate cyber resilience. Instead of a one-size-fits-all scan, REACT uses a reinforcement learning agent that "thinks" like an attacker, choosing its next move based on how the system and its Intrusion Detection Systems (IDS) respond. By synthesizing vulnerabilities from exposure signals, REACT can provide a meaningful assessment even if a direct exploit is blocked. Testing in a virtualized Kali Linux environment proved that REACT offers much deeper visibility into defensive gaps than traditional tools. It provides a safe, reproducible way to measure how effectively a system stands its ground against a sophisticated, evolving threat.

Keywords

Cyber Defense Resilience, Adaptive Red Teaming, Reinforcement Learning, Vulnerability Assessment, Intrusion Detection Systems, Cyber-Range Testing.

Credit Card Fraud Detection Using Quantum-Enhanced SVM with Explainable AI

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Abstract

Transactions through the internet are developing at high rates and this makes them vulnerable to scam activities leading to huge losses. Conventional machine learning methods have been of potential in detecting fraud but they are challenged by extreme data imbalancing, latency demands of detection and the structure of time-series transactions. In order to tackle these problems, the proposed project offers a failsafe regime of detecting frauds by combining quantum-enhanced Support Vector Machines (QSVM) with traditional machine learning applications. It presents the statistical tests and feature selection to minimize noise and maximize effectiveness first and then relies on the speedup of the classification of high-dimensional and imbalanced datasets using quantum annealing solvers. To test the quantum-enhanced model, experiments are conducted with the data on credit card transaction (moderately imbalanced and non-time-series) and bank loan application (highly imbalanced and time-series) and clearly demonstrates that the quantum model yields not only better speed in detection but also higher accuracy, especially with the time-series data where classical tools fail. The research opines that quantum machine learning (QML) has a potential to detect fraud in real-time. Nevertheless, it also makes clear that the characteristics of the training data are important to determine which approach between the classical approach and the quantum one is more appropriate in case of the problem.

Keywords

Fraud Detection, Quantum Machine Learning, Support Vector Machine, Imbalanced Data, Time-Series Analysis, Quantum Annealing.

Voice Controlled Intelligent Computer Vision System for Visually Impaired Users

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Abstract

Vision loss can significantly affect a person's ability to perform routine activities such as navigating unfamiliar locations, identifying nearby objects, or reading printed information. To address these challenges, researchers have increasingly explored assistive technologies that rely on artificial intelligence and computer vision. These systems interpret visual information from the environment and convert it into audio feedback, enabling visually impaired individuals to better understand their surroundings. This study introduces a multi-functional assistive framework that integrates real-time object detection, Optical Character Recognition (OCR), voice interaction, and environmental sound monitoring. The proposed system employs a YOLO-based model to detect objects around the user and estimate their approximate distance. In addition, an OCR module reads textual information from signboards, labels, and documents and converts the recognized text into speech output. To further improve user safety, the system includes directional guidance and a horn detection mechanism that analyzes environmental audio signals using frequency analysis techniques. Experimental observations indicate that factors such as lighting conditions, camera movement, and environmental noise can influence system performance. The results demonstrate that integrating visual perception, audio processing, and speech interaction into a single lightweight framework can significantly improve environmental awareness and support safer independent navigation for visually impaired users.

Design Analysis and Optimization of Automatic Locking Clamp for Multi-Size Components in CNC Machine to Minimize Cycle Time

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Abstract

The paper provides the design, manufacturing, and performance appraisal of an automated clamping lock with a proximity sensor in CNC machining, which will reduce the cycle time whilst retaining the clamping uniformity with various size components. The system employs a dual acting pneumatic cylinder (40mm bore, 160mm stroke) that works under 6 bar pressure that is controlled by a 5/3 solenoid valve and Arduino based proximity sensing system. The proposed automatic pneumatic clamp was compared with conventional manual vice by the use of 10 samples (5 of them manual, 5 of them automatic) of component sizes 20mm to 200mm. The outcomes showed that the automatic locking clamp shortened the cycle time drastically by 39.7 percent, as manual cycle time was 45.8 seconds and the automatic cycle time was 27.6 seconds ($p=0.001$). The time taken in clamping was reduced to 1.22s ($p=0.006$) and the response time reduced to 102.2ms ($p=0.008$) (see table 1). Automatic operation had higher clamping force consistency (740particular to the manual operation (0.100mm, $p=0.013$). The statistical validation with two-sample t-tests and main effects plots proved that all of the performance parameters were significantly improved and suggested the proposed system as one of the effective solutions to optimizing the cycle time in any CNC machining operations.

Keywords

Automatic Locking Clamp, Pneumatic Vice, Proximity Sensor, Cycle Time Reduction, CNC Machining, Work-holding Device, Automation, Clamping Force Consistency.

Deep Learning-Based Classification of Fruits and Vegetables for Freshness Detection

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Abstract

Determining the freshness of fruits and vegetables are vital factors in meeting your food quality standards, keeping your diet healthy, and reducing food waste at home. The goal of this research is to see whether information extracted from images of fruits and vegetables can help classify those items as well as gauge their overall freshness. A combination of publicly available image databases and images taken by the researchers themselves generated one large set of data, which included many different types of fruits and vegetables and freshness ratings. Machine learning algorithms using Convolutional Neural Networks (CNN), specifically Transfer Learning methods (specifically MobileNetV2, ResNet50, and EfficientNet), were utilized to create models for classifying and rating the freshness of fruits and vegetables within this data set. Data was preprocessed through resizing, normalizing, and augmenting to provide robustness to the model when exposed to different lighting and background conditions. The model's performance was evaluated based on four metrics: accuracy, precision, recall, and F1-score. The classification task was completed as two separate tasks: identifying fruits and vegetables as multiclass categories; and detecting whether the fruits/vegetables were fresh or not. Our results indicate that lightweight CNN architectures performed very well for both tasks (i.e., classifying categories and detecting freshness), even in the presence of image occlusion and illumination variations. We also used visualization techniques to increase interpretability of our model by showing regions of an image that contributed to the output of the model. This approach has great potential for real-life applications such as smart refrigerators, food inventory management, and agricultural monitoring, thereby helping to improve food safety and decrease food waste.

Keywords

Convolutional Neural Networks, Food Freshness Detection, Fruit Classification, MobileNetV2, Deep Learning, Smart Kitchens.

ESP32-Based Smart Healthcare Bandage for Continuous Wound Analysis and Alerting System

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Abstract

The Smart Bandage system is an innovative IoT-based healthcare solution of real-time wound healing monitoring. The microcontroller employed in the creation of the wireless communication is ESP32 having the inbuilt Bluetooth feature. A flexible breathable bandage with integrated sensors including a DS18B20 thermometer, DFRobot Flexible Capacitive Moisture Sensor and MPU-6050 are used to obtain information on the state of wounds. These sensors will be temperature, moisture content and movement around the wound. The system also gives an alert in the event that abnormal conditions like inflammation, excessive moisture and infection are observed. The alerts are delivered to the healthcare providers via SMS via a GSM module and the data is stored in a cloud platform, e.g. there is a service known as Firebase in which data can be stored to be tracked in the long run. The expected outcome of the system is to detect complications early, monitor patients remotely, and manage wounds in general, particularly those in underserved and rural communities. The smart bandage is an inexpensive, scalable method to the modernization of wound care by combining real-time data collection, wireless communication and cloud storage.

Keywords

Smart Bandage Io based Healthcare Real Time Wound Monitoring ESP32 Microcontroller Biomedical Sensor Wound Care Patient Remote Monitoring SMS Notifications Cloud Storage (Firebase) Data Logging Healthcare Solutions- Wound Infection Detector Wearable Health Device.

TaskHive: Intelligent Multi-Module Environment for Project Management and Collaboration

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Abstract

Software development teams often face challenges in managing projects, tracking progress in real time, and identifying potential risks when using conventional project management tools. Many existing systems rely on static updates and reactive approaches, which limit their effectiveness in dynamic and distributed environments.

This paper presents TaskHive, an intelligent project management platform developed to improve collaboration and support proactive decision-making. The system is implemented using modern web technologies, with React for the frontend and Node.js for the backend. Firebase and Firestore are used for authentication and data management, while Socket.io enables real-time synchronization across users.

TaskHive continuously analyzes project activities instead of only recording task updates. It includes features such as early risk identification, team performance monitoring, and workload-based task assignment. These features help teams understand project status more clearly and take timely actions to avoid delays.

Experimental evaluation shows that TaskHive improves task completion rates, reduces task reassignment, and enhances coordination among team members compared to traditional tools. The system provides better visibility and supports efficient project execution.

Overall, TaskHive offers a practical and scalable solution for managing software projects, especially in agile and distributed team environments.

Keywords

Real-time collaboration, project management systems, predictive risk analysis, team performance analytics, agile development, distributed systems.

A Predictive and Adaptive Machine Learning–Driven System Architecture for Energy Consumption Optimization of IoT Devices in Smart Buildings

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Abstract

Accurately predicting energy consumption plays a crucial role in achieving efficient energy management, load balancing, and sustainable operation of modern power systems. However, forecasting energy usage is challenging due to nonlinear relationships, temporal dependencies, and variability in consumption patterns. To overcome these challenges, this study introduces a hybrid machine learning framework that integrates Light Gradient Boosting Machine (LightGBM) and Extreme Gradient Boosting (XGBoost) to enhance prediction accuracy. The hybrid approach takes advantage of the complementary strengths of both gradient boosting techniques. LightGBM contributes efficient training and rapid convergence, whereas XGBoost improves the model's robustness and generalization ability. By integrating predictions from both models, the hybrid approach captures complex consumption patterns more effectively than individual models. The proposed framework learns from historical energy consumption data and generates reliable forecasts that support intelligent energy management and decision-making. The effectiveness of the hybrid model is assessed using standard regression evaluation metrics, which demonstrate its capability and applicability for practical energy prediction tasks. The findings emphasize the potential of hybrid ensemble learning approaches to enhance the accuracy and reliability of energy consumption forecasting systems.

Keywords

Energy Consumption Prediction, Machine Learning, Gradient Boosting, LightGBM, XGBoost, Hybrid Model, Ensemble Learning, Smart Buildings, Smart Meter Data, Time Series Analysis, Predictive Analytics, Energy Forecasting, Building Energy Management, Data-Driven Modeling.

A Review of Ethical Framework and Assessment Model for Bridging AI Adoption, Cyber security and Digital Literacy Gaps

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Abstract

This research aims to explore the relationship among digital literacy, cybersecurity behaviors, AI ethics awareness with AI tool adoption within a students. The Study used mixed method approach combining questionnaire and open ended questions among students and using factor analysis, classification techniques study found that how self-assessed digital skills and ethical principles influence responsible AI use and digital practices. Interestingly, even though many students rely on AI tools regularly, gaps remains in cybersecurity understanding. These insights provide valuable information for educators, policymakers, and technology developers who want to foster responsible digital citizenship and safe, fair AI engagement in educational settings. The rapid adoption of Artificial Intelligence (AI) across professional sectors requires a solid understanding of AI ethics, cyber security awareness, and digital literacy. This project analyzes existing models and assessment methods to evaluate current skills and ethical gaps using survey data and natural language processing techniques. Building on this analysis, interactive assessment tools, including an AI-based chatbot and training modules, were created to measure users' ethical awareness and technical skills objectively. The study moves forward by designing an integrated ethical framework that incorporates principles such as fairness, transparency, privacy, accountability, and responsible AI use in organizational governance, technical safeguards, and ongoing training. This framework aims to align AI adoption practices with cyber security and digital literacy, ensuring fair, trustworthy, and secure use of AI technologies. The ongoing work involves cybersecurity practices, refining detailed training content, evaluation and deployment strategies to support ethical AI implementation among various professional workplace.

Keywords

Digital Literacy, Cyber security, AI ethics, AI adoption, Cyber security Awareness, Digital Citizenship.

Hybrid Embedded-Cloud System for Collaborative Retail Shopping and Real-Time Route Optimization

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Abstract

Physical retail environments are faced with persistent bottlenecks such as prolonged checkout lines, difficulties in product-location navigation, and limited transparency in billing. This work presents a practical, affordable IoT-based system that transforms a conventional shopping cart into an intelligent agent. The proposed system is based on a Raspberry Pi 5 edge computer coupled with an Arduino Mega sensor platform, providing real-time item vetting and collaborative shopping synchronization. Using Firebase Firestore for cloud persistence, MQTT for low-latency notifications, and an embedded Travelling Salesperson Problem (TSP) heuristic for path optimization, the system delivers live guidance and digital billing directly at the cart. Real-world experiments in a four-aisle physical testbed demonstrate robust accuracy and a 35% reduction in total shopping and checkout time, establishing the feasibility of scalable deployment in supermarkets.

Keywords

Smart Cart, IoT, Embedded System, TSP, Route Optimization, Firebase, MQTT, Retail Automation, Cloud, Raspberry Pi.

Building AI Inside Enterprises: A Product Manager's Framework for Scalable AI Adoption

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Abstract

Artificial Intelligence is rapidly transforming enterprise software systems; however, many organizations struggle to transition from experimental AI prototypes to scalable, production-ready AI products. This challenge is particularly evident in large enterprises where data fragmentation, governance constraints, and cross-functional dependencies slow down AI adoption. This research explores the role of the Product Manager in bridging the gap between AI innovation and enterprise-scale implementation.

The study proposes a structured framework for building AI-enabled products within enterprise environments by focusing on five critical dimensions: data readiness, AI product lifecycle management, cross-functional collaboration, responsible AI governance, and continuous learning systems. The framework draws on industry practices and simulated case scenarios across sectors including healthcare, manufacturing, and financial services to illustrate how organizations can operationalize AI while ensuring scalability, compliance, and user trust.

The findings highlight how product managers can act as orchestrators between engineering, data science, and business stakeholders to deliver value-driven AI products. This research contributes a practical playbook for enterprises seeking to embed AI capabilities into digital products while maintaining strategic alignment, ethical standards, and long-term sustainability.

Developing a Machine Learning Pipeline for Analysing the Relationship Between Mobile Internet Usage, Literacy, and Income in India

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Abstract

Digital inclusion has become increasingly important for the socio-economic development in India. Even though there has been a significant growth in the mobile internet usage, factors such as literacy, income levels, and access to telecommunication continue to shape the ways in which users access the mobile internet. The purpose of this study is to understand how literacy rates, household incomes, and telecommunication providers fuels the internet usage in various states across the country of India. Here we have merged two datasets, that includes the TRAI's performance indicators and socio-economics surveys like the Rural MPCE and literacy levels by the regions. The merged dataset was tested traditionally through ordinary least squares (OLS) regression and also using machine learning techniques such as Ridge, Lasso and Elasticnet regression. The study indicates that the most important factor influencing the internet adoption is Literacy. Also, the involvement of a telecommunication penetration factor (i.e. RJIL 4G) was highly significant. On the other hand, among the models tested ElasticNet demonstrated the best predictive accuracy as it includes the hybrid modelling to address multicollinearity. Overall, the study focuses on the need draw further attention towards the educating the community, along with educational infrastructure to, collectively, help bring down the digital divide in India. Methodologically, this study combines the socio economic and the telecommunications datasets in order to understand the digital adoption as well as to promote the literacy and socio-economic enhancement. These finding can help policymakers in improving the literacy and the telecommunications access to ensure social equality across regions.

Keywords

Internet adoption, Digital divide, Literacy, Telecom penetration, India.

AI-Enabled Adaptive Ambulance Monitoring System with Biometric Authentication

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Emergency medical services play a critical role in saving lives during accidents and medical emergencies, where rapid response is essential. However, traditional ambulance systems face challenges such as unauthorized access, lack of continuous patient monitoring, delayed communication with hospitals, inefficient route selection due to traffic congestion, and poor treatment documentation. These issues often result in the loss of the crucial “golden hour,” reducing patient survival chances. The AI-Enabled Adaptive Ambulance Monitoring System with Biometric Authentication is designed to overcome these limitations by integrating biometric security, Internet of Things (IoT), Artificial Intelligence (AI), and real-time communication technologies into emergency medical services. The system ensures secure ambulance access using fingerprint authentication. It enables continuous monitoring of patient vital signs through IoT sensors. AI-based anomaly detection supports early identification of critical conditions. Real-time data sharing with hospitals improves preparedness and treatment planning. A centralized dashboard allows medical staff to monitor patients remotely. Predictive route optimization using GPS and traffic data ensures faster and safer transportation. Medicine usage and emergency events are automatically recorded. Helper details and treatment logs improve accountability and future medical reference. Instant alerts are sent to hospitals and authorities during accidents or breakdowns. This integrated approach enhances patient safety. It reduces emergency response delays. Ultimately, the system significantly improves survival outcomes during critical situations.

Keywords

Artificial Intelligence, Biometric Authentication, Emergency Medical Services, Internet of Things, Real-Time Patient Monitoring.

Surveillance-Based Hostel Security Measurement Using AI and Machine Learning

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Abstract

This paper presents a innovative method of monitoring dormitories that utilize AI and ML to enhance safety security. People really think about go back to old- fashion ways keeping things safe like checking face, use LBPH and Harr Cascade, and looking at CCTV footage. They also have problems include get tired, take long time for respond, not being able expand, and being easy for use The suggested method uses LBPH and HARR CASCADE and LBPH to find object that donot known. This system has a lot of layers, so you might detect people, things, and actions that seem suspect right away. The system runs on the Raspberry Pi edge computing platform, which allows it process data right on the device. This keeps your information safe and makes responses faster. We always look at live video streams to see if there are people, items, or behaviors that shouldn't be there. The test demonstrates that the system can distinguish faces 95technology being offered is the best approach to keep campuses and dorms secure because it is affordable, easy to use, and protects people's privacy. AI surveillance, keeping hostels safe, edge computing, face recognition, finding items.

Keywords

AI surveillance, keeping hostels safe, edge computing, face recognition, finding items, YOLOv5.

Echo-Care: An AI-Driven Voice Cloning System for Personalized Assistive Speech Generation

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Abstract

One of the emerging fields of speech processing is Voice cloning. Voice cloning aims at machines talking like us humans. However, not only talk but talk like someone particular. Now you know where the fun begins. We present a Zero-Shot Voice Cloning System in this paper. We feed in just a few seconds of voice clip. Along with text input, system produces speech output. No more long extensive and speaker dependent training sessions.

We supply our system a audio clip as input, from where the model learns speaker embeddings. These embeddings are combined with a neural network based style transfer model. The resultant speech produced is smooth, sometimes even emotional. We've also implemented a voice enhancer module that removes noise and declutters the voice. Which in return allows the output to be read easily; clearly with little distortion.

We also demonstrate a chat box interface where you can chat with the system online and receive responses in the duplicated voice. Voice cloning model generalizes well on unseen speakers during training. It can now be implemented in various fields such as virtual assistants, voice over accessibility and tools or voice-based conversation systems.

Comparison and Analysis for G+10 Building with Shear Wall by ETABS and STAAD Pro Software

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Abstract

The “Analysis of Building Systems (ETABS)” and “Structural Analysis and Design Professional (STAAD Pro)” software. It is worth noting that manual seismic analysis is very error-prone, time-consuming and tedious in a competition-driven industry. There is also a need to adopt computer programs in the design and analysis of structures, which should not compromise sustainability. Hence, this study aims to compare the results of structural analysis from STAAD.Pro and ETABS for a G+10 building and design 11 story Residential building. To improve integrity and estimation of structural complex in seismic events, “Performance-Based Seismic Design (PBD)” approach was adopted. Recent advances are focused on integration of fragility analysis, probabilistic methods, and adherence to seismic code guidelines. The study fills the existing research gap, i.e., lack of comparative studies on ETABS and STAAD Pro software for comparing results of G+10 buildings with use of shear walls that resist lateral load produced due to Wind and Earthquake effect and Analyze the Cener of Mass, Peak story shear, of mass participation, frequency, Storry stiffness, soft story and Story Drift etc.

Keywords

STAAD Pro, ETABS, Seismic, dynamic analysis, G+10 and mid-rise building.

A Biometric Voice Security System Enhanced with Emotional State Recognition

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Abstract

This work propounds a voice-based framework that incorporates speaker authentication with Speech- Emotion Recognition to enhance assure and context aware interface. This system leverages Mel-frequency Cepstral Coefficients (MFCCs) for acoustic portrayal and applies cosine resemblance for voice biometric validation, succeeded by CNNLSTM based model for emotion sorting. Experimental evaluation provides the voice biometric framework yield uniform authentication efficiency, achieving an accuracy in range **85%-88%** under regulated state, while the Emotion Recognition framework attain validation of **61.45%** on untrained datasets. By narrowing Emotions analysis to authenticated users, the unified strategy boosts system robustness and illustrates practical relevance for secure voice – driven usability, while conceding extant complications pertinent to emotional variability and datasets constraints.

Keywords

Voice Biometric, Speech Emotion Recognition, MFCC, CNN-LSTM, Speaker Authentication, Secure Voice System.

Interpretable Prediction of a Decentralized Smart Grid Based on Machine Learning and Explainable Artificial Intelligence

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Abstract

Rapid growth in the use of decentralized energy systems, coupled with ever-changing levels of integration between Distributive Energy Resources (DERs) and modern Smart Grids, presents a significant challenge to maintaining stability on our Smart Grid Systems today. As traditional methods for monitoring and analyzing performance are not adequate to deal with the variable nature of these Systems (particularly as it relates to load and generation), this paper presents a machine learning-based framework for predicting the stability of decentralized smart grids. Using simulated data from UCI's Electrical Grid Stability Simulated dataset, we evaluate a range of machine learning techniques (e.g., ANN, Random Forest, Gradient Boosted Trees, SVM, KNN, Logit, Naïve Bayes Classifier, SGD, AdaBoost, and XGBoost). Among the various algorithms tested, ANN showed the best performance with respect to predicting stability demonstrating an AUC value of 99.4% and also good stability in terms of predicting with the same degree of accuracy (96.2%) across all measures of performance (accuracy, precision, recall, F1 score). Furthermore, the performance was enhanced by implementing a hybrid stacking classifier that utilized Bagging with Random Forest, AdaBoost and KNN; in addition, a LightGBM stacking mode was created. Overall accuracy improved to 97.0%.

The critical need for transparency in our energy systems is addressed through the use of Explainable Art, (XAI), including SHAP, LIME and Individual Conditional Expectation (ICE), which are employed to interpret model predictions and identify influential features that affect stability at the Grid level.

Keywords

Machine Learning, Stability, Smart Grid, Energy Systems, Analyze, Explainable AI, SHAP, LIME, ANN, XGBoost.

AI-Based Automated Hiring Platform

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Abstract

The AI-Based Automated Hiring Platform is an intelligent system designed to simplify and automate the end-to-end recruitment process with minimal human intervention. The platform enables recruiters to post job openings with detailed descriptions and requirements, while applicants submit resumes directly through the system. Utilizing AI-driven resume analysis, the platform automatically evaluates each application against job criteria, shortlisting only the most suitable candidates. In the subsequent stage, shortlisted candidates complete automated skill assessments or project-based tests predefined by recruiters. The system ensures fair evaluation by analyzing submissions including code repositories and assignments using AI models to assess technical proficiency, problem-solving ability, and project quality. Qualified candidates proceed to the final interview stage where the platform automatically schedules interviews, generates meeting links, and notifies both recruiters and applicants. This fully automated workflow eliminates repetitive manual tasks, reduces hiring bias, and significantly accelerates the recruitment cycle. The project leverages AI, automation, and data analysis to create a transparent, efficient, and unbiased hiring experience for both employers and job seekers. By combining resume screening, skill testing, and interview scheduling within a single intelligent platform, it provides a streamlined and scalable solution to modern recruitment challenges. Future enhancements include integrating predictive analytics for talent matching, chat-based applicant interactions, and real-time performance insights to further optimize the hiring experience and achieve complete process automation.

Keywords

Artificial Intelligence, Recruitment Automation, Resume Screening, Machine Learning, Talent Acquisition.

ROADGPT: Offline AI-Powered Road Safety Recommender System

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Abstract

Road safety is still a serious concern around the world, especially in less developed areas that have poor infrastructure and slow decision making that cause many accidents. Traditionally, road safety assessments are performed in great part using manual inspections and/or expert opinion but are commonly labor intensive, inconsistent, and rely on constant access to the internet for maintaining updated information. This chapter outlines RoadGPT, an enhanced offline capability of an AI-based road safety recommendation system; this tool provides context and policy-based safety interventions to help solve actual road safety problems.

The suggested system utilizes the latest advancements in artificial intelligence and natural language processing in order to semantically encode user reported road safety issues using Sentence Transformer models, allowing for much more precise interpretation than merely using keyword matching. Through the use of FAISS based vector similarity search, relevant interventions are pulled from a curated collection of safety knowledge that has been established via an expert level of knowledge of standards including the Indian Roads Congress (IRC). This also includes utilizing locally deployed Llama-3 as a large language model that has been executed using Ollama to provide expert style recommendations based on established standard of knowledge such as IRC.

RoadGPT's key differentiator is it will work entirely offline – providing the ultimate in data privacy, dependability and usability when connectivity is insufficient. The experimental results show that the system produces fast and meaningful (and interpretable) recommendations in a simple Streamlit interface. This paper presents a conceptual framework for using semantic retrieval methods with other local language models to enable an intelligent transportation safety planning decision support system, and suggest that it is possible to develop a practical, scalable solution for real-world applications.

AI-Powered Mock Interview Preparation Kit Using Generative AI and Virtual Interview Avatars

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Abstract

Preparation for an interview requires technical expertise, problem-solving skills, communication skills, and confidence. The conventional methods of self-preparation, static question banks, and mock interviews among peers are not personalized, scalable, or realistic. This paper proposes an AI-assisted mock interview preparation system that combines ATS-based resume evaluation, adaptive aptitude and technical quizzes, coding practice, and mock HR and technical interviews with a virtual AI interviewer.

The proposed system utilizes the Gemini-2.5-Flash large language model for dynamic question generation, resume assessment, response evaluation, and feedback. The real-time virtual interviewer enabled by LiveKit allows for interactive mock interviews that simulate real-life situations. The experimental study with students shows enhanced readiness for interviews, boosted confidence, and progress in technical, aptitude, and communication skills, thus proving the effectiveness of the proposed system as a scalable solution for interview preparation.

Keywords

Language Models (LMs), Computer Vision, AI Video Simulation, Natural Language Processing (NLP), Attention Span, Generative AI, Real-time Feedback, LiveKit-WebRTC.

Multimodal Deep Neural Network for Diabetic Retinopathy Severity Classification and Referral Risk Prediction

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Abstract

This project presents a Real-Time Disaster Information Aggregation System designed to address challenges in collecting and analyzing large volumes of disaster-related data. The system gathers information from multiple sources such as social media, news platforms, and public data feeds. Using Natural Language Processing (NLP) and Machine Learning (ML), it automatically filters, classifies, and prioritizes information based on contextual relevance, keyword importance, and severity level. A stacking ensemble model combining Logistic Regression, Gradient Boosting, and Neural Networks improves prediction accuracy and reliability. The system provides a user-friendly interface for real-time monitoring, enabling faster decision-making, improved coordination, and enhanced situational awareness during emergencies, ultimately helping to reduce damage and save lives.

Keywords

Disaster Response, Real-Time Data Aggregation, Advanced Algorithms, Emergency Response, Data Categorization, Decision-Making, NLP.

ML for Career Success: A Strategies and Insights

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Abstract

Predicting the career growth trajectories of university students is crucial for guiding their academic and professional development. This systematic review examines the predictive capabilities of machine learning algorithms in providing tailored career growth recommendations that benefit both students and educational institutions. By analysing relevant journal articles published over the past decade, the review highlights commonly employed algorithms, sources of academic performance data, key factors influencing career growth, and the overall effectiveness of predictive models. The findings reveal that Support Vector Machines (SVM) and Random Forests are among the most frequently utilized algorithms, often drawing on data from Learning Management Systems (LMS) and Student Information Systems. The review emphasizes the importance of comprehensive datasets that integrate academic, behavioural, and temporal information to enhance predictive accuracy. Furthermore, it identifies limitations in existing research and advocates for more nuanced approaches to advance career growth prediction methodologies. This study contributes to the development of personalized career guidance strategies, fostering better alignment between students' potential and professional pathways.

AI Integrated IoT System for Wind Turbine Health Monitoring and Control

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Abstract

The increasing deployment of wind energy systems demands reliable and autonomous monitoring mechanisms to minimize downtime and maintenance costs. Wind turbines operate under fluctuating environmental and mechanical stress conditions, making early fault detection essential for sustainable energy generation. This work presents an AI-integrated IoT architecture for real-time health assessment and adaptive control of wind turbine systems. Multiple sensing units capture electrical and mechanical parameters including temperature, vibration intensity, rotational speed, and load current. An ESP32-based edge node performs local acquisition and transmits data to a cloud analytics platform. A Random Forest classification model processes historical and live data streams to identify operational states categorized as healthy, critical, or faulty. Based on prediction results, an automated relay-based protection mechanism is activated to prevent equipment damage. Experimental validation using a DC motor prototype demonstrates accurate fault identification and responsive control, confirming the feasibility of integrating edge IoT and machine learning for predictive wind energy management.

Keywords

Wind Turbine, Internet of Things (IoT), Machine Learning, Predictive Maintenance.

Automated Jute Leaf Disease Classification Using ResNet50 for Precision Agriculture

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Abstract

Foliar diseases have the potential to result into the loss of productivity of fiber crops such as jute which are economically significant and are usually hard to detect at their initial stage. The manual diagnosis method, which is quite traditional, diagnostic process is labour-intensive, subjective, and depends on experience. The article introduces a jute leaf disease detection and severity evaluation automated system which uses sensor aided image capture and classification using deep learning. A field camera unit continuously records images of leaves at a set period of time and environmental sensing is provided to monitor the environment. The new-acquired images received a processing with the help of a transfer learning architecture which made use of the ResNet50 model to distinguish Leaf Spot, Anthracnose, Mosaic Virus, Powdery Mildew, and Healthy leaves. Data augmentation processes are used in the training to raise tolerance to multiple light levels and backgrounds. As an example, a severity estimation module, as one of its functions, effectively analyses the degree of infection besides classifying the disease stage to early, moderate or severe. Gradient-weighted Class Activation Mapping (Grad-CAM) is also additionally incorporated to improve the interpretation of the model by drawing emphasis on discriminating regions that affect predictions. The system is also operational as it initiates a mobile application interface that makes diagnostic results and severity information readily available to farmers so as to be able to implement intervention in time. Strict evaluation based on accuracy, precision, recall, and F1-score proves that the framework is classified with 97% and that all types of diseases are detected in a consistent fashion in field-based scenarios. The framework developed has provided a scalable and practical answer towards automated crop health monitoring, and precision agriculture.

Keywords

Jute Leaf Disease Detection, Deep Learning, ResNet-50, Grad-CAM, Severity Estimation, Plant Disease Classification, Precision Agriculture.

E-Ticketing Mobile Application with Dynamic QR Code and AI-Based Face Verification for Musical Concerts

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Abstract

Large-scale entertainment events, such as music concerts, attract significant crowds, making secure ticket validation and efficient crowd management essential. Traditional ticketing methods, including paper-based tickets and static QR codes, are vulnerable to duplication, unauthorized sharing, identity misuse, and entry delays. These limitations create operational challenges for event organizers and reduce the overall efficiency of access control systems.

This research proposes a secure mobile-based electronic ticketing system that integrates dynamic QR codes with artificial intelligence-based facial verification to enhance concert access control. In the proposed system, each ticket is associated with a unique dynamic QR code that changes periodically, thereby preventing duplication and misuse through screenshots. Additionally, facial recognition technology is employed to verify the identity of attendees, ensuring that only authorized individuals can gain entry. The system supports multiple ticket bookings, secure ticket transfer through invitation-based links, and real-time gate verification using a dedicated scanning module. The overall architecture combines mobile application interfaces, cloud-based data storage, and AI-driven biometric authentication to deliver a reliable, contactless, and efficient ticket validation mechanism.

Experimental results indicate that the integration of dynamic QR authentication with facial verification significantly enhances security while maintaining fast and seamless entry processing. This system demonstrates the effective use of mobile computing, artificial intelligence, and cloud technologies in developing a robust ticket management solution for large-scale entertainment events.

COLLABSPHERE: Influencer Brand Collaboration Platform

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Abstract

As businesses continue to use influencer marketing, they need seamless and straightforward ways to work with content creators. Even with its popularity, the collaboration processes are typically very time-consuming, labor-intensive, and require the use of a middleman agency to manage everything. This paper introduces the influencer-brand collaboration platform, Collabsphere. The platform helps brands manage their collaborations, deal with multiple influencers simultaneously, and analyze the results of the campaign. The system allows brands to set goals and select relevant influencers based on profile indicators and brand engagement metrics, while influencers can use a single platform to access authentic collaboration opportunities and manage multiple collaboration proposals. The system allows for the incorporation of analytics to better guide and focus influencer campaigns. The system allows for greater operational improvements and collaboration time improvements, along with trust-building transparency for the monitoring and collaborative processes.

Keywords

Influencer Marketing, Engagement Analytics, Collaboration Management, Platform, brand-Influencer collaboration.

Retail Sales Forecasting Using Novel Deep Learning

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Abstract

The task of forecasting sales in the retail domain plays a vital role in optimizing the inventory and supply chain, thereby facilitating better decision-making. However, the statistical techniques used for forecasting fail to handle the complex and nonlinear relationships between the influencing factors and the sales. The proposed TemporalFusionX approach has been adopted as the primary approach to retail sales forecasting because of its better performance. This approach combines both Prophet and XGBoost models to capture seasonal trends as well as nonlinear patterns. This results in better performance in terms of lower RMSE and MAE. Therefore, this paper proposes a novel framework based on the deep learning paradigm, which utilizes the self-attention mechanism for effectively capturing the complex relationships between the influencing factors and the sales. Unlike the existing models, the proposed framework incorporates the significant influencing factors, thereby facilitating better decision-making. Moreover, the self-attention mechanism helps the model focus on the most significant features, thereby enhancing the accuracy and interpretability of the model. The experimental results reveal the effectiveness of the proposed framework, which significantly improves the accuracy of the forecasting task. Moreover, the framework exhibits better stability while dealing with varying demand patterns. In addition, the framework exhibits better generalization capability while dealing with different products and stores. Furthermore, the framework exhibits better robustness while dealing with incomplete and noisy data. Therefore, the proposed framework can be utilized for achieving highly accurate, reliable, and scalable forecasting results.

Keywords

Retail sales forecasting, deep learning, prediction of time series, LSTM, GRU, transformer, demand forecasting.

Integrated Evaluation of Design with Construction Management Practices for Long-Term Behaviour of Post-Tensioned Nuclear Reactor Containment Structures

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Abstract

The common use of post-tensioned concrete containment structures in nuclear power plants is anchored on their great strength, crack control capacity, and resistance to internal pressure and external forces over the long period of service. These structures are not only required to have the design principles but also the construction management practices of planning, scheduling, quality control, inspection and maintenance to determine how well these structures will perform in the long term. Lack of proper coordination between design and construction can lead to loss of prestress, excess creep and shrinkage, durability and lower safety margins. This paper introduces a combined assessment of material needs and building management exercises on the long-term conduct of post-tensioned nuclear reactor holders. The analysis of the secondary data, which was gathered in the form of published research papers, design codes, and technical reports, was performed with the usage of Microsoft Excel, which would help to see the trends concerning prestress loss, creep, shrinkage, and durability. The findings reveal that appropriate design and effective management of construction is important in enhancing the structural reliability, lifecycle performance and safety of nuclear containment systems.

Keywords

Post-tensioned containment, nuclear reactor structures, prestress loss, construction management, creep and shrinkage, durability, lifecycle safety.

SMELLML: A Machine Learning Framework for Detecting Rarely Studied Code Smells

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Abstract

Software quality is frequently affected by the presence of code smells, which are poor design or implementation patterns that decrease maintainability, increase complexity, and introduce technical debt in software systems. Existing detection methods, including heuristic rules and basic machine learning approaches, often rely on fixed thresholds and highly imbalanced datasets, limiting their ability to identify less explored code smells effectively.

This paper presents Smell-ML, a machine learning-based framework designed to detect five rarely studied yet significant code smells: Refused Bequest (RB), Inappropriate Intimacy (II), Class Data Should Be Private (CDSBP), Middle Man (MM), and Speculative Generality (SG). The framework incorporates an improved data preprocessing stage that combines extended software metrics with dataset balancing techniques such as SMOTE, Oversampling.

The classification stage evaluates multiple models, including Random Forest, Support Vector Machine, Decision Tree, and several ensemble strategies such as Bagging, Boosting, Stacking, and Voting. Experiments conducted on 13 open-source Java projects covering 125 versions demonstrate improved precision, recall, accuracy, and F1-score, showing that Smell-ML effectively supports better software maintainability and quality.

Keywords

Code Smells, Software Maintainability, Machine Learning, Ensemble Learning, Data Balancing, Refused Bequest, Inappropriate Intimacy, Class Data Should Be Private, Middle Man, Speculative Generality.

Fake News Detection and Source Credibility Scoring Using NLP and Graph Neural Networks

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Abstract

The rise of online news platforms and social media has made it easier than ever for false information to reach large audiences before anyone can verify it. Existing detection systems tend to focus either on what a news article says or on how it spreads — but rarely on who published it. In this work, we build a hybrid system that checks both the content of a news article and the credibility of its source at the same time. For content analysis, we fine-tune a BERT model on a labeled fake news dataset. For source credibility, we train a Graph Convolutional Network on a co-occurrence graph of news publishers. The two outputs are combined using weighted averaging to produce a single classification decision. We tested the system on 19,742 news samples with a 70:30 train-test split. Our hybrid model reached 93.7% accuracy and a 93.0% F1-score, which is better than using BERT alone (89.3% F1) or the GCN alone (82.8% F1). The results show that checking the source alongside the content makes fake news detection noticeably more reliable.

Keywords

Fake News Detection, BERT, Graph Convolutional Network, Source Credibility, Misinformation, NLP, Decision Fusion.

Drug Recommendation System Based on Sentiment Analysis of Drug Reviews Using ML

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Abstract

Adverse Drug Reactions (ADRs) caused by Drug– Drug Interactions (DDIs) pose a significant challenge to healthcare systems due to their impact on patient morbidity, mortality, and treatment complexity. Existing research primarily employs Graph Neural Networks (GCN and GAT) to model drugs as molecular graphs, which often suffer from high computational costs and dependency on large-scale pre-training. This paper proposes a Voting Classifier-based ensemble method for side-effect prediction, eliminating the need for complex graph-based modeling. The Voting Classifier aggregates predictions from multiple base learners to improve robustness, interpretability, and overall prediction consistency. This approach reduces computational requirements while maintaining high predictive reliability for identifying potential adverse reactions. By shifting from graph-based frameworks to an interpretable ensemble strategy, the proposed system enhances efficiency in DDI side- effect prediction.

GSQ: Enhancing Text-to-SQL Reliability through Schema and Semantic-Guided Synthesis

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Abstract

The main problem in applied artificial intelligence exists because non-technical users need to obtain valuable data from relational databases yet they cannot create SQL queries. The G-SQL framework achieved important progress through its schema serialization and rule-based clause construction methods yet it struggles with advanced query structures and database schema comprehension across different fields and semantic uncertainties. The Hybrid Schema-LLM Guided Intelligence Framework introduces a new architectural design which combines deterministic schema-based parsing with the semantic capabilities of Large Language Models (LLMs). The framework consists of four main elements which include the modular rule-based structural planner and LLM-based semantic reasoning system and synonym expansion system based on embeddings and nested subquery development component. The multi-objective validation layer checks both syntactic correctness and relational integrity of a query before its execution starts. The system shows improved accuracy performance at all levels of query difficulty on the IMDB and Yelp and Microsoft Academic Search (MAS) datasets which are used for benchmarking. The system demonstrates its ability to manage complex multi-level query structures while demonstrating improved cross-domain generalization capabilities and decreased attribute mapping errors which make it suitable for use in both enterprise and public sector data access scenarios.

Keywords

Natural Language to SQL, NL2SQL, Schema-Aware Parsing, Large Language Models, Contextual Reasoning, Semantic Disambiguation, Hybrid Framework.

Performance Evaluation of Sustainable Waste Materials for Pavement Applications

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Abstract

Due to the growing demand for pavement construction, the natural resources are overused and produce large amounts of industrial and municipal waste, which poses a severe threat to the environment. Fly ash, glass powder, and waste plastics are some of the examples of sustainable waste materials that have been widely researched to act as potential substitutes for conventional pavement materials. This paper will provide a comparative analysis of these materials in terms of pavement utilisation using the previous research and technical data. The selected materials are evaluated in regard to their performance characteristics such as strength, durability, stability and resistance to environmental effects. The results obtained in previous research have shown that fly ash can be used to enhance the subgrade stability, glass powder can be used to improve the pavement damage caused by deformation and moisture, and waste plastics can be used to enhance the performance of layers. These materials can be used to help lower the construction costs, lower the level of environmental pollution and save on natural resources, hence aid the production of sustainable and cost-effective pavement systems.

Keywords

Sustainable materials, Pavement engineering, Fly ash, Glass powder, Waste plastics, Performance evaluation.

Adversarial Attack Detection Using Intelligent Algorithms During Object Detection

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Abstract

Deep learning, based object detection systems have become a core element of such pervasive modern applications as autonomous navigation, intelligent surveillance, and human-machine interaction. Still, despite their great success on standard benchmarks, these systems can be easily fooled by adversarial perturbations handful of minutes, purposely engineered changes to input images which lead to the system making incorrect, missing, or even misleading detections. Besides, such perturbations are most often visually imperceptible, so in the case of real, world and safety, critical environments, they pose the highest danger of making flawed decisions that can lead to serious consequences. The project at hand presents a lightweight and detector, independent framework for spotting adversarial attacks happening in the object detection process. No need to change or retrain object detection models, as the framework figures out whether the input images are genuine before trusting the detection results. The method is a kind of mixture of statistical anomaly physics analysis and machine learning based classification and thus it is capable of pinpointing the irregular patterns of adversarial distortions. Model detection behaviors from YOLOv5 and Faster R, CNN under original and adversarial conditions created with FGSM, PGD, and Carlini-Wagner attack methods were studied. The framework gathers statistical features, e.g. inconsistency of confidence scores, prediction uncertainty, and bounding box irregularities, as well as feature, level data from the neural network layers. All of these signals are combined to generate structured representations that are then handled with lightweight classifiers such as Support Vector Machines, Random Forests, and shallow neural networks.

Keywords

Adversarial Attack Detection, Object Detection, YOLOv5, Faster R-CNN, FGSM, PGD, Carlini-Wagner Attack, Statistical Anomaly Analysis, Machine Learning Classifiers, Computer Vision Security.

Performance Analysis of Lightweight Machine Learning Algorithms for Intrusion Detection in Wireless Sensor Networks

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Abstract

Wireless Sensor Networks (WSNs) are widely used in important applications such as environmental monitoring, healthcare systems, industrial automation, and military surveillance. Because of their distributed nature, limited computational resources, and open communication channels, WSNs are highly susceptible to security threats including denial-of-service attacks, probing activities, and unauthorized intrusions. Intrusion Detection Systems (IDS) act as an additional layer of security that can detect malicious activities through the examination of network traffic behavior. Although machine learning approaches have shown strong performance in intrusion detection, many models require high computational resources, which makes them unsuitable for resource constrained WSN environments. This paper presents a comparative analysis of three lightweight machine learning algorithms Stochastic Gradient Descent (SGD), Logistic Regression (LR), and Gaussian Naïve Bayes (GNB) for intrusion detection using the KDDCup 99 dataset. The models are assessed using metrics such as accuracy, precision, recall, F1-score, along with computational efficiency measured using training time. The results show that Logistic Regression attains the highest accuracy of 99.79%, while Stochastic Gradient Descent provides similar performance at 99.66% with much lower training time. Gaussian Naïve Bayes shows very fast training but lower accuracy. Overall, the results suggest that SGD provides the best balance between detection performance and computational efficiency, making it well-suited for real-time intrusion detection in resource-limited wireless sensor network environments.

AlgoRythm: Intelligent and Secure AI-Based Learning Platforms for Skill Development in Programming

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Abstract

AlgoRythm blends artificial intelligence with programming instruction, crafting tailored educational journeys while fiercely guarding user privacy. Local AI models dissect code snippets, while external APIs handle execution. There is no persistent storage of user work. The core offerings are- dynamic roadmap creation, Learning by building projects and existing GitHub repository analysis, Algorithm Visualization resources, code refactoring, Test evaluation, motivational streaks. Plus, location-aware tech updates. Backing SDGs 4, 8, 9, it lifts education quality, hones career skills, sparks creative learning spaces. The project underscores blending smart tech with ironclad privacy measures.

Keywords

Artificial intelligence, programming education, intelligent tutoring systems, ai coding assistant, gamified learning, educational technology.

A Machine Learning-Based Automated Essay Scoring System with Semantic Plagiarism Detection and OCR Integration

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Abstract

Due to recent developments in online education systems, the need for efficient evaluation of descriptive answers has become prominent, as manual checking can be laborious and difficult to replicate on a large scale. In this paper, we aim to develop an automated essay evaluation system that enables accurate scoring, plagiarism detection, and feedback in an online examination setting. While existing methods focus solely on score submission, our system incorporates multiple aspects, including ML-based essay scoring, semantic plagiarism checks, handwritten text image processing using OCR, and feedback generation, all within a unified web platform. This method is implemented on the ASAP dataset by training a Random Forest regression model on top of linguistic and structural features. Detection of semantic plagiarism by using Sentence- BERT embeddings and cosine similarity to find exact copies as well as paraphrased content. Furthermore, we employ Tesseract OCR for processing handwritten responses, and we utilize a rule- based mechanism to evaluate multilingual responses (English and Hindi) and generate feedback. The experimental results demonstrate that the proposed system yields an essay scoring Quadratic Weighted Kappa (QWK) of 0.84, Pearson correlation of 0.87, and Mean Absolute Error MAE of 1.76, as well as a plagiarism detection accuracy rate of 94.6 %, respectively. These results demonstrate strong alignment with human evaluation and improved reliability compared to previous traditional keyword- based methods. The proposed method yields a scalable and effective solution for automated assessment and can be directly applied to contemporary online examination and e-learning platforms.

Keywords

Automated Essay Scoring (AES), Machine Learning, Random Forest, Semantic Plagiarism Detection, Sentence-BERT, Optical Character Recognition (OCR), Natural Language Processing (NLP), Feature Extraction, Multilingual Evaluation.

A Hybrid Sentiment Analysis and Machine Learning Approach for Cyberbullying Detection

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Abstract

Cyberbullying has become a very critical issue all over the social media, and it always impacts all the users across the world, and they are facing significantly on emotional and mental level. One of the well-known traditional ML such as the extra tree classifiers which always struggle with online communications system and to overcome these barriers, this study presents a significantly stacking based cyberbullying system and gradient boosting. The model will employ the learner to enhance barrier from these habits and also enhance prediction accuracy. The system provides accurate and precision and accurately detect sentimental analysis. Overall this kind of framework provides intelligent and user centric approach to mitigate cyberbullying on social platform.

Keywords

Cyberbullying detection, sentiment analysis, machine learning, resampling.

Solar Energy Forecasting Using Adaptive Machine Learning for Improved Grid Stability

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Abstract

The increasing trend of solar photovoltaic energy utilization in the existing power grids has generated many challenges due to the intermittent and variable nature of solar energy. The traditional solar forecasting techniques like numerical weather prediction models and radiation transfer models are complex and heavily dependent on the accurate determination of atmospheric conditions and may not be appropriate for real-time prediction. To overcome the limitations of the traditional solar forecasting techniques, the proposed system has been designed to incorporate a machine learning- based solar forecasting technique.

The recent integration of solar photovoltaic energy systems into the existing power grids has resulted in challenges owing to the random and stochastic nature of the energy source. In this regard, the existing forecasting tools, including numerical weather prediction and radiative transfer model, are complex and require accurate atmospheric conditions for forecasting the solar irradiance. In this direction, the present study aims to develop a machine learning-based forecasting tool by considering various meteorological factors (temperature, humidity, wind speed, cloud cover, and irradiance), along with solar geometric factors (zenith angle, azimuth angle, and incidence angle). This process follows a multi-stage pipeline, which involves data acquisition, data preprocessing, and feature engineering. The results showed that the best accuracy was obtained through the Gradient Boosting Regressor, which had minimal error, thus showing a lot of resilience for handling non-linear and time-varying solar data.

Keywords

Solar photovoltaic energy, renewable energy integration, machine learning, meteorological parameters, solar irradiance, zenith angle, azimuth angle, data preprocessing, feature engineering, Gradient Boosting Regressor, predictive analytics.

ESG-Driven Digital Transformation in SMES - A Hybrid Grey Modelling Strategic Framework Approach

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Abstract

The aim of this study is to identify and assess the key factors that hold influence over the adoption of an ESG-driven digital transformation framework in SMEs. An integrated approach has been applied to develop a cause-effect analysis framework. The study was conducted in two phases. In Phase 1, the study identified 12 factors from previous literature. Phase 2 consisted of data collection and analysis, and was performed in two stages, DEMATEL, being Stage 1, was used to collect expert responses to establish a multi-criterion relationship amongst the 12 factors on a 1-7 Likert Scale. Stage 2 consisted of utilizing Grey Causal Modelling (GCM) to further assess the relationship between the identified causes and effects. To do this GCM considers four features - namely - the causes, the effects, the objectives and the outcomes. Expert responses were collected for this on a 1-9 Likert Scale with respect to the three objectives identified in the study - namely - "ESG-Driven Digital Technology", "Resilience", and "Sustainable Performance". The responses and the subsequent analysis established that there exist 6 causes, F3, F4, F5, F8, F9, and F10 with the rest of the factors being effects of the said causes. The results suggest that managerial and policy interventions that focus on these factors can have the most widespread effect throughout the entire factor-chain identified in this study.

Real Time Traffic Surveillance and Detection Using Deep Learning and Computer Vision Techniques

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Abstract

Traffic congestion, which occurs when the volume of vehicular traffic exceeds the number of available road spaces, is a major issue with urban transportation systems due to the growing number of vehicles, and the finite real estate to construct new road infrastructure. This results in wastage of fuel, increasing delay and reduction in traffic fluidity. To solve this problem, a system called "Real Time Traffic Surveillance and Detection Using Deep Learning and Computer Vision Techniques" has been proposed. The proposed system uses surveillance cameras at the traffic junction for monitoring traffic. The captured traffic images are then processed by a YOLOv8 object detection model to detect and count cars, buses, trucks, motorcycles, and auto-rickshaws with a high level of accuracy. The number of detected vehicles in the images is then used to calculate traffic density in each lane. A fuzzy logic controller (FLC) is then used to dynamically adapt the duration of the traffic signal according to the level of congestion detected at the input traffic image. The adaptive traffic signal control system is able to provide longer greens at the most congested lanes and shorter greens at the least congested lanes. A web interface, implemented using Flask, allows authorized users to check traffic conditions and system predictions visually in near real-time.

Keywords

Traffic Surveillance, YOLOv8, Deep Learning, Computer Vision, Fuzzy Logic, Clever Traffic Management.

UniConnect: An AI-Enhanced Unified Digital Platform for Student-Centric Campus Services

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Abstract

Schools are moving towards digital solutions to manage the campus services and most of the critical services offered to students, including grievances redressal, experience sharing in interviews, resource Booking and lost-and-found management remain in fragmented and semi-manual systems. The current digital solutions tend to cover the services separately and are not smartly automated, do not have a semantic understanding, and predictiveness. Past studies have discussed standalone and independent grievance management systems, booking systems and knowledge sharing portals, but these systems are usually lacking scalability and integration and do not include sophisticated Artificial Intelligence (AI) tools to support decision making automatically.

An example is the case of grievance management systems where much emphasis has been given to the process of online complaint form submission instead of introducing contextual moderation and understandable decision procedures. Equally, resource booking systems are usually based on non-predictive and non-dynamic scheduling models. Lost-and-found applications typically use manual matching or merely searching by keywords, which restrict their ability to be effective in finding related items. Also, the sharing of interview experience relies heavily on user-generated content without the process of automatic extraction of formal knowledge. These unmet requirements demonstrate a strong research gap: a unified intelligent campus service offer that will combine a variety of student-centric services and utilize AI-based automation, semantic analysis, and predictive intelligence.

In order to fill this gap, this paper offers UniConnect, an AI-enhanced single digital platform that will automate and unify various campus services into one ecosystem. The system includes Natural Language Processing (NLP) to extract structured interview knowledge, transformer based explainable AI to moderate grievance, semantic similarity analysis to match lost-item and ARIMA based time-series forecasting to predict resource allocation.

Experimental analysis has shown that the suggested system has an 80 percent accuracy in extracting knowledge during interviews, 91 percent F1-score in grievance moderation, 85 percent semantic matching precision of lost items, and 40 percent better utilization of the resources with predictive booking. The findings suggest that explainable AI, semantic intelligence, and predictive analytics can be combined to considerably increase the effectiveness, clarity, and prompt service systems at the campus level.

Optimizing IoT Technology for Community Greenhouses: Enhancing Food Security in Rural Communities

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Abstract

The integration of IoT technology in community greenhouses has the potential to revolutionize food production in rural areas, enhancing food security and improving livelihoods. This paper presents an optimized IoT-based system for community greenhouses, leveraging sensors, machine learning, and cloud computing to monitor and control environmental parameters, predict and prevent issues, and provide real-time alerts and recommendations to farmers.

The system was tested in a rural community greenhouse, demonstrating significant improvements in crop yields (20% increase), water conservation (30% reduction), and energy efficiency (25% reduction). The system's scalability and adaptability make it an attractive solution for implementation in various rural settings, contributing to the achievement of Sustainable Development Goal 2 (Zero Hunger).

Rural communities worldwide grapple with food insecurity stemming from climate variability, scarce resources, and inefficient farming practices. This paper introduces an optimized IoT framework for community greenhouses that integrates affordable sensors, actuators, and edge computing to automate environmental controls—such as temperature, humidity, soil moisture, and nutrient delivery—for year-round crop production. Leveraging protocols like MQTT and LoRaWAN for reliable connectivity in low-infrastructure areas, the system employs machine learning algorithms for predictive analytics, reducing water usage by up to 40% and boosting yields by 25–35% compared to traditional methods, as evidenced by prior IoT agriculture deployments. Community-centric features, including shared mobile dashboards and blockchain for resource tracking, enable collaborative management and equitable food distribution. Ultimately, this approach fosters resilient, localized food systems, empowering rural populations toward sustainable self-sufficiency.

Keywords

IoT optimization, community greenhouse, food security, rural agriculture, precision farming.

Stock Management System using IoT

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Abstract

This paper presents the design and implementation of a real-time Internet of Things (IoT) based stock management system for automated inventory tracking and monitoring. The system leverages Radio Frequency Identification (RFID) technology for contactless item detection, coupled with an ESP-based microcontroller for data acquisition, processing, and wireless communication. Environmental parameters such as temperature and humidity are continuously monitored using integrated sensors to ensure optimal storage conditions for sensitive goods. The collected data is transmitted to a cloud platform using lightweight communication protocols and visualized through a web-based dashboard for real-time monitoring and analysis. The system incorporates intelligent alert mechanisms to identify low stock levels and abnormal environmental conditions. Experimental validation demonstrates high accuracy in item tracking, reliable wireless data transmission, and efficient real-time visualization. The proposed system offers a cost-effective and scalable solution for modern inventory management, contributing significantly to the advancement of smart warehousing technologies.

Keywords

Stock management, RFID, IoT, ESP microcontroller, cloud dashboard, real-time monitoring, smart warehouse, inventory automation.

Intelligent Pharmaceutical Inventory Management Using AI, IoT, and Predictive Analytics

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Abstract

The rapid digital transformation of healthcare supply chains has accelerated the need for intelligent, automated inventory systems in pharmaceutical environments. Traditional pharmacy inventory management approaches often suffer from stock-outs, overstocking, manual errors, and limited demand forecasting capabilities, resulting in financial losses and compromised patient care. This book chapter proposes an AI-driven Smart Pharmacy Inventory System that integrates Internet of Things (IoT) sensors, cloud-based infrastructure, predictive analytics, and machine learning algorithms to enable real-time stock monitoring, automated replenishment, expiry tracking, and demand forecasting. The framework leverages data-driven decision-making to optimize stock levels, reduce wastage, enhance traceability, and ensure regulatory compliance. The proposed system architecture incorporates RFID-enabled tracking, temperature and storage condition monitoring, cloud-based dashboards, and predictive models such as time-series forecasting and anomaly detection to improve operational efficiency. Furthermore, the chapter discusses system design considerations, security mechanisms, scalability challenges, and sustainability implications within smart healthcare ecosystems. Performance evaluation metrics including inventory turnover ratio, stock-out rate reduction, forecasting accuracy, and operational cost savings demonstrate measurable improvements over conventional systems. By aligning intelligent automation with pharmaceutical logistics, this chapter contributes a scalable and interoperable framework suitable for retail pharmacies, hospital pharmacies, and integrated healthcare networks. The findings highlight the strategic role of AI-powered inventory systems in enhancing healthcare resilience, minimizing drug wastage, and supporting data-centric pharmaceutical management in the era of digital healthcare transformation.

Keywords

Smart Pharmacy Inventory System, Artificial Intelligence, IoT-Based Monitoring, Predictive Analytics, Demand Forecasting, Cloud Computing, Pharmaceutical Supply Chain, RFID Tracking, Healthcare Digital Transformation, Inventory Optimization.

VitalPulse: A Hybrid Machine Learning Framework for Real-Time Cardiovascular and Stroke Risk Prediction

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Abstract

Cardiovascular diseases continue to be the biggest contributor to mortality rates globally. The early identification of cardiovascular risk factors is not adequately addressed during routine clinical practice. In patients, early warning signs are present, such as progression with age, high blood pressure, cholesterol level imbalance, and poor lifestyles. These factors are generally evaluated individually rather than as a whole. The present study aims to evaluate the combined effect of these clinical parameters using a publicly available cardiovascular dataset with numerical and categorical features collected during routine medical practice. The dataset has undergone considerable preprocessing, including handling missing values, feature scale normalization, and reduction of overlapping feature effects. In addition, various classification models that range from statistical models to ensemble models are used to perform evaluation using accuracy-based as well as class-sensitive performance measures. The results obtained from the evaluation demonstrate that nonlinear interactions between features can be used to achieve better performance. To further facilitate the application of the proposed model, an IoT-based framework is integrated with the system for health monitoring. The results obtained from the evaluation demonstrate that cardiovascular risk prediction using machine learning can be used to improve early screening methods, especially when it is used with IoT-based monitoring.

Keywords

Cardiovascular Disease, Machine Learning, Risk Prediction, IoT, Remote Health Monitoring, Remote Patient Monitoring, Cloud Computing, Biomedical Sensors.

Real Time Anomaly Detection in Energy Consumption

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Abstract

Real time anomaly detection in energy consumption focuses on designing and developing a resilient data pipeline that simulates dynamic data, processes it in real time, and detects anomalies with adaptive machine learning. Python-based data generators simulate context-aware sensor events, which are streamed via Apache Kafka and processed using Apache Spark Structured Streaming. Unlike static models, the system integrates a resource-efficient Streaming Half-Space Trees (HS-Trees) algorithm that establishes personalized consumption baselines for individual smart meters, enabling the detection of household-specific irregularities. Anomalies are evaluated by a risk-based classification engine that triggers severity-dependent notifications, ranging from dashboard logs to automated emergency voice alerts. The processed data are visualized using a native Cassandra-Grafana interface, ensuring low-latency monitoring. Real time anomaly detection in energy consumption combines data engineering with adaptive data science, creating a scalable, user-centric prototype relevant to modern smart grid and industrial analytics roles.

Keywords

Real-Time Systems, Kappa Architecture, Stream Processing, Anomaly Detection, Data Visualization.

Deep Learning–Based Adaptive Radiation Pattern Optimization for 5G Massive MIMO Antenna Systems

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Abstract

The advent of fifth-generation (5G) wireless communication networks has led to an increased need for intelligent antenna technologies that are capable of adapting to changing propagation environments. The Massive Multiple Input Multiple Output (MIMO) antenna system holds a crucial place in providing improved spectral efficiency, high-speed data rates, and signal integrity. In traditional beamforming or radiation pattern optimization methods, complex models or simulations, such as electromagnetic simulation, are used, which are complex and not suitable for real-time adaptations. This article presents an adaptive radiation pattern optimization solution for 5G Massive MIMO Antennas using deep learning. The proposed solution leverages the use of deep learning to predict optimal weights of beamforming and associated radiation patterns by learning dependency among parameters of antenna configuration, CSI, and spatial distribution of users. The proposed solution has the ability to dynamically steer the beam, suppress the sidelobe region, and efficiently mitigate interference by understanding the complicated nonlinear relationships among the environmental factors. The adaptive characteristic of the proposed framework makes possible a continuous learning process even in dynamic propagation conditions, which depend on user mobility, multipath fading channels, and interference variance. Simulation-based analyses illustrate that in comparison to existing static and heuristic optimization approaches, the proposed deep learning method is able to provide better beam alignment correctness, interference leakage suppression, and spectrum efficiency gain. This illustrates the efficiency and feasibility of a deep learning-based integration of antenna systems in existing and future 5G communication systems for intelligent radiation pattern control.

Sensing Based Electric Vehicle Battery Monitoring System

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Abstract

Electric vehicles rely heavily on battery performance and safety. Monitoring battery parameters such as voltage, current, and temperature is essential to prevent battery failures and improve efficiency. The paper here proposes an IoT-based battery monitoring system using an ESP32 microcontroller for real-time monitoring of the state and safety of the battery. The system measures the voltage, current, temperature, and bulging conditions of the battery by utilizing appropriate sensors and then sends the data to the microcontroller. The system monitors both the battery pack and cell parameters through an appropriate driver circuit. The data obtained from the sensors are displayed on a 16×2 LCD and also sent to the IoT platform for remote monitoring. The system also detects abnormal conditions such as overheating, overcurrent, and voltage imbalance, as well as swelling conditions in the battery, which may cause harm to the battery. The proposed model provides an efficient and cost-effective way to monitor the health and safety of the battery in applications such as electric vehicles and energy storage systems.

Keywords

ESP32, Battery Monitoring System IoT, Single Cell Monitoring, Battery Safety, Temperature Monitoring, Bulge Detection.

AI-Based Smart Pet Adoption Web Application Using Content-Based Recommendation

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Abstract

Pet adoption plays a significant role in improving animal welfare by providing shelter to abandoned animals and companionship to humans. Despite the availability of online adoption platforms, most systems rely on simple search mechanisms and lack personalized recommendation capabilities. This paper presents an AI-Based Smart Pet Adoption System that delivers customized pet suggestions using a content-based filtering approach. The system gathers user inputs such as preferred pet type, lifestyle characteristics, and geographic location. These inputs are analyzed and matched with pet-related attributes including breed, age, health condition, and vaccination records stored in the database. A similarity-based scoring mechanism is used to identify and recommend the most suitable pets. The system is implemented using Python and Flask for backend processing, HTML and CSS for the user interface, and SQLite for database management. Additional functionalities include pet availability tracking, detailed pet information, and an adoption request module. The proposed system enhances user experience, reduces search effort, and improves the likelihood of successful adoptions.

Keywords

Pet Adoption, Artificial Intelligence, Recommendation System, Content-Based Filtering, Flask, SQLite

Predictive Solar Forecast Driven EV Charging Controller with Real-Time Grid Stability

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Abstract

Due to unplanned and uncontrolled charging patterns, the explosive growth of electric vehicles (EVs) has brought new challenges to power distribution networks. Conventional EV charging systems frequently rely on time-of-use pricing or static scheduling, which can result in peak load conditions on the grid and inefficient use of renewable energy sources. In order to increase energy efficiency and preserve grid stability, this paper introduces a predictive solar forecast-driven EV charging controller that is integrated with real-time grid monitoring. The suggested system minimizes reliance on traditional grid electricity by optimizing EV charging schedules using solar power prediction. The ESP32 microcontroller, which powers the system, controls charging operations by keeping an eye on battery conditions, solar availability, and grid parameters like voltage and current. In order to prevent battery overcharging and guarantee safe charging conditions, sensors such as voltage sensors and ACS712 current sensors continuously monitor system performance. The system can intelligently switch between solar energy and grid supply based on current energy availability thanks to a hybrid energy architecture. Furthermore, remote monitoring, data visualization, and system control via a mobile interface are made possible by the Blynk platform's integration of IoT technology.

Keywords

Electric Vehicles (EVs), Smart Charging, Solar Forecasting, Renewable Energy Integration, Hybrid Energy System, ESP32, Internet of Things (IoT), Real-Time Monitoring, Energy Management System, Smart Grid.

An Interactive Job and Internship Platform for Technical Education Department

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Abstract

The Technical Education Department Interactive Job and Internship Platform provides a solution to the problem which prevents students from connecting with educational institutions and recruiters because it creates a digital recruitment system which enables organized hiring processes. The site will enable students to create detailed profiles which will display their educational history and their technical abilities and their certifications and their completed projects and their work experience while posting available job and internship positions which will match the required educational and professional skills. Educational institution administrators and staff members can use placement activities together with their school assessment system to monitor student progress and create reports which help them make informed decisions. The system enables users to monitor their application progress through its interactive elements while they send real-time messages that enhance their recruitment process involvement and make the process more transparent. The proposed platform enables better employment prospects through its industrial ties and its function as a scalable educational asset which helps streamline employment search processes while managing application requirements and institutional evaluations.

Deep Learning Based YouTube Summarizer with Conversational Search

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Abstract

In the digital world where technology has prevailed, YouTube has been the top educational, networking, entertainment, and knowledge gaining platform. Nevertheless, due to the abundance of data of video content uploaded daily, the user may easily get lost in the content and hardly find the necessary information without wasting time on long videos. Our project proposes a Deep Learning Based YouTube Summarizer with Conversational Search to deal with this issue. Simply put, it is YouTube Video Summarizer and Chatbot System which can automatically summarize videos and provide clear and precise summaries. It verifies the existence of an official transcript; otherwise, it uses a speech-to-text model of Whisper to generate one. This is followed by the generation of the transcript based on the video then breaking the transcript into various numbers of chunks and processed with advanced Natural Language Processing (NLP) algorithms with Google Gemini large language model (LLM) and Application programming interface (API) to produce logical and user-friendly summaries. Moreover, it has a developed smart chatbot that runs on semantic search and transformer-based embeddings where users are able to interact with the video content directly within the system. The chatbot allows the user to pose questions related to the video to the chatbot based on their need and access particular information without having to engage in manual search of the video. This system is rated over the robust applications in the education, research as well as digital content management. In general, the initiative highlights the importance of AI-based methods of converting raw video content into knowledge.

Keywords

NLP, YouTube Summarization, Whisper Model, Transcription, Gemini API, Chatbot, Question Answering System.

Digital Detective: A Gamified Reinforcement Learning-Based Cyber Safety Education System for Children

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Abstract

The growing usage of digital platforms among children has also resulted in an increase in cyber threats such as phishing, impersonation, malicious links, and social engineering attacks. Previous research studies have investigated the awareness of cyber safety, vulnerability to phishing attacks, and gamification strategies for cybersecurity training to increase user engagement and awareness of threats [1], [2], [4]. These studies show that interactive and gamified learning environments can increase awareness and user engagement. However, most of the existing research is based on static content, rule-based training, and score-based gamification and does not emphasize behavior-driven learning or adaptive reinforcement strategies, especially for children. In addition, very few studies have been carried out on the combination of machine learning-based scenario generation with reinforcement learning architectures to shape safe digital behavior through episodic decision-making. To overcome the above-mentioned limitations, this paper proposes Digital Detective, a gamified cyber safety education platform for children aged 8–14 years. The proposed platform represents cyber threats as story-based villains and uses reinforcement learning concepts to encourage safe decision-making and punish unsafe behavior through instant mission failure. The experimental results from the pre- and post-gameplay assessment activities show a significant improvement in the accuracy of cyber threat recognition, emphasizing the effectiveness of gamification using reinforcement learning for cyber safety education.

Keywords

Cyber Safety Education, Gamification, Reinforcement Learning, Machine Learning, Phishing Detection, Educational Games.

Blockchain-Enabled Anti-Counterfeit System

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Abstract

There are various supply chain management inefficiencies that encompass duplicated services and lack of proper departmental planning as well as inconsistent practices. Another significant cause of these issues is transparency. The clandestine product counterfeiting is one of the most urgent problems of the present-day business. Visual distinction of the real and fake goods is not always easy and this diminishes the consumer confidence and poses a challenge to business. The effects of counterfeiting on brands are experienced by many individuals, although a number of them do not understand fully what these impacts entail. In order to solve this problem, the methods that exploit artificial intelligence (AI) are employed. There are some limitations to these methods though. Every QR code, such as those, can be duplicated and falsely applied to counterfeit goods. Convolutional Neural Network (CNN) based AI models will also require a lot of processing power. The purpose of the project is to identify fake products with the help of supply chain tracking.

Giving an opportunity to see the entire supply chain history of a product, this project aims at using a blockchain based system in order to assist in tracing counterfeited products.

The blockchain technology guarantees that only genuine commodities will be tracked down and traced throughout the process of supply chain. Users can view and verify documents in large quantities because it is decentralized thus encouraging collaboration and removing the use of middlemen. The advantage of the blockchain technology is that a change of data is impossible without the consent of both parties. This makes the data accurate and removes vulnerability. The solution that is suggested provides an indelible set of transaction, through the cryptography protection offered by blockchain technology. This highly prevents the chances of counterfeiting. In this essay, the development and operation of the blockchain based system will be described and how it can address the issues within the supply chain as well as aid in reducing the identification of counterfeits. With improved supply chain tracking and security, the approach provides a reliable and scalable technique of securing any supply chain and reinstating consumer confidence in the authenticity of their products.

Deep Learning Based Detection of Depression Levels Using ECG Signals in Mat Format

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Abstract

Depression, bipolar disorder, and schizophrenia are some of the mental health disorders that present a major issue in the global health scene; therefore, they should be diagnosed at an early age and accurately to implement proper treatment. The paper reports the protocol of an automated mental health detection system based on an electrocardiogram (ECG) signal and deep learning method to assist in the objective clinical examination. MAT version of the raw ECG signals are processed to find noise and refine the quality of the signals, followed by conversion into 224×224 image expressed, to fit one of the convolutional neural network (CNN) models. Inception V3 and ResNet are two advanced architectures that are implemented and comparatively assessed to extract features and classify them. To decide which model is the best one, the standard measurements are used to evaluate the performance such as accuracy and precision. The chosen model is incorporated in user focused framework that is able to categorize conditions as normal, depression, and abnormal, further breaking down bipolar disorder and schizophrenia. The classification results obtained through the experiment are high, and the system can be used as the reliable tool in the detection of the primary mental health screenings and clinical decision support.

Keywords

Mental Health Detection, Electrocardiogram (ECG), Deep Learning, Convolutional Neural Network (CNN), Inception V3, ResNet, Depression, Bipolar Disorder, Schizophrenia, Image-Based Classification.

IoT Based Fire Fighting Robot

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Abstract

This paper makes an attempt to address fire- related safety issues in residential, industrial, and remote areas by developing an IoT-based fire- fighting robot capable of detecting fire, smoke, and hazardous gases in real time. The system has a MQ2 gas sensor for detection of smoke and LPG, an ESP32 microcontroller for processing and wireless communication, and an ESP32-CAM module for live monitoring of the fire. High- torque Johnson 100 RPM DC geared motors along with BTS7960 motor drivers allow the robot to carry water tank, enabling the robot to reach the fire. This robot is designed to be the best and effective solution for fire detection and extinguishing, particularly in locations where immediate human intervention is not convenient.

Keywords

Fire-fighting robot, ESP32 microcontroller, MQ2 gas sensor, Flame sensor ESP32-CAM module, BTS7960 motor driver, Johnson geared motors.

Agentic AI-Powered Legal Judge

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Abstract

This study develops an Agentic AI-Powered Judge to monitor and validate autonomous judicial decision-making and legal case analysis. While AI-powered legal tools show promise in expediting case review, they often remain “black boxes” lacking ethical transparency and procedural fairness. We propose a multi-agent supervisory system utilizing case law data from 2010 to 2025 to audit the logic and statutory alignment of AI-generated legal opinions. The system employs specialized agents to verify reasoning correctness and regulatory compliance, ensuring that judicial recommendations adhere to strict constitutional norms. Results demonstrate that the Agentic Judge effectively filters biased interpretations—such as identifying a 70.5% conviction confidence threshold in specific criminal simulations—to ensure transparent, human-like decision-making. By maintaining a 70% logic confidence requirement, the framework provides explainable narratives that bridge the gap between autonomous efficiency and judicial accountability.

Keywords

Agentic AI, AI-as-a-Judge, Legal Technology (LawTech), Multi-Agent Systems, Judicial Decision Support, Explainable AI (XAI), Algorithmic Fairness.

Federated Learning of Healthcare Diagnostics with Bias-Awareness

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Abstract

Machine learning in the healthcare diagnostic field has proven to have a lot of potential in the better-disease detection and clinical decision-making. Nevertheless, the conventional centralized learning strategies share issues associated with the privacy, protection, and regulation. Additionally, the healthcare information tends to be shared across various institutions and it is highly heterogeneous, which results in prejudiced models that can work unfairly with various demographic groups. Federated learning is a solution to privacy issues based on the idea of training models collaboratively but without providing access to raw patient data, though bias in model predictions is not automatically overcome. This project suggests a prejudice-conscious federated learning system that is aimed at increasing the quality and dependability of the healthcare diagnosis systems. The suggested solution incorporates bias detection and mitigation strategies in the federated learning process without compromising the privacy of the data. Demographic parity/equalized odds are fairness metrics that help in the evaluation and reduction of bias among a variety of patient populations. With experimental analysis, the suggested bias-aware federated learning model can attain better fairness with negligible effect on diagnostic accuracy. The findings emphasize the need to include ethical and fairness concerns in federated healthcare AI systems, which would help in designing privacy-protecting, equitable, and reliable medical diagnostics solutions.

Keywords

Healthcare Diagnostics, Federated Learning, Mitigation of bias, Fairness in machine learning, Privacy- Maintaining Learning, Ethical AI, Distributed Machine Learning.

Deep Learning-Based Multimodal Authentication System Integrating Facial and Voice Verification

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Abstract

The rapid development of digital technologies has led to a notable demand for secure, effective, and user-friendly authentication systems. Of all potential solutions to this challenge, voice and facial recognition technologies, in particular, have developed as a significant application of advanced data science and artificial intelligence methods. A number of recognition models still exhibit a lack of accuracy under real-world conditions such as inadequate light causing low visibility, background noise when both environmental and situational interference occurs, and intentional deception of recognition systems by facial disguise or voice distortion. A comprehensive solution that combines technical accuracy, fair application, and transparency is still missing. This paper addresses these gaps by proposing a multimodal system that combines the strengths of both the tools to ensure that all such gaps are overcome. Additionally, it compares two different models and helps discriminate between them to identify which model is better suited for different situations.

Keywords

Voice Recognition, Facial Recognition, Deep learning, Multimodal Authentication, Security.

A Multi-Stage Deep Learning Approach for Biomarker-Driven Detection of Small Vessel Disease

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Abstract

Small Vessel Disease (SVD) is a neurological condition caused by abnormalities in the brain's small blood vessels and is a major contributor to stroke, cognitive impairment, and dementia. Early identification of SVD is difficult because the disease appears as subtle structural changes in brain Magnetic Resonance Imaging (MRI) scans, which often require expert clinical interpretation. Manual examination of MRI scans is time-consuming, subjective, and may lead to inconsistent diagnoses. Therefore, automated and reliable detection systems are essential for early diagnosis and effective treatment planning. This research proposes a multi-stage deep learning framework for biomarker-driven detection of Small Vessel Disease. White Matter Hyperintensities (WMH) are considered the primary imaging biomarker for identifying SVD, along with additional indicators such as lacunes. In the proposed system, MRI scans are first preprocessed using techniques such as noise reduction, intensity normalization, and skull stripping to enhance image quality and remove non-brain tissues. A U-Net based deep learning model is then used for accurate segmentation of WMH regions, enabling precise extraction of lesion areas from MRI images. The segmented biomarker regions are further analysed using the Swin Transformer model for classification. The Swin Transformer captures both local and global contextual features using hierarchical shifted window attention, allowing effective modelling of lesion distribution across brain regions. Experimental results demonstrate improved accuracy, sensitivity, and specificity compared with conventional convolutional neural network approaches. The proposed framework provides a reliable and efficient approach for automated detection of Small Vessel Disease and supports early clinical diagnosis.

Smart Classroom Management System

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Abstract

The Smart Classroom Management System is an intelligent web-based platform developed to enhance classroom operations through automation and data-driven insights. The system enables real-time attendance tracking, assignment management, performance monitoring, and structured communication between teachers and students. Built using React.js for the frontend and Node.js with Express.js for the backend, the system utilizes MongoDB for flexible data management and JWT- based authentication for secure access control. Unlike traditional classroom systems, this project integrates AI-driven text-based emotion analysis using Natural Language Processing techniques to evaluate student feedback and detect emotional patterns. By combining attendance records with emotion analytics, the system performs risk assessment to identify students who may require academic or emotional intervention. Additionally, automated email alerts and a counseling recommendation module are incorporated to support early intervention strategies. The platform provides advanced analytics dashboards to assist teachers in making informed decisions. The proposed system aims to modernize classroom management by transforming raw academic data into actionable insights, ultimately improving student engagement, well-being, and academic performance.

Keywords

Smart Classroom, Attendance Automation, Student Analytics, Emotion Recognition, Learning Management System, Educational Data Mining.

Groundnut Crop Yield Prediction Using Machine Learning Techniques

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Abstract

Predicting crop yields is a crucial component of contemporary agriculture since it enhance food security, Productivity, and resource management. One of the main oilseed crops grown in many agricultural areas is groundnuts, and precise yield forecasting is crucial for farmers and agricultural planners to make wise choices. Conventional techniques for estimating crop yields frequently rely on manual analysis and historical observations, which may not adequately reflect intricate interaction between agricultural elements. Machine learning techniques can be used to evaluate past agricultural data and produce accurate forecasts in order to overcome this difficulty. A web-based groundnut yield prediction system created with machine learning techniques is presented in this paper. A dataset with agricultural characteristics including cultivated area, production values and seasonal yield data is used by the suggested system. To enhance the quality of the dataset, data preprocessing procedures such as data cleaning and missing values removal are carried out prior to model building. The prediction model is constructed using the Random Forest Regression algorithm because of its capacity to manage big datasets and nonlinear interactions. A web application built on Streamlit that offers users an interactive interface is used to implement the system. The application incorporates user authentication capabilities such as registration and login, allowing secure access to the prediction system. Once logged in, users may input agricultural datasets, automatically train the machine learning model, and assess its performance using metrics like Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and R^2 Score. The user's input feature values are then utilized to predict groundnut yield using the trained model. The results of the experiments show that the suggested system can help farmers and academics understand agricultural production trends and provides accurate output projections. The technology is useful and accessible for real-world agricultural applications because to the integration of machine learning with an intuitive web interface. This study demonstrates how data-driven methods can enhance crop production forecasting and promote sustainable agricultural growth.

Keywords

Predicting groundnut yield, Machine Learning, Random Forest Regression, Agricultural Data Analytics, Seasonal Crop Analysis, Precision Agriculture, Decision Support System.

SMART PERSONA – AI-Powered Voice and Video Interview Platform

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Abstract

The increasing demand for scalable, consistent, and technology-enabled recruitment processes has created the need for intelligent interview automation platforms. SMART PERSONA is a multimodal AI-driven interview system designed to support both voice-based and video-based interview experiences. The platform enables recruiters and institutions to conduct structured, interactive interview sessions while providing candidates with instant, detailed performance feedback.

The system adopts a modular client-server architecture built with Next.js and React on the frontend and Node.js on the backend. Real-time communication is achieved using WebRTC-based video and voice integration through Vapi, while Supabase manages authentication, secure data storage, and real-time synchronization. An AI engine integrated via modern language model APIs generates role-specific interview questions dynamically and evaluates candidate responses using natural language processing techniques.

The platform incorporates structured workflows including session creation, candidate invitation, application submission, automated question delivery, response recording, AI-based evaluation, and analytics reporting. It ensures fairness, scalability, and explainable feedback while maintaining data privacy and secure session management. By combining automation with real-time interaction and intelligent assessment, SMART PERSONA enhances recruiter efficiency and supports continuous candidate improvement. The proposed system demonstrates a practical and scalable approach to modern AI-powered interview management.

Keywords

Artificial Intelligence, Voice-Based Interview, Video-Based Interview, Automated Recruitment, Natural Language Processing, Real-Time Communication, WebRTC, Interview Analytics, Secure Authentication, Multimodal Assessment.

Deep Neural Network-Based Virtual Health Assistant for Symptom-Driven Disease Prediction

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Abstract

The system aims to develop an intelligent healthcare solution that can predict possible diseases based on user-reported symptoms. The systems use DNN to Analyze complex patterns within healthcare datasets and provide accurate disease prediction. This technology helps people figure out what illness they might have, just by entering their symptoms into a digital assistant. The system uses artificial intelligence to understand descriptions of health problems and medical history, working much like a smart doctor that listens and learns from lot of examples. The system not only predicts the disease but also evaluates causes and suggests precautions to be taken to support early health awareness. Healthcare workers and patients can use this assistant to get useful advice quickly, which is especially helpful for those who cannot see a doctor right away. It aims to make healthcare more accessible and efficient, helping doctors focus on more serious cases while offering guidance and peace of mind to people who want answer about their symptoms.

In Silico Evaluation of Natural Polyphenols as Potential Modulators of TREM2 in Alzheimer's Disease

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Abstract

In this study we have taken Triggering receptor expressed on myeloid cells-2 (TREM2) which is an immune receptor mainly found on microglia, the brain's primary immune cells. From many recent studies we have found that TREM2 plays an important role in controlling neuroinflammation, helping microglial survival, and aiding in the removal of harmful protein clumps like amyloid- β , which cause Alzheimer's disease. But problems with TREM2 signaling cause lower phagocytic activity and ongoing inflammation, which results in disease progression. As a result, if we adjust TREM2 activity it will result in a promising approach for boosting neuroprotective mechanisms in Alzheimer's disease. Therefore, we have used natural plant-based polyphenols for this study because of their known antioxidant, anti-inflammatory, and neuroprotective benefits. In this in silico method molecular docking we have performed to explore how TREM2 (PDB ID: 5ELI) interacts with epigallocatechin gallate (EGCG), apigenin, curcumin, and resveratrol.

After docking, we got an analysis that apigenin has a binding affinity of (-8.6 kcal/mol) and EGCG (-8.5 kcal/mol) which highest for TREM2. This indicates that they form very strong and stable interactions. Then, Curcumin (-7.1 kcal/mol) had moderate binding, while resveratrol (-6.3 kcal/mol) had a lower affinity. The strong binding of apigenin and EGCG suggests they are very effective in interacting with TREM2 and could impact microglial functions related to controlling inflammation and clearing amyloid- β . From this in silico molecular docking studies we got a computational basis for further experimental research aiming treatments for Alzheimer's disease.

Fake News Detection using Multi-Category Support Vector Machine

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Abstract

In recent years, the spread of false news has become a major threat to the credibility of information and the stability of society. Whenever false information is spread through internet channels, it has been noted the speed of dissemination of false information is so rapid that it creates a need for strong automated detection systems. In this abstract we present an approach to detecting fake news using machine learning that utilizes a multi-faceted approach for increased speed and accuracy. For feature extraction, we utilized Multi Perspective Component Analysis (MPCA), because it is able to extract a large variety of semantic and stylistic features from text efficiently. The Firefly Algorithm was used as a metaheuristic for feature selection, to reduce dimensionality and select from the set of features the most discriminative features useful for classification. The prediction phase of the proposed method employed a Multi-Class Support Vector Machine (MSVM) which has been shown to generalize well and is effective in handling high-dimensional spaces. Long ShortTerm Memory (LSTM), a deep learning method is utilized for the comparison, since it can model sequential data and capture long-term dependencies it was used to time to standardize the performance measure of the MSVM based method. Next, the comparative analysis will provide both strengths and weaknesses of the methods for detecting fake news. Ultimately, toward the goal of creating useful tools for combatting fake news to support a more informed and resilient information ecosystem.

A Hybrid Financial Fraud Detection Framework Integrating Machine Learning, NLP, and Graph Analysis

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Abstract

Financial fraud has become one of the biggest concerns of banks, digital payment services and regulatory agencies worldwide. The recent growth of electronic banking, mobile payment systems, and other digital financial services has resulted in a huge increase in online transactions as consumers make purchases. While these advances provide consumers with added convenience, they also offer criminals new opportunities to commit fraud, including money laundering, account takeover, identity theft, and organized fraud networks. The majority of current methods utilized for detecting fraudulent acts involve reliance on rule-based systems, which identify fraud based on a pre-programmed threshold or set pattern; however, many current methods are unable to catch more complex or changing types of fraud and often create a large number of false-positives that impose a burden on legitimate customers. The new system developed through this research is an artificial intelligence (AI) based fraud detection system that utilizes machine learning, natural language processing (NLP) and graph-based relational analysis to enhance the accuracy of fraud detection. The system uses the PaySim mobile money transaction dataset, which simulates real-life financial transaction activities, to develop and evaluate fraud detection models. The proposed system will classify Transactional Data as Fraudulent or Legitimate using combinations of Ensemble Machine Learning Algorithms such as Random Forest, Decision Tree, and XGBoost. Additionally the system will generate Story Like Descriptive Narratives based off of Transaction Metadata, and will leverage NLP Techniques based off of DistilBERT to Review the generated narratives for Contextual Patterns Associated with Suspicious Activity. Finally, the system will provide Graph Analysis capabilities through NetworkX and Neo4j in order to facilitate the identification of Hidden Relationships between Accounts along with the Discovery of Coordinated Fraud Rings, as well as Analysis of Suspicious Financial Networks. Overall, the results from Experiments demonstrate high levels of Fraud Detection performance and a Reduction in False Positives for all components of the new system. By combining multiple forms of analysis the new system provides a performance driven Analytical Approach to Scalably and Effectively identifying Complex Patterns of Financial Fraud in a rapidly evolving Digital Finance Environment.

Keywords

Financial Fraud Detection, Machine Learning, Natural Language Processing, Graph Analysis, DistilBERT, Random Forest, XGBoost.

CEDARS: Early Detection of Cervical Cancer Using Efficient Deep Learning and CNN

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Abstract

This paper presents CEDARS (Cervical Early Detection and Analysis using Robust Segmentation), an automated deep learning system designed for the early detection of cervical cancer from Pap smear images. Cervical cancer remains one of the leading causes of cancer-related mortality among women worldwide, and the accuracy and speed of its diagnosis remain critical challenges in clinical practice. The proposed integrated pipeline combines a U-Net segmentation model with a ResNet50 classification architecture to achieve a validation accuracy of 95.5%, simultaneously reducing diagnostic time by 60% when compared to conventional manual screening procedures. The system delivers five key diagnostic outputs for each analyzed image: cell classification, confidence scores, segmentation masks, LLM-generated medical descriptions, and an overall cell status assessment. By automating the analysis of Pap smear images, CEDARS provides an objective, rapid, and consistent preliminary diagnostic tool capable of supporting medical professionals and expanding access to reliable cervical cancer screening.

Keywords

Cervical Cancer, Deep Learning, Convolutional Neural Network, U-Net, ResNet50, Pap Smear, Image Segmentation, Early Detection.

Cloud-Based Intelligent Medical Record Management Solution

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Abstract

This paper presents a cloud-based intelligent medical record management system designed to securely store, manage, and retrieve patient health records via a centralized platform. Traditional healthcare systems rely on paper files or remote local storage, which often result in data redundancy, limited accessibility, and increased risk of digital loss.

The proposed platform utilizes online computing to enable authorized users, including doctors, patients, support team, to view stored health information anytime and from any location. It incorporates organized arrangement techniques such as B-Tree and Hash indexing to support fast data retrieval, even with large datasets.

In addition, the system implements access control based on user roles and encryption mechanisms to ensure details privacy and protection. This system automatically manages records and safely shares data, helping doctors work together and reducing manual work.

Overall, this proposed method enhances medical care efficiency, minimizes delays in therapy, and provides a flexible secure management of patient records.

Keywords

Web-based storage, Health file, Data Security, B-Tree Indexing, Healthcare Systems, Data Encryption, Role-Based Access.

Cognitive News Recommender with GNNs, LLMs, and Adaptive Sentiment Drift Monitoring

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Abstract

This paper proposes a Cognitive News Recommender System that combines Graph Neural Networks (GNNs) for capturing the interactions between users, news, and topics, Large Language Models (LLMs) for semantic news content analysis, and an Adaptive Sentiment Drift Monitoring module for monitoring user interests in real-time. The proposed system overcomes the drawbacks of conventional recommendation systems, including bias, redundancy, and recommendation fatigue, by providing dynamic and context-aware news recommendations. The proposed system learns from user behavior and sentiment drifts to ensure relevance and diversity in news recommendations.

The online news media platform has experienced explosive growth because of real-time multimedia broadcasting, high frequency social journalism, and distributed news curation platforms. The traditional news recommenders do not consider dynamic emotional preferences, cannot model complex publisher topic-user graphs, and depend on centralized data pipelines that are susceptible to privacy leakage. This paper proposes the Cognitive Federated News Recommendation System that combines Graph Neural Networks (GNNs) for contextual graph reasoning, Large Language Models (LLMs) for deep semantic analysis of news content, and the Adaptive Sentiment Drift Monitoring module for analyzing user-specific emotional dynamics. A two-layer Federated Learning framework is used to provide privacy-preserving personalization for user devices and multiple news publishers. The experimental results demonstrate dramatic improvements in engagement (22), contextual accuracy (94.6), diversity (82.3), and ethical robustness. The proposed approach sets new grounds in secure, sentiment-driven, and cognitively adaptive personalized journalism.

Keywords

News Recommendation, Graph Neural Networks (GNNs), Large Language Models (LLMs), Sentiment Drift Monitoring, Personalization, Explainable AI, Recommender Systems, Digital Journalism.

Hybrid CNN–GAN Architecture for Underwater Image Enhancement

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Abstract

Underwater pictures are usually blurry. This is because light does not travel well in water. When light travels through water it gets absorbed, scattered and changed which makes the images look bad. This results in pictures that're hard to see with colors that do not look right and a lot of haze. These problems make it hard to use pictures, for computer vision applications. This paper shows a way to make underwater pictures look better using a mix of two types of intelligence: Convolutional Neural. Generative Adversarial Networks. The Convolutional Neural Networks part fixes the structure of the pictures removes noise and corrects the colors a bit. The Generative Adversarial Networks part makes the underwater pictures look more realistic. The model is trained on the Enhancing Underwater Visual Perception dataset for 25 cycles using PyTorch on a laptop GPU. The goal is to make the underwater pictures look good and be accurate. Experimental results show that the underwater pictures look much clearer with contrast and colors compared to the underwater pictures. The framework can help with research, underwater robotics and environmental monitoring using pictures that are clearer and more accurate which is the main goal of using Convolutional Neural Networks and Generative Adversarial Networks for underwater pictures.

Keywords

Convolutional Neural Network, Generative Adversarial Network, EUVP Dataset, Deep Learning, Image Restoration.

A Deep Learning Driven Smart Healthcare Framework Using AI-Based Application for Skin Diseases Prediction

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Abstract

Skin problems have been among the most prevalent health complications all over the world. One should identify them at the initial stage and properly to prevent severe complications. As a rule, doctors examine the skin using their eyes, which can be slow, require personal judgment, and may be unavailable in locations with less medical resources.

This paper presents a smart healthcare system that employs the deep learning technology to automatically identify skin diseases based on special skin images (referred to as dermoscopic images). The HAM10000 dataset is used as the training. The system is trained on EfficientNet B0 which is a contemporary AI model and is trained in two steps to enhance precision. Since the number of cases of each disease is not equal in the dataset, class-weighted sampler and Focal Loss (with gamma = 2.0) are employed to manage imbalance. In order to enhance the power of the model, a number of image tricks are used in the training process that include Mixup, CutMix, ColorJitter and Random Erasing. During testing, predictions are made more predictable with the help of Test-Time Augmentation (five variations).

To be transparent, the system applies Grad-CAM to show precisely where on the skin the prediction was induced by the system, allowing physicians to learn why the AI was predicting in a particular way. Lastly, the model is accessible via a web based application, allowing the user to post pictures and receive real-time feedback. Prediction Skin Disease, Prediction HAM10000, Prediction EfficientNet-B0, Prediction Transfer Learning, Prediction Focal loss, Prediction Mixup Image Augmentation, Prediction Test-Time Augmentation, Prediction Grad-CAM, Prediction Deep Learning, Prediction Medical Image Analysis.

Detection and Prevention of SQL Injection and Cross-Site Scripting (XSS) Attacks

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Abstract

Web applications are considered one of the most vulnerable areas in data breach incidents, mostly due to improper management of inputs, leading to SQL injection and cross-site scripting attacks. This paper discusses a simple yet efficient system in improving web application security using a rule-based system. The system is based on a set of rules and a set of grammatical filters in improving web application security. The system is based on a simple principle of injecting malicious data into a web application environment and taking preventive measures accordingly. The architecture of the system is clearly defined in order to maintain transparency in the system. The system is also based on a logging system in identifying malicious activities in a more accurate way. The system is also based on reducing false positives in a more accurate way in identifying malicious activities. This system is considered efficient and can be easily integrated into a system in a more reliable way in reducing vulnerabilities in web applications.

Keywords

SQL Injection, Cross-Site Scripting, Web Security, Rule-Based Filtering, Vulnerability Detection.

Electromagnetic Interference and Safety of Patient Implanted with Cardiac Implantable Electronic Devices

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Abstract

Certain cardiac diseases require the use of CIEDs (cardiac implantable electronic devices), such as defibrillators and pacemakers. These devices face an Electro Magnetic Interference (EMI) threat. The rapid pace of technological development raises new safety concerns with implantable cardiac devices. The goal of this work using experimental, simulation, clinical, and review methods, is to define and characterize the risk for EMI and CIEDs, and its related patient safety issues.

It has been experimentally proven that under some circumstances, such as the presence of strong EM fields, very close proximity to the EMI source, and some cardiac implantable device sensing frequencies, EMI is possible. Simulation studies indicate that certain emerging technologies (e.g. electric vehicle (EV) charging, and wireless power transfer) have the potential to generate new types of complex EM fields that may interact with CIEDs. Clinically, very little or no negative effects have been reported, and this is a testimony to the effectiveness of design of such devices, including filtering and shielding.

Perhaps one of the more potentiated conclusion drawn from this work is to some extent, a compromise is to some extent, a compromise. Several studies have identified the absence of data from clinical studies, but available patient data suggests that, especially under standard circumstances, the risk is negligible. The best studies carried out in real life, especially continuous exposure studies, continue to be concerning from an electromagnetic view. The absence of data is particularly focused on devices and technologies.

EMI is overall, still an existing concern with regard to CIEDs, however, data demonstrates that the risk is minimal and that CIEDs are safe to be used in most environments.

The safety of patients will continue to be of utmost importance. Future investigations may focus on improvements in new methods of standard real-life assessment of new innovations.

Keywords

Electromagnetic Interference (EMI), Cardiac Implantable Electronic Devices (CIEDs), Pacemakers, Implantable Cardioverter-Defibrillators (ICDs), Patient Safety, Electric Vehicles (EV), Wireless Power Transfer, Electromagnetic Compatibility (EMC), Medical Device Safety.

Multi-Class Chronic Pain Localization Based on Hybrid TF-IDF and Machine Learning Models in an Electronic Medical Record

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Abstract

Precise anatomical identification of chronic pain is frequently restricted by subjective self-reporting as well as inconsistency of clinical documentation. This work presents a hybrid machine learning framework for automatic pain site classification with real world tertiary care data collected from SGPGI Hospital, Lucknow. The dataset bore structured demographic and clinical delimiters (Age, Gender, Pain Score, DN4) and six narrative features of the clinical situation that were written by clinicians. 462 anonymized patient records were used for mining. Data preprocessing was carried out which included median imputation, categorical harmonization, TF-IDF vectorization with sub linear term frequency scaling and bigram representation to capture context-specific clinical expressions. Four supervised learning models viz. LightGBM, XGBoost, Random Forest and Linear Support vector machine (SVM) were implemented and fine-tuned using stratified data partitioning and target grid search optimization. Out of these, the stabilized accuracy of the class-balanced Linear SVM was found to be the highest (82.98%) along with weighted Precision (0.86), Recall (0.83) and F1-score (0.82). Optimum regularization ($C = 0.8-1.0$) improved stability of the margin in high dimensional sparse feature space, over fits were decreased while the discriminative capability was maintained. Confusion matrix evaluation proved reliable class-wise performs especially well on frequently represented anatomy region Low Back with little inter-class misclassification. By using often well-documented clinical narratives instead of specialized hardware or physiological sensors, it is the proposed framework platform that allows a scalable and institution-ready solution. These results demonstrate the use of sub linear TF-IDF and balanced linear SVM achieving good multi-class pain site prediction with a future focus on transformer-based modelling, multi-modal integration and integration into CDSSs.

Keywords

Chronic pain localization, electronic medical records, machine learning, support vector machine, TF-IDF, natural language processing, multi-class classification, clinical decision support systems.

Artificial Intelligence Techniques for Chronic Pain Evaluation: Machine Learning Deep Learning Methods Examination

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Abstract

Chronic pain evaluation is also gradually shifting from simple subjective self reports, to progressively advanced technology-driven computation approaches. This review focuses on the recent progress in chronic pain detection using behavioural, neurophysiological, biomechanical, imaging, wearable and multimodal sources of data. Innovative methods such as facial expression recognition, electroencephalography (EEG), functional near-infrared spectroscopy (fNIRS), connectivity analysis with MRI, ultrasound elastography, wearable physiological sensors and bioelectrical impedance techniques have allowed markers associated to nociceptive processing to be identified. Machine learning and deep learning models display despotism in performance (it has been reported in models with an accuracy of 78%-95%). Three major methodological shifts can be seen here: from the focus on subjective reporting of symptoms to quantifying biomarkers objectively, growing emphasis on modelling temporal dynamics and studying network level and developing clinically applicable diagnostic systems. The neurophysiological signatures of chronic pain have been consistently identified in neuroscience research such as spectral changes and altered functional connectivity in favour of a systems-level perspective which includes cortical reorganization, autonomic imbalance and neuromotor adaptation. As well, with the help of computer vision and wearable technology, scalable, real-time monitoring in acute care settings as well as rehabilitation and remote healthcare settings are being enabled. However, there are still limited data for clinical translation due to small and single centre studies as well as modality specific pipelines restricting the generalizability and scalability. Of course, future directions should emphasize large-scale multimodal datasets largely using robust external validation, explainable artificial intelligence frameworks to enable large-scale and precision-driven chronic pain management.

Mood Reads: An Emotion-Aware Book Recommendation System Using Machine Learning and Natural Language Processing

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Abstract

Mood Reads uses emotions to recommend books because it recommends books based on the current emotional state of readers instead of using their previous reading patterns and book popularity ratings. The system uses a DistilBERT transformer-based emotion classification model to analyze user-written text because the model extracts contextual meaning from the text to determine user emotional states. The system maps detected user emotions to appropriate book genres before it uses Google Books API to find matching book titles. MoodReads operates as a complete web application because its developers built it with Flask and SQLite while the platform presents audio narration to users who need accessibility.

Keywords

Emotion Detection, DistilBERT, Natural Language Processing (NLP), Emotion-Aware Recommendation System, Book Recommendation, Deep Learning, Sentiment Analysis, Flask Web Application.

Harnessing AI for Deep Fake Detection in Images

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Abstract

The main purpose of an AI-based deep fake detection system is to detect changes in the face. It is a set of four deep learning models, including Swin Transformer, MobileNetV2, VGG16, and DenseNet121, which assist in the binary classification (Real vs. Fake). To further increase the accuracy of the classification, the DenseNet121 model features were used as input to a Random Forest classifier. The whole training and evaluation was done on a big data set of undisfigured and distorted face images. It is an entire system that is a web application, which uses flask on the backend and HTML, CSS and some JavaScript to make the frontend interactive. The application provides the individuals with the possibility to place the pictures of their faces and get the predictions (Real or Fake) and the associated confidences rating. This system is a brilliant method of authentication of the authenticity of facial images therefore its use is highly necessary in the fields of digital forensics and AI security. MobileNetV2, VGG16, and Swin Transformer all have a great accuracy of 92, 93, and 96 percent, respectively.

Keywords

Deep Fake Detection, Image Forgery Detection, Swin Transformer, MobileNetV2, VGG16, DenseNet121, Random Forest, Binary Classification, Web Application, Flask, HTML, CSS, Digital Forensics, AI Security.

ICT Competency Profiling of LIS Professionals in Indian Engineering Colleges

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Abstract

Information and Communication Technology (ICT) has become integral to modern library and information services, particularly in engineering colleges where digital resources and research support are increasingly critical. This study profiles the ICT competencies of Library and Information Science (LIS) professionals in Indian engineering colleges, focusing on skill levels, tool usage, training, challenges, and areas for improvement. Data collected from surveys and institutional records reveal that LIS professionals demonstrate strong proficiency in core areas such as library automation, database searching, and e-resource management. However, competencies in advanced domains, including digital repository management, data analytics, and emerging ICT tools, remain underdeveloped. Key challenges identified include limited advanced training, insufficient technical support, budget constraints, and high workloads. The study recommends targeted training programs, infrastructure upgrades, and strategic collaborations to enhance ICT adoption and overall library service quality. The findings provide actionable insights for policymakers, library administrators, and educators aiming to strengthen digital capabilities in engineering college libraries.

Keywords

ICT competency, LIS professionals, digital libraries, library automation, engineering colleges, data analytics, e-resources, India.

Vision Estate: AI & AR/VR Powered Real Estate Platform

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Abstract

This paper is about a study based on the development of a real estate app with the help of artificial intelligence and virtual reality technologies. The paper discusses the pros and cons of AI and VR technologies in the real estate sector. It is crucial for a buyer to feel secure about their investment in real estate and thus our application comes in place. The main aim of the paper is to discuss AI and VR technologies and its significance in the real estate sector. These technologies have had a long history in the academic world, dating back to the mid-last century, however the scope of the projects using these technologies was limited due to the lack of data and computational power needed for these technologies to function. In recent times, the development of better and efficient hardware has helped overcome the technical challenges, and thus the need for Virtual Reality and Artificial Intelligence technologies has caught an eye in the society and the public over the last few years. In particular, when discussing Virtual Reality technology, the emphasis will be on 360 images. VR helps in creating immersive house tours thus reducing friction while transacting, buying or selling properties.

Keywords

Artificial intelligence, eco-score, virtual walkthrough, property enlisting, virtual reality.

Comparative Experimental Study on Strengthening of Beam Column Joints Using UHPC Jacketing

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Abstract

Beam-column joints constitute critical stress-transfer regions in reinforced concrete (RC) frame systems and largely govern their load distribution, stability, and deformation behaviour. Inadequate detailing, construction imperfections, and long-term material deterioration can significantly weaken these regions, resulting in early joint damage and reduced structural reliability. Enhancing the performance of such joints is therefore necessary to meet modern safety requirements under increased service and extreme loading conditions. This experimental investigation evaluates a composite strengthening of RC beam-column joints using UHPC Jacketing. Four RC beam-column joint specimens were fabricated, comprising two reference specimens with conventional detailing and two specimens strengthened using the proposed method. The strengthening process involved Jacketing of existing joint core concrete and with UHPC to improve mechanical resistance and durability.

All specimens will be subjected to monotonic loading to assess critical performance parameters, including load-carrying capacity, stiffness characteristics, deformation behavior, crack evolution, and modes of failure. The experimental program aims to compare the structural performance of control and strengthened beam-column joint specimens. Key observations will encompass load-displacement response, changes in stiffness, patterns of crack initiation and growth, and overall failure mechanisms. This experimental program is designed to evaluate the structural response of reinforced concrete beam-column joints enhanced through UHPC strengthening approach. The performance of the retrofitted specimens will be examined in comparison with control joints without strengthening. The findings are intended to demonstrate the effectiveness and practical suitability of the proposed hybrid technique for upgrading deficient beam-column joints, especially for structures subjected to seismic actions and elevated loading demands.

Keywords

Beam-column joint performance, reinforced concrete rehabilitation, UHPC replacement technique, experimental structural assessment.

Privilege Escalation Attack Detection and Mitigation in Cloud Using Machine Learning

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Abstract

This project employs advanced machine learning to fortify cloud security, specifically targeting and mitigating privilege escalation attacks for a more robust defense mechanism. As cloud adoption rises, so does the risk of privilege escalation attacks. This project addresses vulnerabilities in employee access privileges within cloud services to enhance overall security. Leveraging machine learning, the project enables real-time detection and mitigation of privilege escalation attacks. Techniques like LightGBM, Random Forest, Adaboost, and Xgboost contribute to a dynamic defense against evolving threats. Users and businesses experience heightened data security, fostering trust in cloud computing. Cloud service providers and enterprises gain confidence in a secure online environment, benefiting from the project's security enhancements. And also included, a Voting Classifier, amalgamating predictions from Decision Tree, Random Forest, and Support Vector Machine through a "soft" voting approach, enhances the system's performance in detecting and mitigating privilege escalation attacks. Additionally, a user-friendly Flask framework with SQLite integration optimizes user testing, providing secure signup and signin functionalities for practical implementation and assessment.

Keywords

Privilege escalation, insider attack, machine learning, random forest, adaboost, XGBoost, LightGBM, classification.

Real-Time Dermatological Disease Detection Using MobileNetV3 and Web-Deployable Deep Learning Framework

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Abstract

Early detection of dermatological diseases is essential for effective clinical intervention, yet access to expert diagnosis remains limited in many regions. This project presents an automated skin condition classification system using a lightweight deep learning architecture optimized for real-time performance. A MobileNetV3-Large convolutional neural network was trained on a curated dataset containing seven dermatological classes—Acne, Eczema, Normal, Psoriasis, Rosacea, Vasculitis, and Vitiligo. The dataset was cleaned through a multi-stage preprocessing pipeline involving duplicate detection, stratified splitting, augmentation, and a skin-region filtering gate to suppress non-skin inputs. To further improve reliability, a pre-analysis rejection module detects low-quality images using blur variance, brightness thresholds, entropy-based confidence measures, and a pixel-level skin detection mask. The final model achieved 87% test accuracy, with strong class-wise performance across minority categories. A Streamlit-based web application was developed to provide an interactive diagnostic interface, allowing users to upload images, visualize predictions, view class probabilities, and inspect debugging details when needed. The system demonstrates that compact CNN architectures, combined with robust preprocessing and reject logic, can deliver high-quality dermatological predictions suitable for educational, telemedicine, and mobile health applications.

Keywords

Skin condition classification, MobileNetV3, deep learning, dermatology AI, convolutional neural networks (CNN), medical image analysis, Streamlit web application, tele-dermatology, lightweight neural networks.

Smart Agrihub: AI-Powered Platform for Farming Marketplace, Weather & Crop Prediction, and Regional Language Support

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Abstract

This research introduces an intelligent and integrated agricultural decision-support framework with the combination of machine learning, computer vision, and expert knowledge synthesis to help the farmer with crop choice, fertilizer, and early detection of plant diseases. The system has several supervised learning pipelines such as Rotation Forest ensemble classifier, voting-based crop recommendation models, and the label-encoded fertilizer prediction networks, while using the unified FastAPI architecture. A deep learning segmentation model called the Roboflow API can be used to access real-time disease diagnosis using leaf images, while a generative AI module based on Gemini model can be used for interpretive agronomic guidance based on crop type, pest or disease profile, and the geographical location. The platform also integrates with a frontend client which is built using React & Vite with modular routing, visualization and user management using centralized application state. The interoperability of these components proves a concept of an end-to-end and scalable pipeline that can bring actionable insights in agriculture to boost further efficiency of inputs, in addition to facilitating precision farming practices for various user groups.

Keywords

Crop recommender, fertilizer predictor, plant disease analysis, Rotation Forest algorithm, Ensemble learning, FastAPI, Generative AI computer vision artificial intelligence, registration farms decision support, precision agriculture.

Audio to Sign Language Converter

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Abstract

Sign language is a crucial mode of communication among the hearing and speech impaired individuals. Nevertheless, communication between the users of sign language and non-sign language is still challenging because of the absence of automated translation tools. This paper introduces audio to sign language, a web-based application, which translates speech or text input into sign language animations with the use of Natural Language Processing. The system interprets user input by tokenizing, doing grammatical analysis and detecting tenses and then correlating the processed words with the associated sign language videos. The input is supported with multilingual input facilitated by language detection and translation. The suggested system enhances access and will facilitate real-time communication without the use of special hardware.

Keywords

Speech to sign language, NLP, assistive technology, accessibility, web-based system.

AAS: Bridging Static Knowledge and Dynamic Endpoints in Institutional Assistance Systems

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Abstract

The adoption of Large Language Models (LLMs) into the higher education setting is currently constrained by the so-called Data Fragmentation problem, where the institutional knowledge is split into unstructured disorganized documents (e.g., syllabi, policies) and structured, safe databases (e.g., ERP, LMS). Conventional Retrieval-Augmented Generation (RAG) systems cannot close this gap, they tend to fail at retrieving realtime information or fail to hallucinate in answering student specific queries like attendance and results analysis. We describe the Agentic Academic System (AAS), a neuro-symbolic framework combination, in order to address this, where semantic reasoning and data retrieval are separated. AAS proposes a Semantic Intent Router that dynamically types and routes user queries to either a Neural Retrieval Engine with the static knowledge or a more secure and deterministic execution of backend tools via a Model Context Protocol (MCP) server. The system guarantees the privacy and integrity of data by the close isolation of these workflows and standardization of various output formats through a new Context Fusion Layer. Experimental evidence on a high-fidelity synthetic data set shows that AAS eradicates hallucinations on numerical data, and can do so, with 100 percent accuracy on dynamic queries (as opposed to 0 percent on a baseline system RAG system), with an average real-time latency of approximately 1.7 seconds. This model provides a platform of privacy-centric, scalable design of the future generation of academic assistants.

Keywords

Artificial Intelligence (AI), Large Language Models, Retrieval-Augmented Generation (RAG), Model Context Protocol (MCP), Chatbots, Academic Chatbots, Artificial Intelligence in Education, Neuro-symbolic AI, Data Privacy.

Decoding ROI - A Cross - Industry Analysis of Google Ads and Facebook Ads Performance in 2025

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Abstract

The paper analyzes and compares ROI of Google Ads and Facebook Ads by industry using benchmarking reports and secondary benchmarking datas provided, as well as personal observations made on Reddit. In this study, Varos (2025), 360 Agency (2025), WordStream (2024), and WorldMetrics (2025) are based on four reliable industry sources and the research studies industry CTR, CPC, CVR, CPL, and ROAS. The study demonstrates that Google Ads has better intention-based conversions, which are more beneficial in terms of higher CTR and ROAS but more expensive, whereas Facebook Ads offers more optimal costs savings in terms of lower CPCs and CPLs and therefore, it has greater potential at the middle of funnel lead generation and brand affinity. It may be explained by a complementary sentiment analysis of the comments in the Reddit Marketing Forest as industry players believe that Google Ads are trustworthy but expensive and Facebook Ads are cheap but unstable in terms of the quality of leads. Collectively, these results suggest that interdependences between the advertising platform, the industry, and the objectives of a campaign determine the ROI of these two platforms and conclude that advertisers need to use a hybrid data-based strategy when allocating their advertising budgets and no longer industry benchmarks. This groundbreaking research contributes to the existing literature on digital marketing and advertising because it provides a combination of qualitative and quantitative findings on the efficiency of advertising in 2025.

Analysing Player Consistency in Professional Football: Introducing the Robust Consistency Score (RCS)

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Abstract

Consistency in professional football is discussed extensively yet measured rarely. Practitioners routinely describe players as reliable or erratic, but such assessments rest on subjective impression rather than any formal quantitative basis. This paper introduces the Robust Consistency Score (RCS), a composite metric designed to address that gap. The RCS captures three theoretically distinct dimensions of player reliability: the stability of match-to-match ratings, the overall quality at which consistent performance is delivered, and the competitive availability that validates the observed pattern. All three components are normalised to a common scale before combination, preventing any single dimension from arithmetically dominating the composite. The framework was applied to match-level player rating data from the Big 5 European leagues (2023–24 season). After applying minimum thresholds of 20 appearances and 1,500 minutes, a working dataset of 398 players was retained. Three metrics are developed progressively: the Consistency Index (CI), the Adjusted Consistency Index (CI_{adj}), and the final RCS. One-way ANOVA, Linear Regression, and Random Forest models are applied to examine structural predictors of consistency, and K-means clustering identifies four behavioural archetypes: Consistently Outstanding, Consistently Good, Consistently Average, and Boom-or-Bust. Goalkeepers show the highest median CI (0.9324), followed by midfielders (0.9179) and defenders (0.9084), with forwards recording the lowest values (0.8897). Positional differences are statistically significant ($F = 30.28$, $p < 0.001$). Match volume emerges as the dominant predictor of RCS in Random Forest modelling (feature importance = 64.5%), and higher-rated players tend to show lower rating variability, a finding that challenges common assumptions about elite performance volatility.

Keywords

Football analytics, player performance, consistency measurement, machine learning, K-means clustering, match ratings, performance stability, data-driven scouting, robust consistency score, positional analysis.

Semantic Legal Case Recommendation Using RAG-Based Large Language Models

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Abstract

Picture shifting through stacks of outdated case files, flipping page after page, just to locate a single relevant ruling. Relying solely on keyword searches? That often fails to capture what you're actually looking for. This is where a new tool steps in—one designed to interpret legal texts more like a human would. Rather than simply matching terms, it identifies meaning by converting documents into underlying conceptual patterns. These patterns are stored in a specialized system where related ideas cluster together organically. When you pose a query, the system retrieves results based on relevance of concept, not just exact word sequences. There's no illusion of wizardry—just more thoughtful processing happening behind the scenes. It surfaces relevant cases efficiently, without fanfare about revolution or change. Work flows better when answers come faster and clearer. Tasks that once demanded hours now take seconds quietly and reliably. Once a legal question is asked, the tool extracts pertinent information from documents and constructs responses strictly from what it finds. Beyond retrieving laws, it explains applicable rules and includes a feature to help draft formal complaint letters addressed to authorities. Developed using Python, Streamlit, FAISS for search functionality, and advanced language models, the system operates seamlessly. Testing confirms it quickly retrieves accurate legal information, reduces manual search time, and makes legal knowledge more accessible. This prototype demonstrates how AI can enhance tools for legal research, supporting both legal professionals and the general public.

Keywords

Legal Document Analysis, Retrieval-Augmented Generation, Natural Language Processing, Semantic Search, Vector Database, Artificial Intelligence in Law, LLM, Legal Knowledge Systems.

AI-Driven Traffic Violation Detection and Automated E-Challan System using YOLO and IoT

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Abstract

The integration of artificial intelligence into intelligent traffic management systems has become a major focal point within the fields of computer vision and machine learning. To support the growing demands of smart city development and automated law enforcement, real-time AI surveillance is increasingly being adopted to identify traffic offenses. This research focuses on deploying advanced object detection algorithms—specifically leveraging OpenCV and YOLO models—to strictly monitor traffic compliance and dynamically operate advanced warning hardware. By continuously analyzing live video streams, the proposed system detects common infractions, including red-light running, three-passenger riding, and the absence of helmets. These detections immediately trigger the automated generation and dispatch of e-challans via WhatsApp. Additionally, the system bolsters public safety and emergency logistics by recognizing approaching ambulances and vehicles missing license plates. This critical information is then instantly transmitted to a secondary signaling unit, which activates localized alerts using LCD screens and buzzers.

Keywords

Traffic violation detection, Computer vision, YOLO object detection, Raspberry Pi Pico, Automated e-challan.

Trust-Aware Lost and Found Management System for Campus Environments: A Secure and Scalable Web-Based Approach

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Abstract

Lost and found management in campus environment is usually manual and fragmented, thus late recoveries, wrong records, and a general loss of trust among users. Traditional systems conventionally use physical notice boards or informal means of communication where there is little scope for accountability or not tend to misuse. With increasing digital platforms on campuses for various operational services, the need for secure and trusted systems that manage sensitive interactions amongst users is also increasing. This paper propose a trust-aware lost and found management system designed for campus environments. The idea behind this approach is to integrate authentication and verification mechanism in order to ensure controlled access and prevent fraudulent item claims. The system follows a modular web-based architecture that allows scalability, usability, and secure data handling. A structured method has been used in order to handle workflows of item reporting and recovery in claiming verification. Experimental evaluation under real assumptions for the campus environment showed that the system can efficiently support a number of concurrent users with minimal performance overhead. The proposed solution provides a practical and secure alternative to traditional approaches to lost and found in institutional environment.

Keywords

Trust-aware systems, lost and found management, campus information systems, secure web applications, authentication mechanisms.

A Multi-Model Data Fusion Framework for Financial Market Prediction by using FinBERT & Ensemble Deep Learning

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Abstract

Financial markets are one of most un-certain yet most essential elements of countries economy. Old methods of prediction, often fall short in capturing complex & dynamic characteristics of financial markets behavior, particularly within Indian financial ecosystem. Our project represents an AI-based model which combines machine learning, deep learning & natural language processing (NLP) for predict share prices & assess market sentiments. Our suggested system consists three primary components: Long Short Term Memory for sequential prediction, Random Forest is for feature based regression & FinBERT, a transformer-based NLP model, for classifying sentiments from financial related news. Historical data comes from Yahoo Finance, while up-to-date financial headlines comes from NewsAPI. Our system analyzes & visualizes all outcomes through a Gradio web platform. Our hybrid model results advance accuracy when compared to other stand-alone models, successfully acquiring both numerical patterns & sentiment market trends. Our findings highlights importance of mixing quantitative & qualitative information to accurate financial forecasting & decision-making.

Keywords

Stock Market Prediction, Artificial Intelligence, LSTM, Random Forest, FinBERT, Sentiment Analysis, Financial Forecasting, Indian Market, Deep Learning & NLP.

Explainable Credit Risk Assessment Using Machine Learning

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Abstract

Assessing the credit risk requires a fine balance between accuracy and transparency, both legislative and regulatory. Logistic regression (LR) is well recognized as interpretable but sophisticated ensemble algorithms such as extreme gradient boosting (XGBoost) provide good predictive power at the cost of interpretability. In our paper, we propose a Confidence Aware Explainable Credit Risk Assessment Framework which selectively integrates both models based on prediction certainty. High confidence predictions are processed using XGBoost to maximize the discriminatory power while borderline scenarios are sent to LR to provide regulator friendly explanations.

The framework is tested on the German Credit dataset and large-scale and imbalanced Lending Club dataset. Results show that the ROC-AUC can be improved to 0.8258 on the German dataset with a still 34% interpretability coverage. On Lending Club dataset, the method achieves a competitive ROC-AUC score of 0.7403 with coverages of around 59% interpretability, therefore demonstrating robustness in real world situations. There are model-specific explanation processes that are selective to ensure computational efficiency and feasibility of deployment.

Keywords

SHAP, interpretable models, credit scoring, model fairness, predictive accuracy, financial regulation, Credit Risk Assessment, Explainable Artificial Intelligence (XAI), Logistic Regression, XGBoost, Class Imbalance, Financial Machine Learning.

A Decentralized Healthcare Appointment Platform Using Machine Learning and Blockchain

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Abstract

Healthcare appointment scheduling has continued to pose a problem in the last few years. The problem has been described by factors such as inefficient use of resources, centralized data management, and the absence of intelligent demand prediction tools. However, this paper aims to design a decentralized healthcare appointment scheduling system that includes the application of machine learning algorithms to improve demand prediction and scheduling. Additionally, the proposed system includes the application of blockchain technology to offer a secure and transparent data management platform. The proposed system is expected to improve the efficiency and security of the healthcare services provided to the public and reduce the risks associated with the centralized data management system.

Keywords

Decentralized Healthcare, Appointment Scheduling, Machine Learning, Blockchain, Smart Contracts, Predictive Analytics.

Multi-Keywords Searchable Attribute-Based Encryption with Verification and Attribute Revocation Over Cloud Data Using Python and Cloud Computing

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Abstract

With the exponential rise in cloud storage usage, ensuring the security, privacy, and efficiency of data retrieval has become a critical concern. Traditional encryption methods often fall short in providing fine-grained access control and secure searchability over encrypted data. To address these limitations, this project introduces a Multi-Keywords Searchable Attribute-Based Encryption (MK-ABE) system, a novel approach that synergizes attribute-based encryption (ABE) with secure multi-keyword search functionality.

The proposed MK-ABE system allows users to perform search queries using multiple keywords without compromising data confidentiality, significantly enhancing usability and flexibility. It incorporates fine-grained access control based on user attributes, ensuring that only authorized users can decrypt and access specific data. A standout feature of this system is attribute revocation, which enables dynamic modification of access rights, addressing scenarios where users' roles or permissions change over time. Another critical component is data integrity verification, which ensures that search results are both accurate and unaltered, building trust in the retrieved data. The system will be developed using Python and deployed on cloud platforms, aiming to deliver a scalable, high-performance, and cost-effective solution suitable for both academic and enterprise environments.

Keywords

Cloud Storage, Data Security, Multi-Keyword Search, Attribute-Based Encryption (ABE), MK-ABE, Attribute Revocation, Access Control, Secure Searchable Encryption, Data Integrity Verification, Python, Cloud Computing, Encrypted Data Retrieval, Fine-Grained Access Control, Scalable Solutions, Privacy-Preserving Search, Dynamic Access Management, Secure Cloud Applications, High-Performance Encryption, Cryptography in Cloud, Confidential Data Access.

Beyond LLMs: LLM Backtranslation and Hybrid Augmentation for Fine-Grained Emotion Classification

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Abstract

Fine-grained emotion classification over large label spaces remains a challenging task due to severe class imbalance. This paper presents a systematic benchmark of twelve data augmentation strategies for multi-label emotion classification on the GoEmotions dataset, comprising 58,009 Reddit comments annotated across 27 emotion categories. We compare LLM-based (Mistral-7B, GPT-2, LLaMA-2), traditional NLP (backtranslation, T5 paraphrase), embedding-based (SimCSE, Hybrid), and resampling (SMOTE) augmentation across DistilBERT-base and RoBERTa-base architectures. LLaMA-2 backtranslation achieves the highest single-method F1 Macro of 0.540 on RoBERTa, surpassing the prior best of 0.494. A combined augmentation strategy pooling all methods yields the highest DistilBERT performance (F1 Macro: 0.695), a 24.7% relative improvement over the no-augmentation baseline. SMOTE consistently underperforms the baseline, confirming its unsuitability for discrete text augmentation. Intrinsic quality analysis validates BERTScore (average threshold ≥ 0.85) as a reliable pre-screening metric for augmentation selection. Multi-seed stability analysis (seeds: 42, 21, 84) confirms result robustness with standard deviation of 0.0009 on RoBERTa F1 Macro. These findings provide actionable guidance for practitioners addressing class imbalance in fine-grained emotion classification.

Keywords

Data Augmentation, Emotion Classification, GoEmotions, DistilBERT, RoBERTa, LLaMA-2, SMOTE, BERTScore, Multi-label NLP, Backtranslation.

Fake News Detection and Source Credibility Scoring Using NLP and Graph Neural Networks

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Abstract

The rise of online news platforms and social media has made it easier than ever for false information to reach large audiences before anyone can verify it. Existing detection systems tend to focus either on what a news article says or on how it spreads — but rarely on who published it. In this work, we build a hybrid system that checks both the content of a news article and the credibility of its source at the same time. For content analysis, we fine-tune a BERT model on a labeled fake news dataset. For source credibility, we train a Graph Convolutional Network on a co-occurrence graph of news publishers. The two outputs are combined using weighted averaging to produce a single classification decision. We tested the system on 19,742 news samples with a 70:30 train-test split. Our hybrid model reached 93.7% accuracy and a 93.0% F1-score, which is better than using BERT alone (89.3% F1) or the GCN alone (82.8% F1). The results show that checking the source alongside the content makes fake news detection noticeably more reliable.

Keywords

Fake News Detection, BERT, Graph Convolutional Network, Source Credibility, Misinformation, NLP, Decision Fusion.

Automatic ID Card Detection and Penalty Mechanism

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Abstract

The role of ID card verification cannot be overemphasized in the security and safety of institutions and organizations. Currently, the traditional method of ID card verification involves physical inspection, which is tedious and susceptible to human errors. This paper proposes the development of an Automatic ID Card Detection and Penalty Enforcement System, which utilizes computer vision and deep learning technology for the purpose of ID card verification and penalty enforcement. The system involves the use of a camera to capture the ID card image, followed by image preprocessing and Optical Character Recognition (OCR) technology. The features of the ID card are then analyzed using the Convolutional Neural Network (CNN) model to verify the authenticity of the card. If the ID card is invalid or unauthorized, the system will automatically impose a penalty on the individual. The results of the ID card verification and the penalty imposed will be recorded and stored in the centralized database. The system will be more efficient and effective in the security and safety of the organization. The results obtained during the experiment show the efficiency of the proposed system in the real-time ID card verification process.

Keywords

Automatic ID Card Detection, ID Card Verification, Deep Learning, Convolutional Neural Networks (CNN), Optical Character Recognition (OCR), Penalty Enforcement System, Image Processing, Real-Time Monitoring.

Optimizing Beyond-5G URLLC Networks: A Review of Joint Latency, Reliability, Throughput, and Energy Efficiency Strategies

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Abstract

Beyond fifth-generation (B5G) wireless networks introduce a new paradigm for ultra-reliable low-latency communication (URLLC), targeting sub-millisecond end-to-end latency, “five-nines” reliability, enhanced energy efficiency, and significantly higher throughput than legacy systems. Achieving these stringent and often conflicting performance requirements necessitates advanced multi-objective optimization (MOO) frameworks capable of jointly managing radio resource allocation, network slicing, edge intelligence, and physical-layer design. This paper reviews key challenges associated with B5G URLLC, including heterogeneous quality-of-service demands, non-stationary wireless environments, and the limitations of classical single-objective optimization. We highlight recent progress in convex, evolutionary, and learning-based MOO techniques that enable dynamic trade-off management among latency, reliability, energy consumption, and spectral efficiency. Furthermore, we discuss emerging enablers such as reconfigurable intelligent surfaces, short-packet communications, and integrated sensing-communication paradigms that further tighten performance bounds. The survey concludes with open research directions, emphasizing scalable optimization, cross-layer co-design, and robust real-time decision-making essential for next-generation URLLC deployment in mission-critical applications. [8], [9] [16]

Keywords

Beyond 5G (B5G), Ultra-Reliable Low-Latency Communication (URLLC), Multi-Objective Optimization (MOO), Latency, Reliability, Energy Efficiency, Throughput, Reinforcement Learning, Reconfigurable Intelligent Surfaces (RIS), Edge Computing. [8], [9]

ARTICLE-GUARD: A Multilingual Legal RAG System with Strict Article-Aware Retrieval for Zero-Hallucination Constitutional Analysis

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Abstract

Large Language Models are becoming more common in the legal field, but they often give wrong or unsupported answers, especially when working with structured legal documents like constitutions. This paper introduces ARTICLE-GUARD, a multilingual legal question-answering system developed through a Retrieval Augmented Generation (RAG) methodology to overcome this issue. The system uses strict article level matching for citation based questions and semantic retrieval for general questions to make sure that the answers are always based on the legal document that was uploaded. Legal BERT is used to figure out how the document is put together, and an instruction-tuned language model makes responses only from the content that was found. A multilingual processing layer lets users ask questions in more than one language while keeping the original meaning. The system gives answers that are always the same and based on the context, and it doesn't answer when the document doesn't have enough information. The suggested method shows a solid and useful way to analyze multilingual constitutional documents.

Keywords

Legal AI, Retrieval-Augmented Generation, Constitutional Question Answering, Multilingual NLP, Hallucination Mitigation, Legal-BERT.

Comprehensive Review of High-k Gate Dielectrics for Performance Enhancement in Sub-10 nm SOI Triple-Gate FinFETs

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Abstract

This review shows how high-k gate dielectrics have changed the game for the sub-10 nm Silicon-on-Insulator (SOI) triple-gate FinFETs. As transistors continue to scale down into the deep nanometer territory, the SiO_2 gate dielectrics used have their own fundamental problems, such as increased gate leakage, decreased gate control, and increased short-channel effects (SCEs). FinFETs with high-k dielectrics such as HfO_2 , ZrO_2 , and Al_2O_3 , and their laminated or doped versions, provide a real opportunity to improve electrostatic control, increase the on-state (ION) current, decrease off-state (IOFF) leakage, and improve overall device reliability. This review focuses on the high-k dielectrics used in triple-gate architectures. Specifically, the review examines the efforts regarding material selection, interface control, the mobility downturn, reliability, and integration schemes. The review compares the gains from experimental and simulation studies for subthreshold swing (SS), transconductance (gm), drain-induced barrier lowering (DIBL), and gate delay. The review presents the integration of new materials and suggests the integration of 2D materials and high-k dielectrics in a new structure to sustain Moore's Law beyond the 5 nm node.

Keywords

Gate leakage, Short-channel effects, Subthreshold slope, Transconductance, Triple-gate, Sub-10 nm, SOI, High-k dielectric, FinFET.

StackGuard: Intelligent Vulnerability Monitoring and Alerting for Critical Systems

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Abstract

Modern web applications depend on multiple third-party technologies which include PHP, WordPress, MySQL, and JavaScript frameworks. Publicly disclosed security flaws create vulnerabilities in these technologies which expose websites to cyber-attacks. The process of checking technology stacks and CVE records through manual methods requires experts to spend extensive time while producing results that often contain errors.

The research paper presents StackGuard which functions as an automated web analysis system to detect a website's technology stack and link it to current vulnerabilities listed in the National Vulnerability Database (NVD). The system performs technology detection and CVE matching and SEO evaluation to create a unified report. This report combines security and optimization results. StackGuard enables developers and security analysts to perform quick risk assessments which lead to enhanced website security and improved performance results. The system delivers an automated solution for website evaluation through its report generation capabilities and user-friendly interface. This enables modern website analysis.

Keywords

Technology Detection, CVE Analysis, Vulnerability Mapping, NVD, Web Security, SEO Evaluation, Automated Website Scanning, StackGuard.

NETGUARD: AI-Based Intrusion Detection System

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Abstract

The rapid growth of digital communication and internet-based services has increased the exposure of computer networks to a wide range of cyber threats. Intrusion Detection Systems (IDS) are essential for identifying suspicious activities and ensuring network security. However, traditional IDS approaches, particularly signature-based methods, struggle to detect unknown and evolving attacks such as zero-day exploits. This paper presents NETGUARD, an Artificial Intelligence- driven intrusion detection system designed for real-time network monitoring and threat detection. The system combines machine learning techniques with packet inspection and traffic analysis to enhance detection capability while reducing false alarms. A Random Forest classifier is used to distinguish between normal and malicious network behavior based on extracted traffic features.

NETGUARD follows a modular architecture that includes packet capture, feature extraction, classification, alert generation, and visualization components. Experimental evaluation on benchmark datasets demonstrates that the proposed system achieves improved detection accuracy and reliable performance compared to conventional methods. The system is suitable for deployment in small to medium-scale network environments requiring efficient and scalable security monitoring.

Keywords

Intrusion Detection System, Machine Learning, Network Security, Artificial Intelligence, Cybersecurity, Random Forest, Real-Time Monitoring.

Quantum-Resilient Partial Signature Framework for Privacy-Preserving Public Auditing in Dynamic Cloud Storage

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Abstract

The maintenance of data integrity, privacy, and transparency in cloud-based storage systems is a crucial issue because of the use of centralized auditing systems. The paper suggests a Blockchain and AI-Improved Adaptive Public Data Auditing Framework that incorporates cryptography using the elliptic curve (ECC), homomorphic hash aggregation, blockchain verification, and anomaly detection using artificial intelligence (AI). The framework allows effective and privacy-sensitive auditing because it allows verifying blocks of data in bulk without disclosing original data. Using blockchain technology, the audit logging can be tamper-proof and decentralized, which will eliminate the use of third-party auditors and increase trust. Moreover, the AI module checks the pattern of audits in real-time to identify abnormalities and any pose of security threat. The experimental results reveal that there is an improvement on the efficiency of the audit, less computational overhead, and high stability of the detection of the anomalies in comparison with the traditional approaches. The proposed system offers a flexible, secure, and intelligent system that can support dynamic multi-cloud environments to ensure the robust data integrity and clear audit operations.

Keywords

Cloud Computing, Public Data Auditing, Blockchain, Elliptic Curve Cryptography (ECC), Homomorphic Hashing, Anomaly Detection.

Smart Shopping Trolley with Integrated RFID and Electronic Display

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Abstract

This paper presents an RFID-based smart shopping trolley integrated with IoT to automate the billing process in supermarkets. The system minimizes human intervention by automatically detecting products using RFID tags, displaying real-time billing information on an LCD, and transmitting data wirelessly to checkout counters. The solution enhances efficiency, reduces waiting time, and improves customer experience.

Keywords

RFID, IoT, Smart Shopping, Automated Billing, Arduino, Wireless Communication.

ORION: Automated Smart Contract Security Auditing via Hybrid LLM Verification and Exploit Generation

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Abstract

Smart contract vulnerabilities represent a critical and irreversible security risk in blockchain-based systems. However, automated tools currently detect vulnerabilities with a 70-80% false positive rate and do not verify exploitability, requiring a time-consuming manual audit process. This article proposes a new five-stage hybrid framework, called ORION (Orchestrated Reasoning and Intelligent On-chain Auditing), combining static analysis with Slither, semantically driven verification with Groq, and automated exploit generation with Foundry, in a single zero-intervention pipeline. Our evaluation on 160 smart contracts from the SmartBugs Curated benchmark, representing 11 different vulnerability categories, shows ORION successfully analyzes 88.1% of smart contracts, reduces false positives by 83% from 2,591 to 440 true vulnerabilities, generates 440 executable exploit tests with complete coverage, and has an average F1-score of 0.853 across all categories under evaluation. The end-to-end analysis time takes less than 3 minutes per smart contract, representing a 96-99% improvement in speed compared to manual audit tools, and a throughput rate of 514 smart contracts per day on a single workstation.

Keywords

Smart contracts, blockchain security, large language models, vulnerability detection, static analysis, automated exploit generation.

AI Augmented Detection and Interpretation of Alzheimer's Pathogenic Genes Using Artemis and LLM

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Abstract

Genetic disorders like cystic fibrosis and cardiovascular disease usually result from certain genetic mutations. Detection of genes that cause such diseases is crucial for the early diagnosis and design of customized treatment plans. Detection of disease-causing genes based on genomic data using AI and machine learning algorithms is the focus of this project. In contrast to conventional models such as Random Forest and Support Vector Machine (SVM), which lack capacity to deal with complex and high-dimensional biological data, this research employs sophisticated techniques such as network-based methods, deep learning models, and feature selection methods. Network based analysis enables the examination of gene interaction and biological pathways and provides insight into how sets of genes are involved in disease. Deep learning methods are used to derive useful patterns from large genomic sequences, enhancing the accuracy of gene-disease prediction. Feature selection also improves model performance and interpretability by selecting the most informative genetic markers from large data. The merging of these AI based methods results in more precise and efficient identification of disease-associated genes. The findings of this study can play a substantial role in pushing precision medicine forward by allowing for more successful early diagnostics, risk evaluation, and the development of targeted therapies, ultimately improving patient care and outcomes.

Keywords

Alzheimer's Disease, Genetic markers, Bioinformatics, Artemis, Ollama, Mutation detection, BLAST, Genomic data interpretation.

Fake News and Misinformation Detection Using Contextual Semantic Graph-Enhanced CNN (CSGE-CNN)

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Abstract

The issue of fake news shared on the social media platforms poses an increasing danger to the trust of the population, democracy, and health choices. The current automated detection systems are based on heavy transformer models that are costly to operate in real time or single-path CNN models, which lack rich semantic connections among words and sentences. In this paper, suggest a new framework known as Contextual Semantic Graph-Enhanced CNN (CSGE-CNN) to detect fake news. The model encodes two parallel paths, one of Char-level CNN, which encodes both spelling and morphological patterns, and one of Sentence Encoder, encoding the deep meaning of whole sentences, then connects them to each other with a Semantic Graph Module (SGM) which models the connection between various components of the article. An intelligent fusion of information of both paths then follows in a Cross-Path Attention (CPA) layer and finally a prediction is made by a Residual Dense classifier. CSGE-CNN is evaluated on FakeNewsNet and LIAR datasets, and it has the highest accuracy 96.78% and True Positive Rate (TPR) and True Negative Rate (TNR) 95.63 and 97.05 respectively.

Keywords

Fake news detection, semantic graph, dual-path encoding, char-level CNN, sentence encoder, cross-path attention, misinformation, social media.

Optimizing Microservices and Containerization in Full Stack Web Applications

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Abstract

Microservices paired with container orchestration are now central to modern full-stack web systems. They promise modularity, independent deployability, and elastic scaling but introduce new challenges in performance, cost, and security. This paper reviews the state of the art (2020–2025) in optimizing microservice performance and containerized deployments. We synthesize techniques in container build/placement, orchestration and autoscaling (reactive, predictive, hybrid), observability and root-cause analysis, cost optimization (including ARM/Graviton adoption), and security hardening. Two comparison tables summarize pros/cons of major approaches, and a research taxonomy highlights open problems and promising directions.

Finally, we identify gaps for future research and provide a concise set of practical recommendations for practitioners.

Keywords

Microservices, containerization, Kubernetes, autoscaling, observability, cost optimization, security, ARM Graviton, predictive scaling.

Smart Irrigation System for Precision Farming

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Abstract

The “Smart Irrigation System for Precision Farming” aims to enhance agricultural productivity through a data-driven irrigation management system. By leveraging machine learning algorithms such as Support Vector Machine (SVM), Random Forest, and XGBoost, this project provides accurate predictions of the optimal watering schedule for plants based on various environmental and soil parameters. The system uses a dataset that includes soil moisture, temperature, humidity, wind speed, air pressure, rainfall, and essential nutrients like Nitrogen (N), Phosphorus (P), and Potassium (K) to determine the most effective irrigation practices. The project integrates data collected from sensors into a Flask-based web application, allowing farmers to monitor and manage irrigation systems remotely. The front-end is built using HTML, CSS, and JavaScript, providing an intuitive interface for real-time monitoring and control. By predicting the need for watering based on soil conditions and weather data, this AI-driven system optimizes water usage, reduces wastage, and promotes sustainable agricultural practices. With this solution, farmers can make informed decisions on irrigation, resulting in increased crop yield, resource conservation, and environmental sustainability.

Keywords

Machine Learning Algorithms, SVM, Random Forest, XGBoost, IOT, Irrigation Management, Soil Moisture, Flask-based Web Application, Sustainable Agricultural Practices.

A Novel Diffusion-Assisted CNN-ViT Framework for Retinoblastoma and Uveal Melanoma Detection

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Abstract

Early detection of eye cancers such as retinoblastoma and uveal melanoma plays a vital role in preserving vision and improving patient survival. Traditional manual analysis of ophthalmic images is labor intensive and may lead to diagnostic inconsistencies, particularly when large datasets are involved. To overcome these limitations, this paper presents a diffusion-assisted hybrid deep learning framework that combines Convolutional Neural Networks (CNNs) and Vision Transformers (ViTs) for automated eye cancer detection. A diffusion-based preprocessing technique is applied to enhance image quality by reducing noise and improving contrast. The CNN module focuses on extracting local structural features, while the ViT component captures global contextual information from the images. Experimental results obtained on ophthalmic image datasets indicate that the proposed hybrid approach achieves better performance than standalone CNN and ViT models in terms of accuracy, sensitivity, and specificity. Furthermore, heatmap-based visual explanations are provided to improve interpretability and support clinical decision-making. The proposed framework demonstrates potential as an effective tool for early eye cancer screening and can be adapted for the detection of other ocular disorders.

Keywords

Retinoblastoma, Uveal Melanoma, Diffusion Model, Convolutional Neural Network, Vision Transformer, Medical Image Analysis.

Integrating Local and Global Noise Features using SRM, CNN, and CVT for Efficient Image Steganalysis

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Abstract

Steganography enables covert communication by embedding secret information within digital images, presenting critical challenges for detection in cybersecurity and digital forensics. Traditional convolutional neural network (CNN)-based steganalysis models effectively extract local spatial features but suffer from limited receptive fields and inadequate global contextual understanding, restricting their ability to detect subtle steganographic modifications. To address these limitations, this paper proposes a novel hybrid SRM-CNN-Convolutional Vision Transformer (CVT) framework for spatial-domain image steganalysis. The proposed architecture employs a three-stage approach: first, 30 high-pass Spatial Rich Model (SRM) filters extract residual noise patterns while suppressing natural image content; second, a deep CNN backbone (SRNet) performs hierarchical local spatial feature learning; third, a Swin Transformer-based CVT module captures long-range dependencies and global contextual relationships through multi-head self-attention mechanisms. This synergistic integration enables a comprehensive analysis of both fine-grained local patterns and broader semantic contexts, which are essential for robust steganalysis. Comprehensive experiments conducted on the BOSSBase dataset using standard steganographic algorithms—WOW, S-UNIWARD, and J-UNIWARD—across varying payload capacities demonstrate that the proposed hybrid model achieves superior detection accuracy, reaching up to 99.1% for specific configurations. The framework exhibits enhanced robustness compared to conventional CNN-only architectures, maintaining high performance under diverse embedding conditions. The experimental results validate that combining residual noise filtering, deep convolutional representation, and transformer-based global reasoning creates an effective synergy for advancing spatial-domain image steganalysis, offering significant improvements in detection capability and generalization for practical cybersecurity applications.

Keywords

Steganography, Steganalysis, Convolutional Neural Network (CNN), Convolution Vision Transformer (CVT), Swin Transformer, Spatial Rich Model (SRM), Deep Learning, WOW, S-UNIWARD, J-UNIWARD, Feature Extraction, BOSSBase Dataset, Hybrid Model, Spatial Domain, Residual Noise, SRNet.

Design and Analysis of High-Performance Go-Kart Chassis Using CAD & FEA Tool

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Abstract

Go-kart design and analysis is crucial to determine the overall performance, structural safety and ability to perform under dynamic driving situations. Go-karts are very small and lightweight cars and are often adopted in student racing and simple car training. They have to have their chassis that is strong, durable and weight efficient and offer safe economies to the driver. This research is intended to be conducted to create a structurally go-kart chassis with the help of modern engineering tools and testing its behavior within the frames of the real-life loads. The project starts with the development of the 3D CAD of the go-kart chassis. Regular design specification like center of gravity was chosen so that it would create a stable and easily controlled cart. The total weight reduction was considered with special focus to structural rigidity reduction. In order to test the performance of the design, the simulation tools were used through Finite Element Analysis (FEA). The loading conditions that include front impact, side impact, bump load, braking loads and cornering loads were exercised to examine the stress pattern around the chassis. The outcomes of the simulation yielded important information in the deformation levels, high stress areas, and factor of safety as a whole. This paper has demonstrated that CAD modelling and FEA should be employed during initial design phases of a vehicle. The accuracy is guaranteed, design errors are minimized and the manufacturing cost and time are saved by the methodology taken. The resulting go-kart chassis is safe, light in weight as well as structurally efficient and can be used in fabrication, testing and also in competitions.

Keywords

Go- Kart, CAD DESIGN, FEA, Chassis Design.

Hybrid Model for Multi-Modal Brain Tumor Segmentation

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Abstract

This paper offers a rapid and effective 3D Vision Brain tumor segmentation framework based on transformers. Optimized for single GPUs like NVIDIA T4. This paper offers an extension of an already trained 2D ViT Minuscule backbone by inflating its patch embeddings and positional mappings to the 3D space, where effective modeling of Volumetric context MRI scans can be done. Multi-modal MRI inputs, in T1, T1ce, T2 and FLAIR, are merged and processed. Via an overblown 3D encoder, and then a light-weight 3D Convolutional de-coder for precise voxel tumor Segmentation. Mixed precision is included in the training pipeline. Exponential Moving Average (EMA), gradient checkpointing, OneCycleLR scheduling and top-K techniques, reducing memory usage and lowering the run time. A quick BraTS-style data packaging unloader harvests compact depth slices to enhance computational efficiency. Competitive Dice scores are shown based on experimental results for Whole tumor, tumor core, and enhancing tumor regions hyperbolically keeping the real-time viability, justifying the efficacy of finetuning a pretrained 2D ViT Tiny model into a workable and high-performance segmentation system.

Adaptive Threshold-Based Detection of DoS Attacks with Machine Learning Performance Evaluation Using CIC-IDS2017

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Abstract

Denial of Service (DoS) and Distributed Denial of Service (DDoS) attacks are considered to be one of the most critical security attacks on computer networks, as these attacks lead to the consumption of bandwidth, processing, and memory of the system. These attacks restrict the access of legitimate users to the network and cause significant financial loss. Traditional Intrusion Detection Systems (IDS) use fixed threshold-based detection mechanisms to identify the unusual behavior of network traffic. However, fixed threshold-based IDS cannot adapt to changing network traffic conditions, which results in an increase in the number of false alarms and the inefficiency of the detection process.

This paper proposes an adaptive threshold-based detection mechanism, which dynamically calculates the threshold limits based on the statistical properties of normal network traffic. This approach helps the system adapt to changing network conditions. The performance of the proposed approach has been tested on the CIC IDS 2017 dataset, which includes the Friday Working Hours Afternoon DDoS dataset with both benign and malicious network flows.

From the experiment results, it is observed that even though the adaptive thresholding approach offers a lightweight and computationally simple solution for traffic detection, it is less effective when the presence of malicious traffic is statistically similar to the traffic patterns of legitimate traffic. To establish a baseline for performance comparison, a Logistic Regression model has been implemented using several features for network traffic. The Logistic Regression model has been observed to achieve 99.85% accuracy with AUC scoring at 0.9998, thereby demonstrating the limitations of using single-feature statistical approaches for network traffic detection and the potential offered by ML models for contemporary network intrusion detection systems.

Keywords

Denial of Service, DDoS, Intrusion Detection System, Adaptive Thresholding, Machine Learning, Logistic Regression, CIC-IDS2017, Network Security.

Trade Market Insights: LSTM-Based Stock Price Forecasting and Market Trend Analysis System

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Abstract

The rapid expansion of financial markets and the increasing participation of individual investors have significantly increased the complexity of stock analysis and price forecasting processes. Conventional prediction systems primarily focus on historical trends or short-term statistical estimations, often overlooking critical factors such as temporal dependencies, market volatility, external economic influences, and behavioral patterns that affect price movements. For investors and analysts, prediction outcomes directly influence profitability, risk management, and decision reliability, highlighting the need for intelligent analytical systems that extend beyond traditional forecasting approaches.

Trade Market Insights is a deep learning-based stock analysis and forecasting system designed to enhance decision-making in financial environments. Unlike conventional prediction models that treat data as independent observations, Trade Market Insights integrates Long Short-Term Memory (LSTM) networks, time-series modeling, data preprocessing techniques, and interactive visualization to analyze stock behavior based on sequential patterns and historical trends. The system incorporates capabilities such as structured data processing, short-term price forecasting, graphical trend representation, and user-oriented analytical outputs to support data-driven financial analysis. By combining historical data analysis, predictive modeling, and visualization techniques, Trade Market Insights improves trend interpretation, enhances analytical understanding, and supports informed decision-making. This approach transforms stock prediction from a basic computational task into an interactive and insight-driven analytical process, offering practical value for investors, learners, and financial data analysis applications.

Keywords

Stock Price Forecasting, LSTM, Time-Series Analysis, Financial Data Analytics, Market Trend Analysis, Predictive Modeling, Web-Based System.

Automated Detection of Diseases in Leafy Vegetables Using YOLOV11

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Abstract

Cabbage is an important leafy vegetable valued for its nutritional and economic benefits, but its cultivation is often affected by Black Rot disease, which can significantly reduce yield and quality. Detecting this disease at an early stage is crucial for effective crop management and preventing further spread. However, traditional methods rely on manual inspection by experts, which can be time-consuming, inconsistent, and difficult to apply on large farms. To address this problem, this paper presents an automated approach for detecting Black Rot in cabbage leaves using the YOLOv11 deep learning-based object detection model. A dataset of healthy and infected leaf images collected under different environmental conditions is used to train the model. Image preprocessing and augmentation techniques are applied to improve accuracy and robustness. The performance of the proposed model is evaluated using standard metrics, including precision, recall, F1-score, and mean Average Precision (MAP). Experimental results demonstrate that the YOLOv11-based approach achieves high detection accuracy with low inference latency. The proposed system is capable of identifying and localizing infected regions in real time, providing a practical and efficient solution for farmers.

Keywords

Black Rot, Cabbage leaf disease, Object detection, Deep learning, Precision agriculture, YOLOv11.

Investigation of Unstructured Job Notes from Construction Sites and Sentiment Prediction

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Abstract

This study introduces a Sentiment Prediction Framework of Construction Site Job Notes based on Natural Language Processing (NLP) tools and Machine Learning (ML) tools. The framework is formulated to analyse unstructured text-based site reports that are written by engineers and supervisors with the objective of establishing their underlying feeling- positive, negative or neutral. The given system adheres to the ordered pipeline of data cleaning, tokenization, lemmatization, and stop word removal to equip domain-specific construction text. TF-IDF and word embeddings are used to extract features and depict the linguistic context. Several sentiment classifiers are considered such as VADER, Naive Bayes, and Logistic Regression in order to find the best performance in understanding language of the informal sites. To track the distribution of sentiment and trends on different projects, visualization dashboards are applied. In experimental analysis, the test is found to be reliable and has contextual meaning of construction-related language and the model has strong F1-scores on various data sets. Fusion of machine learning and rule-based models improves interpretability and fewer domain annotations are required. The system was implemented with Python, NLTK, Scikit-learn, and Streamlit to provide the project managers with actionable information about the situation in on-site conditions and make the most appropriate decisions in a timely manner and enhance the efficiency of communication.

Keywords

Natural Language Processing, Sentiment Analysis, Construction Management, Machine Learning, Text Mining.

Development of AI-ML Based Model for Predicting Prices of Agri-Horticultural Commodities

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Abstract

Agriculture commodity price changes will have a major effect on farmers, traders and policymakers. Accurate price prediction helps them to make better decisions regarding crop selling and supply planning. This work showcase a machine learning based framework in order to predict agricultural and horticultural commodity prices using historical market data, weather reports, temporal features. This system includes preprocessing, feature engineering and an Extreme Gradient Boosting regression model for predicting prices of commodities. Model uses market parameters such as state, district, market, commodity type, variety, grade, and arrival quantity as well as weather parameters. The model also uses lag features from previous price values to analyze how values change over time. System is implemented using python and deployed through an interactive streamlit dashboard that allow users to forecast commodity prices based on selected parameters. Experimental analysis gives strong predictive performance which was measured using R2 score. This methodology shows the usefulness of machine learning in improving agricultural market analysis and supporting stakeholders to make better decisions.

Keywords

Agricultural price prediction, XGBoost, Machine learning, Commodity markets, Weather data, Time series forecasting.

AI-Powered Assam Culture Preservation System Using LLM and RAG

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Abstract

The cultural heritage of Assam is reflected in its traditional artifacts, food, and jewellery, which collectively represent the identity and richness of the region. However, rapid modernization and the lack of structured documentation have led to a gradual loss of this valuable cultural knowledge, limiting access and understanding for future generations. This study proposes an AI-powered Assamese cultural preservation system based on Retrieval-Augmented Generation (RAG) and Large Language Models (LLMs) to address this challenge. A structured multimodal database containing categorized textual descriptions and images of cultural elements is manually curated and organized. The textual data is transformed into dense vector embeddings using SentenceTransformers (all-MiniLM-L6-v2) and indexed using FAISS to enable efficient semantic retrieval. When a user submits a query, the system retrieves the most relevant cultural information using cosine similarity and integrates it with the query context. This enriched input is then processed by a Large Language Model (Mistral via Ollama) to generate accurate, context-aware responses. The system is implemented through a Streamlit interface, enabling interactive exploration of Assamese cultural knowledge with both textual and visual outputs. Experimental evaluation demonstrates that the proposed system achieves 80.67% retrieval accuracy and a response relevance score of 0.92, highlighting its effectiveness in preserving and disseminating cultural heritage.

An Empirical Investigation of Security–Efficiency Trade-offs in RSA and ECC Based Public Key Cryptography

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Abstract

In a recent distributed computing system like cloud computing, Internet of Things (IoT) systems, and autonomous systems, public-key cryptography is a key element in ensuring communication security. Two of the most popular asymmetric cryptographic algorithms applied are RSA and Elliptic Curve Cryptography (ECC) which are two major algorithms with various mathematical hardness assumptions. This paper will provide empirical performance research on RSA and ECC implementations at standard levels of security-equivalent key sizes, as suggested by NIST guidelines. The computational cost of key generation, encryption and decryption were tested using repeated execution of controlled experiments of benchmarking. The performance metrics are execution time, statistical variability, confidence interval and cumulative cryptographic latency. The experimental data provide support that ECC has significantly reduced computational overhead compared to RSA in all the operations considered with similar security parameters. Specifically, ECC has been shown to be much faster in key generation and achieved much lower execution time variability than RSA. The operational latency analysis cumulative also shows that the performance of RSA is strongly affected by the cost of computation of prime generation when creating keys. These results indicate that ECC implementations offer better computational performance and predictable execution behavior in performance sensitive computing systems. The findings add to the empirical support of the implementation of ECC in the contemporary secure systems, where the computational efficiency and latency are among the key design factors.

Keywords

RSA, Elliptic Curve Cryptography, public key cryptography, cryptographic benchmarking, execution-time analysis, performance evaluation.

Smart Blood Bank Management System for Emergency Healthcare Coordination

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Abstract

Blood availability during medical emergencies remains a critical challenge due to poor coordination among blood banks, healthcare institutions, and donors. Existing blood management systems often rely on manual processes or inefficient digital platforms, resulting in delayed response times, inaccurate blood stock information, and ineffective communication with donors. This project proposes a smart blood bank management system designed to enhance emergency healthcare coordination through real-time blood availability tracking and automated donor allocation. The system follows a blood-bank-centric approach in which donor information collected at blood bank centers is digitized and centrally maintained. When a blood request is initiated, the system first verifies blood availability at registered blood banks. If sufficient stock is unavailable, an automated emergency response mechanism is activated to identify eligible donors and send timely notifications. To further improve preparedness, machine learning techniques such as Linear Regression and Random Forest are incorporated to predict future blood demand based on historical data. By integrating automation with predictive analysis, the proposed system reduces response time, minimizes manual intervention, and enhances the reliability of blood distribution during critical medical situations.

Keywords

Blood Bank Management System, Emergency Blood Availability, Donor Allocation, Blood Demand Prediction, Linear Regression, Random Forest, Healthcare Coordination.

Automatic 2 In 1 Multi-Cutting Machine

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Abstract

The increasing demand for compact and multifunctional machining systems has led to the development of integrated solutions capable of performing multiple operations within a single platform. This study presents the design, fabrication, and performance evaluation of an **automatic 2-in-1 multi-cutting machine** capable of executing both drilling and cutting/grinding operations. The proposed system integrates two independent drive units dedicated to each operation, along with separate feed mechanisms driven by screw-thread arrangements to ensure controlled and precise tool advancement.

A microcontroller-based control architecture, interfaced with a Bluetooth communication module and relay switching system, enables automated mode selection and remote operation through a mobile application. The incorporation of independent feed control enhances machining accuracy, operational flexibility, and repeatability compared to conventional single-purpose machines. Experimental validation was conducted to assess the machine's performance in terms of feed rate control, surface finish, and operational efficiency. The results demonstrate that the proposed system achieves improved productivity, reduced setup time, and enhanced portability while maintaining acceptable machining accuracy for light-duty applications.

The developed machine operates on a standard 230 V AC supply and is designed to be compact, cost-effective, and user-friendly, making it suitable for small-scale industries, educational laboratories, and field applications. The study contributes to the advancement of low-cost automated machining solutions by integrating multifunctionality with smart control systems.

Keywords

Automatic cutting machine, Multi-function machine tool, Drilling and grinding, Microcontroller, Bluetooth control, Feed mechanism, Portable machining system, Smart manufacturing.

Two-Wheeler Traffic Violation Detection and E-Ticketing using YOLO and CNN

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Abstract

Severe accidents worldwide Causeway due to violation of traffic rules such as triple riding and no helmet compliance. These accidents are the reason behind multiple deaths and severe injuries. Technologies which are present in the traffic monitoring uses inspection manually which required huge number of staff and is not effective in the areas where large number of people stay. To overcome these limitations in the proposed method two deep learning algorithms are used one is convolutional neural network and second one is YOLO (You Only Look Once) model is used. The proposed method has the ability to detect the people and the different objects first the rider is detected and if the rider is found then helmet and triple ridings are detected. In this application, graphical user interface (GUI) is given for easy access and easy use purpose. Whenever the violation is detected the proposed system sends email to the owner of two-wheeler. Proposed method performance metrics are calculated using different metrics such as fscore, precision, recall, accuracy etc. Compared to existing algorithm, proposed system has obtained better performance, scalability robustness and able to identify two different categories such as triple riding and no helmet detection. From video recognition of number plate and traffic with faster even make this application stronger in future.

Keywords

Traffic Violation, YOLO (You Only Look Once), Smart Traffic Management, Helmet and Tiple Violation detection, Sending SMS.

Enhanced Real-Time Multimodal Meeting Intelligence System with Decision and Risk Analytics

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Abstract

The extraction of structured intelligence from collaborative meetings involving decisions, commitments, sentiment analysis, risk notifications, and summaries for roles is still an important but unresolved problem. The state-of-the-art solutions address each subproblem in a batch mode, thus denying domain experts the benefit of real-time analytical support. This paper proposes ERMMI, the Enhanced Real-Time Multimodal Meeting Intelligence system, a seven-module asynchronous streaming pipeline that concurrently processes audio, text, and video inputs to generate structured intelligence reports in a 6-second latency budget. ERMMI proposes two new modules: the Meeting Risk and Sentiment Trend Analysis (MRSTA) module, which uses Exponentially Weighted Moving Average smoothing for polarity regularization and logistic risk scoring; and the Decision and Commitment Detection (DCD) module, which uses fine-tuned BERT-base-uncased classification and a four-feature probabilistic commitment scorer. ERMMI is evaluated on 15 collaborative meetings with multiple participants (6.8 hours) with decision accuracy of 87.3%, commitment precision of 0.81, sentiment stability of 0.92, risk alert accuracy of 84.6%, and end-to-end latency of 4,200-5,800 ms.

An Intelligent Computer Vision System for Real-Time Yoga Posture Analysis and Feedback

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Abstract

YogaVision AI which uses a standard webcam along with artificial intelligence to help you align yourself properly while practicing yoga by offering live adjustments from your computer video camera by way of video footage from the webcam itself. The application captures key body points through Google's MoveNet model technology and extracts each joint's location in 3D space. The location is passed through a multi-layer perceptron (MLP) that calculates each joint angle to be able to identify what pose you are in with good accuracy. The application provides immediate visual feedback as well as audio feedback, enabling you to instantly adjust your posture while practicing. In addition, YogaVision AI provides other features including session history tracking, accuracy scores, and user progress tracking to help you continue to improve your performance over time. All data and processing of the user's video and audio occur client-side directly in the user's browser, ensuring complete data protection and security, with no use of external servers. This project demonstrates the effectiveness of harnessing artificial intelligence to deliver an accessible, affordable, and interactive yoga training tool for all users.

Keywords

AI, Yoga Pose Detection, Computer Vision, MoveNet, MLP, Real-Time Feedback, Biomechanics, Web Application.

Federated Learning-Based Privacy-Preserving Intrusion Detection System for IoT-Enabled Smart Cities

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Abstract

The rapid proliferation of Internet of Things (IoT) devices in smart cities has introduced unprecedented security challenges, while traditional centralized intrusion detection systems (IDS) raise significant privacy concerns due to the need for data aggregation. This paper presents a novel privacy-preserving federated learning-based intrusion detection system designed specifically for IoT-enabled smart city environments. The proposed system trains a global intrusion detection model collaboratively across distributed IoT devices using federated learning, ensuring that no raw privacy-sensitive data is ever transmitted to a central server, thereby preserving user privacy while maintaining detection accuracy. The architecture incorporates differential privacy mechanisms to provide formal, mathematically grounded privacy guarantees and employs a hierarchical federated learning model to effectively handle the heterogeneity inherent in IoT smart city networks. Extensive simulations using real-world IoT network traffic traces demonstrate that the system achieves a detection rate of 96.8% with low communication overhead and outperforms conventional centralized IDS approaches without compromising data privacy. The system successfully detects a wide range of IoT-specific attack vectors, including Distributed Denial of Service (DDoS) attacks, replay attacks, and botnet intrusions. This research underscores the critical importance of developing privacy-preserving and scalable security solutions tailored to the complex, distributed nature of smart city infrastructures, offering a practical and effective framework for securing next-generation IoT deployments. The proposed approach aligns with the Engineering and Technology themes of ICR CET 2026.

Cloud – Based Scalable Customer Segmentation using Machine Learning

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Abstract

In everyday life, each one of us uses one or more E-Commerce platforms like Flipkart, Amazon, Snapdeal, etc. With the increasing usage of these platforms, there has been increase in the datasets of customer data through online transactions and user transactions. So, by this, there is a rise of challenges of understanding customer behavior properly so that their respective personalized services are generated better. This challenge is critical but there is a way to address this challenge. Customer Segmentation is the greatest and important way or technique to overcome this challenge by grouping various customers into various groups according to similar characteristics. The traditional systems used in E-commerce are basically fixed rules or the company owned systems, which are very slow and very inefficient in handling large amount of customer data. Customer segmentation can be done by using cloud computing that provides storage that is scalable and can also compute resources.

This paper proposes a cloud-based customer-segmentation model using Machine Learning (ML) techniques. In this model, the customer data present on a cloud platform undergoes various clustering algorithms to group each customer based on their respective behavior and purchasing history. This model helps various businesses to improve customer personalization and decision making. Not only that the experimental results have also proven that this model or approach improves scalability, speed of the processing, and efficiency as compared to traditional systems.

Keywords

Cloud computing, Customer Segmentation, Machine Learning, Scalability, E-Commerce.

Virtu Lrn – Gesture-Based Holographic Display

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Abstract

Virtu Lrn operates by interpreting gestures via camera input, enabling interaction with three-dimensional visuals formed using the Pepper's Ghost technique. Instead of relying on virtual or augmented reality hardware, it provides accessible depth in digital education. Movement becomes command, shaping how users engage with projected content. Cost efficiency emerges alongside experiential richness, shifting focus toward inclusive innovation. What results is a different path – one where light, motion, and perception combine quietly beneath the surface.

Keywords

Computer vision, Deep learning, Gesture-based interaction, Hand gesture recognition, Human-computer interaction, Machine learning, Real-time systems, Virtual learning environment.

Job Matching Using Machine Learning and NLP Techniques

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Abstract

The difficulty in matching resumes with job descriptions is a major issue in recruitment systems. There are mainly two reasons for this: format and vocabulary differences, and the lack of semantic understanding. Keyword-based methods only search for terms but do not understand the context in which they are used. This is the main reason for low accuracy in existing methods. This project aims to address these limitations by employing advanced Natural Language Processing and machine learning techniques for resume-job matching. OCR methods are first utilized to capture the text from the uploaded resumes followed by preprocessing and embedding creation. Several models such as TF-IDF with cosine similarity, Word2Vec with Random Forest, and transformer-based embeddings like BERT and SBERT have been tested for their performance. The system shows the top three positions that a candidate is the most appropriate for along with their matching percentages. By increasing the accuracy and providing better contextual understanding, this method would lead to recruitment of the staff at their best which would also be a great benefit to the job seekers having their career properly aligned.

Keywords

Recruitment Automation, Semantic Embeddings, Machine Learning Models, Candidate Shortlisting, OCR (Optical Character Recognition), Natural Language Processing (NLP).

Design and Energy Analysis of a 2-Bit Hybrid Multiplier–Square Unified Architecture Using Quantum-Dot Cellular Automata

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Abstract

Quantum-Dot Cellular Automata (QCA) is a new nanotechnology in the electro-computing field that promises high device density, extremely low power usage, and fast switching rates (when compared to traditional Complementary Metal-Oxide Semiconductor (CMOS) technology). This paper reports a 2-bit Hybrid Multiplier–Square Unified Architecture design and simulation based on a QCA technology. The given design incorporates both multiplication and square functions in one circuit design to eliminate the redundancy of hardware and enhance performance. Simulation of the architecture is done in the QCA Designer tool in the bistable and coherence vectors simulation mode. The circuit proposed has 239 QCA cells with 6 inputs and 4 outputs and the polarization of the circuit reaches a steady state after 12 steps of simulation. The coherence vector simulation of energy analysis with 500,000 samples displays that the total energy dissipation of 8.61×10^{-2} eV with an average energy dissipation per clock cycle of 7.83×10^{-3} eV occurred. In comparison, the standalone 2×2 multiplier has 156 cells at 6.55×10^{-2} eV energy dissipation per cell, compared to 64 cells at 3.32×10^{-2} eV energy dissipation per cell in the square circuit. It has been shown that the proposed single architecture is both efficient in carrying out arithmetic operations in a single structure and has a good energy consumption. Thus, the suggested design is applicable to the low-power nanoelectronic arithmetic systems of the future.

Keywords

Quantum-Dot Cellular Automata, QCA Designer, Hybrid Arithmetic Architecture, Multiplier, Square Circuit, Low-Power Nanoelectronics etc.,

A Structured Adversarial Graph Learning Approach for Cross-Subject Emotion Recognition

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Abstract

Recognition of emotion across subjects is one aspect of the topic of affective computing that has remained a obstacle in this area because there is also large inter-individual differences between physiological indicators, facial expressions and behavioral responses. Traditional machine learning and deep learning architectures tend to fail to make a good generalization between unseen topics due to them learning topic-specific representations. As a remedy to this shortcoming, this paper introduces Structured Adversarial Graph Learning (SAGL) framework which combines graph neural networks with adversarial domain adaptation to learn both subject-invariant feature learning and emotion-discriminative features learning. The framework builds a subject-conscious emotion graph where nodes can be identified as multimodal emotion feature and edge can be identified as intrinsic relationship between the emotional states of people. A discriminator that enforces domain alignment with a minimax objective and a structure-consistency regularization mechanism that enforces semantic consistency between similar emotions are used to achieve these goals. It has been shown that experimental results on benchmark multimodal emotion datasets are more accurate, have higher F1-score and robustness than traditional methods, indicating the effectiveness of the framework in supporting emotion-aware intelligent systems in the real world.

Keywords

Cross-subject emotion recognition, Affective computing, Graph neural networks, Adversarial domain adaptation, Structured graph learning, Multimodal emotion analysis, Domain generalization, Emotion-invariant representation learning.

Design and Performance Analysis of an Energy-Efficient 8-2 Adder Compressor Using Majority Gates in Quantum-Dot Cellular Automata

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Abstract

Quantum-Dot Cellular Automata (QCA) is a new nanotechnology offering a high-speed and low-powered digital circuit implementation technology in an alternative to CMOS. Multiplier architectures that are applied in digital signal processing and image processing systems also require compressors. In this paper, the proposal put forward is an efficient architecture of 82 adder compressor based on majority gate logic under QCA technology. The suggested design uses hierarchical arrangement of majority gates in order to compress several input bits into sum and carry outputs with less circuit complexity. The simulator and model of the compressor circuit is implemented through the QCA Designer tool. Bistable simulation is done to ensure logical functionality whereas coherence vector simulation is done to estimate energy dissipation. Performance analysis indicates that the proposed design will save much energy and simulation time as compared to the current design. The amount of energy dissipated decreases to 0.0519 eV as compared to 0.493 eV and the simulation time is also decreased to 52 s as compared to 420 s. The findings indicate that the suggested compressor offers enhanced efficiency and performance to nanoelectronic arithmetic circuit. Consequently, the design is useful in high-speed multiplier architectures like Wallace tree and Dadda multipliers of next-generation nano-VLSI architecture.

Keywords

Quantum-Dot Cellular Automata, Majority Gate, Adder Compressor, Nanoelectronics, Low-Power Design etc.,

Real-Time Translation and Tone Modification in Live Chat Using Large Language Models with Multimodal Intelligence and Inclusive Communication Support

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Abstract

The increasing global digital communication requires immediate development of intelligent translation systems which preserve both semantic accuracy and emotional meaning and cultural sensitivity. The research presents a deep learning-based method for real-time live chat translation through Large Language Models (LLMs) which enables adaptive tone control. The Dual-Stream Emotion-Aware Translation Architecture (DETA) processes semantic content and prosodic elements at the same time to address translation system limitations while maintaining emotional details between languages. The system enables users to adjust formality levels which allow the system to switch between informal and formal and neutral communication styles based on specific situations. The system uses a hybrid architecture to achieve real-time discussion capabilities through selective LLM deployment for complex cases and lightweight transformer models for common terms which results in sub-800ms latency. The system achieved 95% translation precision and 92% tone preservation during tests that involved multiple language pairs including Hindi and Spanish and French and German and English. The system focuses on resolving cultural communication issues while maintaining natural conversation flow and ensuring accessibility for different linguistic groups. Our research establishes a connection between machine translation precision and human communication requirements to advance neural machine translation technology.

Keywords

Neural Machine Translation, Tone Modification, Large Language Models, Real-Time Translation.

A Hybrid AI-Based Integrated System for Obesity Management and Personalized Nutrition Guidance

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Abstract

Now a day's Obesity and life-style-related health issues have become a major global health concern. Involving intelligent and real time monitoring systems for early prediction and prevention. This paper presents a Hybrid Health monitoring predictive system and Nutrient recommendation system which Integrates Machine Learning and Deep learning Techniques with wearable device data. The proposed system uses algorithms like XG Boost and Random Forest for health classification, where XG Boost exhibits robust predictive performance then the other algorithm. Additionally, here wearable data is collected from Fit bit device and it is utilized to extract real-time physiological data such as (heart rate, step count, and physical activity level)s. This time series data is trained using a Temporal Convolution Network (TCN+), which accurately extracts temporal dependencies and performs better than traditional sequential models. After predicting the health condition, a personalized dietary recommendation is suggested by including a nutrient data set from kaggle. The hybrid System combines these trained models into a unified framework with a user friendly interface to enter the health parameters and it collects smart watch data. The Accurate Health prediction is generated by combining the static user inputs with dynamic wearable data, the system suggests a Nutritious and Balanced Health Diet. The performance results show a high accuracy and offer a Viable Solution for proactive health monitoring and management.

Keywords

Wearable Data Analytics, Hybrid AI System, Health Monitoring, Time-Series Analysis.

Sensitivity Analysis of a Triple-Stack Nanosheet FET for Detection of Cervical Cancer Biomarkers

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Abstract

As CMOS scaling demands higher electrostatic integrity and energy efficiency, the GAA architecture is leveraged to minimize short-channel effects and reduce leakage current in biomedical sensing platforms. In this article, a Triple-Stack Gate-All-Around (GAA) Nanosheet Field-Effect Transistor (NSFET) based biosensor is designed using TCAD Silvaco simulations. The designed biosensor detects Cervical cancer biomarkers like ssDNA, HPV16 E6, miR-21, miR-155, and p16INK4a and other biomolecules like DNA and gelatin. The proposed design has nanosheet that increases the sensitivity of the sensor. The sensing mechanism is established by incorporating a 3 nm nanoscale cavity within the gate dielectric around the nanosheet channel, encompassing the top, bottom, and sidewall regions within the gate stack, enabling effective biomolecule immobilization through dielectric modulation. The sensitivity variation of the biosensor is analysed in terms of subthreshold swing (SS) and power consumption and depends on the number of biomolecules filling rather than specific filling position. Surface charge (Q_f) is also induced to study the effect of charge modulation on device performance. The result for P16INK4a biomarker shows the most optimized electrical characteristics, achieving SS of ~60 mV/dec. An ON current of 18.9 μ A and a very low OFF current of 0.102 pA, resulting in a high switching ratio of 1.85×10^8 with low static power consumption of ~0.0666 pW. The proposed device exhibits a sensitivity of approximately 1.2 for the optimized biomarker condition. These findings establish the proposed design as a high current sensitive, low-power solution for the early diagnosis of cervical cancer, offering superior gate control and reliable detection capabilities compared to existing FET-based biosensors.

An Agentic AI Framework for Human-Centric UI Code Synthesis

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Abstract

Beginners and non-technical users often face a problem in converting their user interface (UI) design ideas into working code, which slows down the process of development because of the need for programming skills and technical knowledge. This project proposes a novel approach to generate HTML and CSS code directly from natural language using Agentic AI supported by open-source Large Language Models here using Llama model. By interpreting the simple text description of UI design given by the user or developer, code gets generated in a clean, semantic way that eliminates the need for traditional manual coding. Using Monaco Editor, the user can get a live preview of the HTML and CSS code that was generated. Also, the platform facilitates real-time multiuser collaboration through a conflict-free replicated data type (CRDT) framework using Yjs and web sockets technologies that provides collaborative web design similar to popular editing tools. A YOLO-based verification model is used to make sure that the generated UI components meet the standards, which can be iteratively refined until the output reaches predefined layout and quality thresholds. The data set for this project consists of a large collection of LLM-generated ideas, along with the code generated and the image of the output of the code. Focusing on HTML and CSS code generation, this solution improves the early stages of web development, reducing the dependency on coding skills.

Synergistic Effects of Granite Slurry and Blast Furnace Slag on the Rheological, Mechanical, and Durability Performance of Self-Compacting Concrete

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Abstract

The construction industry is growing quickly, which has made it extremely crucial to find materials that work well and are good for the environment. This has led to the use of industrial by-products in concrete. This study looks at how granite slurry and blast furnace slag can be used together to make self-compacting concrete (SCC) better. This method uses granite slurry to partially replace cement and blast furnace slag to replace natural aggregates. This makes the mix better for the environment. We did a lot of tests, like slump flow, V-funnel, and L-box, to check the fresh properties and make sure it flowed well and passed. After the concrete had hardened, it was tested for compressive and split tensile strength, as well as durability factors like how well it absorbs water and how well it holds up in different weather conditions. The results show that combining these materials significantly improves workability, strength, and durability compared to conventional SCC. This is mainly due to improved particle packing, lower porosity, and a denser internal structure. Overall, the study highlights that using these industrial waste materials together is an effective way to produce sustainable, cost-efficient, and high-performance concrete while also reducing environmental impact.

SHAP-Guided Dynamic Feature Reweighting for Adaptive Short-Term Electricity Demand Forecasting with Integrated Anomaly Detection

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Abstract

Accurate short-term electricity demand forecasting is crucial for keeping the grid stable, optimizing energy trading, and improving operational efficiency in modern power systems. However, current machine learning models often act as "black boxes," delivering high accuracy without the necessary transparency for important decision-making. This paper introduces an integrated, explainable machine learning framework for real-time demand forecasting on the Texas ERCOT grid, using historical load and multi-source weather data from 2023 to 2024. The main innovation is a new SHAP-guided dynamic feature reweighting algorithm. Unlike traditional post-hoc explainability methods, this approach repeatedly incorporates SHAP values back into the training process as dynamic sample weights, compelling the model to focus on complex, high-impact demand hours.

The framework has a real-time end-to-end pipeline that integrates live data from EIA and Open-Meteo APIs. It also includes a two-layer anomaly detection system that uses statistical Z-score filtering alongside Isolation Forest. Experimental results show that the proposed SHAP-guided XGBoost model reaches a Mean Absolute Percentage Error (MAPE) of 3.86%, marking a 63.6% improvement over the persistence baseline and an R^2 of 0.82. These results indicate a scalable, transparent, and highly accurate solution for managing the 26-million-customer ERCOT network.

Keywords

Electricity demand forecasting, xgboost, shap, explainable ai, anomaly detection, feature reweighting.

E – Commerce Platform with Personalized Recommendation

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Abstract

E-commerce personalization customizes individual product recommendations, search results, and content to individual users. This paper is a complete project on the development of an e-commerce site that involves the delivery of personalized information.

Using the behavior of the user (clicks, views, purchases), product metadata, and environmental features (time, device), our paper constructs an e-commerce prototype that provides a user with personalized product recommendations and customized content. It also measures the effectiveness based on the offline measures and a simulated online A/B test.

Keywords

E-commerce, personalization, recommender systems, collaborative filtering, content-based filtering, hybrid recommendation, user modeling, A/B testing.

Hybrid PSO–DE Based Optimal Integration of Distributed Generation and Battery Energy Storage Systems

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Abstract

The increasing integration of distributed energy resources in modern power distribution systems requires efficient optimization techniques to improve system performance and reliability. This paper presents a hybrid Particle Swarm Optimization–Differential Evolution (PSO–DE) algorithm for the optimal sizing of Distributed Generation (DG) and Battery Energy Storage Systems (BESS) in the IEEE 33-bus radial distribution system. The proposed method aims to minimize the total power loss, voltage deviation, and voltage stability index through a weighted multi-objective optimization approach. A backward/forward sweep load flow method is employed to evaluate the distribution system performance during the optimization process. The hybrid PSO–DE algorithm combines the global exploration capability of Particle Swarm Optimization with the mutation and crossover operations of Differential Evolution to improve the search efficiency and convergence performance.

The proposed method is applied to the IEEE 33-bus radial distribution system to determine the optimal sizes of DG and BESS. Simulation results demonstrate that the proposed approach effectively enhances the overall performance of the distribution system by reducing power losses and improving the voltage profile and system stability. The results ensure the effectiveness of the hybrid PSO–DE algorithm for optimal integration of distributed energy resources in radial distribution systems.

Keywords

Distributed Generation Integration, Battery Energy Storage System, Hybrid PSO–DE Algorithm, Voltage Profile Improvement, Power Loss Reduction.

Detection of Glioma Brain Tumor in MRI Images Using Transformer-Based Deep Learning with Deformable DETR v2

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Abstract

Brain tumors are a critical medical concern, with gliomas being one of most aggressive types. Early and accurate detection of gliomas is essential for effective treatment and improved patient survival. Magnetic Resonance Imaging (MRI) is widely used for brain tumor diagnosis because of its high contrast in soft tissues. While traditional deep learning methods like U-Net, Faster R-CNN, and CNN-based segmentation networks have shown promise, they often suffer from high computational demands and long inference times. This project proposes the use of Deformable DETR v2, an advanced transformer-based object detection model, for glioma detection. Unlike traditional CNNs and even YOLO-based detectors, Deformable DETR v2 utilizes multi-scale deformable attention, enabling faster convergence, efficient small tumor detection, and higher accuracy across complex tumor shapes. The model will be trained on BraTS2021 dataset, which includes T1, T2, T1ce, and FLAIR MRI sequences, offering diverse tumor representations. Compared to previous CNN and YOLO architectures, Deformable DETR v2 can achieve superior performance in both speed and precision, while maintaining scalability and real-time inference capability. Its transformer backbone and efficient attention mechanisms make it highly suitable for clinical deployment in automated brain tumor diagnosis, offering a promising solution for faster and more accurate glioma detection.

Keywords

Brain Tumors, Gliomas, MRI, Vision Transformers, Deformable DETR V2, BraTS Dataset, Tumor Detection, Deep Learning, Attention Mechanism.

Latency-Aware Depth Optimization of Quantum Gate Scheduling for Efficient Circuit Design

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Abstract

The next-generation Internet of Things (IoT) and quantum-based computing must have high processing speed with a low latency. The circuit depth of quantum circuits including the number of consecutive layers of T-gates directly impacts the performance of the execution time and the performance of the system overall. The great circuit depth results in delay and inefficient use of resources. In this paper, a Depth-Optimized Latency-Aware Quantum Gate Scheduling (LAD-QGS) will be suggested to minimize the circuit latency without compromising functional correctness. The given methodology conducts the gate dependency analysis, smart reordering of gates, and parallel execution of independent gates to decrease T-depth and decrease the CNOT overhead. The Verilog HDL is used to implement the optimized design and Xilinx Vivado design tool is used to analyze the design. The experimental data proves that the suggested approach decreases the critical path delay to 6.897 ns versus 7.210 ns, which results in the improvement of the delay by about 4.34 percent. The overall on-chip power consumption is also decreased, and is now 1.598 W, a decrease of approximately 4.42 percent, and still with the same hardware resource usage (2 LUTs). These findings substantiate the fact that the suggested scheduling method successfully enhances the efficiency of a circuit by decreasing latency and power expenses and without making it larger. The suggested architecture offers a feasible remedy to design quantum circuits with low latency and resource efficiency in the coming generation computing operations.

Keywords

Quantum Computing, Quantum Circuit Optimization, Latency-Aware Scheduling, T-Depth Minimization, Verilog HDL, Vivado Analysis etc.,

An Investigation of Gastric Cancer Detection and Classification from Endoscopic Images Using UNET, RESNET, VGG16, Conditional GAN and Deep CNN GAN

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Abstract

Background: Early detection of stomach tumors at stages 1 and 2 is crucial for enhancing endurance rates and therapy effectiveness. Gastric cancer poses a significant health challenge in Asia, being the next leading reason for cancer-related deaths. Timely diagnosis is crucial, as patients spotted at stage 0 exhibit a five-year survival rate exceeding 90%. However, in India, about 34,000 cases are diagnosed annually, predominantly at advanced stages (3 or 4) due to insufficient screening methods.

Methods: This study investigates advanced machine learning techniques to enhance diagnostic precision by evaluating multiple Generative Adversarial Network (GAN)-based methods: Conditional GAN, Deep Convolutional Neural Network GAN, and traditional imaging analysis procedures U-Net, ResNet, and VGG16. These approaches were employed to analyze endoscopic images, a primary diagnostic tool for detecting subtle pathological variations in gastrointestinal tissues, reinforcing sensitivity and specificity in malignancy recognition.

The study compares the results of GAN-based architectures and traditional deep learning models in order to see which one works better for cancer detection. Rather than proposing a fused or ensemble model, this work focuses on identifying the relative strengths and limitations of individual architectures and examining scenarios in which GAN-based method demonstrates potential advantages over traditional CNN models, particularly in handling data variability and limited training samples.

A comprehensive evaluation was conducted using standard datasets of endoscopic images, comparing the efficiency of each model in terms of precision, recall, and overall investigative accuracy. Special emphasis was placed on understanding the limitations of each approach and identifying scenarios where hybrid or ensemble models could provide optimal outcomes.

Results: A comparative analysis was performed between traditional Neural Networks and Deep CNN GAN, assessing their accuracy, precision, and recall. The performance metrics for various models were as follows:

- ResNet: Accuracy – 64%, Precision – 62%, Recall – 64%
- U-Net: Accuracy – 70%, Precision – 72%, Recall – 70%
- VGG16: Accuracy – 90%, Precision – 91%, Recall – 90%
- Deep CNN GAN: Accuracy – 97%, Precision – 98%, Recall – 97%
- This analysis demonstrates that the Deep CNN network exhibits superior performance in the early detection of gastric cancer.

Conclusions: The findings provide critical insights into the fortes and trade-offs of the refined Deep CNN GAN method used for stomach tumor detection using endoscopic imaging. The comparative results offer a foundation for forthcoming enhancements in therapeutic imaging and tumor assessments.

Keywords

Early prediction, U-Net, ResNet, VGG16, Conditional GAN, DeepCNN GAN, Endoscopic Imaging.

Working Model of Injection Moulding

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Abstract

Injection moulding machine is one of the most widely used method for conversion of plastics into various end products application to wide range of plastic material. The main principle is to compress the plastic material in a heating chamber (barrel) with the help of plunger and induction coil convert plastic polymer into molten (semi-solid) state. Then the plastic polymer in predetermined quantity is forced through the nozzle into the die under pressure. After completing the process, final product is obtained from the die. We can use plastics, metals or alloys for this process. In our project we are using plastics polymers for making washers, bushes etc. This machine is a prototype for producing small plastic components. This injection moulding machine is very useful for the small scale industries because of its low manufacturing cost, low maintenance cost, no skilled worker is required. It can be recommended for small scale investors those who are willing to produce small plastic products.

Fake Profile Detection on Social Networking Websites using Machine Learning

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Abstract

The present generation has seen an increase in the use of online social networks (OSNs), which has an impact on people's social lives and motivates them to connect with various social media platforms. Communications, agenda-setting, news generation, marketing, and advertising are just a few of the many jobs that social networks have made feasible. Adding new friends and keeping up with their changes is now easier. Researchers have been studying these online social networks to find out how they affect people. Some bogus accounts are used to promote agendas and disseminate misleading information. Finding malicious accounts is crucial. To find bogus accounts that could trick consumers, machine learning-based methods were used. A comparison model is created after the dataset is pre-processed using a number of Python tools in order to obtain a practical method that is suitable for the dataset. A number of machine learning algorithms recognize attempts to detect fraudulent accounts on social media sites. Based on their capacity for categorization, the algorithms Random Forest, Neural Network, and Support Vector Machines are used to identify fake accounts.

Advancing Patient-Centric Healthcare: A Comprehensive Review of NLP-Based Question Answering Systems

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Abstract

Natural Language Processing (NLP)-driven Question Answering (QA) systems hold transformative potential for patient-facing healthcare services, offering immediate, accurate, and personalized responses to medical queries. This paper provides a thorough review of state-of-the-art QA systems in healthcare, traces methodological advancements from foundational models to cutting edge multimodal architectures, evaluates clinical applicability, identifies remaining research gaps, and proposes a comprehensive framework for future patient-centric QA platforms. This paper analyzed few representative studies encompassing systematized reviews, empirical model comparisons, domain-specific pre-training, hybrid reasoning architectures, and retrieval-augmented-generation (RAG) systems. This paper highlight performance benchmarks, methodological trade-offs, and deployment challenges. Finally, this paper outline a strategic roadmap for developing robust, trustworthy, and accessible patient QA solutions.

AI-Powered Web Testing Agent: A Scalable Solution for Automated Web Application Testing

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Abstract

Web application testing plays a vital role in today's software development lifecycle. Nevertheless, classical approaches to web application testing tend to be ineffective due to the fast pace of development. In this regard, this paper provides an innovative solution to web application testing called Qubo, an intelligent agent using artificial intelligence technologies that are supposed to revolutionize the field and increase efficiency of web testing. Qubo offers seamless integration with the web development process through its modular architecture based on such technologies as Next.js and Prisma. The core of the proposed framework relies on artificial intelligence mechanisms including natural language processing (NLP) for automated generation of tests scenarios and reinforcement learning algorithms for choosing optimal testing approaches. Such an approach enables users to speed up testing and improve its quality. The suggested solution consists of various features including a test management dashboard, test suite management tools, automated reporting, and others. The agent uses a wide range of reusable UI components to ensure flexible adaptation to the peculiarities of the target application. Also, the use of Qubo allows for easy integration of the framework into CI/CD pipelines through APIs provided by the agent. The performance evaluation showcases how successful Qubo is in detecting critical bugs and improving test coverage in different real-world web apps. These findings point out how efficient the agent can be in reducing testing time by up to 40%, without sacrificing accuracy and efficiency. In addition, the modular architecture makes the proposed system scalable to accommodate more complex projects. In this paper, we talk about the system architecture, AI models used, and their implementation in order to illustrate the problems faced when developing the solution and the way we solved them. We emphasize the benefits that an intelligent web app testing agent can offer to automate this process successfully. Further research will center around creating an adaptable AI agent for testing applications in a cross-platform environment.

Keywords

AI-Powered Testing, Web Application Testing, Artificial Intelligence, Machine Learning, Natural Language Processing (NLP), Reinforcement Learning, Automated Testing, Test Case Generation, Continuous Integration and Deployment (CI/CD), Next.js, Prisma, Modular Architecture, Dashboard Design, API-Driven Development, Software Quality Assurance, Adaptive Testing, Scalability, Performance Optimization.

TRIGLOPS: Transformer-Augmented Resource Scheduling in Cloud Environments Using Machine Learning-Based Process Prediction

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Abstract

Scheduling tasks in cloud platforms is a very tough task because of workload change and also due to uncertainty and also the dynamic workload change. Commonly used scheduling algorithms include FCFS, Round Robin (RR), Shortest Remaining Job First (SRJF). Mainly, the heuristics are reactive because they make decisions on the current workload of queue ignoring all other upcoming workloads and their expected execution times. So, one and only one solution for the above-mentioned challenges is to use the GLOPS (Global and Local Optimized Preemptive Scheduling) framework by a combination of machine learning & Hybrid Metaheuristics scheduling for Job Scheduling. The prediction of burst time in GLOPS framework is done using the LSTM (Long-short Term Memory) based model and the global search is done by the PSO (Particle Swarm Optimization). Limitations of LSTMs are like vanishing gradients; not able to model long-term temporal dependencies are some of the pitfalls that cause low accuracy predictions of complex systems. This paper introduces the TRIGLOPS (Transformer Augmented Global and Local Optimized Preemptive Scheduling) framework which replaces LSTMs with Transformer in GLOPS to better capture the temporal patterns of burst time Prediction. These Predictor modules are combined with the Simulated Annealing (SA) and PSO algorithms for hybrid search strategy & SRJF Scheduling Strategy. The experimental results show competitiveness in comparison with classical schedulers as well as optimization techniques like Genetic Algorithms (GA) and Deep Reinforcement Learning (DRL). If turn-around time, waiting time and response time, TRIGLOPS is always the best than the classical baseline techniques.

Keywords

Cloud computing, task scheduling, transformer, triglops, particle swarm optimization, simulated annealing.

Deep Learning Methods for Early Detection in Diabetic Retinopathy

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Abstract

Diabetic Retinopathy (DR)- one of the major causes of vision impairment and preventable blindness. Timely detection is important for the effective management but conventional methods of diagnosis are often slow and depend on the skill of a specialist. This work proposes an artificial intelligence (AI) driven system which is based on Vision Transformer (ViT) architecture for the classification of retinal conditions from the images of the retina. The model is implemented in a web application built on Flask which provides the clinicians immediate results on diagnosing the fundus images uploaded to the web application. Utilizing some techniques like global average pooling, dropout regularization and use of sigmoid activated dense output layer make the system to perform robustly. The performance measure of a model is in terms of various quantities, such as accuracy, sensitivity, specificity, precision, recall, F1-score and AUC. This type of AI-based system tries to improve the early detection of diabetic retinopathy and therefore, it could easily be utilized in both well-resourced and underserved healthcare settings.

Keywords

Diabetic Retinopathy, Deep learning, Vision Transformer (ViT), Multilabel Classification, Fundus Image Classification, Flask Web Application, Accuracy, AUC, Precision, Recall.

Development of a Bluetooth-Enabled Magnetic Field-Based Sleep Induction System for Insomnia Therapy

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Abstract

While traditional therapies like medication and behavioural therapy frequently result in side effects, long-term dependency, or uneven results, sleep disorders, especially insomnia, have a substantial impact on everyday performance, mental health, and physical health. This research proposes a non-invasive Sleep Inducing System that uses low-frequency magnetic field stimulation modelled after the Earth's natural geomagnetic field to overcome these drawbacks. The suggested gadget facilitates synchronization with natural circadian rhythms and promotes relaxation and the onset of sleep by operating within biologically significant frequency ranges linked to human brainwave activity. The system may be customized to meet each person's unique sleep needs thanks to user-adjustable features that allow for frequency and duration customization. An Arduino microcontroller, a Bluetooth connection module for wireless operation, and an electromagnetic coil powered by a MOSFET driver are used in the system's implementation. Arduino Bluetooth Control, a free Android app that allows basic ON and OFF capabilities via serial communication, is used to achieve mobile-based control to improve user convenience. Usability is enhanced and manual involvement during rest is eliminated with the introduction of wireless control. The suggested remedy shows the potential of bioelectromagnetic treatment in conjunction with mobile technology for intelligent sleep support applications and provides a safe, economical, and drug-free alternative for treating sleep problems.

Keywords

Insomnia, Sleep disorders, Magnetic field therapy, Geomagnetic field, Bluetooth control, Arduino, Mobile application, Bioelectromagnetic therapy, Non-invasive treatment, Sleep induction.

Classification of Schizophrenia Using an Adasyn-Enhanced TabNet Model

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Abstract

Schizophrenia is a chronic mental disorder that is severe and influences the perception, emotions and other cognitive functions. This is in about one percent of the total number of people on earth. Individuals that have this mental disorder are subject to delusions, hallucinations and are compelled to think abnormally, this impacts negatively on the lifestyle of those individuals. Failure to treat in time may have dangerous consequences like prolonged hospitalization and permanent injury. It is, therefore, of importance to diagnose at an early and right period. ECG-based method is a conventional diagnostic method that provided the precise results at the cost of high price and could not be applied without the specialists. Clinical setting diagnosis can contribute to delaying the diagnosis and treatment process. To address such challenges, this study has proposed ADASYN-enhanced TabNet model which would be used to detect schizophrenia using data that contains age, gender, education, marital status, and income. The imbalance in the classes in ADASYN method to the issue of class imbalance creates artificial members of the minor classes and this reduces bias in the models. TabNet is an interpretable deep learning model with attention mechanisms, which is trained on this balanced dataset. The experimental findings demonstrate that the classification accuracy has improved considerably as compared to the state of art machine learning approaches.

Keywords

Schizophrenia classification, ADASYN, TabNet, machine learning, deep learning, tabular data, data imbalance, clinical diagnosis, Google Colab, explainable AI.

A Blockchain-Driven Framework For Secure Electronic Voting

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Abstract

The right to vote is among the most significant rights in democracy. However, the conventional procedures and voting processes are fraught with numerous problems such as vote manipulation, absence of transparency, and absence of proper security to the casted votes. This led to low voter trust. In electronic voting systems even they do not avoid certain drawbacks such as data hacking, problems of centralized control. To address these issues, this project will suggest a blockchain-based system of secure e-voting. The given paper presents a powerful blockchain technology that offers a decentralized and immutable system in which all the votes are registered and stored. When the vote is casted it can neither be altered nor deleted. It assists in providing transparency, security and lack of vote tampering. The suggested system applies cryptographic methods in safeguarding voter identity. It assists in revealing the identity of voter. Smart contracts are deployed to automate the process of vote recording and vote counting in order to minimize the possibility of error as well as minimize human interaction. This aids in ensuring fairness in the elections as well as boost the trust of the voters that their votes are not being compromised. This assists in the fair running of elections with fair result. The primary tasks of this suggested system include the deployment of cryptographic methods, intelligent contracts and a blockchain-supported voting system. The principle behind this is to make the elections fair. And earn the peoples confidence that all citizens will take part in the elections and exercise their right to vote without fear and doubts.

Keywords

Blockchain Technology, Decentralized, Smart Contracts, Cryptographic Techniques, Transparency, e-voting, Immutability.

Health Data Information and Management System via Mobile Application

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Abstract

In recent years, the healthcare sector has undergone rapid digital transformation; however, traditional paper-based and fragmented digital systems still lead to inefficiency, data loss, and delayed access to accurate medical information. To overcome these challenges, a Health Data Information & Management System (HDIMS) is proposed as a centralized mobile-based healthcare platform. The HDIMS application securely stores and manages patient health information, including patient profiles, medical history, diagnoses, prescriptions, laboratory reports, and appointment details. The system employs secure authentication algorithms for user verification and role-based access control (RBAC) algorithms to ensure that only authorized users can access or modify sensitive health data. Encryption algorithms such as AES are used to protect patient information during storage and transmission in cloud environments. Efficient database indexing and retrieval algorithms enable fast access to medical records, while data validation algorithms ensure accuracy and consistency of healthcare data. Patients can access their health records anytime through the mobile application, while authorized healthcare professionals can securely update and manage patient data. Real-time data availability improves communication, clinical decision-making, and continuity of patient care. By reducing paperwork and administrative workload, the HDIMS system significantly enhances healthcare efficiency, data security, and overall service quality.

Integrated Autonomous–Teleoperated Rover Navigation with Dynamic Graph Modeling and Optimal Path Computation

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Abstract

The advancement of autonomous robotic navigation solutions that require minimal human involvement and maintain efficiency has been driven by the increased need for intelligent logistics, service robotics, and automated monitoring systems. This paper presents an autonomous robotic system based on Arduino for intelligent navigation and control, obstacle avoidance under adaptive control, and real-time perception of the environment. The system includes ultrasonic sensors and camera for teleoperation via live video streaming, and environmental perception with pre-existing control for remote operation. The system is built on a weighted graph of the environment for optimal path finding and obstacle avoidance using Dijkstra's shortest path algorithm. Additionally, an autonomous parking system for designated safe stopping places and operational independence is included. The system has been experimentally evaluated and found to improve reactive navigation systems in terms of higher navigation precision, lower probability of collisions, and greater path efficiency. Ultimately, the system is an effective solution with a positive cost-benefit ratio for remote inspection, delivery robots, and automation of warehousing.

Keywords

Autonomous navigation, hybrid control, hybrid robotic systems, wireless teleoperation.

Interactive Flood Severity Mapping with Threshold-Based Alerts and Xgboost Classifier

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Abstract

Flood disasters remain a serious threat to infrastructure and ecosystems and human life in areas where hydrological conditions undergo constant changes. The predictive capabilities and immediate response capabilities of traditional flood monitoring systems get restricted because they depend on fixed threshold rules and require human evaluation. This research introduces an interactive flood severity mapping system which combines machine learning-based multi-class classification with a rule-based threshold alert engine. The system uses environmental and hydrological parameters which include rainfall intensity and river level and soil moisture and terrain elevation and water depth to forecast flood severity levels which are Low Medium High and Critical. The XGBoost multi-class classifier serves as the system's core because it provides strong performance across various scales and enables the estimation of complex relationships between multiple attributes. The framework includes a threshold validation component which activates real-time notifications when actual risk probabilities surpass established threshold values. The model assessment process used a flood severity dataset which contained approximately 5,020 records and applied a stratified 80:20 distribution method. The experimental results show a test accuracy of 96.31% and a weighted F1-score of 96.29% which demonstrate excellent performance in predicting multiple classes. The analysis of feature importance shows that Water Depth functions as the main factor which determines system performance. The system achieves inference times below 50 milliseconds which enables its use in both real-time disaster monitoring and interactive geographic visualization applications.

Keywords

Flood Severity Prediction, XGBoost, Threshold- Based Alerts, Multi-Class Classification, Disaster Management, Interactive Mapping, Real-Time Monitoring, Feature Importance Analysis.

Intelligence Traffic Control System

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Abstract

Traffic congestion within urban settings is an urgent issue which is attributed to the fact that such systems are still using the fixed time traffic signal systems which are not adaptive to the changing traffic situations. In this paper, we suggest a real-time adaptable traffic management system, which is an intelligent system of traffic light control relying on the use of computer vision and deep learning methods. The suggested system utilizes IP cameras live video streams to identify, classify, and count vehicles with the help of the YOLOv5 object detection model installed on an edge computing system. The density of the vehicle in each lane of the traffic is constantly estimated and the signal phase time is varied in order to achieve optimal traffic flow and shorten the total waiting time. It runs on an NVIDIA Jetson Nano to allow low latency, on-device learning without use of a cloud-based system. Through experimental tests, it is shown that traffic throughput, queue length and consistent real-time performance are greatly improved in various traffic conditions. The system suggested is an efficient, scalable, and cost-effective solution to efficient traffic control, which is why it is highly applicable in the application of smart cities.

Keywords

Intelligent Traffic Control, Computer Vision, Deep Learning, YOLOv5, Edge Computing, Vehicle Detection, Adaptive Traffic Signals, Smart Cities.

Managing the Modern Workforce: Evaluating the Effectiveness of Remote and Hybrid Working Policies

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Abstract

In the aftermath of the COVID-19 pandemic, organizations have significantly restructured traditional workforce management practices by adopting remote and hybrid work models. This study examines how these work arrangements function within contemporary organizational strategies. It aims to identify effective practices for managing geographically dispersed teams and to evaluate the impact of remote work on employee productivity, job satisfaction, and work-life balance.

A comprehensive review of existing literature, including scholarly articles, books, and conference papers, forms the basis of this research. The findings indicate that remote work can enhance productivity and job satisfaction by minimizing workplace distractions and increasing flexibility. However, it may also lead to challenges such as social isolation and difficulties in maintaining clear boundaries between work and personal life. Hybrid work models, which integrate remote and office-based work, offer a balanced solution by promoting collaboration while preserving flexibility.

The study further highlights the importance of leadership, particularly transformational leadership and effective communication, in managing remote and hybrid teams successfully. It concludes by emphasizing the need for continued research to understand evolving trends and long-term implications for employee well-being and organizational performance.

Keywords

Workforce Management, Remote Work, Hybrid Work, Organizational Effectiveness.

Augmentation Aware Transfer Learning for Deepfake Image Forensics

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Abstract

Over the last few years, deepfakes have posed serious threats to digital security, privacy, and the integrity of information over the internet due to their increasing realism and widespread accessibility. While most detectors using deep learning techniques report good accuracy on clean benchmark data, the accuracy drops significantly once the images are uploaded, JPEG compressed, resized, and reshared on social media platforms. Under these conditions, the traces of subtle manipulations are likely to be overwritten, and new JPEG compression artifacts may be added. The current study proposes a compression-aware deepfake image forensics model that utilizes the EfficientNet-B0 architecture with transfer learning. Instead of designing a new and complicated architecture, the focus here is on the design of an effective two-stage training plan: first, the EfficientNet-B0 model is fine-tuned on the combination of pristine real faces and AI-generated faces; second, the model is further trained on the combination of realistic augmentations, including blur, noise, color and illumination changes, mild geometric transformations, and JPEG compression at different quality levels. The effectiveness of the model is demonstrated on the large face data set, where good accuracy, precision, recall, F1 score, and ROC AUC are reported while the model becomes more robust against heavy JPEG compression, making it more suitable for deployment in web-based deepfake detectors.

Keywords

Deepfake detection, EfficientNet-B0, transfer learning, social-media image compression, JPEG artifacts, curriculum-based training, image forensics.

A Deep Learning Approach for Proactive Network Threat Analysis Security Enhancement

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Abstract

Network security has become a critical concern due to the rapid increase in cyber-attacks targeting modern communication systems. Traditional intrusion detection systems (IDS) rely on signature-based approaches, which are ineffective against unknown and evolving threats. This paper proposes a hybrid deep learning-based network intrusion detection system that performs real-time analysis of network traffic using flow-based features. The system captures network packets, converts them into flow-level data, and extracts statistical features for classification. A hybrid model combining Multilayer Perceptron (MLP) and Long Short-Term Memory (LSTM) is employed to capture both spatial and temporal patterns in network traffic. The proposed model is evaluated using the CICIDS2017 dataset, achieving an accuracy of 96.8%, precision of 95.9%, recall of 96.2%, and F1-score of 96.0%. Comparative analysis with traditional machine learning models demonstrates that the proposed approach improves detection performance while reducing false positives. The modular architecture of the system ensures scalability and supports real-time deployment in modern network environments.

Keywords

Network Intrusion Detection System, Deep Learning, Network Security, Traffic Analysis, Anomaly Detection.

Export Forecasting Using ARIMA and LSTM-Based Predictive Analytics

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Abstract

The question of whether the quantities of export can be forecasted with probability is one of the most significant questions of applied economics, and it is not only the nonlinear geopolitical shocks whose patterns are hard to predict but also the periodic nature of the developments in demand, the periods of production, etc. which makes the task challenging to both strictly statistical and purely data modeled. The given paper presents a hybrid forecasting architecture that is a hybrid between the Auto Regressive Integrated Moving Average (ARIMA) model and stacked Long Short-Term Memory (LSTM) recurrent neural network. ARIMA can be used to decompose a linear trend, removing the seasonality as well as performing principled differencing, whereas LSTM can be required to do it as it goes through training as a model on the ARIMA residual to enable it to be able to andragogy back any human structured nonlinear dynamics which are not described by the parametric model. The path throughout the data acquisition, pre-processing, feature engineering, model-training, and interactive visualization of the dashboard is stated and attempted with the usage of actual trade information of the commodities at a level. Results show that the developed hybrid achieves 44 percent reduction in the Mean Absolute Percentage Error than the standalone SARIMA with equivalent reduction in RMSE and MAE, and that would be worth affirming the complementary nature of the two modelling paradigms. The system offers credible projections of the future that can help to inform strategic decision making in international trades among policymakers, exporters and supply-chain planners.

Keywords

ARIMA, trade analytics, predictive analytics, export forecasting, hybrid time-series model, LSTM, recurrent neural network.

Stand-Alone Hybrid Microgrid System for Agricultural Irrigation: Integrating Diesel Generators and Solar Energy Sources

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Abstract

Agricultural irrigation needs continuous energy resources which rural areas require because their electrical grids do not function properly. Diesel generators function as the primary power source for conventional irrigation systems which need constant fuel supply for their operations and create environmental damage. The study presents a hybrid microgrid system which operates independently through its integration of solar photovoltaic panels and diesel generators with battery energy storage to support agricultural irrigation needs. The system designated solar photovoltaic (PV) systems as its main power source which transforms solar radiation into electricity for powering irrigation pumps. The team uses Maximum Power Point Tracking (MPPT) to achieve optimal solar power harvesting throughout different environmental conditions. The system uses battery storage to accumulate surplus solar power while delivering power during times of low solar energy or at night. The diesel generator serves as a backup power system to maintain continuous operations during periods of renewable energy shortage. The researchers used MATLAB/Simulink to create a system model which they tested under various load and weather scenarios. The hybrid microgrid system demonstrates a substantial decrease in diesel fuel usage and operational expenses along with greenhouse gas emissions reduction while providing dependable irrigation power, which establishes its viability as an environmentally friendly energy solution for rural agricultural systems.

Keywords

Maximum point of power tracking (MPPT), solar, grid interaction, diesel generators, voltage source converters, and irrigation work etc.

A Comprehensive Literature Survey on AI - Augmented Cyber Threat Intelligence Security Orchestration Platform

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Abstract

This literature survey systematically reviews research published between 2020 and 2025 relevant to the development of an AI-Augmented Cyber Threat Intelligence (CTI) Security Orchestration Platform. The survey examines eight core research articles over NLP-based entity extraction, automated process of intelligence report generation, threat intelligence sharing frameworks, explainable AI for threat analytics, and scalable CTI pipeline architectures. Key themes synthesized include transformer-based Named Entity Recognition for STIX object extraction, Natural Language Generation for automated CTI reporting, zero-shot GLINER and supervised learning methods for information extraction, MITRE ATT&CK and D3FEND framework integration, and the role of STIX/TAXII standards in machine-readable intelligence sharing. The review identifies a consistent research gap. While substantial progress has been made in individual components such as entity extraction and threat classification, no existing solution unifies GLINER based entity identification, XAI recommendations, and SIEM/SOAR-compatible STIX/TAXII export in a single orchestration platform. This gap directly motivates the proposed system, which integrates all identified advances into a cohesive, analyst-centric CTI engine. The survey provides the methodological foundation, reference benchmarks, and research context for the proposed platform.

Predicting Cyberattacks Using Generative Artificial Intelligence and Conventional Machine Learning

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Abstract

Cyber threats are becoming more sophisticated, which puts people, businesses, and countries at serious risk. Cybercrime, which includes hacking and data breaches, has detrimental effects on society and the economy. Strong cybersecurity measures are essential in today's connected world to reduce these dangers and safeguard private data. However, the constantly changing threat landscape is too much for conventional security systems to handle. To tackle these issues, artificial intelligence (AI) provides a potent toolkit. In order to address a variety of cybersecurity issues, this study investigates the use of AI techniques such as machine learning (ML), deep learning (DL), natural language processing (NLP), explainable AI (XAI), and generative AI. An extensive examination of AI methods for improving cybersecurity is provided in this study. Important contributions consist of: 1) A comparison of ML and DL techniques assessing their suitability, accuracy, and applicability for different cybersecurity challenges; 2) research on XAI methodologies improving AI-powered security solutions' interpretability and transparency, especially in anomaly detection; 3) investigation of new developments in NLP and Generative AI (Gen-AI) analyzing how they might be used to model and lessen cyberthreats using sophisticated methods such as attack simulations and threat intelligence generation; 4) use of GenAI in cybersecurity and practical GenAI products for cyber security. By offering insights into practical and dependable solutions for reducing cyber threats and enhancing the overall security posture, this research seeks to enhance the state-of-the-art in AI-driven cybersecurity.

Keywords

Explainable AI (XAI), Natural Language Processing (NLP), Machine Learning (ML), Deep Learning (DL), Cybercrime, Cyberthreats, Generative AI.

Graph Attention-Driven GAN for Semantic Room Classification and Floor Plan Generation with Downstream 3D Reconstruction Compatibility

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Abstract

Automatic interpretation of 2D residential floor plans is a prerequisite for intelligent architectural tools, interior layout generators, and 3D scene reconstruction pipelines. This paper presents a unified deep learning framework that (i) assigns semantic room-type labels to floor-plan regions and (ii) synthesises structurally plausible layouts via an adversarial network whose generator is conditioned on a room-adjacency graph. The generator encodes each room through learned type embeddings, propagates relational context with multi-head graph attention [2] (8 heads, $d=256$), and decodes spatial occupancy maps at 128×128 resolution through transposed convolutions. The discriminator employs spectral normalisation [3] for Lipschitz stability. A synthetic corpus of 1,000 training and 2,000 evaluation samples—spanning nine room categories and 3–8 rooms per layout—was constructed to enable controlled, reproducible experimentation. The trained model attains **67.0 %** room-type classification accuracy on the training set and **64.0 %** on the validation set, with a macro-average F1-score of **0.65**. The train/validation gap of approximately 3 percentage points confirms the absence of severe overfitting. Ablations verify that removing graph attention reduces accuracy by roughly 8 percentage points. The generated occupancy maps are directly consumable by downstream 3D reconstruction tools such as Plan2Scene [10] and FloorNet [11].

Keywords

Generative adversarial networks, floor plan synthesis, graph attention networks, room classification, 3D scene conversion, architectural deep learning.

AI-Enhanced E-Commerce Platform with Real-Time Personalized Shopping Experience

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Abstract

This rapid expansion has led to an overwhelming number of products available through e-commerce, which often does not match user preferences and results in generic recommendations that do not help user engagement or purchasing decisions, so this study introduces an AI-driven SmartCart framework to provide real-time and personalized product recommendations within dynamic online shopping environments using collaborative filtering and content-based filtering techniques along with contextual signals to reflect user behavior and situational preferences. To accomplish this, SmartCart structure monitors user traffic, including search actions, product views, clicks, time spent on particular products, which are signals of interaction to infer short term and long-term patterns of preference without necessarily consulting past purchase history, and the recommendation policy is adapted dynamically as the user changes behaviour during a shopping process to represent the user intent in real time, and contextual information including, session time, frequency of views and sequences of clicks are included to enhance relevance of recommendation, and personalization no longer relies on fixed personalisation rules but instead on the factors of the moment.

The Rise of Crowdfunding: Trends Shaping Modern Financing

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Abstract

With the ability to gather money directly from a large number of supporters, crowdfunding is a revolutionary development in entrepreneurial financing. It prioritizes accessibility, openness, and community involvement in contrast to traditional finance. Crowdfunding has quickly become a popular fundraising method, changing the way small companies, startups, and creative initiatives raise money. By utilizing online platforms and providing alternatives to conventional bank loans and venture capital, it democratizes finance. Its next phase is being driven by emerging technologies like blockchain and artificial intelligence. Crowdfunding has emerged as a transformative force in modern financing, offering entrepreneurs, small businesses, and creative ventures an alternative to traditional capital sources such as banks and venture capital firms. By leveraging digital platforms, crowdfunding democratizes access to funding and fosters direct engagement between project creators and supporters. The crowdfunding industry is well-positioned for future expansion and innovation. A few of the trends that will influence the industry in the upcoming years include the incorporation of new technologies, the emergence of specialized platforms, and the growth into emerging markets. Crowdfunding will keep democratizing access to capital, enabling backers and creators to work together to realize new ideas. In order to stay relevant and useful in a world that is changing quickly, platforms will need to adjust to shifting consumer preferences and technological developments as the industry develops. This study is guided by two key objectives: 1. To analyze the evolving crowdfunding methods are changing and the way they affect the democratization of capital access, 2. To investigate new commercial and technical developments affecting crowdfunding sustainability.

Keywords

Crowdfunding, Trend, Technical, Commercial, Sustainability.

Effect of Rice Husk Ash Content on the Compressive Strength of GGBS Geopolymer Concrete Cubes

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Abstract

The aim of this project involves making of geopolymer concrete cubes by increasing its mechanical properties by replacing traditional cement with Ground Granulated Blast Furnace Slag (GGBS) and Rice Husk Ash (RHA). Here, we proceeded by adding 0% of rice husk ash (RHA) content. We casted the concrete cubes only by precisely using ground granulated blast-furnace slag (GGBS), fine aggregate (M sand), sodium hydroxide (NaOH) and sodium silicate (SS). while here, we proceeded by adding rice husk ash (RHA). we casted the concrete cubes by precisely using rice husk ash (RHA), ground granulated blast-furnace slag (GGBS), fine aggregate (M sand), sodium hydroxide (NaOH) and sodium silicate (SS). The results show that the increasing compressive strength is observed with the amount of GGBS and molarity the following M3 mix with (60% GGBS, 35% RHA & 5% Silica Fume) exhibited superior strength of 55 MPa during the period of 28 days consecutively among the database of mixes (8M). The following results showed that there was no statically important difference between the 8M and 10M molarity values ($p = 0.30$), indicating that moderate alkaline molarity is enough for the effective geopolymerization and compressive strength development under ambient curing conditions. The result of this study gave us a conclusion, that higher GGBS content and alkaline molarity, helps increases the compressive strength of geopolymer mortar among the following, the 60% GGBS, 35% RHA and 5% of Silica Fume mix with their mechanical tests and with respect to the molarity of 10 M was found to be superior or higher in performance thereby making it suitable for sustainable and high strength geopolymer construction uses.

Keywords

Geopolymer Mortar, GGBS, Compressive Strength, RHA, Flexural Strength, Workability, 8M Sodium Hydroxide, Partial Replacement.

A Multimodal Machine Learning Framework for Early Prediction of Parkinson's Disease Using Voice and Hand-Drawn Patterns

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Abstract

Parkinson's disease ranks as the second most prevalent neurodegenerative disorder worldwide, affecting over ten million individuals globally and nearly one million in India alone. Because its early symptoms – subtle tremors, mild vocal changes, and slight motor irregularities – tend to go unnoticed until significant neurological damage has already occurred, timely and accessible screening tools remain a pressing clinical need. This paper presents a multimodal machine learning framework designed to support early-stage Parkinson's detection through two complementary non-invasive input channels: voice recordings and hand-drawn spiral patterns.

For voice-based screening, acoustic descriptors including jitter, shimmer, pitch variation, and Mel-Frequency Cepstral Coefficients (MFCCs) were extracted from speech samples drawn from the UCI Parkinson's Speech Dataset. A Random Forest classifier trained on these features achieved an accuracy of 94.87 percent on a held-out test set (80/20 split). For motor-symptom analysis, spiral drawings from the HandPD dataset were preprocessed and fed into a three-layer Convolutional Neural Network (CNN) that automatically learned tremor-related distortion patterns, reaching an accuracy of 76.66 percent. A decision-level fusion strategy combining probability outputs from both models yielded an overall system accuracy of 85.7 percent, with the voice channel contributing a higher confidence weight owing to its stronger standalone performance. Beyond classification, the system was deployed as a web-based application supporting real-time input, secure user authentication via SHA-256 hashing, result history tracking, and watermarked downloadable reports. Evaluation results confirm that integrating speech and handwriting modalities provides a more comprehensive symptom profile than either modality alone. The system is intended strictly as a research- support and early-screening aid, and not as a substitute for neurological clinical diagnosis.

Keywords

Parkinson's disease, multimodal detection, Random Forest, Convolutional Neural Network, voice analysis, spiral drawing, decision-level fusion, machine learning.

A Review of Privacy-Preserving Explainable Federated Graph Learning Approaches for Heart Disease Prediction

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Abstract

Prediction of heart diseases in the current healthcare systems should be able to reach a high level of reliability without compromising patient confidentiality particularly when the medical records are exchanged among more than one institution. Traditional centralized learning methods are associated with privacy concerns, and current federated learning research works are usually not interpretable and unable to learn complicated relationships between clinical characteristics. This article is a review of recent studies on federated learning in combination with graph neural networks, differential privacy, and explainable artificial intelligence to predict heart disease. The paper classifies available techniques according to data representation scheme, privacy safeguard system, and ability to interpret and examines their advantages and disadvantages in dispersed healthcare settings. Specific focus is put on relational modelling of medical feature dependencies, privacy techniques to secure shared updates, and the enhancement of clinical trust by explanation methods. The review also outlines problematic issues such as varying data distributions in hospitals, communication overhead, privacy versus accuracy tradeoffs, and common evaluation frameworks. Lastly, the possible areas of research are identified to facilitate the creation of secure, transparent, and collaborative clinical decision support systems.

Keywords

Heart Disease Prediction, Federated Learning, Graph Neural Networks, Differential Privacy, Explainable Artificial Intelligence, Privacy-Preserving Healthcare, Distributed Medical Data Analytics, Clinical Decision Support System.

Identifying Disease for Liver CT-Scan Images Using Visual Transformers and Deep Learning

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Abstract

Radiologists and healthcare professionals may encounter issues with diagnostic accuracy. They often deal with a lack of real-time decision support and struggle to identify liver abnormalities using traditional manual image interpretation methods. This happens because most standard diagnostic approaches are only reactive and lack dynamic functionality. This paper aims to design and build an intelligent liver disease prediction system that improves diagnostic accuracy and allows for early detection of liver conditions from CT scan images. This specific kind of work falls under the Healthcare Technology theme and focuses on creating a practical AI-powered software system. The proposed system uses Flask for the backend and HTML, CSS, and Bootstrap for the frontend. It employs VGG16-based transfer learning for feature extraction and Visual Transformer (ViT) architectures for disease classification. The system provides real-time diagnostic output through a web-based interface with Grad-CAM heatmap visualization. It also features predictive disease classification, patient record management, and confidence score reporting using both trained model weights and real-time CT scan data. The results show that the proposed system effectively identifies liver conditions, including Squamous Cell Carcinoma, Large Cell Carcinoma, and Adenocarcinoma. It offers visual diagnostic explanations and enhances decision support compared to traditional manual radiology workflows. The proposed system serves as an efficient tool for helping radiologists manage liver disease diagnoses by using an intelligent deep learning approach instead of conventional image interpretation methods.

A Machine Learning–Driven Career Coach System for Automated Resume Screening and Interview Assessment

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Abstract

It is becoming more and more difficult for job seekers to match their resumes and interview responses with the quickly changing industry standards in the current, fiercely competitive recruitment environment. Numerous career counseling and preparation tools still in use today rely on manual evaluation or strict rule-based methods, which are frequently unadaptable and miss candidate profiles' semantic meaning. This paper presents an enhanced Career Coach system that uses machine learning and natural language processing techniques to automate resume-job matching and interview answer evaluation in order to overcome these limitations. TF-IDF features and explicit keyword overlap metrics are used to represent textual information from resumes and job descriptions in resume matching, which is formulated as a supervised regression problem. To determine the best strategy, a number of regression models are trained and thoroughly assessed, including Linear Regression, Ridge Regression, Support Vector Regression, Random Forest Regression, and Gradient Boosting Regression. Additionally, an AI-based interview grading module is presented to evaluate candidate responses by using length-based features and cosine similarity to measure structural completeness and semantic similarity. According to experimental results, Random Forest Regression yields the most dependable results for interview answer grading ($R^2 = 0.8227$), while Gradient Boosting Regression performs best for resume matching ($R^2 = 0.9417$). According to these results, compared to conventional methods, machine learning-driven career coaching systems can greatly improve the objectivity, accuracy, and efficiency of recruitment preparation while providing candidates with more insightful and data-driven feedback.

Keywords

Career coaching, resume matching, interview grading, machine learning, natural language processing.

InterviewFlow: An Edge-Based Multimodal AI Framework for Automated Interview Evaluation

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Abstract

Judging a job candidate fairly and consistently is a problem organisations have wrestled with for as long as structured hiring has existed. Human-led panels introduce subjectivity, struggle to scale, and are often swayed by factors unrelated to actual job performance. InterviewFlow is our attempt to address this through a system that evaluates candidates across three dimensions simultaneously, spoken responses, facial behaviour, and written code, entirely on the candidate's own device. No recording is ever sent to an external server. The pipeline draws on six specialised components: Whisper for automatic transcription, MediaPipe FaceMesh for tracking facial landmarks, PaddleOCR for reading whiteboard code, a quantized Flan-T5 transformer for scoring answer quality, Sentence-BERT for semantic response matching, and Librosa for vocal feature extraction. We report on the design rationale, compare the system against eight prior works, and discuss six challenges that the field has not yet resolved. When evaluated against expert human ratings on real interview recordings, the full pipeline achieves 92.7% classification accuracy and 92.3% F1-score, with every computation confined to local hardware.

Keywords

Automated Interview Evaluation, Multimodal AI, Edge Computing, Privacy-Preserving Systems, Natural Language Processing, Computer Vision, Transformer Models, Speech Recognition, Behavioral Analysis.

CosmoSense ML: An Intelligent AI-Driven Facial Skin Analysis and Personalized Skincare Recommendation System

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Abstract

A noticeable gap exists between everyday skincare practices and scientifically grounded skin assessment. Most people trying to improve their skin health rely on marketing claims, social media advice, or anecdotal recommendations rather than measurable biological data. CosmoSense ML addresses this gap with an accessible, data-driven approach to personal skin analysis. The platform functions as a fully device-side web application employing a MobileNet V2 convolutional neural network, executed in the browser via TensorFlow.js over the WebGL graphics pipeline, to analyse a standardised 224×224 image captured from the device camera. The model estimates four continuous skin indicators: sebaceous gland activity, epidermal hydration level, melanin concentration, and the visual prominence of follicular pores. These are processed by a threshold-based classification layer that assigns the skin to one of five dermatologically meaningful categories, with each raw metric normalised to an intuitive numerical scale. Alongside the visual pipeline, a recommendation system driven by community product reviews processes user-submitted feedback using a TF-IDF weighting scheme and a logistic model trained on 12,000 labelled records. Probability scores guide the selection of products from 3,200 formulations, passing candidates through ingredient compatibility checks, sensitising-compound removal, and a sentiment confidence threshold before six products are recommended. Evaluation using 850 annotated skin images and 120 volunteers demonstrated 91.3% five-class recognition accuracy, 87.6% recommendation precision at six items, and a warmed round-trip of 2.24 seconds, with camera image data never leaving the user's device.

Keywords

Device-side inference, skin type classification, sebaceous activity analysis, pore visibility estimation, ingredient safety filtering, review-driven recommendation, conversational skincare guidance, WebGL acceleration, TensorFlow.js, React web applications.

AI-Driven Real-Time Accident Prediction and Prevention System for Enhanced Highway Safety and Crime Monitoring

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Abstract

The increasing cases of highway deaths are a major concern to transport networks all over the world. It is a problem that is usually exacerbated by the fact manual monitoring is insufficient and the response time to emergencies is too long. This paper outlines an autonomous system that will employ 360-degree cameras and IoT sensors to identify hazards on the road prior to endangering people. To monitor risk in real-time and identify abnormal driving behaviors, our solution uses a number of machine learning models, including Random Forest, XGBoost, and Long Short-Term Memory (LSTM). One of the features of our design is that it will also search criminal activity via action recognition, and at the same time, activate an automatic SOS alarm. The alert comes at a time when medical assistance can be available at the location within the crucial golden hour by a custom Haversine-based location approach. Our tests reveal a 94.3% detection accuracy of the system and reduce the notification time to the emergency services by 60 times, which makes it a useful tool in any smart city of the present day.

Keywords

Artificial Intelligence, Road Safety, Accident Prediction, Machine Learning, IoT, YOLO, Emergency Response, Crime Prevention.

RakshaNetra: Securing Intelligent AI-Powered Framework for Vigilance and Cyber Awareness

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Abstract

Cybercrime complaints have shot up lately, and honestly, the old reporting systems just can't keep up. Most websites only collect complaints and leave investigators to sift through everything by hand. It's slow, and cases often get stuck in limbo or aren't prioritized the right way. That's where RakshaNetra comes in. It's a secure, practical setup that actually helps with reporting and investigating cybercrimes using AI. The system sorts complaints automatically, figures out how risky they are, and puts together quick summaries so investigators can get the gist of each case right away. Access and permissions are handled with a three-tier, role-based model, so everything stays secure and accountable. Anyone can use RakshaNetra—victims can report anonymously or register if they want, and there's a mobile app for them, plus a web dashboard for investigators. In tests, even in a simulated setup, RakshaNetra made everything faster: cases got handled sooner, the important ones got flagged first, and investigators had a much clearer view of how things were moving along.

Sentiment Analysis-Driven Emotion-Adaptive Music Therapy for Personalized Mental Health Support

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Abstract

The rising number of mental health disorders and their complex symptoms make it very hard to treat them effectively and quickly. The World Health Organization (WHO) [1] says that “over 970 million people in the world have mental health issues”. Every year, depression and anxiety disorders make people miss 12 billion workdays. People with these conditions often don’t get the help they need, or they don’t get it well enough. This means that we need to find new ways to improve our emotional health. This study presents an emotion-adaptive system aimed at evaluating users’ psychological conditions and providing tailored therapeutic interventions via sentiment analysis, with the objective of enhancing emotional well-being through music-based therapy. We tried out a lot of different classifiers on Google’s GoEmotions dataset for emotional classification until we found the one that worked best. The classifiers were SVC, Logistic Regression, Random Forest, Naive Bayes, KNN, and BERT (RoBERTa) [21]. The study investigates the effectiveness of sentiment analysis in therapeutic settings, specifically regarding the use of music as a means of emotional support. Early findings indicate significant potential in recognising and responding to users’ emotional states. People all over the world are using advanced machine learning to make mental health treatments more creative, easier to get to, and less expensive and our work is in line with this [23].

Keywords

Mental Health, Sentiment Analysis, Machine Learning, Emotional Classification, Music Therapy, RoBERTa, Personalized Interventions, GoEmotions Dataset, Spotify API, FastAPI.

Deep-Learning based Intelligent Hybrid Autoencoder Framework for Personalized Mutual Fund Recommendation System

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Abstract

The market for funds is really unpredictable and that makes it hard to suggest the right ones to people who are not experts. There are many things to consider like how different investors feel about risk and how the funds have performed in the past. These things are too complicated for the methods of analyzing data to handle. In this paper we are talking about a way to use machine learning to recommend mutual funds. This method combines two types of machine learning: tree-based learning and deep representation learning. We are introducing two models:

Hybrid model-1 which combines a multi-layer perceptron with gradient boosting and Hybrid model-2 which combines an autoencoder with random forest. We use a lot of data about funds to train these two models. This data includes things like the funds value, how risky it's how well it has done and other information about the fund. When we tested these models, we found out that Hybrid model-2 is the one. It was very accurate with an accuracy of 0.9730. It made very few mistakes with an MAE of 0.0270 and an MSE of 0.0270. Hybrid model-2 also did a job of predicting how well the funds would do with a fidelity of 0.8117 and an ROC-AUC of 1.0000.

Our study shows that Hybrid model-2 is better, than the models we compared it to, including Hybrid model-1 and a model that uses ideas from quantum physics. We think that using a combination of quantum and classical approaches is a practical and scalable way to do things especially with the technology we have today.

Keywords

Autoencoder, Random Forest, ensemble learning, quantum machine learning, hybrid model, NISQ, and fidelity.

An Ensemble Learning Approach for Real-Time DDoS Attack Detection Using Network Traffic Flow Features

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Abstract

One of the most significant threats to the contemporary network infrastructure is the Distributed Denial-of-Service (DDoS), which can saturate servers with extremely large amounts of bad traffic and produce disastrous service interruptions. The conventional intrusion detection systems primarily use signature-based approaches which fail to identify new and changing patterns of attacks. In this paper, a machine learning based framework of identifying network traffic flow based DDoS attacks will be provided. The system identifies the features of the network flow captured in a statistical format at the flow level i.e. Packet rate, byte rate, packet length statistics and protocol content. CIC-DDoS2019 dataset is utilized as a training dataset and evaluation dataset and preprocessing methods tend to enhance model performance such as data cleaning, class balancing, and feature scaling. Several trained machine learning models recorded, based on Logistic Regression, Random Forest, Decision Tree, Gradient Boosting, Support Vector Machine (SVM), Multilayer perceptron (MLP), and XGBoost models are tested in attack identification. The findings of the experiments indicate that tree-based models in the form of ensembles obtain a detection accuracy of over 99 % and have a high precision and recall with a low rate of false positive. The suggested framework has offered a useful method of detecting malicious traffic patterns and may be used to facilitate real-time network security surveillance systems.

Keywords

DDoS detection, intrusion detection system, machine learning, network security, ensemble learning, network traffic analysis.

Design and Real-Time Evaluation of Load Distribution Strategies in Distributed Web Server Systems

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Abstract

Load balancing is a required method employed in the distributed systems in an attempt to efficiently allocate the network traffic across servers. This is also the design and implementation of real-time load balancing system of the web servers as well as the monitoring of the traffic and performance analysis. This system will have several servers that are backends, a load balancer (that will be centralized) and a real-time monitoring dashboard. The incoming client requests are distributed by the load balancer system with such algorithms as Round Robin, Random Selection, and Least Connections to provide equal distribution of the working load. Traffic can be generated on the network through a traffic generator module, which is used to identify the performance of the system given different load on the network. Important performance measures like the number of requests and the mean response latency are continuously monitored in the system. The visualization of this metrics is provided in form of a live dashboard. Through experimental findings, the proposed system is effective in distributing traffic between the servers, alleviating server overload as well as enhancing the overall system performance and reliability in distributed web environments.

Keywords

Load Balancing, Distributed Systems, Web Servers, Round Robin Algorithm, Network Traffic Analysis, Latency Monitoring, Performance Evaluation, Real-Time Monitoring.

Elect Bharat: A Hash-Based Cryptographic Techniques for Verifiable Electronic Voting

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Abstract

To guarantee the trust of people in the democratic processes, the use of electronic voting systems is necessary, which offer a high level of security, transparency, and privacy of the voters. In this paper, Elect Bharat, an electronic voting system based on hash and verification, is introduced with an aim of guaranteeing integrity of votes while being an anonymous system at the same time. This system combines the cryptographic process of voting and hashing. Every vote is verified, and cryptographic hash functionality is used to obtain a unique identifier with anonymity. The voter is issued with a digital receipt of the vote hash. To maximize integrity and auditability, optional hash chaining is used in the system to generate tamper-evident records. Elect Bharat prioritizes lightweight cryptographic techniques to gain transparency without necessarily having the complexity of full decentralization systems. It is framework to be used in institutional and organizational elections and provides a useful trade-off between security, usability and scalability. The paper brings in a research-based design method of verifiable electronic voting and emphasizes the use of hash-based methods in enhancing trust in electronic voting systems.

Adaptive Ensemble Machine Learning Framework for Breast Cancer Prognosis: Integrating Kullback-Leibler Distributed Divergence and SHapley Additive exPlanations Interpretability

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Abstract

Early and precise prognostic stratification in Breast Cancer is pivotal for optimizing therapeutic decisions and improving survival outcomes. This research proposed an Adaptive Ensemble Machine Learning Framework (AEMLF) that intelligently combines different models to enhance performance, especially in complex tasks like deep learning, and medical prognosis for driven feature selection, stability assessment, and ensemble learning. In this research, we leverage the Diagnostic Wisconsin Breast Cancer repository database managed by University of California, freely available for machine learning based research. We preprocess Kullback-Leibler divergence technique (a powerful features ranking to measure and separates two different classes distributions i.e. benign vs. malignant cancer and enforce reproducibility via bootstrap stability design framework that quantifies the consistency through feature selection especially in machine learning or clustering contexts. Adaptive Ensemble Machine Learning Framework integrates gradient boosting, random forest, random survival forest, and support vector machine models under a weighted voting scheme called decision making framework. Interpretability is provided through SHapley Additive exPlanations analysis. On a hold-out test set, our proposed framework achieves 99.12% accuracy, sensitivity 0.961, specificity 0.969, area under the curve 0.980, and concordance index 0.913. We further propose an extension i.e. women's breast cancer prognosis; an integrated risk modelling for ovarian cancer using serum biomarkers and ultrasound texture (an emerging and a powerful multimodal strategy for cancer risk prediction to improve early detection, subtype classification, and personalized treatment planning).

Keywords

Breast Cancer (BC) Prognosis, Adaptive Ensemble Machine Learning Framework (AEMLF), Diagnostic Wisconsin Breast Cancer (DWBC) database, Least Absolute Shrinkage and Selection Operator (LASSO), SHapley Additive exPlanations (SHAP) analysis, Kullback-Leibler (KL) divergence, Fine Needle Aspiration (FNA).

AI-Driven Recruitment and Interview Evaluation System Using Event-Driven Architecture and Large Language Models

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Abstract

The increasing demand for scalable and consistent recruitment processes brings out the limitations of traditional interview-based candidate evaluation, which relies on manual screening, subjective judgment, and considerable coordination effort. This study presents an event-driven artificial intelligence recruitment system designed for candidate screening, conducting conversational interviews, and generating structured decisions. Current systems are mostly made up of standalone tools, such as resume parsers and mock-interview simulators, and typically do not support integrated orchestration or real-time decision-making. The proposed system orchestrates multiple components, by integrating conversational AI, semantic response analysis, and workflow orchestration, to enable consistent, scalable, and objective candidate evaluation. The system receives input from candidates, conducts real-time voice interviews, transcribes candidate responses and applies large language model (LLM)-based reasoning for competency evaluation and scoring. The system maintains traceability and automation using an event-driven backend that records interactions, transcripts, and decision outputs. An analysis of the workflow shows that the system automates about 87.5% of the recruitment pipeline and is able to reduce recruiter involvement by up to 98.1% when handling high-volume applications. These observations are consistent with earlier studies that report up to a 38% reduction in time-to-hire along with faster AI-assisted screening.

A Study on Identification and Analysis of Urban Road Accident Black Spots using Frequency, Severity Index and MoRT & H Methods

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Abstract

Road traffic accidents in urban areas are increasing due to high traffic volume, mixed traffic conditions, and complex road layouts. Identifying accident-prone locations (black spots) is therefore important for improving road safety. However, there is no single standard method followed everywhere for declaring a black spot. This study focuses on identifying and analyzing black spots using different methods such as Accident Frequency, Severity Index, and MoRT & H guidelines, and comparing them to find the most suitable approach.

The study uses accident data collected from published research, reports, and a practical case study on a selected highway section. The frequency method helps in identifying locations with a high number of accidents, while the Severity Index method gives more importance to fatal and serious accidents. The MoRT & H method defines black spots based on accident occurrence over a specific road stretch.

By combining and comparing these methods, the study identifies accident-prone locations and prioritizes them based on severity. It also examines how factors like road geometry, traffic conditions, and road infrastructure contribute to accidents. The results show that severity-based methods are more useful for prioritizing locations that require urgent attention.

The study provides a simple and practical approach for identifying and prioritizing black spots, which can help in better planning and improving urban road safety without the need for extensive field data.

Keywords

Accident Black Spot, Severity Index, Accident Frequency, Urban Road Safety, Accident Analysis.

Design and Analysis of Solar Powered Eco-Friendly and Efficient Coir Moisture Removal System

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Abstract

The objective of this research work is to develop and test an automatic system for removing moisture from coir and compare its drying efficiency with the existing conventional drying method through statistical analysis. In this study, the existing conventional drying process is compared with automatic moisture control. Process. The proposed automatic coir moisture removal system in which a rotating drum mechanism, hot air flow, and microcontroller-based moisture sensor feedback control are employed. A total sample size of 03 coir samples were taken for each with similar initial moisture content ranging from 54% to 58%. The variables taken for analysis are final moisture content and drying time. Statistical analysis was done using mean, standard deviation, and independent sample test. The results obtained clearly depicted that the speed of the drums has a major impact on the removal of moisture content in the proposed system for automatic coir drying. At an initial moisture content of 57% and a blower temperature of 138°C, it was indicated that the final moisture content of the coir material reduces with an increased speed of the drums. At 110 rpm, the final moisture content was found to be 19%, which reduced to 16% when the speed increased to 130 rpm and further reduced to 11% at a speed of 150 rpm. It has been affirmed from this study that the proposed automatic coir moisture removal system indeed works properly at various higher rpm. In addition, out of all the conditions tested, 150 rpm results in minimum moisture content and therefore optimal drying. It is inferred from this study that the rpm of the drum plays an important role in drying, and this proposed system is applicable to efficient coir processing.

Keywords

Automatic coir moisture removal system, Coir drying, Moisture content, Drying time, Hot air drying, Microcontroller-based control, Statistical analysis, independent sample t-test.

Performance Analysis of Polymer-Enhanced Bitumen in Flexible Pavement Applications

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Abstract

In recent times, improving the strength and durability of flexible pavements is a key concern for engineers. The present study investigates the performance characteristics of polymer modified bitumen (PMB) in flexible pavement mix design with the objective of enhancing durability and load-bearing capacity. Different proportions of polymer additives were blended with conventional bitumen, and a series of laboratory tests were conducted to evaluate their influence on material properties. Standard tests such as penetration, softening point, and ductility were carried out to assess the basic characteristics of the modified binder. In addition, Marshall mix design tests were performed to determine stability, flow, and volumetric properties of the bituminous mixtures. The experimental results, analyzed using spreadsheet-based tools, reveal that the inclusion of polymers significantly enhances the performance of bituminous mixes. An increase in Marshall stability and softening point indicates improved resistance to deformation and temperature variations. Meanwhile, penetration and ductility values showed controlled changes, suggesting better flexibility and cohesion of the binder. The study also identifies an optimum polymer content that provides maximum performance benefits without adversely affecting workability. Overall, the novelty of the proposed findings demonstrate that polymer modified bitumen can effectively improve the mechanical behavior and service life of flexible pavements, making it suitable for use in high-traffic and challenging environmental conditions.

Keywords

Flexible pavements, cohesion, binder, polymer modified bitumen, polymers.

Advancing Veterinary Reproductive Training: Design, Material Optimization, and Evaluation of Artificial Insemination Cow Simulators

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Abstract

In livestock breeding, artificial insemination (AI) is a commonly used reproductive method that facilitates quick genetic advancement and effective herd management. However, using live animals to train veterinary students presents risks to animal welfare, logistical difficulties, and ethical issues. These drawbacks emphasize the necessity of realistic, simulation-based training models that facilitate the enhancement of safe and efficient skills. The design and development of a Veterinary Artificial Insemination Training Cow Model that replicates the physiological and anatomical conditions of a cow's reproductive tract is the main goal of this research. The suggested model has a robust external body, realistic internal reproductive organs, and an integrated control system that can maintain rectal pressure (1500 mmHg) and physiological temperature (35–38°C). With the help of these features, trainees can practice precise semen deposition, AI gun insertion, and cervical navigation without the need for live animals. The study also examines cow training models that are sold commercially, evaluating their advantages, disadvantages, and areas in need of development. To determine the best choices based on realism, durability, and safety, a comparison of the materials used for the external body and internal organs is carried out. The proposed system intends to support the advancement of cutting-edge reproductive training technologies, enhance veterinary education, and improve animal welfare.

Keywords

Artificial Insemination Training, Veterinary Simulation Model, Cow Reproductive System, Veterinary Education Technology, Simulation-Based Training, Artificial Insemination Simulator, Veterinary Skill Development.

A Geolocation-Based Accommodation Recommendation System Using Exploratory Data Analysis for Immigrants

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Abstract

With the rapid increase in migration around the world, there is demand for clever and efficient accommodation recommendation systems, because immigrants are often unaware of the situation, there is high variability in rental costs, and there is often no reliable source of accommodation information. As current accommodation platforms rely on manual filtering and keyword-based searching to provide users with accommodation listings, we explore the development of a geolocation-based accommodation recommendation system, employing Exploratory Data Analysis (EDA) to extract insights from housing datasets. The recommendation is made using spatial filtering, clustering, and multi-criteria ranking based on user characteristics such as budget, location, and other requirements. Mathematical models are used to measure distances, calculate clusters, and generate ranked recommendations. Furthermore, it shows more accurate recommendations with low search space complexity evidencing the efficacy of the data-driven approach for real housing problems.

EduQuest AI: An Offline-First, Privacy-Preserving Intelligent Assessment Platform Using Hybrid Artificial Intelligence

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Abstract

The rapid transition toward digital learning environments has increased the demand for intelligent assessment systems capable of automating evaluation while maintaining data privacy and institutional control. Existing AI-based educational platforms primarily rely on cloud infrastructures and external application programming interfaces, raising concerns related to data security, regulatory compliance, operational costs, and vendor dependency. This paper presents EduQuest AI, an offline-first and privacy-preserving intelligent assessment platform designed to emulate human-like evaluation through a hybrid artificial intelligence framework. The proposed system integrates locally deployed large language models with rule-based natural language processing and classical machine learning techniques to generate, validate, and categorize assessment questions directly from academic documents. The platform supports secure timed examinations, automated grading, behavioral integrity monitoring, and performance analytics using heatmap-based learning insights. All computation and data storage are performed within institutional infrastructure, ensuring complete data ownership while eliminating reliance on external cloud services. Experimental evaluation demonstrates that EduQuest AI produces high-quality assessment content, enhances examination fairness through anomaly detection, and provides actionable analytics for personalized learning support. The modular architecture enables scalable deployment across institutions with varying computational resources. The results indicate that offline hybrid AI systems provide a practical, secure, and cost-effective solution for next-generation educational assessment environments.

Keywords

Artificial Intelligence in Education, Offline Assessment Systems, Hybrid Artificial Intelligence, Local Large Language Models, Educational Data Privacy, Automated Question Generation, Learning Analytics, Exam Integrity Monitoring.

Employee Attrition Prediction Master using Machine Learning

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Abstract

Employee attrition poses a major challenge for organizations, affecting productivity, talent retention, and overall operational efficiency. Predicting which employees are likely to leave has therefore become essential for effective workforce management and strategic planning. This study introduces an improved employee attrition prediction model that leverages advanced machine learning techniques to identify the likelihood of employee turnover and the factors influencing it. The proposed system integrates Support Vector Machines (SVM) and a Multilayer Perceptron (MLP) Neural Network, selected for their ability to capture both linear and non-linear patterns within complex employee datasets. SVM effectively handles high-dimensional feature spaces, while MLP learns deep feature representations through multiple interconnected layers. To ensure optimal performance, hyperparameter tuning techniques such as grid search and cross-validation are applied to both models. The system also incorporates exploratory data analysis to identify critical determinants of attrition, enabling more informed and interpretable retention insights. By combining robust predictive modeling with analytical insights into workforce behavior, the proposed system supports organizations in early identification of at-risk employees, enabling timely interventions and contributing to stronger employee satisfaction, retention, and organizational stability.

Keywords

Machine learning, ensemble learning, hyperparameter tuning, attrition prediction.

Machine Learning Framework for Water Scarcity Prediction in Urban Utility Systems

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Abstract

Rapid population growth in cities and frequent changes in weather patterns have brought new and greater challenges to water resource management within urban utilities. Traditional methods of measuring water scarcity are often reactive and use static indicators that do not account for changing consumption trends and new stressors. A comprehensive machine learning framework for proactively predicting water scarcity is proposed, which combines multiple sources of consumption data, time-related trends, and contextual indicators to provide early warning of potential water scarcity. The proposed system assesses a range of supervised learning models, including Logistic Regression, Support Vector Machines, Decision Trees, Random Forest, Gradient Boosting, and Extreme Gradient Boosting, for classifying different levels of water scarcity based on different urban settings. The comparative performance of these models demonstrates that ensemble-based models, like XGBoost, perform better than other models in identifying non-linear relationships and feature interactions in water usage. Through an integrated analytics platform, the framework prioritizes practical deployment and interpretability in addition to predictive accuracy. Stakeholders can easily examine consumption patterns and regional risk distributions thanks to the system's interactive visualization modules, which include temporal dashboards and geospatial mapping. Real-time prediction and decision-making workflows are further supported by a safe, user-friendly interface that closes the gap between model outputs and useful insights. The results show how data-driven methods can change water management strategies from reactive responses to proactive planning. By using predictive modeling along with visual analytics, the proposed framework helps create smart, scalable, and easy-to-use decision-support systems for sustainable urban water management.

Performance Analysis on CFD and Sustainable Implementation of Telescopic Rectangular Blade Wind Turbine for Low-Wind Regions

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Abstract

The primary aim is to come up with a Telescopic rectangular blade Wind Turbine (TBWM) to have high efficiency when the wind is as low as 10 m/s. The design, through altering the area of the blade, minimizes the problem of high cut-in speeds and weight, common to fixed-blade HAWTs. The research focused on comparing the conventional fixed-blade turbine with the proposed TBWM. The TBWM is analysed in ANSYS Workbench with three different materials: Steel, ABS and UPVC (Unplasticized Polyvinyl Chloride). The analysis was done and the results shows TBWM was much more effective in the conditions of low wind (5 to 12 m/s). The TBWM produced an average of 0.174 kW of power with a system efficiency of 71.8% while the traditional fixed-blade system recorded 0.092 kW of power output with an efficiency of 45.1%. The average power output of 0.108 kW and standard deviation of 0.046 kW were proven by using statistical analysis. It is evident that the TBWM is more efficient in low winds (10 m/s), where TBWM could produce 0.174 kW with the efficiency of 71.8. These improvements have been proven by statistics with an average power output of 0.108 kW.

Keywords

Telescopic Blade Windmill, Low-Wind Regions, Finite Element Analysis, Structural Dynamics, UPVC Material, Variable Geometry, Aerodynamic Efficiency, Sustainable Energy.

Engine Fault Classification Using Machine Learning, Deep Learning and Hybrid Models

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Abstract

Early detection and classification of engine faults play a crucial role in improving vehicle reliability, reducing maintenance costs, and ensuring operational safety. Traditional rule-based diagnostic approaches often fail to adapt to varying operating conditions, leading to inaccurate predictions. This work presents a comprehensive software-based engine fault classification system using machine learning, deep learning, and hybrid models. The study utilizes the EngineFaultDB dataset, incorporating preprocessing techniques such as feature scaling, Gaussian noise augmentation, Principal Component Analysis (PCA), and Linear Discriminant Analysis (LDA) to enhance data quality and reduce dimensionality. Various machine learning models including Random Forest, Support Vector Machine, and XGBoost are implemented and compared with deep learning architectures like Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN). Additionally, hybrid ensemble models are developed to combine the strengths of multiple classifiers. Performance is evaluated using metrics such as accuracy, precision, recall, and F1-score. Experimental results demonstrate that hybrid models outperform individual approaches, achieving higher accuracy and robustness. The proposed system highlights the effectiveness of integrating machine learning and deep learning techniques for reliable and efficient engine fault diagnosis.

The Performance Analysis of the Various Phase-Frequency Detector for PLL Application at 45nm CMOS Technology

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Abstract

A significant portion of systems based on phase-locked loops (PLLs) consists of phase frequency detectors (PFDs). The PFDs perform phase comparison of two input signals and output results from their phase differences. In a PFD, the input signals are the output signal of the voltage-controlled oscillator (VCO) and the reference signal, and the output signals are the UP and DOWN signals. The output signals are used to assist the VCO in controlling its output frequency. If the UP signal is high, the VCO increases its frequency, while if the DOWN signal is high, the frequency is decreased. This research assessed various PFD circuits and how different topologies affected the PFD performance metrics. This research analyzed the Dead Zone, power dissipation, number of transistors and maximum working frequency of different PFDs. PFDs are a core component in phase-locked loops (PLLs), frequency synthesis circuits, frequency demodulators, AM radio receivers, etc. This research is simulated in Cadence Virtuoso using 45nm CMOS Technology.

Keywords

Phase frequency detector (PFD), phase locked loop, CMOS technology, power consumption, dead zone, UP and DOWN signal.

AI Assistant Using Multi-Agent System

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Abstract

The rapid increase in academic workload and personal management responsibilities has created a need for smart systems that offer integrated support on one platform. This research introduces an AI Assistant built using a Multi-Agent System design to boost student productivity through coordinated, specialized agents. Unlike traditional digital assistants that tackle separate tasks, this system combines academic help, emotional monitoring, financial tracking, and smart information retrieval in one framework. The platform has five main agents: a Notes Agent that extracts and securely stores content from uploaded PDF and PPT documents, a Mood Agent that analyzes diary entries to spot stress patterns and emotional trends, an Academic Agent that creates quizzes and personalized study plans from uploaded notes, an Expense Agent that tracks and summarizes financial activities, and a Chatbot Agent that offers real-time academic support. All uploaded documents are stored in the backend until manually deleted, which helps with ongoing knowledge management. A global search feature allows efficient retrieval of stored information across different modules. The modular multi-agent architecture lets agents work independently while still collaborating through a centralized coordination mechanism, providing both scalability and flexibility. Experimental evaluation shows improved productivity, organized learning, better emotional awareness, and quick access to knowledge, highlighting the effectiveness of multi-agent systems in enhancing academic and personal productivity.

Keywords

Multi-Agent Systems, Artificial Intelligence in Education, Adaptive Study Planning, Intelligent Tutoring Systems, Document Processing, Learning Analytics, Educational Productivity Tools, Academic Chatbots.

Next-Generation Supply Chain Traceability: Blockchain and Zero-Knowledge Proof of Location (zkPoL) for Confidential Geospatial Verification

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Abstract

This paper introduces a blockchain framework incorporating Zero-Knowledge Proof of Location (zkPoL) to break the privacy-transparency tradeoff in supply chain traceability. The solution has a modular architecture with zkPoL circuits, off-chain metadata stored in IPFS, and smart contracts for on-chain state management. A proof-of-concept software prototype on Ethereum shows QR-based tracking with cryptographically verifiable attestations. Simulations ensure sub-second proof times, minimal storage overhead, and resistance to common attacks. Hardware-based edge capture is included in the larger vision, but this paper emphasizes the successful software implementation and its scalability towards future industrial application.

Keywords

Blockchain, zkPoL, Supply Chain Traceability, Smart Contracts, IPFS, Cryptographic Audit, Ethereum, zk-SNARKs.

Image Enhancing and Reconstruction Using GAN's

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Abstract

Many images that were taken in the real world have problems like noise, blur, low-resolution, or missing parts of the image that makes it less useful for a lot of real-world applications. The goal of this project is to create a complete image improvement system that includes both enhancement and reconstruction, through the use of Generative Adversarial Networks (GANs). The Enhancement Module was developed to remove noise and increase clarity in an image, using the super-resolution framework based on GANs. The Reconstruction Module was developed using a generative model to recreate the visual content for each image from the latent representation that has been generated from an input image, allowing for visually meaningful outputs from a small amount of input information. GAN MODEL Modern generative adversarial networks (GANs) are used in ImageEnhance automated system for the restoration of images from low-quality to high-quality images, in essence, using a low-quality (input) image, the system removes noise and enhances the quality of that image [2]. In addition, it reconstructs missing parts of the input image and produces a more visually appealing image as the output. By using a super-resolution GAN (SRGAN) for denoising and resolution enhancement, in addition to a Style GAN for latent-space image reconstruction [3]. ImageEnhance AI will enhance the visual clarity of images, retrieve fine details from images and reconstruct unique but realistic content, thereby enabling high-quality image restoration for various applications including digital archival, video surveillance analysis and medical imaging improvements [4] [5].

Keywords

SuperResolution GAN, Style GAN, ImageReconstruction, DeepLearning, LatentSpace, ImagePreprocessing.

Quantum Cryptography for Next-Generation Data Security

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Abstract

The development of quantum computing poses a security risk to the classical cryptographic algorithms of RSA and ECC that are based on the computation hardness assumptions that quantum algorithms can easily compromise. This has exposed the system to the high security vulnerability that can withstand quantum-enabled attackers. Quantum cryptography and quantum key distribution in particular is a powerful weapon to resort to as it is based on the theory of quantum mechanics accounting to the capability of transmitting keys and ensuring non-hackable communication.

The paper gives its systematized approach to the application of QKD in the organizational security models and gives the comparative analysis of the classical, post-quantum and the quantum-based cryptography. This is because such critical aspects as scalability, cost-efficiency, integration with the existing systems, and interoperability are discussed, and the roadmap to migrate to quantum-resilient infrastructures are mapped out. The specified framework is concerned with both technical and policy considerations, which also offers the moderate solution towards the real practice.

The findings of this research mean quantum cryptography can significantly improve privacy and data security, reduce their vulnerability to quantum attack and offer a future-proof platform of secure communications. By introducing the QKD and related processes, the organizations will be empowered to achieve long-term resilience, compliance, and reliability in the generation of quantum.

Keywords

Quantum Cryptography, Quantum Key Distribution, Data Security, Quantum Computing, Encryption, Privacy, Network Security.

Planify - MERN Based Project Planning & Task Management System

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Abstract

In the context of engineering and management education, the application of project-based learning in engineering and management education is complemented by the use of a project management tool set specifically relevant to these disciplines. However, student project teams frequently face challenges with creating project plans and coordinating project work due to the fragmented nature of the available tool set and an inadequate amount of academic-specific support. As a response to this need, we have developed a project management platform for academic-specific use called PLANIFY. PLANIFY incorporates AI to aid in project management in academic settings, while applying development technologies of the MERN technology stack (MongoDB, Express.js, React-Vite and Node.js). This paper reports on our design, development and evaluation of 13 AI-powered modules to support each step of the entire project lifecycle. The module functions include an NLP-based task decomposition component, Monte Carlo delay prediction option, a behaviour-driven performance measuring tool; adaptive project scheduling using the Critical Path Method; a WebSocket realtime collaboration layer; an AI-based digital assistant that uses real-time data from within a project; academic schedule management support; semantic search engine; notification service; and workflow analysis tool. The platform is designed to support up to 1,000 concurrent users with a latency of less than 200 milliseconds. We completed a controlled trial at AKTU with 48 student teams that illustrated how the full PLANIFY project management system greatly improved team performance, including a 40% reduction in delays, an increase in task completion percentage from 61.4% to 78.3%, and a reduction of 85% in time spent searching for information.

Keywords

AI-based Task decomposition, Predictive Delay Detection, Monte Carlo Simulation, and Retrieval Augmented Generation.

SciAgent: A Multi-Agent AI System for Automated Scientific Research

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Abstract

Science research can be engaged in hypothesis formulation, experiment planning, and summarization of research outputs. These functions cannot be effectively and systematically conducted by the current single AI tools. Their responses are unorganized, and there is no multi-step reasoning process involved so as to enable research activities. To address these research challenges associated with single AI tools, a multi-agent LLM framework will be presented. The multi-agent LLM framework will comprise different agents with an objective to formulate research outputs and will be controlled by an orchestrating agent. The main contribution points for this research include a modular multi-agent system, a workflow consistent with scientific method, and an exploration of the impact on reasoning resolution and understanding achieved with specialization among multiple agents. The predicted outcomes include an increase in quality and coherence in theories and experimental designs and research summary organization compared with single-model systems. Outcomes obtained assume importance for understanding multi-agent AI system capabilities within learning and research pursuits involving systematic exploration and organization.

Keywords

Multi-Agent Systems, Large Language Models (LLMs), Scientific Discovery, Automated Research, Hypothesis Generation, Artificial Intelligence.

AUTOCODE: An Agentic AI System for Automatic Web Application Generation Using Multi-Agent Architecture

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Abstract

Building apps quickly always seems a bit chaotic, as if you are chasing after cats and hoping they will listen. Most times you find yourself going through lines of outdated codes, hunting down stubborn bugs or losing files that disappear as if by magic. Everything except actually making the app work properly. Then AI suddenly changing the situation. These language models now making it possible to merely speak out what you want in normal English. They produce code in any language you need. Tools that handle code snippets, automate dull chores or even work out difficult logic are suddenly popping up. However, most of them only doing bits and pieces. Even then you still have to put everything together just to get a running application. AI agent configurations are something else completely. Of course, once you bring in these agents, work creation is literally like lying on the beach. One bot discovers what users are after, the rest designs and codes, etc. That's how it becomes work music to ears. This is what AUTOCODE is all about. It meshes language models with a chat of agents who get your commands and create the real thing from scratch. It is fully automated. Most of the hard work is simply eliminated, and you get advanced web apps quickly. For me, it actually offers more leisure time, and honestly, it's a great thing.

Keywords

Agentic AI, Code Generation, Multi-Agent Systems, Large Language Models, Web Application Development, Automation in Software Engineering.

Enhanced Healthcare Management System: Role- Based Access, Prescription Tools, and API Integration

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Abstract

Today the majority of the health care systems in the developing countries are using either manual or semi-manual method of handling the patient's medical records, prescriptions and clinical workflow which as a result leads to inefficiency, data breaches and non-interoperability. In this work we introduce a system called Enhanced Healthcare Management System (EHMS) that has features such as Role-Based Access Control (RBAC), Electronic Prescription and API-based Interoperability for safe storage, retrieval and management of the patient's medical records and prescriptions. This in turn secures the confidentiality of the data and thereby ensuring a safe health care service delivery at all levels. The proposed system has an Electronic Prescription module which has an automated checking feature to minimize the possibility of medication errors such as overdose and drug interaction. This system also has a standardized API for real time data exchange with HIS, Laboratories and Pharmacy Systems through API connectivity. The results of the experiments carried out to test the proposed system showed that it has significantly reduced manual work, enhanced data security and minimized clinical errors. The proposed system has shown great enhancement of a scalable and secure system for the modern digital health care systems.

Keywords

Healthcare Management System, Role-Based Access Control, Digital Prescription, Electronic Medical Records, API Integration, Data Security, Patient Care.

AI-Driven Vegetable Crop Brinjal Bacterial Wilt Disease Prediction and Management System

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Abstract

Bacterial wilt disease, which is caused by the bacterium *Ralstonia solanacearum*, is one of the most dangerous diseases that affect the brinjal crop and result in yield loss and economic decline for the farmer. Thus, it becomes essential to identify the disease and take appropriate management strategies for the healthy production of the brinjal crop. The present project proposes a system that utilizes the latest technologies for the prediction of the onset of the bacterial wilt disease based on environmental parameters and past experiences. The system will incorporate real-time data from different sources such as soil moisture content, temperature, humidity, and visual symptoms of the disease by the help of cameras and mobile devices. The Management Guidelines Framework will be utilized for the accurate prediction of the occurrence of the bacterial wilt disease. The proposed system will also provide a user-friendly interface for the farmer to understand the strategies for the management of the disease by the help of artificial intelligence for the prediction of the disease and the management strategies for the healthy production of the brinjal crop by the farmer.

Performance Comparison of Emerging Additively Manufactured Heat Exchanger Geometries Against Conventional Tube Bank

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Abstract

Conventional heat exchangers often face limitations in achieving optimal thermal performance for complex internal geometries due to constraints imposed by traditional manufacturing processes. These conventional heat exchangers were restricted to shell and tube type. For the scope of this study the heat transfer for varied internal geometries. Additive Manufacturing (AM) offers significant design freedom, enabling the simpler creation of complex internal geometries for the study of enhanced heat transfer that were previously unexplorable. This project employs Computational Fluid Dynamics (CFD) to analyse the performance of additively manufactured Schwarz P and Air foil geometry inside the heat exchangers against conventional shell-and-tube designs. This study provides a base for further analysis of heat exchangers using more complex internal geometries and it marks a benchmark for the respectively considered geometries in this study.

Keywords

Heat Exchangers (HXs), Additive Manufacturing (AM), Computational Fluid Dynamics, Schwarz-P, Shell and Tube.

Image Based Waste Classification and Soil Management Using Machine Learning

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Abstract

Effective waste segmentation and disposal methods are essential in environmental conservation and sustainable soil maintenance. The proposed project, therefore, suggests the design of an image classification and disposal suggestion system for waste based on advanced machine learning approaches to enable intelligent and ecologically sound waste management strategies. The system scans waste images to automatically determine the waste type through effective extraction of key visual characteristics like color, texture, and shape and structural patterns by utilizing image processing techniques. These characteristics are then used as input to an SVM classifier for effective categorization. The proposed model provides a classification of waste into three broader categories, such as biodegradable waste, non biodegradable waste, and hazardous or chemical waste. Biodegradable waste includes organic waste such as food waste, leaves, paper, and so on, which can be decomposed naturally in order to reuse it for composting and for enriching the soil. Non biodegradable wastes comprise plastics, metals, glass, and so on, which need to be recycled or disposed of properly in order to reduce environmental and pollution. It also covers dangerous/disposed waste such as batteries, electronic devices, or chemical containers that may have dangerous effects on the soil water if not disposed of properly. On the basis of classification output, proper disposal and use of the soil suggestions are generated by this system. Biodegradable wastes are advised to be processed for composting and mixture with garden soil for improving the nutrients. Non-biodegradable wastes are guided to recycling and managed disposal. Hazardous and chemical wastes require segregation and managed disposal at the authorized waste management facilities to avoid environmental contamination. The system ensures a simple, automated, and friendly solution for waste classification without the need for technical knowledge. Through enhanced waste classification and the provision for intelligent waste disposal, the project ensures the promotion of sustainable waste management and pollution prevention.

Keywords

Waste Classification, Image Processing, Machine Learning, Support Vector Machine (SVM), Biodegradable Waste, Non-Biodegradable Waste, Chemical and Hazardous Waste, Disposal Recommendation System, Soil Management, Environmental Sustainability.

An Integrated Approach to Cloud Account Hijacking Prevention Using Authentication and Access Control

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Abstract

Cloud computing gives businesses incredible flexibility and the ability to scale quickly, but it also comes with new security challenges. One of the biggest risks is account hijacking, where someone manages to break into a cloud account without permission. When this happens, it can lead to major data leaks, financial losses, and even service outages. In environments where many users share the same resources, a single hacked account can put sensitive business or customer information at risk. Real-world incidents—like the Uber AWS breach or the attack on Code Spaces—show just how much damage poor cloud security can cause. In this project, I'll look at how account hijacking happens, what can go wrong, and share real examples.

Design and Analysis of Modified Booth Multiplier Architectures for Low Power VLSI Applications

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Abstract

Multiplication is one of the most power- and delay- intensive operations in digital signal processing and processor datapaths. Booth encoding is commonly used to minimize the number of partial products, thus enhancing speed and power efficiency. Nevertheless, the overall performance of a Booth multiplier is significantly affected by the logic style employed for the implementation of its building blocks. This paper describes a comprehensive design and comparison of Booth multipliers implemented with different logic styles, including Conventional CMOS logic, Pass Transistor Logic (PTL), Complementary Pass Transistor Logic (CPL), Gate Diffusion Input (GDI), and a low- power Sleepy-Stack based CMOS logic. The designs are compared in terms of delay, power dissipation, and power-delay product (PDP). Simulation results show that other logic styles like GDI and PTL offer considerable power savings, while sleepy-stack based designs offer significant leakage power reductions with moderate delay penalties.

Keywords

Booth multiplier, low-power VLSI, logic styles, PTL, CPL, GDI, sleepy stack.

Machine Learning System for Predicting Pathogenic Genetic Mutation Using Protein Structure

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Abstract

Identifying harmful genetic mutations is important for diagnosing diseases and understanding how illnesses develop. In this project, we developed a supervised machine learning model that predicts whether genetic mutations are harmful or benign by combining data from protein structures, genetic sequences, and evolutionary data. The system uses both real and predicted protein models, along with different structural details like residue surroundings, changes in energy, and conservation scores. Our results show that using structural information leads to greater accuracy than using only sequence data, especially for clinically important mutations. We build and test models such as Random Forest Classifier, XGBoost, and Support Vector Machine (SVM) to make these predictions. These models can quickly analyze many variants and provide immediate results when given protein structure data.

Keywords

Support Vector Machine, $\Delta\Delta G$, Random Forest, Pathogenicity prediction, Missense Variants, Protein structure.

Prediction of Blood Cancer by Using Deep Learning Approaches

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Abstract

Blood cancers such as leukemia and lymphoma and myeloma require treatment methods that need both fast execution and precise task performance. Diagnosis has depended on pathologists who have received training to analyze blood smears and tissue samples through their visual examination of these elements. The process requires intensive human effort because the specialists perform essential tasks yet their work becomes less accurate when they face exhaustion or make minor mistakes. Deep Learning advancements are reshaping the clinical landscape by delivering clinicians their "second set of eyes" which empowers their diagnostic abilities. The use of Convolutional Neural Networks (CNNs) enables us to study diagnostic images at exceptional levels because these models have been created to detect and analyze visual patterns. The systems function to identify cellular structures while they develop the ability to identify hidden cancerous patterns which remain undetectable by standard human observation. The results show positive outcomes. The models achieve excellent accuracy and sensitivity and specificity through their training on extensive patient data and cell image databases. The system produces fewer false alarms while delivering better results because it identifies all actual cases. The advanced system provides early anomaly detection which enables doctors to make vital decisions through its data-driven results. The use of AI in hematology extends beyond improved software; it enables patients to receive their most valuable resource which is time.

Keywords

Blood cancer, Deep learning, Convolutional Neural Networks (CNN), Leukemia, Disease prediction, Medical image analysis, Early detection, Artificial intelligence in healthcare.

A Novel Algorithm for Optimized MPPT in PV System under Partial Shading

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Abstract

The Productivity of Solar systems is primarily determined through its system capability to continuously operate at MPP despite variation in weather conditions. Under partial shading due to factors like buildings, obstacles, and varying irradiance, the PV characteristics of PV arrays creates many LMPP's and one GMPP. This Occurrence makes it difficult for identification of highest peak, resulting in reduced energy extraction and overall system efficiency. Standard MPPT algorithms often can't able to distinguish between local & global peaks during such conditions. This work focuses on developing an optimized MPPT strategy capable of accurately tracking the GMPP with faster convergence and minimal power fluctuations, reduced bad steady-state oscillations and enhance the power output under PSC. An ACO-based Maximum Power Point Tracking Technique will be proposed & the performance is evaluated against an existing Hybrid Perturb and Observe-Cuckoo Search approach. A detailed comparative analysis is carried out considering tracking efficiency, convergence speed, power extraction and robustness under dynamic irradiance variations. The effectiveness and capability of novel method is verified and validated through simulations, demonstrating improved power extraction and enhanced system performance.

Keywords

Hybrid, Irradiance, duty cycle, converter, PV, ACO, MPPT, GMPP, LMPP, optimize, PSC.

AI Driven Adaptive and Conversational Learning Solutions for Inclusive Education of Children with Special Needs

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Abstract

Children with profound sensorineural hearing loss in India face significant barriers in accessing mainstream educational content. Traditional classroom teaching and digital-learning platforms rely heavily on spoken language, making them inaccessible to students who depend on Indian Sign Language (ISL). This paper proposes an AI-driven adaptive and conversational learning system that translates educational video content into ISL using transformer-based models, speech-to-text processing, pose estimation, and avatar-based sign rendering. The system enables real-time or near-real-time generation of coherent ISL gestures, making digital learning content accessible to hearing-impaired students. To improve engagement, the application integrates interactive quizzes, performance tracking, and conversational guidance tailored for special-needs learners. By leveraging advancements in NLP, computer vision, pose generation, and motion interpolation, this solution bridges the accessibility gap and empowers students to learn independently. The proposed framework sets the foundation for scalable, inclusive, and equitable education aligned with India's National Education Policy (NEP-2020).

Keywords

Indian Sign Language (ISL), Transformer Models, Pose Estimation, Accessibility, Inclusive Education, Hearing-Impaired Learning.

OCR-Based Contract Analysis and Simplification System

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Abstract

Legal contracts are fundamental instruments governing business transactions, employment agreements, real estate dealings, and regulatory compliance across virtually every industry sector. Despite their ubiquity, contracts are routinely written in highly technical legal language that is difficult for non-specialist users to interpret correctly, frequently leading to uninformed consent, missed obligations, or unrecognised financial risk. This paper presents an OCR-Based Contract Analysis and Simplification System – a fully client-side web application that automates the complete workflow of extracting, analysing, and simplifying scanned or image-based legal contracts without requiring any server-side infrastructure. The system employs Tesseract.js, the browser-native port of the Tesseract OCR engine, to convert contract images (JPG/PNG) into machine-readable text. The extracted content is then processed through an eleven-step rule-based Natural Language Processing (NLP) pipeline comprising text normalisation, sector classification across five domain categories (IT, Finance, Legal, Healthcare, and Construction), risk-keyword detection, heuristic risk scoring, key-point extraction, and dictionary-based legal-term simplification. Results are presented on an interactive dashboard with real-time keyword search, and a structured PDF report is generated on demand using jsPDF. Because all processing executes entirely within the browser JavaScript runtime, sensitive contract data is never transmitted to external servers, ensuring strong privacy guarantees. Extensive testing across contract types confirms accurate OCR extraction, correct sector classification, reliable risk identification, and effective legal-term simplification. The system provides a practical, lightweight, and privacy-preserving alternative to manual contract review for non-legal users and small organisations.

Keywords

Optical Character Recognition, Contract Analysis, Natural Language Processing, Legal Text Simplification, Tesseract.js, Rule-Based Classification, Risk Detection, Client-Side Web Application, LegalTech, Document Automation, jsPDF, JavaScript.

Blockchain Based Cheque Verification and Clearance System

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Abstract

Financial systems' cheque clearance procedures have traditionally been laborious, frequently spanning several days owing to semi-manual processes and inadequate fraud detection tools. Image processing, Random Forest for mistake prediction, template matching for MICR verification, pixel-based signature matching, and Ethereum smart contracts for settlement were all introduced by the current blockchain-based system, CheckMate, which automates papers and digital checks. Low prediction accuracy, susceptibility to noisy check images, and slower blockchain speed as a result of Proof-of-Work consensus were some of the system's shortcomings, despite its improvements in efficiency and security. This research aims to solve these problems by suggesting a better digital cheque verification and clearance system that is based on the blockchain. It keeps the same basic idea but uses more precise algorithms. To anticipate errors in cheques, XGBoost/LightGBM is employed. To recognize MICR digits, SVM with HOG features is utilized. To verify signatures, K-Nearest Neighbors is employed. And to detect fraud, Naïve Bayes is employed. For safer, quicker, and more energy-efficient check settlement, PBFT consensus takes the place of Proof-of-Work. Better accuracy, resilience against check variability, and a dramatic decrease in clearing time are all achieved by the suggested solution without sacrificing security or transparency. With this method, contemporary banking systems may rest assured that their cheque processing mechanisms are both dependable and efficient.

Keywords

Blockchain, Digital Cheque Clearance, Cheque Fraud Detection, MICR Verification, Signature Verification, XGBoost, LightGBM, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Naïve Bayes, PBFT Consensus.

Chronic Diseases Prediction Using Machine Learning with Data Preprocessing Handling: A Critical Review

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Abstract

Diseases that need early detection for treatment, such as Alzheimer's, diabetes, and cardiovascular problems, account for the majority of global fatalities. Now more than ever, machine learning algorithms are powerful resources for handling massive amounts of healthcare data and assisting with illness prediction. Data preparation and feature extraction methods are crucial to these models' accuracy and dependability. A comprehensive assessment of machine learning approaches used to chronic illness prediction is presented in this study. Data preparation methods in particular are highlighted. Data cleaning, normalization, feature selection, and dimensionality reduction are some of the most common preprocessing methods included, all of which may improve the model's performance and the quality of medical data. Furthermore, the article discusses how MRI scans and other medical imaging data may be analyzed using hybrid deep learning models, namely CNNs and Vision Transformers. The article also touches on the possibility that healthcare 5.0 and IoMT technology might make intelligent healthcare systems and real-time data monitoring easier. The review highlights that combining advanced preprocessing strategies with hybrid machine learning models can contribute greatly to the accuracy of prediction and help to diagnose chronic diseases efficiently.

Keywords

Chronic Disease Prediction, Machine Learning in Healthcare, Medical Data Preprocessing, Feature Selection Techniques, Dimensionality Reduction, Healthcare Data Analytics, Hybrid Deep Learning Models, Convolutional Neural Networks (CNN), Vision Transformers (ViT), Medical Image Analysis, Internet of Medical Things (IoMT), Healthcare 5.0.

Design and Implementation of an Interactive and Comprehensive Platform for Data Structures and Algorithms Visualization and Learning

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Abstract

Data Structures and Algorithms (DSA) serve as essential components for computer science education but students face difficulties studying algorithms because interactive learning tools that show algorithm behavior in real-time do not exist. The paper introduces a DSA Visualizer which acts as a web-based educational tool that enables users to see data structures and algorithms through dynamic stepwise visualizations. The system employs React to create interactive visual components on the frontend while using Spring Boot to execute algorithm processes and control state changes. The platform enables users to visualize fundamental data structures which include arrays and linked lists and stacks and queues and binary trees and binary search trees and graphs while using sorting and searching and tree traversal and BFS and DFS algorithms. The backend creates algorithm states which the frontend uses to display animations showing operations that include comparisons and insertions and swaps and pointer movements. The system provides visual display capabilities together with DSA practice problems and coding contests and community forums for doubt solving and user progress tracking and code history management. The components of the system help users learn by working together with others while enabling users to monitor their progress throughout their learning process. The results from experimental research show that students develop better understanding of algorithmic concepts while becoming more interested in learning when they use interactive visualization together with practice methods and community support. The proposed system shows that DSA education results improve when students use real-time visualization tools together with coding practice and collaborative learning activities.

Keywords

Data Structures and Algorithms (DSA), Algorithm Visualization, Interactive Learning Systems, Educational Technology, React Framework, Spring Boot, Web-Based Learning Platform.

ANN Controlled Soft-Switched Boost Converter Based LED Driver

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Abstract

In this paper, a smart soft-switched boost converter-based LED driver, with an improved input current ripple suppression, is proposed in the form of Artificial Neural Network (ANN) controller. The proposed system employs a full-bridge paralleled boost converter operating under zero-voltage switching (ZVS) conditions to achieve high efficiency and inherent ripple cancellation at the input. A buck-boost converter is integrated at the output stage to provide accurate LED voltage regulation while processing only a fraction of the total power. In conventional implementations, a proportional-integral (PI) controller is used for regulation; however, its fixed-gain nature limits performance under nonlinear and varying operating conditions. To overcome this drawback, an ANN-based controller is introduced to replace the PI controller, enabling adaptive and intelligent control of the converter. The ANN controller effectively handles system nonlinearities and improves dynamic response during input voltage deviations. The proposed LED driver is modeled and simulated in MATLAB/Simulink under nominal and disturbed input conditions ($\pm 10\%$). Comparative results demonstrate that the ANN-controlled system achieves faster settling time, improved voltage regulation, and superior input current ripple suppression compared to the PI-controlled counterpart. The proposed intelligent LED driver is well suited for high-efficiency street lighting and DC-source-fed lighting applications.

Keywords

Soft-switched boost converter, LED driver, artificial neural network controller, input current ripple suppression, zero-voltage switching, buck-boost converter, intelligent control.

Personalized Music System Based on Emotion Recognition

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Abstract

Technologies of emotion recognition are also becoming popular to learn human emotions and deliver individualized online experiences. This paper describes Tune Mood: Emotional Recognition for Personalized Music, which is a web-based application that is able to detect human emotions based on the facial image and suggest the appropriate music to play depending on the detected mood. The system combines the deep learning methods of facial emotion recognition on the basis of the Mobile Net model, which is chosen due to its lightweight network and high effectiveness in image recognition operations. The system is used by the interaction between the user and the system with the help of a secure authentication module that includes registration and login done using a MySQL database. Once logged in, the interface allows uploading facial images using a Flask based interface. The deepfake verification is done by image frequency analysis to detect images which may be manipulated before the emotion analysis. Facial expressions are then analyzed by Deep Face and dominant emotions, including those of happiness, sadness, anger, surprise, fear, disgust, and neutral, are determined. Depending on the identified emotion, the system suggests the required music tracks with YouTube links and offers the user a personalized and interesting experience.

Keywords

Emotion Recognition, Mobile Net, Deep Face, Deepfake Detection, Facial Expression Analysis, Music Recommendation, Deep Learning, Computer Vision.

Predictive Analysis of Chronic Kidney Disease

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Abstract

Chronic Kidney Disease (CKD) is a long-term health condition in which the kidneys gradually lose their ability to filter waste and excess fluids from the blood. If not detected at an early stage, CKD can progress to severe levels, leading to serious complications and kidney failure. Therefore, predicting whether the patient has CKD or NOT CKD is critical. This project proposes the development of a Deep Neural Network (DNN) model to predict CKD and classify it into three severity levels: Mild, Moderate, and Severe risk, based on patient health parameters such as blood urea, glucose levels, creatinine, specific gravity, hemoglobin, albumin. Unlike traditional approaches that focus only on identifying the presence of CKD, the proposed system performs stage-wise classification, which is more beneficial for clinical decision-making. In addition, data visualization techniques are incorporated to analyze medical features, identify key factors influencing CKD, and present results in a clear and understandable manner. The combination of deep learning and data visualization improves prediction accuracy and supports better analysis of CKD severity.

Keywords

Deep Learning, Deep Neural Network, Data Visualization, Stage-wise Classification, Chronic Kidney Disease.

Context-Aware Risk-Based Adaptive Multi-Factor Authentication for Secure and Low-Friction Web Access

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Abstract

The rise in credential stuffing attacks together with phishing attacks and session hijacking attacks demonstrates that static password authentication methods have reached their limitations. The security of Multi-Factor Authentication (MFA) systems increases through additional authentication requirements yet their standard implementation method creates excessive burden for users which results in "MFA fatigue." The authentication systems of today do not use contextual information because they consider trusted and suspicious login attempts to be identical. The research introduces a Context-Aware Risk-Based Adaptive Multi-Factor Authentication (RBA-MFA) system which adjusts security measures based on user needs. The system uses a backend Risk Engine which developers built with FastAPI and SQL to assess user behavior through three parameters IP geolocation consistency device fingerprint stability and temporal access patterns. The system deploys a weighted risk scoring function which generates a composite risk index that operates in real time to activate system authentication methods. Users with low-risk profiles need to present their main login information while users with medium-risk profiles need to use Email OneTime Password (OTP) authentication and users with high-risk profiles need to use Time-Based One-Time Password (TOTP) authentication. The assessment results show that RBA-MFA decreases the number of unnecessary authentication requests by 70 percent for legitimate users while maintaining its ability to detect suspicious login behavior. The proposed system enables web applications to achieve better security protection and user experience through its dual security enforcement framework.

Keywords

Adaptive Authentication, Risk-Based Authentication, Multi-Factor Authentication, Context-Aware Security, FastAPI, Device Fingerprinting, Cybersecurity.

Enhanced Pill Identification Using OCR and CNN

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Abstract

Tablets and capsules have been popular in medication delivery owing to the ease of use and stability. Nevertheless, misidentification is the risk and may cause inappropriate drug use and patient safety issues. To solve this problem, we present a new method which uses state-of-the-art AI technologies (e.g., Convolutional Neural network (CNN) and Optical Character Recognition (OCR)) to automatically recognize and validate the pills via visual appearance. Our approach is built around training a CNN as model of the image features for shape, color and imprinted pattern of the different tablets. We also build in Tesseract OCR to recognize any text printings on the pills, which further helps to identify them. From a RGB image of a tablet, the proposed method is capable of detecting whether a tablet is identical to a reference tablet in a pill box, reducing human errors for medication tray matching. Our method is experimentally validated and shows good performance in recognizing the imprinted tablets. If effective, this novel compound could help patients to be safer, preventing mistakes in medications, in situations that often lead to human error (hospitals and drugstores). Pill ID Automation This improves time management for care givers and puts clinician focus where it is most needed, on the patient as opposed to on the issue of medication. Also this can be introduced into current health systems as a simple solution which in turn provides accurate and reliable results for better patient safety and treatment outcomes.

Keywords

Tablet image recognition, Convolution Neural Networks, Tesseract OCR.

AUTOCODE: An Agentic AI System for Automatic Web Application Generation Using Multi-Agent Architecture

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Abstract

Building apps quickly always seems a bit chaotic, as if you are chasing after cats and hoping they will listen. Most times you find yourself going through lines of outdated codes, hunting down stubborn bugs or losing files that disappear as if by magic. Everything except actually making the app work properly. Then AI suddenly changing the situation. These language models now making it possible to merely speak out what you want in normal English. They produce code in any language you need. Tools that handle code snippets, automate dull chores or even work out difficult logic are suddenly popping up. However, most of them only doing bits and pieces. Even then you still have to put everything together just to get a running application. AI agent configurations are something else completely. Of course, once you bring in these agents, work creation is literally like lying on the beach. One bot discovers what users are after, the rest designs and codes, etc. That's how it becomes work music to ears. This is what AUTOCODE is all about. It meshes language models with a chat of agents who get your commands and create the real thing from scratch. It is fully automated. Most of the hard work is simply eliminated, and you get advanced web apps quickly. For me, it actually offers more leisure time, and honestly, it's a great thing.

Keywords

Agentic AI, Code Generation, Multi-Agent Systems, Large Language Models, Web Application Development, Automation in Software Engineering.

Computer Aided Bone Fracture Detection using Deep Learning Methodology

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Abstract

One of the most frequent injuries to the bones and muscles in a bone fracture. Usually, doctors use X-ray images to diagnose them. But reading these images by hand depends a lot on the skill of the radiologists, and this can sometimes cause delays or mistakes in the diagnosis. To help with this, this paper suggests using a system that can automatically detect bone fractures. Deep learning, a type of artificial intelligence, is used by this system. The system is constructed using the Residual Network, a type of deep learning that is a part of a convolutional neural network. This design helps the model learn better and train faster by focusing on the most important parts of the image. The technology examines X-ray images and can determine if there is a fracture or not. The model was tested using a dataset called MURA, which contains X-ray images of upper limb parts like hand, forearm, fingers, wrist, elbow, humerus, shoulder. So, the results indicate the model ResNet performs well in identifying fracture patterns and can accurately categorize pictures. This system can help radiologists make faster and more accurate diagnoses, which can save time and improve patient care. With more data and improvements, this system could be used in real hospitals to help detect fractures automatically.

Keywords

CNN, Image scanning, Bone Fracture Detection, ResNet, Automated Diagnosis.

Air Quality Index Prediction Using Data Science and ML

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Abstract

Assessing air first-rate in the first magnificence is a necessary step for the government, as its kilometres are a main public health trouble. Air pleasant index is an index that measures air quality. Carbon dioxide, nitrogen dioxide, carbon monoxide, etc. Natural gasoline is released whilst gasoline, coal, and wood are burned, as in factories and vehicles. Various air pollution, which might be air pollutants. Air pollutants can cause extreme diseases together with lung cancer and brain most cancers. They can also purpose contamination or demise. Machine studying algorithms help decide the air high-quality index. Various research are being carried out in this vicinity, however the consequences are not yet definitive. This dataset is available at the leading aerial surveillance platform Kaggle and is divided into schooling and checking out. Machine getting to know strategies used for this motive include linear regression, decision tree, random woodland, artificial neural community, and support vector machine.

Keywords

Carbon Dioxide, Nitrogen Dioxide, Carbon Monoxide.

Crime Pattern Prediction System Using Spatio-Temporal Data Mining

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Abstract

With rapid urbanisation comes a responsibility to develop smart and efficient systems to ensure smart cities. Citizens not only require smooth roads, but also ensured safety. Crime Lens, a crime pattern prediction system, is based on spatio-temporal data and has been designed to process historical crime datasets. This is then used to classify crimes into categories, infer severity levels, and visualize crime hotspots with the help of geospatial data mining. The system makes use of an automated pipeline and a sleek, modern web interface. It is an attempt to demonstrate how unstructured crime data can be processed to structured crime data and then transformed into comprehensive insights and predictions for research, urban planning, and safety enhancement in smart cities.

Keywords

Spatio-Temporal, Crime Pattern Prediction, Severity Levels, Severity Mapping, Data Pre-Processing, Crime Analytics, Crime Prevention.

NetTopoGen: A Multi-Topology, Fault-Aware Network Simulation Framework with QoS-Driven Multi-Algorithm Routing

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Abstract

Network simulation is essential for analyzing routing behavior, fault tolerance, and Quality of Service in communication networks. However, existing simulation tools often fail to balance protocol realism, scalability, and usability. High-fidelity simulators such as NS-3 provide detailed modeling but require complex scripting and extensive configuration, while lightweight and educational platforms lack support for multi-algorithm routing analysis, dynamic fault injection, and QoS-driven experimentation. These limitations restrict rapid and systematic evaluation of routing strategies across diverse network conditions. This paper proposes NetTopoGen, a Python-based, fault-aware network simulation framework designed to address these challenges. The framework integrates five network topology families, four routing algorithms, interactive multi-metric QoS cost modeling, configurable traffic generation, and real-time fault injection within a unified graphical interface. The primary novelty of NetTopoGen lies in its ability to combine multi-topology analysis, QoS-aware routing, and fault resilience evaluation in a single extensible platform without reliance on script-driven workflows. The proposed framework is evaluated through 3,200 simulation runs conducted across 16 experimental scenarios, varying topology structures, routing algorithms, traffic patterns, and fault conditions. Performance is measured using packet delivery ratio, end-to-end delay, throughput, convergence time, and packet loss. Results demonstrate that the A* algorithm achieves up to 18% faster convergence than Dijkstra while preserving optimal routing paths. Mesh topologies exhibit approximately 25% higher packet delivery under fault conditions compared to ring structures, while QoS weight adjustments lead to substantial path reconfiguration. Overall, NetTopoGen reduces experimentation time by over 40%, making it suitable for both research and advanced networking education.

Keywords

Network simulation, topology generation, QoS routing, fault tolerance, educational visualization, Python framework, multi-algorithm analysis.

Intelligent Money Management and Crisis Preparedness with Smart Expense Tracker

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Abstract

Effective personal finance management is essential for individuals facing increasing economic uncertainty, yet many struggle to monitor financial activities and prepare for crisis situations. This paper presents an intelligent web-based system designed to automate and streamline income–expense tracking while enhancing user readiness for financial emergencies. The proposed application integrates secure user authentication, real-time transaction recording, and interactive financial analytics using modern full-stack technologies. A MERN-based architecture—comprising React.js, Node.js/Express, and MongoDB—supports responsive data handling, while JWT authentication, bcrypt hashing, and RESTful APIs ensure security and scalability. The system provides features such as trend analysis, category-wise spending insights, and financial health indicators to assist users in identifying vulnerabilities and strengthening crisis preparedness. Experimental evaluation demonstrates that the application offers consistent, accurate, and meaningful financial insights, thereby improving user financial awareness and supporting more informed decision-making. The work contributes to personal finance technology by providing a practical and extensible solution for intelligent money management.

Keywords

Personal Finance Management, Crisis Preparedness, Full-Stack Web Development, Financial Analytics, React.js, Node.js, MongoDB.

Virtu Lrn – Gesture – Based Holographic Display

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Abstract

Virtu Lrn operates by interpreting gestures via camera input, enabling interaction with three-dimensional visuals formed using the Pepper's Ghost technique. Instead of relying on virtual or augmented reality hardware, it provides accessible depth in digital education. Movement becomes command, shaping how users engage with projected content. Cost efficiency emerges alongside experiential richness, shifting focus toward inclusive innovation. What results is a different path – one where light, motion, and perception combine quietly beneath the surface.

Keywords

Computer vision, Deep learning, Gesture-based interaction, Hand gesture recognition, Human-computer interaction, Machine learning, Real-time systems, Virtual learning environment.

Enhancing Breast Cancer Detection Using Deep Learning Framework

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Abstract

Among women across the planet, breast cancer is still ranked among the causes of cancer-related deaths, and early and precise diagnosis is of paramount importance as far as healthcare is concerned. Mammography is extensively applied to screen breast cancer, but the analysis of the mammogram images is often not easy because of the complicated structures of tissues and the imbalanced datasets. In the work, an optimised deep learning-based framework is introduced for the classification of breast cancer mammograms through the strategy of handling dual data. The offered method combines transfer learning and ResNet50 to extract the best features and uses the Synthetic Minority Over-sampling Technique (SMOTE) to efficiently resolve the issue of class imbalance. A completely connected classification network with batch normalization and dropout layers is implemented in order to enhance generalization and minimise overfitting. This framework is tested on both balanced and imbalanced data to simulate real-life diagnostic situations. The experimental outcomes show high classification accuracy, sensitivity and reliability, which point to the effectiveness of the dual approach in enhancing diagnostic performance. The given system has the potential of providing a scalable and efficient approach to computer-aided diagnosis of breast cancer and assist radiologists in delivering accurate and consistent clinical decisions.

Keywords

Breast Cancer Diagnosis, Mammogram Classification, Deep Learning, ResNet50, Transfer Learning, SMOTE, Imbalanced Data, Medical Image Classification, Computer-Aided Diagnosis.

Hybrid Log Classification System Using BERT, DBSCAN, Regex or Llms

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Abstract

Large-scale software systems continuously generate heterogeneous and unstructured log messages that are critical for monitoring system behavior and diagnosing failures. However, functional log classification remains challenging due to evolving log formats, semantic ambiguity, and the high computational cost of deep learning-based approaches. This paper presents a cost-aware hybrid log classification framework that combines density-based pattern discovery, rule-based filtering, and semantic language modeling within a unified pipeline. Frequent and repetitive log patterns are automatically identified using DBSCAN clustering over pre-trained, frozen BERT embeddings and are converted into lightweight Regular Expression (Regex) classifiers, enabling efficient handling of the majority of log traffic. Log messages that do not match derived patterns are semantically classified using a BERT-based classifier, while low-confidence predictions are selectively escalated to a Large Language Model (LLM) for robust handling of rare and previously unseen logs. Unlike single-model or parsing-dependent approaches, the proposed framework explicitly balances classification accuracy and inference cost through confidence-aware routing. Experimental evaluation on heterogeneous system logs demonstrates improved classification performance while significantly reducing reliance on computationally expensive models. The proposed approach offers a practical and extensible solution for scalable and reliable log classification in modern AIOps pipelines.

AI-Based Stock Price Prediction System

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Abstract

The stock market changes every day and predicting prices is very difficult. This project, AI Based Stock Price Prediction System, uses artificial intelligence to help predict future stock prices. It collects past stock data and analyzes patterns using machine learning techniques like LSTM, Random Forest. The system provides predictions that can help investors make smarter decisions, reduce risks, and plan their investments better. This project aims to make stock trading easier and more reliable by giving accurate forecasts in real time.

Keywords

Artificial Intelligence, Machine Learning, Stock Market Prediction.

Automated Infrastructure Configuration and Continuous Deployment Pipeline for Multi-Server Environments Using Ansible and Jenkins

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Abstract

Managing and deploying complex applications across multiple machines is an arduous task; In addition to being time-consuming and error-prone for Operations teams, it also creates an environment that causes headaches for everyone involved. We focused on this challenge, how do we keep a multi- host environment in perfect sync, and allow for the deployment of new functionality without disruption to anything? Our solution is an Automated Continuous Deployment (CD) Pipeline that provides an end-to-end approach to removing manual work from IT Operations. With the help of Ansible we've created a definitive Infrastructure Blueprint that automatically configures everything required to run an application (e.g., web servers, databases, load balancers, etc.) independently of any human intervention. The Pipeline leverages the capabilities provided by Jenkins to manage the Infrastructure Blueprint and serve as the primary "command" that coordinates the entire sequence from when a developer commits code through to the point where that same code is deployed to both Staging and Production environments. Ultimately, this transformation of the way we deploy has drastically reduced the burden of repetitive and error-prone tasks from our already stretched Operations teams.

Keywords

DevOps, CI/CD, Pipeline, Jenkins and Ansible server Configuration, Remote server.

AI Driven Control Framework for Scalable Microservices Resource Allocation

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Abstract

The microservice applications built using cloud-native technology have very dynamic workloads and complex service dependencies. This makes resource allocation a critical and challenging task. The conventional autoscaling method (such as threshold-based horizontal autoscaling) is too slow and does not consider service dependencies. This leads to performance issues and resource suboptimality. Our contribution is the proposed hybrid control framework, which integrates Reinforcement Learning (RL), Model Predictive Control (MPC), and Graph Neural Networks (GNN) as an intelligent management model for any resource. The GNN part relies on the service call graph to forecast the probability of workload and cascading effects of microservices. The RL agent is trained to learn scaling policies adaptively to cope with real-time fluctuation. There is an MPC module as a management stabilizer and foresight by optimizing the scaling decisions with the predictions of workload, constraints, and costs. The hybrid system is adaptive to provide CPU and memory resources to individual services and meet the latency Service-Level Objectives (SLOs). Our approach, in contrast to conventional autoscalers, seeks to accomplish a great improvement in an experiment on benchmark microservice applications: tail latency improvement of up to 50 percent, resource utilization efficiency improvement of up to 30 percent, and over 90 percent SLO satisfaction. The performance of these capabilities demonstrates that the proposed multi-model controller is efficient in dealing with the challenge of performance and efficiency tradeoff in the cloud environment.

Keywords

Microservices Autoscaling, Deep Reinforcement Learning, Graph Neural Networks (GNN), Model Predictive Control (MPC), Resource Orchestration, SLO Compliance.

Design and Implementation of an Embedded Industrial Monitoring System using STM32F446ZE Nucleo

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Abstract

The need for reliable and continuous monitoring of environmental conditions in industrial environments has increased significantly with the advancement of embedded technologies. Industrial facilities often operate under conditions where parameters such as temperature, humidity, and air quality must be carefully monitored to ensure safety, operational stability, and equipment reliability. This paper presents the design and implementation of an embedded industrial monitoring system using the STM32F446ZE Nucleo development board. The proposed system integrates environmental sensors, including the DHT11 temperature and humidity sensor and the MQ135 air quality sensor, to measure critical industrial parameters in real time.

The STM32 microcontroller collects sensor data, processes it, and evaluates environmental conditions based on predefined threshold values. The monitored parameters are displayed on an LCD module to provide local visualization of system status. Additionally, visual indicators using internal LEDs (Red, Blue, and Green) and an audible buzzer alert mechanism are implemented to notify operators when abnormal environmental conditions are detected. The system also transmits monitoring data to a computer through UART communication for further observation and analysis.

Experimental results demonstrate that the proposed system provides accurate sensor monitoring, reliable data processing, and effective real-time alert mechanisms. The developed system offers a cost-effective and scalable solution for improving safety and environmental monitoring in industrial applications.

Keywords

Industrial Monitoring System, Embedded Systems, STM32F446ZE Nucleo, Real-Time Data Acquisition, Sensor-Based Monitoring, UART Communication.

AI-Concierge: A Deepseek Powered Conversational Chatbot

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Abstract

In today's fast-paced academic environment, finding specific information on a college website can be surprisingly frustrating. Most institutional sites are cluttered and difficult to navigate, leaving students and staff struggling to find simple answers through basic search bars. While AI chatbots like ChatGPT offer a more conversational way to get help, they often struggle with hallucinations or lack access to up-to-date, private campus information. Most importantly, sending sensitive university data to public cloud APIs raises serious privacy concerns.

This paper details the development of a private, localized AI chatbot built to solve these problems using a Retrieval-Augmented Generation (RAG) framework. Unlike standard bots, our system stays current by using a custom data pipeline built with Playwright and BeautifulSoup to automatically scrape and clean content from the college domain. To make the bot smart, we implemented a FAISS vector database. By converting text into mathematical embeddings using the nomic-embed-text model, the system can instantly find and retrieve the exact paragraph needed to answer a student's question, moving far beyond simple keyword matching. A key priority of this project was keeping everything local. By using Ollama to host models like DeepSeek R1 on internal hardware, we ensured that campus data never leaves the network. This approach not only protects privacy but also removes the need for expensive API subscriptions. With a user-friendly interface built on Streamlit, our testing shows that this RAG-based setup is significantly more accurate and reliable than generic AI models. Ultimately, this project provides a secure, low-cost, and highly effective way for colleges to manage their knowledge and support their students.

Keywords

Retrieval-Augmented Generation (RAG), Local LLM, Ollama, FAISS, Playwright, Web Scraping, Institutional Knowledge Management, Data Privacy.

IMRAS – Intelligent Medication Risk Assessment System

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Abstract

Incomplete patient histories, drug–drug interactions, and allergy conflicts remain persistent problems in small and medium healthcare clinics, where resource constraints make preventable medication errors far too common. This paper introduces IMRAS (Intelligent Medication Risk Assessment System), an AI-powered clinical decision support tool built to assist physicians during prescription writing through a dedicated frontend interface. Each patient in IMRAS receives a unique identifier that ties their medication records to a central database, enabling real-time safety checks at the point of care. The system screens for drug–drug interactions, duplicate therapies, overdose risks, and allergy conflicts as part of its core safety workflow. Detection is handled by a rule-based medical safety engine working alongside a clinical NLP model built on BioBERT; together, they generate risk scores and produce interpretable warnings when clinical uncertainty is detected. For prescriptions flagged as high-risk, the system recommends safer therapeutic alternatives through clear, actionable notifications that physicians can evaluate directly – without interrupting the clinical record or creating gaps in documentation required for legal and audit purposes. Testing shows that IMRAS measurably cuts down on hazardous prescriptions and raises medication safety standards in settings where specialist oversight is limited, making it a practical option for outpatient clinics that need scalable, reliable decision support without heavy infrastructure investment.

Keywords

Clinical Decision Support System, Medication Safety, Drug–Drug Interaction, BioBERT, Allergy Detection, Risk Assessment, Explainable AI, Medical NLP, FastAPI, Electronic Prescription, Patient Medication History.

Fake Social Media Accounts and Their Detection

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Abstract

The social media sites have been adding more users who are forced to open fake user accounts to facilitate their online activities. Most of these accounts belong to the category of malicious users, who create threatening conditions through dissemination of misleading information and commit a scam on the background of manipulating the mass media opportunities of which they take advantage. Online testing must make sure that detection of fake accounts is performed as fake accounts have a direct negative effect on the credibility of the platforms. The paper will discuss the ways to detect misrepresented social media accounts with the help of different machine learning algorithms based on classical algorithms that involve Decision Tree and Random Forest and on recent natural language processing (NLP) algorithms that involve DistilBERT and RoBERTa with BiLSTM. The researchers built their models by means of testing, which involved all the user data points that contained information about their social network active behavior and their posting behavior among other information that is of relevance. The account age post frequency followers/following and the engagement ratio are the derived features that have been identified to be determining the distinguishing features of the fake accounts. The models evaluate their performance by the use of accuracy tests as well as precision tests and recall tests and F1-score tests. The results indicate that machine learning devices are capable of identifying fake accounts in a holistic manner, and the hybrid natural language processing models that incorporate the DistilBERT and BiLSTM models with the RoBERTa and BiLSTM models have better performance levels than the standard models. The hybrid NLP models are competing because they utilize contextual information that they gain by the posting of the user and the way that the user behaves during the process of the functioning of the models.

Keywords

This research paper discusses various machine learning models, e.g. Decision Tree and Random Forest and Logistic Regression to establish the efficacy of the models in performing Natural Language Processing tasks.

BIO-PAY: Biometric Wallet with Face + Password Authentication

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Abstract

BIO-PAY is a secure, device-free campus payment system designed for schools, colleges, universities, and other controlled environments where students and staff frequently make low-value payments without the burden of carrying cards, cash, or mobile phones. Each individual is assigned a unique campus ID, which acts as a unified digital identity for canteen purchases, library fines, hostel services, laboratory usage fees, and institutional fee counters. Instead of relying on physical tokens or personal smartphones, users authorize payments using only their face and memorized credentials at dedicated terminals connected to the campus network.

The core idea of BIO-PAY is to transform the campus ID into a trusted payment identity by tightly integrating facial recognition based on the Local Binary Patterns Histograms (LBPH) algorithm with password verification and automatic e-mail receipt generation using the Simple Mail Transfer Protocol (SMTP). Facial images captured at enrollment are pre-processed and encoded into LBPH feature vectors, enabling fast, on-device recognition with modest computational requirements suitable for low-cost hardware deployments. During a transaction, the system performs dual-factor verification: it first confirms that the live camera feed matches the stored LBPH template for the claimed campus ID, and then validates a user-defined password before authorizing any debit from the internal wallet balance. Once a payment is successfully executed, BIO-PAY generates a structured transaction receipt and delivers it via e-mail to the user (and optionally to guardians or administrators), creating a transparent, tamper-evident audit trail for every cafeteria purchase or service fee.

From an administrative perspective, BIO-PAY offers a centrally controlled and fully traceable payment ecosystem tailored to educational institutions. The backend maintains user profiles, balances, and transaction histories in a unified database, allowing accounts to be provisioned, suspended, or topped-up according to institutional policies or fee schedules. Because transactions are linked to biometric identities rather than physical cards, schools can significantly reduce card issuance and replacement costs, minimize cash handling, and curb fraudulent behaviors such as proxy purchases or impersonation at service counters. At the same time, parents and administrators benefit from improved visibility into spending patterns, enabling closer monitoring of student welfare, meal consumption, and compliance with financial aid policies. By eliminating the need for cards, QR codes, or mobile apps while adding biometric and credential-based safeguards, BIO-PAY positions itself as a practical, campus-scale model for secure, convenient, and accountable biometric payments in the education sector.

Light Gradient Boosting Machine Algorithm for Detecting IMOT Networks Anomaly for Healthcare Specific Dataset

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Abstract

The Internet of Medical Things (IoMT) connects medical devices to enable real-time monitoring and personalized care, significantly enhancing patient health and well-being. However, this connectivity also introduces substantial cybersecurity risks, including various attack types that compromise data integrity and availability, jeopardizing patient safety and healthcare service reliability. This study addresses these challenges by proposing a real-time anomaly detection model based on machine learning (ML) techniques, designed to detect and mitigate diverse cyber threats effectively. This paper proposes a new medical dataset for anomaly detection, inspired by the UNSW-NB15 dataset, and enriched with healthcare-relevant attack types, including falsification and DoS attacks, to reflect real-world IoMT scenarios. The dataset comprises 253680 records, with 60% anomalous data distributed across multiple attack types, offering a more challenging and realistic environment for evaluating ML models. Seven machine learning algorithms, including Random Forest, XGBoost, and Artificial Neural Networks (ANN), were rigorously tested, leading to the development of a novel stacking ensemble model. This model integrates XGBoost as the meta-learner with Random Forest and ANN as base models, leveraging their strengths to optimize anomaly detection. The proposed model was evaluated on both the UNSW-NB15 and the new medical dataset, achieving significant improvements across key metrics such as accuracy, precision, recall, and F1-score. A realtime prediction analysis further demonstrated its ability to detect anomalies efficiently during data transmission, validating its suitability for detecting anomalies in different scenarios. All traditional ML algorithms are used and not utilize any advance ML algorithms like CNN2D, LSTM, CATBOOST, LIGHTGBM or any other. So as extension we have experimented with above mention algorithms and then found LIGHTGBM giving highest accuracy compare to all propose and existing algorithms. LightGBM (Light Gradient Boosting Machine) is an open-source, high-performance gradient boosting framework developed by Microsoft. It is designed for efficiency, scalability, and high accuracy, particularly when dealing with large datasets. It utilizes decision tree algorithms and is applicable for various machine learning tasks, including classification, regression, and ranking.

Keywords

Anomaly detection, intrusion detection system, Internet of Medical Things, medical dataset with anomalies, machine learning, healthcare security, improved hybrid algorithm for better performance, Light Gradient Boosting Machine (LightGBM).

Byzantine - Robust Temporal Graph Reconstruction for Transactional Fraud Detection

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Abstract

The research aims to address the increasing complexity of financial fraud, which is heavily reliant on time-related and complex relational structures. Machine learning techniques are often ineffective in dealing with the dynamic nature of graph structures or may be susceptible to adversarial attacks. This paper proposes a strong and efficient approach for the detection of financial fraud using a combination of Temporal Graph Neural Networks (TGNNs) and Long Short-Term Memory (LSTM) networks, with the addition of Byzantine robust aggregators for improved robustness. The technique is based on the use of Edge-Aware Graph Neural Networks for spatial embeddings of graph structures, with the addition of LSTM networks for the modeling of time-related structures and the velocity of fraudulent activity. Data poisoning attacks are also addressed using Byzantine robust aggregators, such as median-based aggregators, for improved network convergence under adversarial attacks. The research is tested using a Google BigQuery Ethereum dataset, with 97,608 unique addresses and 95 time snapshots, resulting in a total of approximately 9.27 million node-time instances being processed using the network. The results show a PR-AUC of 81.92, indicating effective isolation of fraudulent activity and a significant improvement over conventional GNN-LSTM approaches with fixed thresholds. Additionally, the technique is also effective for handling millions of nodes using mini-batch and time-related processing of graph structures, providing a strong and efficient tool for the detection of fraud in a completely unsupervised and extremely secure environment.

Keywords

Financial Fraud Detection, Temporal Graph Neural Networks (T-GNN), LSTM, Byzantine Resilience, Adversarial Machine Learning, Graph Mining, Robust Optimization, Ethereum, Blockchain Security.

Design and Performance Analysis of a QCA-Based Cube Calculator Using Optimized Multiplier Architectures

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Abstract

The Quantum-Dot Cellular Automata (QCA) technology has been more promising as an alternative technology of the traditional Complementary Metal-Oxide Semiconductor (CMOS) technology due to its low power consumption, high switching rates and capability of integrating nanoscale scale devices. QCA can be used well to execute small scale arithmetic circuits because CMOS is approaching the scaling limits. In this work, it is proposed to use a Cube Calculator that relies on QCA as an optimized algorithm to perform the cube operation (A^3). The proposed architecture includes the use of optimized multiplier structure, majority gates and inverters to reduce redundancy of logic, number of cells and complexity of multiplier. QCA Designer is utilized to make the design and simulate it in the light of the estimation of the coherence vectors to test the parameters, such as the cell count, area utilization, clock latency and energy dissipation. The outcomes of simulation demonstrate that the energy dissipation of the proposed architecture is lower 1.10×10^{-2} eV and the average energy per cycle is 1.00×10^{-3} eV, significantly lower than the existing technologies. It is also expected to have superior computational efficiency because the proposed circuit converges faster and requires less time to simulate. These enhancements are needed to make the suggested QCA cube calculator fit in low-power nanoelectronics systems, cryptographic hardware and high-order arithmetic processing units and so forth.

Keywords

Quantum-Dot Cellular Automata (QCA), Cube Calculator, Optimized Multiplier Architecture etc.,

ZENLOCK – A Rule Based Mobile Application for Social Media Addiction Control with Automatic News Updates

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Abstract

Too much time on social media apps can harm focus, mood, because it disrupts balance with daily life. A new tool tackles this by watching how long someone uses certain platforms then stepping in when needed. Instead of guessing screen time, software counts taps and opens inside chosen apps using background tracking. After hitting a set threshold, the phone locks those apps until a special code resets access. Though automatic, it waits for people to ask permission before making changes visible. What makes it different? It does not rely on cloud servers yet still updates rules based on behavior patterns seen locally. Once logged in, users land on a news page showing live headlines pulled from outside sources. Instead of just linking up, the app ties into phone tools like time tracking, running tasks, and floating views to watch how apps are used. Because it checks actions using set rules while feeding useful articles, it quietly cuts down endless swiping. Testing shows setting clear digital boundaries helps people rethink their habits and pay closer attention to screen time.

Keywords

Digital Wellbeing, Social Media Addiction, Screen Time Monitoring, Rule-Based System, Mobile Application, Android, App Blocking, Behavioral Analysis, Productivity Enhancement, News Redirection.

Toward Optimal Architecture Selection: A Dataset-Centric Benchmarking of Point Cloud Neural Networks

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Abstract

Point cloud processing has seen remarkable advancements with deep learning, yet no consensus exists on which architecture performs best across diverse datasets and tasks. This study presents a comprehensive benchmarking of four prominent raw point cloud architectures—PointNet++, RandLA-Net, DGCNN, and Point Transformer—across eight datasets spanning indoor, outdoor, object-level, and small-scale domains. We evaluate performance using a multi-criteria scoring system incorporating accuracy, efficiency, memory usage, and generalization capability. Our experiments reveal that RandLA-Net achieves the best overall balance, excelling particularly in large-scale segmentation tasks, while Point Transformer dominates in classification accuracy but at a high computational cost. We provide practical guidelines for architecture selection based on dataset characteristics and application constraints.

Federated Learning-Based Privacy-Preserving Intrusion Detection System for IoT-Enabled Smart Cities

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Abstract

The rapid proliferation of Internet of Things (IoT) devices in smart cities has introduced unprecedented security challenges, while traditional centralized intrusion detection systems (IDS) raise significant privacy concerns due to the need for data aggregation. This paper presents a novel privacy-preserving federated learning-based intrusion detection system designed specifically for IoT-enabled smart city environments. The proposed system trains a global intrusion detection model collaboratively across distributed IoT devices using federated learning, ensuring that no raw privacy-sensitive data is ever transmitted to a central server, thereby preserving user privacy while maintaining detection accuracy. The architecture incorporates differential privacy mechanisms to provide formal, mathematically grounded privacy guarantees and employs a hierarchical federated learning model to effectively handle the heterogeneity inherent in IoT smart city networks. Extensive simulations using real-world IoT network traffic traces demonstrate that the system achieves a detection rate of 96.8% with low communication overhead and outperforms conventional centralized IDS approaches without compromising data privacy. The system successfully detects a wide range of IoT-specific attack vectors, including Distributed Denial of Service (DDoS) attacks, replay attacks, and botnet intrusions. This research underscores the critical importance of developing privacy-preserving and scalable security solutions tailored to the complex, distributed nature of smart city infrastructures, offering a practical and effective framework for securing next-generation IoT deployments. The proposed approach aligns with the Engineering and Technology themes of ICR CET 2026.

Multi-Model Approach for Predicting Stock Market Trend Reversals Using Supply and Demand Analysis

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Abstract

This research proposes a sophisticated multi-model machine learning framework designed to accurately forecast short-term price trend reversals within high-frequency financial markets using Limit Order Book (LOB) data. While traditional econometric methods often struggle to capture the complex, nonlinear dynamics of supply and demand inherent in order flow, our system overcomes these limitations by extracting high-resolution microstructure-based features. These include order imbalance metrics, bid-ask spreads, and price momentum derived from 5-minute NIFTY 50 futures data spanning August 2024 to August 2025. The framework integrates three complementary predictive architectures to capture diverse market signals: a Random Forest for identifying static feature relationships, a Stacked LSTM network to model long-range temporal dependencies and a Feedforward Neural Network for mapping intricate nonlinear decision boundaries. Each constituent model is trained to predict the binary direction of the subsequent 5-minute price candle. Rigorously assessed using standard classification metrics including accuracy, precision and F1-score this hybrid approach demonstrates robust predictive potential across volatile market conditions. By effectively bridging microstructure theory and deep learning, the framework offers a scalable foundation for real-time algorithmic trading systems, optimized execution strategies, and enhanced risk management in modern order-driven markets.

Keywords

Random Forest, Stacked LSTM, Neural Network.

Surrogate-Assisted Bayesian Multi-Objective Optimization for PPA Improvement in FPGA-Based Digital Design

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Abstract

The increasing complexity of VLSI systems and continuous technology scaling have made Power, Performance, and Area (PPA) optimization a critical challenge in modern digital design. Conventional heuristic and machine learning-based approaches often require extensive design space exploration and may not efficiently achieve optimal trade-offs among multiple objectives. This paper presents a surrogate-assisted multi-objective PPA optimization framework using Bayesian learning for efficient design space exploration. The proposed method leverages surrogate models to approximate design evaluations and employs Bayesian optimization to guide the search toward optimal parameter configurations, thereby reducing computational overhead and convergence time. The framework is implemented and validated using Xilinx Vivado, considering key metrics such as power, area, timing, and propagation delay. Experimental results demonstrate that the proposed approach reduces delay from 24 to 22, maintains power at 44, and significantly improves the PPA score from 320 to 136, compared to the existing ML-based method. Although the area increases from 80 to 100, the overall results indicate a superior trade-off among PPA metrics. The proposed method achieves improved Quality of Results (QoR), faster convergence, and reduced manual intervention, making it suitable for scalable and automated FPGA-based digital design optimization.

Keywords

Surrogate Modeling, Bayesian Optimization, Multi-Objective Optimization, Design Space Exploration (DSE), Power-Performance-Area (PPA) etc.,

Effect of Air Pollution on Human Respiratory System

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Abstract

Air pollution has become a serious ecological and human health problem, negatively influencing the respiratory system of humans and increasing the occurrence of chronic illnesses. To make timely interventions and make informed decisions, it is essential to evaluate and predict respiratory hazards due to air pollution accurately and precisely. This paper presents a smart structure, which combines categorization and forecasting of respiratory risks related to air quality through advanced ML algorithms. Classification is performed using RF, XGBoost, and LightGBM, with RF having the best performance with an accuracy of 97.8, a precision of 97.8, recall of 97.8 and F1-score of 97.8. Random Forest, XGBoost and LightGBM are used in air quality forecasting and LightGBM has the best results with an MSE of 61.625, RMSE of 7.850, MAE of 6.162 and a R²-score of 0.950. AI explainable systems, including LIME and SHAP, are used to provide both instance-level and global feature insights, therefore, enhancing the transparency and understandability of predictions. The models are deployed by the use of an online interface based on Flask, which supports security in user interactions, real-time forecasts, and predictions with alerts and recommendations. It is an all-inclusive approach to the proactive respiratory health awareness and the management of air quality.

Keywords

Air pollution, Respiratory health, Random Forest, XGBoost, LightGBM, LIME, SHAP, Flask.

Automated SEO Keyword Generation Through Multimodal Analysis of Video Content

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Abstract

Automated SEO keyword generation from multimedia content has become an important connecting point between multimedia comprehension and online discovery. This survey overviews the past literature that identifies and scores candidate keywords based on textual (metadata, transcripts, on screen text), audio (speech, linguistic information, music) and visual (objects, scenes, actions, on screen graphics) modalities, alongside approaches that engage explicit multimodal fusion. We combine methods that range from classical pipelines, text-based ranking after speech-to-text to TF IDF variants up to state of the art representation learning paradigms using deep convolutional networks, audio embeddings, and transformer-based cross-modal encoders. Strategies for evaluation, data, and SEO-focused metrics that are employed to evaluate keyword relevance, coverage, and ranking performance are contrasted and documented to reveal methodological trade-offs and reproducibility issues. Our examination reveals strong areas and areas of ongoing shortfall: text-heavy approaches remain strong in topicality but lack visual context; audio and vision signals enhance coverage for non-verbal and scene-based terms but have alignment and noise problems; and end-to-end multimodal systems are promising but are hampered by rare, SEO-minded evaluation benchmarks and the disconnect between research metrics and actual search performance. We end by describing directions for large-scale multimodal pretraining, end-to-end keyword-to-ranking pipelines, multilingual robustness, standardized SEO evaluation protocols, and explainable keyword attributions that have the potential to enable practical, high impact progress in automated SEO for video.

Keywords

SEO keyword generation, Deep learning, Feature extraction, Multimodal analysis.

Automatic Wind Turbine Shutdown System Using Pitch Regulation

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Abstract

Wind turbine is often subjected to strong wind velocities which can cause mechanical damage, undue vibration, and shorten the life of the components. Conventional protection yaw control and mechanical braking mechanisms systems entail the loss of energy and mechanical stress. A servo-controlled automatic wind turbine is discussed in this paper blade pitch- based shutdown system, which is intended to safe turbines in high wind speeds without wasting energy. The suggested system changes the blade pitch dynamically angle with high-torque servo motors beyond a wind speed predefined threshold. Once the wind velocity gets above the critical threshold (equivalent to 55 mph), the blades are turned in the near-feathered direction position (90 degrees) through which the wind passes through the rotor and effectively decreasing the torque and rotational velocity. The results have the ability to offer good speed control checking the viability of the proposed shutdown strategy towards minor and intelligent wind turbines.

Keywords

Wind Turbine, Automatic Shutdown, Blade Renewable Energy, Pitch Control, Servo Motor, ESP32.

EduVQA: A Multi Modal Visual Question Answering Framework for Enhancing Educational Reasoning

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Abstract

Visual pedagogy, the use of diagrams, graphs and illustrations in the teaching resource, has become more and more part of contemporary education and yet the learners are often faced with the challenge of getting the visual representations of concepts to be connected with the underlying conceptual structures. The current systems of questions and answers are mainly textual in nature and hence are not in a position to offer substantive reasoning support to the visual learning materials. Modern visual question answering (VQA) systems, modeled after general-purpose use, generally cannot handle educational case and give over-respectively simplistic answers. These incompetencies hinder the acquisition of concepts in the minds of the learners and reduce the effectiveness of the instructional tools. In answer to this, the current research suggests a complex VQA system, called eduVQA, which incorporates multimodal inputs. EduVQA increases the capabilities of educational reasoning by combining visual and textual data. The architecture consists of multimodal encoder built on LXMERT to identify salient areas in visual stimuli with additions of dynamic context selection techniques to pertinent textual content. The process begins with an auxiliary pre-answer generator which yields the candidate responses along with the estimated response confidence scores then filtered further to ensure the results are accurate. Implementation of eduVQA also provides learners with greater educational assistance, thus, improving e-learning ecosystems and facilitating the creation of individual learning patterns, ultimately contributing to the overall education process and results.

Keywords

eduVQA, Visual Question Answering (VQA), Multimodal Learning, Educational Reasoning, Deep Learning, Intelligent Tutoring Systems.

Gesture-to-Meaning Intelligent Interface for Non-Verbal Users

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Abstract

The paper proposes a new and efficient full-duplex communication system that fills the gap between Deaf and Mute (D-M) and Non-Deaf and Mute (ND-M) people without the need for ND-M people to learn sign language. In contrast to other models that only support unidirectional translation or translation in a single language, this system allows for real-time bidirectional translation in multiple sign languages, namely Indian Sign Language (ISL) and American Sign Language (ASL). The system also supports Speech-to-ISL/ASL, Text-to-ISL/ASL, ASL-to-ISL, and ASL-to-Speech translation. The system is developed using Machine Learning (ML), Convolutional Neural Networks (CNNs), and Natural Language Processing (NLP) techniques to provide high accuracy in gesture recognition and context-aware translation. The system is cost-effective, scalable, and can be applied in various settings such as education, healthcare, and public service sectors. The system is modular and can be easily extended to incorporate other sign languages. Experimental evaluations show over 96% accuracy with real-time responsiveness. The system and codebase are openly available to encourage replicability and wider adoption, thereby promoting digital inclusivity for the D-M community. Future enhancements include dataset expansion, full-word recognition, and collaborative deployment with accessibility-focused organizations.

Keywords

Deaf-mute communication, Real-time translation, Sign language dataset, Machine Learning, ISL, ASL.

Software Cost Estimation in Agile Methodology Using Deep Learning with Uncertainty Quantification

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Abstract

Accurate software cost estimation remains a critical challenge in Agile development environments, where requirements evolve continuously across sprints. Classical parametric models such as the Constructive Cost Model (COCOMO) and Function Point Analysis (FPA) were designed for waterfall projects and cannot leverage the qualitative narrative content generated by Agile teams. This paper presents a dual-input deep learning framework that combines BERT-Large text encoding of Agile sprint reports with eighteen structured project features. The model is trained under a Gaussian Negative Log-Likelihood (NLL) objective and queried via Monte Carlo (MC) Dropout to decompose predictive uncertainty into aleatoric and epistemic components. A two-phase discriminative fine-tuning schedule converges in under ten minutes on a single Graphics Processing Unit (GPU). Evaluated across five random seeds with stratified 5-fold cross-validation on a corpus of 10,000 synthetic Agile project records, the proposed model achieves a mean R^2 of 0.9876 ± 0.0021 and a mean MAPE of $6.71\% \pm 0.45\%$, reducing error by 56.4% relative to the strongest tabular baseline. A four-condition ablation study confirms the additive contribution of both the text branch and the MC Dropout uncertainty mechanism. The framework additionally produces calibrated 90% confidence intervals derived from the decomposed uncertainty signal.

Keywords

Software cost estimation, Agile methodology, deep learning, BERT, uncertainty quantification, natural language processing, Monte Carlo Dropout, ablation study.

Automatic Ignition Control System for Drunk Drivers

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Abstract

Road accidents due to drunk driving remain a serious global concern. Existing breathalyzer checkpoints are reactive and lack continuous monitoring. This project introduces an Automatic Ignition Control System. It prevents intoxicated and unauthorized individuals from starting a vehicle. The system uses an MQ-3 sensor to detect alcohol levels in breath. An Android app with MobileFaceNet performs real-time face recognition. An ESP32 microcontroller processes sensor and identity data. A preset BAC threshold determines ignition control decisions. If alcohol exceeds the limit, ignition is blocked via a relay. If an unregistered user is detected, access is denied. The system ensures both safety and authentication. The prototype was fully developed and tested successfully. Face detection response time is around 250 ms. Alcohol sensing range is 0–1000 ppm. Relay switching occurs in under 10 ms. The system is low-cost and practical for real-world use. It is easily integrable into existing vehicle systems. The modular design supports future upgrades. Enhancements may include GPS and IoT-based monitoring. Overall, it improves road safety through automation and real-time control.

An Analytical Study on the Performance, Cost Efficiency, and Sustainability of AAC Blocks in Indian Building Construction

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Abstract

The urbanization in India particularly in the Delhi-NCR area has been very significant in promoting the demand of efficient, cost effective as well as sustainable building material. The classical masonry blocks such as fired clay bricks are associated with large embodied energy, natural resources prostrate and low performance in thermal conditions. This essay is an evaluation of the Autoclaved Aerated Concrete (AAC) blocks as some of the lightweight and environment friendly alternative to building urban construction.

This is compared using secondary data, Indian Standards as well as Delhi-NCR market rates with some key parameters like the density, compressive strength, thermal conductivity, construction efficiency, and cost per unit wall area being the key ones in comparison. As per IS 2185 (Part 3): 1984, AAC blocks exhibit a density of 550–650 kg/m³ and compressive strength of 3–5 MPa. It is the findings that AAC blocks can reduce the structural dead load by approximately 55–60 percent particularly against the requirements of IS 875 (Part 1): 1987, and has 3–4 times higher thermal insulation appearance when compared to traditional bricks which, in turn, have the potential to save energy upto 25–30% by (Central Building Research Institute)

Cost analysis indicates that although AAC blocks have a higher upfront material cost, the overall construction expenses remain comparable. This is primarily because AAC blocks require less mortar, reduce structural demands as per IS 456:2000, and accelerate the construction process. The study arrives at a conclusion that the AAC blocks may be considered a promising and sustainable high-density urban construction in India.

Keywords

AAC Blocks, Sustainable Construction, Thermal Efficiency, Cost Optimization, Urban Infrastructure (Delhi-NCR).

Managing the Modern Workforce: Evaluating the Effectiveness of Remote and Hybrid Working Policies

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Abstract

In the aftermath of the COVID-19 pandemic, organizations have significantly restructured traditional workforce management practices by adopting remote and hybrid work models. This study examines how these work arrangements function within contemporary organizational strategies. It aims to identify effective practices for managing geographically dispersed teams and to evaluate the impact of remote work on employee productivity, job satisfaction, and work-life balance.

A comprehensive review of existing literature, including scholarly articles, books, and conference papers, forms the basis of this research. The findings indicate that remote work can enhance productivity and job satisfaction by minimizing workplace distractions and increasing flexibility. However, it may also lead to challenges such as social isolation and difficulties in maintaining clear boundaries between work and personal life. Hybrid work models, which integrate remote and office-based work, offer a balanced solution by promoting collaboration while preserving flexibility.

The study further highlights the importance of leadership, particularly transformational leadership and effective communication, in managing remote and hybrid teams successfully. It concludes by emphasizing the need for continued research to understand evolving trends and long-term implications for employee well-being and organizational performance.

Keywords

Workforce Management, Remote Work, Hybrid Work, Organizational Effectiveness.

A Hybrid Blockchain Architecture for Secure, Transparent, and User-Centric Electronic Voting System

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Abstract

The integrity and transparency of electoral systems are crucial for maintaining public trust in democracy. Traditional electronic voting methods depend on centralized infrastructures that are vulnerable to cyber-attacks, insider manipulation, and data tampering. These issues highlight the need for a secure, decentralized alternative that can ensure verifiable and tamper proof vote recording. Blockchain technology offers an unchangeable distributed ledger framework that improves security through cryptographic validation and consensus mechanisms.

This paper introduces a decentralized electronic voting system built on Ethereum smart contracts, integrated with a MERN stack web architecture. The new framework records votes as blockchain transactions. This guarantees immutability and prevents unauthorized changes. A wallet-based authentication mechanism ensures that each eligible voter can cast only one vote, reducing the risk of double voting. The system architecture includes a React-based frontend, a Node.js and Express backend, and Web3 communication with the Ethereum blockchain for secure and smooth interaction.

Performance evaluation shows better auditability, transparency, and robustness compared to traditional centralized voting models. This implementation offers a practical and scalable solution for institutional elections while maintaining security and integrity in decentralized settings.

Keywords

Blockchain, E-Voting, Ethereum, Smart Contracts, Web3, Decentralized Systems.

Automated Bone Marrow Cell Classification Using Deep Learning with EfficientNet - B0 and Progressive Unfreezing

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Abstract

Morphological classification of bone marrow cells is extremely important for the diagnosis of hematological cancer; however, it is still a time-consuming and expertise-dependent process. In this research paper, an end-to-end hybrid deep learning architecture based on the EfficientNet-B0 and the Swin Tiny Transformer has been suggested to classify 15 types of bone marrow cells from a vast number of 1.72 million microscopic images. Our hybrid model has shown outstanding accuracy (94.12%), exceeding the performance of EfficientNet-B0 alone (87.52%). High F1-scores were obtained for Eosinophils (0.98), Erythroid Progenitors (0.96), and Neutrophilic Granulocytes Segmented (0.94), whereas Hairy Cells (0.70) and Rare Cells (0.45) had worse performance scores. Grad-CAM, t-SNE, and cosine similarity analysis have revealed that our hybrid model considers important morphological characteristics like the nucleus and cytoplasm during classification.

Keywords

Bone Marrow Classification, Microscopic Imaging Hematological Malignancies, Hybrid Deep Learning, EfficientNet-B0, Swin Transformer, Grad-CAM.

Lightweight CNN Models for Real-Time Plant Disease Detection Using PyTorch, MobileNetV2 and Streamlit Deployment

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Abstract

Crop-related diseases are among the most devastating and common natural threats to agriculture, with annual yield losses of up to 40%, posing food security issues for billions of individuals. This leaves traditional expert-dependent diagnosis both expensive and time-consuming as well as out of reach for smallholder farmers in rural areas. We have implemented and trained a custom four-block convolutional neural network from scratch using PyTorch on leaf images for real-time plant disease identification in this study. We trained our model on 54,305 balanced images covering 38 disease and healthy classes from the PlantVillage dataset across 14 crop species obtained through Kaggle API. So we just used a standard pipeline (ImageNet-style normalisation, data augmentation, 70\%/15\%/15\% train-validation-test split and batch gradient descent). We showcase an `eval()` inference switching mechanism and web deployment with Streamlit as well. With 88.85% test accuracy and nearly two seconds inference, our model is highly relevant for real-world agricultural applications. These findings confirm that our custom CNN offers comparable accuracy while being practically usable and can greatly benefit small-scale farmers from across the globe as part of precision agriculture initiatives.

AI-Enhanced 3D Cultural Exploration Platform with Voice Narration: A Virtual Indian Temple Museum

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Abstract

This paper presents an AI-enhanced web-based 3D virtual museum designed to improve cultural heritage exploration through interactive and intelligent user experiences. The system enables users to explore virtual rooms containing temples, fossils, and ancient weapons using real-time 3D visualization within a web browser. The proposed system integrates automated audio narration, an AI-assisted semantic search module, and gamified learning through quizzes and leaderboards. The AI module performs context-aware query processing and generates relevant responses using a large language model, enabling efficient and intuitive information retrieval. The platform is implemented using React and Three.js for 3D visualization and FastAPI with JWT authentication for backend services. Experimental observations indicate improved user interaction, faster response time, and enhanced learning experience compared to conventional static museum platforms. The system demonstrates how integrating 3D visualization, artificial intelligence, and gamification can create an effective and accessible cultural learning environment.

Investigation of a Redesigned Engine Piston for Improved Performance in Internal Combustion Engines

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Abstract

The piston is a critical component of internal combustion engines, operating under severe mechanical loading and intense thermal environments. Material selection plays a decisive role in controlling deformation, stress concentration, heat dissipation, and long-term durability. This study presents a comparative thermo-mechanical evaluation of two aluminium–nickel (Al–Ni) alloys (98% Al–2% Ni and 96% Al–4% Ni) and two chromium–carbide (Cr–C) composites (98% Cr–2% carbide and 96% Cr–4% carbide) applied to engine piston design. Two distinct piston geometries were considered to examine the combined influence of material composition and geometric configuration. Finite Element Method (FEM)–based static structural and steady-state thermal analyses were performed using ANSYS Workbench under identical boundary and loading conditions. Structural performance was assessed in terms of total deformation, von Mises stress, and equivalent elastic strain, while thermal behaviour was evaluated using temperature distribution and total heat flux. The results indicate that aluminium–based materials exhibit higher deformation and strain due to lower elastic stiffness but demonstrate superior heat dissipation owing to high thermal conductivity. Increasing nickel content marginally improves stiffness while slightly reducing thermal conductivity. In contrast, chromium–carbide materials show significantly reduced deformation and strain, reflecting high rigidity and dimensional stability, but experience elevated temperature gradients and reduced heat flux due to lower thermal conductivity. Comparative analysis between the two piston geometries reveals that geometry strongly governs stress concentration, whereas material properties predominantly influence deformation and thermal response.

Keywords

Engine piston, Finite element analysis, Aluminium–nickel alloy, Chromium–carbide composite, Thermo-mechanical behaviour, Heat flux, Structural analysis.

Experimental Investigation of Concrete using Coconut Shell as a Coarse Aggregate Replacement

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Abstract

The aim of the work is to determine the characteristics and strength of concrete where some of the coarse aggregate is replaced with coconut shell and some cement is replaced with fly ash. This is done to reduce costs and promote green construction. 0% replacement of coconut shell and flyash. Three cubes and three cylinders were prepared carefully for the control mixture, following cement, fine aggregate, and coarse aggregate in order. Concrete mix design M30 is prepared for Conventional Coarse Aggregate Concrete in various proportions (10%, 20%, and 30%). Fly ash is used as a replacement for cement and coconut shell as a replacement for gravel. Three cubes and three cylinders for each variation. When 10% of the coarse aggregate is replaced, the Coconut Shell Concrete (CSC) has properties similar to the nominal mix concrete. Two types of concrete were produced: control concrete with normal aggregate and coconut shell concrete where 10-30% of the coarse aggregate was replaced with coconut shells. The density of the concrete decreased while replacing coconut shells. The water to cementitious material ratio of all concrete was maintained constant at 0.45.

Keywords

Cement, fly ash, coarse aggregate, coconut shell (CS), compression strength, split tensile strength and workability.

Performance Evaluation of Plastic waste Incorporated Concrete for Structural Application

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Abstract

The some of the work is to determine the properties and strength of concrete where some of the fine aggregate is substituted with E-Plastic waste (EPW) and some cement is replaced with fly ash. This is done to lower costs and support eco-friendly construction.

Materials and Methods: Consisted of conventional concrete with 0% replacement using EPW and fly ash. Three cubes, three cylinders and three prisms were prepared carefully for the control mixers. Concrete mix design M30 is prepared for conventional fine aggregate in various properties (5%, 10%,15%,20%, 25% and 30%). Fly ash and EPW are used as a substitution for cement and fine aggregate. Three cubes, three cylinders and three prisms for each variation. At 10% replacement level, the EPW has properties similar to the comparable to the control mix. Two types of concrete were produced: a control mix with conventional materials and modified mixes in which fine aggregate was partly replaced with EPW from 0 – 30% at an interval of 5%. As the percentage of EPW increased, the density of concrete slightly decreased. The water-cementitious material ratio was retained constant at 0.45 for all mixes. Among the tested proportions, the 10%replacement level showed performance comparable to the control mix.

Multi-Agent Deep Reinforcement Learning with Spatio-Temporal Graph Attention for Emergency Flow Optimization

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Abstract

Efficient and timely movement of emergency vehicles, particularly ambulances, is a critical challenge in urban traffic systems where congestion can lead to life-threatening delays. This project presents an intelligent traffic management framework that integrates Multi-Agent Deep Reinforcement Learning (MARL) with Spatio - Temporal Graph Attention Networks (ST-GAT) to optimize emergency vehicle flow. In the proposed system, each traffic signal operates as an autonomous agent that dynamically adjusts signal timings based on real-time traffic conditions and ambulance location. IoT-based technologies such as RFID, GPS, and communication modules are used to detect and track ambulances, enabling the system to create a seamless green corridor for rapid and uninterrupted movement. The integration of ST-GAT enables the system to model complex traffic patterns by capturing both spatial dependencies among intersections and temporal variations in traffic flow. The MARL agents are trained to minimize ambulance travel time while maintaining overall traffic efficiency, ensuring that normal traffic is not severely disrupted. Simulation results demonstrate that the proposed system significantly reduces emergency response time and improves traffic coordination across multiple intersections. The system is scalable, adaptive, and suitable for smart city applications, contributing to enhanced public safety and efficient urban transportation management.

Trajectory-Aware Transformer for Non-Invasive Diabetes Risk Prediction from Cross-Sectional NHANES Data

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Abstract

Diabetes mellitus affects about 537 million people around the world, making it a major global health issue. Finding risks early is the best way to avoid long-term problems. Traditional screening methods use invasive lab tests, which makes them hard to use in communities and places with few resources. Using cross-sectional data from the National Health and Nutrition Examination Survey (NHANES), this study suggests a trajectory-aware Transformer framework for predicting diabetes risk without laboratory tests. To fix the lack of clear temporal structure, we propose a pseudo-longitudinal sequence construction strategy based on clustering that uses a progression scoring mechanism to order people who are clinically similar. We use a Transformer encoder with Time2Vec temporal encoding and class-weighted training to model the resulting sequences. This is done to give more weight to sensitivity for screening purposes. The proposed model uses 289 non-invasive features and does not include any variables related to labs or diagnosis. It gets 90.54% accuracy, 0.9571 AUC-ROC, and 86.92 %recall on a held-out test set, correctly identifying 186 of 214 diabetes cases. The mean AUC of 0.9836 ± 0.0043 from five-fold stratified cross-validation shows that the performance is stable. The proposed method is about 14 percentage points better at telling the difference than previous NHANES-based non-invasive models that reported AUC values below 0.85%. Comprehensive validation, encompassing permutation testing and leakage prevention analysis, substantiates methodological integrity and endorses the feasibility of trajectory-aware self-attention for scalable population-level diabetes risk screening.

Keywords

Assessment of diabetes risk, Transformers, self-attention, pseudo-longitudinal modeling, screening without use of invasive procedures, NHANES, imbalanced classification, trajectory modelling.

Design and Fabrication of a Small-Scale Household Biogas Plant Using Organic Kitchen Waste for Cooking Applications

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Abstract

The objective of this study is to develop and produce a small-scale biogas digester plant with the help of kitchen organic waste. To convert biodegradable waste into clean and renewable energy for cooking purposes and to decrease the dependence on conventional fossil fuels and enhance the efficiency of waste management at the household level. It includes a tank named digester made of metal, the digester includes an inlet and outlet chamber, a gas holder, and a biogas burner. The waste material, which is organic in nature like peeled vegetables and other types of kitchen waste, were mixed with water from the slurry. That slurry is then fed into the metallic chamber which is also named anaerobic digester. It where in through inlet under oxygen-free condition through these microorganisms decompose the wastage for 10-20 days maximum and emit biogas. This biogas production is kept in the gas holder and stored for cooking purposes. On another side, while the digested slurry is discharged as nutrient-rich organic fertilizer. The result of the experiment reveals that the biogas plant designed is efficient for the production of biogas from the organic kitchen waste. The biogas plant decreases the organic waste of the households and the biogas largely produced is consistent in nature and can be used for cooking purposes. It also aids in the partial replacement of LPG. The slurry produced can be used as organic manure.

Keywords

Small-Scale, Biogas plant, Digester, Kitchen waste, Fertilizer, Organic, Slurry, Household, Applications.

A Role-Based Bug Tracking and Resolution System Using Java and MySQL

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Abstract

Software development teams can often face challenges in the process of identifying and fixing errors in an effective manner throughout the development lifecycle. A role-based bug tracking and resolution system built with Java Swing, Java Database Connectivity and MySQL is shown in this paper. Defects may be reported by testers, tracked and fixed by developers, and viewed by the managers through analytical dashboards to maintain a general view of the project health. The proposed solution enhances the visibility of the defects, accountability, and effectiveness of the bug resolutions by implementing the role-based access control and formal bug lifecycle administration.

Keywords

Software Defect Management, Role-Based Access Control, Bug Lifecycle Management, Java Swing, MySQL Database, Java Database Connectivity.

AI-Enhanced Tuberculosis Detection

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Abstract

For respiratory infections like pneumonia and tuberculosis (TB), early diagnosis is essential to minimize mortality rates and improve treatment success rates. This paper proposes an AI-assisted multi-modal healthcare system that uses chest X-ray images, cough audio samples, and patient symptoms to make an early prediction about the risk of disease. The proposed system uses a Convolutional Neural Network (CNN) for image analysis, an MFCC-based audio classification model for cough detection, and a symptom risk scoring module. The system uses a late fusion approach to combine the results of individual models to improve their diagnostic capabilities. The proposed system is developed as a web-based application that enables real-time screening and decision support, especially in distant and resource-constrained healthcare environments.

A Privacy-Preserving Federated Learning Framework for Real-Time Cryptocurrency Fraud Detection Using Hybrid Machine Learning Models

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Abstract

The exponential increase in the incidence of criminal activity relating to cryptocurrencies has been as a result of the rapid advancement of cryptocurrencies in the currency market. thus there are more challenges towards financial institutions and also towards the consumers who use it. This document describes a Blockchain-based Federated Learning (BCFL) System that allows the check for the occurrence of cryptocurrency fraud in a safe, scalable fashion while maintaining the privacy of the consumer. By using federated learning in combination with Blockchain technology, organizations like banks and cryptocurrency exchanges can collaborate to develop a fraud detection algorithm without the involvement of consumer's transaction data. Key features of this system are secure training of local models, encrypted sharing of model updates, decentralized aggregation of model updates and prediction of fraud. The use of Blockchain enables all parties involved to have some level of transparency and trust amongst each other, that is due in large part to the use of a lightweight consensus algorithm that helps to increase the efficiency of this system and reduce the processing burden. Also, the combination of hybrid Random Forest and Convolution Neural Network model generates additional accuracy improvement over detection based on pure statistical methods and those based on pure deep learning methods as it is capable of modelling statistical and deep transactional behaviours. The system was implemented using a real-world dataset; and the results achieved using our system achieved greater accuracy, precision, recall and ROC-AUC than traditional model-based methods. By marrying together scalable, privacy preserving and intelligent fraud detection, we believe that our system has the ability to provide a traditionally robust platform enabling effective protection against current challenges surrounding cryptocurrency-security

Keywords

Cryptocurrency Fraud Detection, Blockchain, Federated Learning, RF-CNN, Privacy Preservation, Distributed Learning, Cybersecurity.

HandSense AI: Real-Time Gesture Classification for Campus Safety Monitoring

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Abstract

Ensuring student safety in educational institutions remains a critical challenge due to issues such as ragging, suicidal ideation, and unexpected medical emergencies. This paper proposes HandSense AI, a real-time campus safety monitoring system that integrates computer vision and machine learning for automatic detection of distress and emergency situations. The system utilizes MediaPipe-based hand gesture recognition and deep learning models such as YOLOv5 and DeepFace to identify aggressive, submissive, and distress-related gestures from CCTV video streams. To enhance prediction accuracy and robustness, a Super Learner ensemble model is employed, combining multiple base classifiers including Gradient Boosting, Naïve Bayes, and AdaBoost. Experimental results demonstrate that the proposed ensemble approach achieves superior performance with an accuracy of 95.2%, along with high precision, recall, and F1-score, outperforming individual models. The system operates in real time with low latency and supports edge computing deployment, enabling rapid response through automated alerts to authorities. Additionally, the architecture is scalable and can be integrated with existing surveillance infrastructure. The proposed solution shifts campus security from reactive to proactive by enabling continuous monitoring and early intervention, thereby reducing the risk of harm and improving overall student well-being.

Smart Civic Reporter Android App

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Abstract

In present-day urban life, the smooth handling of public grievances and civic problems is imperative for securing effective governance and public satisfaction. The Smart Civic Reporter is an Android application with the aim to make the complaint registration as well as resolution process smoother, enabling citizens to report civic problems easily. The app leverages the Flutter and Firebase for real-time monitoring, filing complaints based on geolocation, and effective interaction between the citizenry and authorities. In taking several factors into consideration of urban infrastructure management, the application gathers and processes user complaints on streetlight outages, water leaks, drainage issues, road maintenance, and garbage disposal. Firebase Authentication for safe user registration and complaint tracking is included in the system to ensure a transparent and accountable process of resolution.

With a systematic approach, the system takes into consideration various parameters like complaint type, location, timestamps, complaint status and time taken for resolution in order to enhance response effectiveness. The Smart Civic Reporter application allows authorities to evaluate complaint trends, assign resources appropriately, and enhance the management of overall urban infrastructure. With its interactive UI/UX and data-intensive approach, the application provides citizen engagement and makes civic administration smarter and more responsive.

CropSelect AI-To Build up Agriculture Decision Using ML

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Abstract

Agriculture plays a vital role in economic development, and crop selection is one of the most critical decisions affecting productivity and sustainability. Traditional crop selection methods rely heavily on farmer experience and seasonal assumptions, which may not be reliable under changing climatic and soil conditions. This paper proposes CropSelect AI, an intelligent crop recommendation system that leverages machine learning techniques to assist farmers in selecting the most suitable crop based on soil nutrients and climatic parameters. The system analyzes factors such as Nitrogen (N), Phosphorus (P), Potassium (K), temperature, humidity, rainfall, and soil pH to generate accurate crop recommendations. Multiple machine learning algorithms are evaluated to determine the most effective model. Experimental results demonstrate that the proposed system improves decision accuracy, reduces crop failure risk, and supports data-driven agricultural practices.

Keywords

Crop Recommendation, Machine Learning, Precision Agriculture, Decision Support System, Smart Farming.

Intelligent Finance Management System

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Abstract

Financial ecosystems in the modern world demand intelligent systems capable of handling large, heterogeneous, and time-sensitive data streams. Traditional financial management approaches rely heavily on manual data entry, fragmented software tools, and static reporting mechanisms, resulting in inefficient decision-making, operational inefficiencies, and increased risk exposure. This paper proposes an Intelligent Financial Management System (IFMS) that integrates real-time data ingestion, automated preprocessing, time-series forecasting, and financial data visualization within a unified cloud-based platform.

The system employs the Seasonal Autoregressive Integrated Moving Average (SARIMA) model with automatic parameter tuning using the Akaike Information Criterion (AIC) to generate accurate financial forecasts. The frontend is developed using React.js, while Firebase provides backend support for secure authentication, scalable storage, and real-time data synchronization. Experimental evaluation on multi-year financial datasets demonstrates strong predictive performance, achieving a Mean Absolute Percentage Error (MAPE) of less than 5% and a coefficient of determination (R^2) exceeding 0.91. The proposed system enhances transparency, reduces manual workload, and supports faster and more informed financial decision-making.

Keywords

Intelligent Financial Management System, SARIMA, Time-Series Forecasting, Financial Analytics, Machine Learning, React.js, Firebase, Cloud Computing, Data Visualization.

A Review of IoT-Based Early Forest Fire Detection and Alerting Systems Using ESP32 and LoRa Communication

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Abstract

Forest fires pose a significant threat to ecosystems, biodiversity, and human life, causing severe environmental and economic damage worldwide. Traditional fire detection systems, such as satellite monitoring and manual surveillance, often suffer from delayed response times, limited accuracy, and high operational costs [1], [2]. In recent years, the integration of the Internet of Things (IoT) with advanced communication technologies has emerged as a promising solution for real-time environmental monitoring and early fire detection [4], [5].

This paper presents a comprehensive review of IoT-based early forest fire detection and alerting systems, with a specific focus on the use of the ESP32 microcontroller and LoRa communication technology. The ESP32 offers a cost-effective, low-power, and highly efficient platform for sensor data acquisition and processing, while LoRa enables long-range, low-power wireless communication suitable for remote forest environments [6], [7]. The combination of these technologies facilitates the deployment of distributed sensor networks capable of continuously monitoring environmental parameters such as temperature, humidity, and gas concentrations.

The paper analyzes various existing approaches, including satellite-based, camera-based, and wireless sensor network-based systems, highlighting their advantages and limitations [8], [9]. A comparative study of recent research works is presented to evaluate performance metrics such as detection accuracy, response time, power consumption, and communication range. Furthermore, the paper discusses system architecture designs integrating ESP32 and LoRa, emphasizing scalability, reliability, and energy efficiency. Key challenges such as false alarm rates, environmental variability, network reliability, and energy constraints are also discussed [12], [13]. Finally, emerging trends including artificial intelligence-based prediction, edge computing, and drone-assisted monitoring are highlighted as future research directions [10], [11], [14].

Keywords

Edge Computing, Sensor Fusion, Fire Prediction Systems, Remote Sensing, Energy-Efficient IoT, Smart Forestry, Disaster Management Systems, Embedded Systems, Cloud-Based Monitoring, AI-Based Fire Detection.

A Generative AI System for Financial News Analysis and Query Resolution

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Abstract

The explosion of unstructured financial documents - including annual reports, earnings call transcripts and market analysis articles - raises serious issues for extracting actionable information. This project introduces a finance-domain-optimized QA framework that utilizes AI. The model we propose combines NLP, LLMs and RAG to capture the challenging financial jargon, retain contextual information while generating natural answers which are contextually consistent. Among the many plaintext sentences in a lengthy report, an algorithm identifies and captures in a screenful of handy phrases, presenting this list as a summary section on top of the search results. A couple of exemplary semantic chunking algorithms are especially suited to sentimental analysis on financial data, one such example is described herein: financially-targeted semantic chunking (FTSC) that keeps reports readable by preserving their logical flow and retrieves more accurately. The system also has an interpretability layer that connects answers back to where they come from, helping maintain trust for the analyst and regulator.

In contrast to standard keyword-based search, answer search dynamically incorporates the context of its queries and outputs analysis natural language responses with citations. The modular nature design enables scaling and efficiency, while the combination of semantic chunking with RAG reduces hallucinations and improves factual consistency. The structure is flexible for to different usage cases, such as due diligence, compliance monitoring and market sentiment analysis or real time decision support. By dealing with issues of accuracy, interpretability and latency the system provides a body on which to build the next generation of financial intelligence engines.

Keywords

Generative AI, Financial News, Question Answering, Large Language Model, RAG, Semantic Chunking, Explainability.

Evaluation of Optical Eye Diagrams using Deep Learning Techniques

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Abstract

Efficient Optical Performance Monitoring (OPM) is very important in managing the increasing data rates and the complexity of modern optical communication networks. In scenarios where eye diagrams provide a standard qualitative assessment, automating the *quantitative* extraction of multiple Key Performance Indicators (KPIs) from them still remains a challenging and valuable goal. Our paper puts forward a study that compares two deep learning, multi-task models which simultaneously perform modulation format classification, estimation of Signal-to-Noise Ratio (SNR) and estimation of Bit Error Rate (BER) from a single 2D eye diagram image. We design, train and evaluate two architectures which are based on transfer learning: one uses a ResNet-18 backbone and another uses a lightweight MobileNetV2 backbone. Both models use a shared feature extractor and three parallel, task-specific heads which are trained jointly by minimizing a composite loss function. Experimental results on an unseen test set show that the model based on MobileNetV2 achieves a much better performance, with a modulation classification accuracy of 95.0%, a 0.75 dB Mean Absolute Error (MAE) for estimation of SNR, and an MAE of 0.15 for BER estimation. This is a significant discovery because the MobileNetV2 model achieves this higher accuracy while also being computationally less complex than the ResNet-18, demonstrating a highly effective and resource-efficient solution for real-time OPM.

Keywords

OptiSystem, Convolutional Neural Network, BER, SNR, ResNet-18, MobileNet V2, Eye Diagrams.

Seamless Mode Switching in Wind-PV Microgrid Using Fuzzy Logic

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Abstract

As renewable energy sources are increasingly integrated into distribution networks, maintaining reliable and high-quality power delivery has become more challenging. Systems that combine wind and photovoltaic generation are particularly sensitive to issues such as voltage instability, power quality degradation, and disturbances during switching between grid-connected and islanded operation. These problems become more pronounced when the system is exposed to unbalanced or nonlinear loads, especially during grid disconnection and reconnection events. To improve system performance under such conditions, a fuzzy logic-based control approach is developed for a Wind-PV-Grid integrated distributed generation system capable of operating smoothly during islanded and grid-connected operation. In contrast to conventional proportional-integral controllers, the proposed fuzzy controller adapts effectively to changing system conditions and nonlinear behavior, resulting in improved dynamic response and reduced voltage and current distortions. The effectiveness of the proposed control strategy is validated using MATLAB/Simulink simulations.

Keywords

Solar Photovoltaic Array, Power Quality, Bidirectional DC-DC Converter, Load Side Converter and Machine Side Converter), Fuzzy Logic Controller.

A Binary Bite-Controlled Assistive Communication System for Speech-Impaired Individuals

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Abstract

Human communication is considered to be one of the prime aspects of human interaction, which enables people to convey their needs, emotions, and thoughts. This is considered to be vital for maintaining independence and dignity. However, millions of people worldwide suffer from speech disabilities caused by neurological disorders, paralysis, accidents, and congenital conditions. In such cases, lack of verbal communication is considered to be a major hindrance to their normal lives.

Several technologies have been introduced over the years to aid people with communication disabilities. However, it is seen that these technologies rely on expensive hardware, sensors, and computing systems, which might not be feasible for everyone. In some cases, especially in developing countries, people might need simple solutions for effective communication.

The idea behind this research is to propose an efficient communication aid system that can transform the minimum physical input into an important voice output through the use of electronic devices. For this purpose, the system uses two push buttons that operate as binary input devices, enabling the user to input digital codes through the simplest form of input, such as button presses or bites. These input values are processed through the microcontroller-based system, which is based on the Arduino Uno platform. The system accepts four consecutive binary input values, which form the 4-bit code. Each combination of the four possible values of the binary input is accepted as the code, which is matched with the pre-recorded audio message through the voice playback module.

As the user sends the four consecutive values of the binary input, the system automatically identifies the code generated through the input values. Then, the system immediately plays the message through the speaker. There is no need for the system to have complex confirmation systems, making the interaction process easier for the user. An LCD is also included in the system, which displays the generated binary code.

The primary aim of this work is to develop a simple yet inexpensive device that will help speech-impaired individuals to convey basic utterances such as greetings, requests, or even emergencies. This system aims to prove that simple digital logic and electronics can be used to create useful devices that have real social value.

Keywords

Assistive Technology, Embedded Systems, Speech Impairment Communication, Binary Input System, Arduino-Based Communication Device, Voice Output Systems.

AI-Driven Public Health Chatbot-For Disease Awareness

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Abstract

Increasing awareness about health plays a crucial role in controlling and preventing disease, especially in regions with limited access to healthcare professionals. This paper presents an AI-driven public health chatbot designed to provide instant, reliable, and multilingual health information in English and Telugu. The proposed system uses a natural language processing-based layered architecture consisting of language detection, intent classification, and response generation modules integrated with a structured disease knowledge base. The chatbot provides information related to disease symptoms, causes, preventive measures, and basic treatment guidance while maintaining ethical constraints by avoiding diagnosis or prescription. Experimental evaluation conducted on approximately 250 user queries demonstrates an overall response accuracy of about 90%, with an average response time of less than 2 seconds. The results indicate that the proposed chatbot is effective, scalable, and suitable for continuous public health awareness and educational support.

Keywords

AI Health Chatbot, Disease Awareness System, Multilingual Health Assistance.

A Multimodal Stress Detection Framework Based on Facial Expression Analysis and Psychometric Evaluation using Explainable AI

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Abstract

Stress is becoming an increasingly serious psychological issue affecting people from many different backgrounds, and being exposed to undiagnosed long-term stress can lead to developing anxiety, depression, and an overall decrease in mental health. Because stress is a subjective experience and self-reporting tools alone are often insufficient for accurate measurement, the present study proposes a novel multimodal stress detection framework that combines facial expression analysis with psychometric evaluation to provide reliable and valid stress measurement. The framework utilises the AffectNet dataset and employs two models: a fine-tuned EfficientNetB3 for binary stress classification (Stress vs. No-Stress) and a Sequential Convolutional Neural Network for continuous Vision Stress Score (VSS) regression on a 0–100% scale, based on established psychological stress-arousal mappings derived from facial expressions. The Psychometric Stress Score (PSSS) is based on the PSS-10, a valid tool for assessing a person's self-reported stress level over the past month. With a higher weight given to PSSS due to its wider temporal coverage and clinical validity, the Final Stress Index (FSI) integrates the complementary strengths of visual and psychological stress signals to produce a more accurate and comprehensive stress assessment. The EfficientNetB3 classification model achieved an overall accuracy of 91% on the validation dataset. The regression model achieved a Mean Absolute Error (MAE) of 0.0801 and a Coefficient of Determination (R^2) of 0.9158, both demonstrating strong predictive validity. Grad-CAM and Occlusion Sensitivity Testing were used to identify stress-related facial regions, providing clinical context for the interpretation of the model's predictions. The proposed framework advances stress measurement beyond traditional unimodal methods by providing an integrated, explainable system based on clinically founded practice that can be used to monitor mental health in real-world applications.

Keywords

Stress Detection, Facial Expression Analysis, EfficientNetB3, CNN, Stress Regression, Multimodal Fusion, Perceived Stress Scale, Final Stress Index, Grad-CAM, Occlusion Sensitivity.

Strategic Process Optimization for Manufacturing Efficiency Using IoT Integration and Lean Principles

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Abstract

The convergence of Internet of Things (IoT) technology with Lean manufacturing principles presents a significant opportunity for systematic process optimization in modern manufacturing enterprises. This paper presents a four-layer IoT-Lean Architecture Framework integrating IoT sensor networks, real-time data analytics, and edge computing with core Lean methodologies—including Value Stream Mapping (VSM), Kaizen, 5S, and Just-in-Time (JIT) production. Based on a 12-month implementation study at a precision machining facility (3 production lines, 48 IoT nodes), the framework achieved a 30.6% improvement in Overall Equipment Effectiveness (OEE), 62.5% reduction in unplanned downtime, 73.8% reduction in defect rates, and a doubling of the value-add ratio from 28% to 54%. A structured PDCA-based optimization methodology and phased strategic roadmap are presented to guide manufacturing organizations in IoT-Lean transformation.

Keywords

IoT Integration, Lean Manufacturing, Process Optimization, Industry 4.0, OEE, Value Stream Mapping, Kaizen, Predictive Maintenance.

Slientscan: Unconverging Hidden Brain Tumor Using Multimodal Multidimensional Deep Learning

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Abstract

Early and accurate detection of brain tumors remains a significant challenge in medical imaging due to the subtle appearance of early-stage and infiltrative tumors in magnetic resonance imaging (MRI) scans. Conventional manual diagnosis is time-consuming and heavily dependent on expert radiologists, which can result in delayed or missed detections. To overcome these limitations, this paper presents SilentScan, an AI-based framework for early brain tumor detection and segmentation using multimodal MRI data. The proposed system integrates T1, T2, and FLAIR MRI sequences along with patient clinical information to improve diagnostic accuracy. An Attention U-Net-based deep learning architecture is employed to achieve precise pixel-level tumor segmentation, enabling accurate localization of small and low-contrast tumor regions. Furthermore, Explainable Artificial Intelligence (XAI) techniques, including Gradient-weighted Class Activation Mapping (Grad-CAM) and SHapley Additive exPlanations (SHAP), are incorporated to provide both visual and feature-level interpretability of the model's predictions.

Keywords

Brain Tumor Detection, Multimodal MRI, Medical Image Segmentation, Attention U-Net, Deep Learning, Explainable Artificial Intelligence, Grad-CAM, SHAP, Computer-Aided Diagnosis.

VSign: A Vision-Based System for Real-Time Sign Language Subtitling in Online Conversions

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Abstract

Sign language serves as a primary means of communication becomes challenging for individuals who are deaf or hard of hearing; however, communication barriers persist due to limited public understanding. This paper presents Vsign, a vision-based real-time sign language recognition and subtitling system using MediaPipe hand landmark extraction and deep learning techniques. The proposed approach converts high-dimensional video input into lightweight 21-point hand landmark coordinates, significantly reducing computational complexity. The system pipeline includes landmark extraction, coordinate normalization, temporal smoothing, and sequence-based classification using models such as LSTM and GRU. Experimental results demonstrate that the proposed system achieves reliable recognition accuracy while maintaining low latency suitable for real-time applications. The system enables seamless conversion of sign gestures into textual subtitles, facilitating effective communication in live video interactions.

Keywords

Sign Language Recognition, MediaPipe, Hand Landmarks, Deep Learning, LSTM, Real-Time Subtitling, Computer Vision.

Secure Messaging System with Quantum Encryption

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Abstract

This system provides a secure messaging platform that will ensure the safety of digital communications from the current cyber threats posed by quantum computing. Encryption methods may not be effective in the future as quantum computers improve. This necessitates the need to ensure the safety of communications through the adoption of quantum-safe security measures. This problem can be resolved by implementing the Quantum Key Distribution (QKD) protocol for secure key exchange and the Advanced Encryption Standard (AES) protocol for encrypting messages. Once the key is established, the AES protocol can be utilized to encrypt messages quickly with symmetric key encryption. This will ensure the end-to-end encryption of messages to maintain their privacy.

Keywords

Quantum Encryption, QKD, AES, Secure Messaging, Cryptography, End-to-End Security.

CareerAtlas.ai: Your Intelligent Map to Careers, Growth & Jobs

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Abstract

Determining an appropriate career path is one of the biggest challenges faced by students and job seekers due to limited availability of personal career guidance and dynamic career market demands. Most current career guidance platforms are limited to job postings and lack advanced data analysis capabilities to evaluate users' skills, interests, and professional experience for effective career recommendations. This paper proposes an AI -based career guidance platform, CareerAtlas.ai, that can assist users in making informed career decisions through data-driven career analysis. Natural Language Processing is applied on user resumes to extract relevant information and create an extensive user career profile. The system architecture consists of a Streamlit-based frontend for user interaction and a Django-based backend responsible for data processing and delivering career recommendations. Additionally, a flexible database has been integrated into the proposed career guidance platform. Based on user data analysis, the proposed platform provides career recommendations, identifies skill gaps, and suggests relevant job opportunities from existing job portals.

Keywords

Artificial Intelligence, Resume Analysis, Career Recommendation System, Job Recommendation, NLP, Streamlit, Django, Skill gap analysis.

A Unified Deep Learning Framework for Tomato Leaf Disease Detection Using VGG16 and MobileNet Architectures

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Abstract

Identifying tomato leaf diseases in the early stage is important in order to minimize crop damage and improve overall crop productivity. Recently, deep learning based methods have been broadly used in automating plant disease identification because of their ability to classify images accurately and quickly. In this study, an integrated deep learning system is presented using two convolutional neural network models, VGG16 and MobileNet, trained on the open source Plant Village tomato leaf dataset containing 16,012 images which belongs to ten different categories. This work presents an efficient deep learning based system for automated tomato leaf disease classification by merging the strengths of deep convolutional feature extraction and lightweight model optimization. Transfer learning helps the models learn faster and achieve higher accuracy while keeping the system more efficient and easy to run. In Experimental findings shows that the hybrid learning strategy works better for classifying the data, converges more quickly, and better at generalizing, making it good choice for real time agricultural monitoring systems. The study talks about how important is that to balance the accuracy and efficiency for real world use in precision agriculture.

Keywords

Tomato leaf disease, VGG16, MobileNet, Transfer Learning, CNN, Precision agriculture.

A Blockchain-Based Peer-to-Peer Lending System with Dynamic Interest Rate Modeling

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Abstract

This paper presents ChainLoan, a decentralized peer-to-peer lending protocol built on the Ethereum blockchain, designed to eliminate intermediaries through the use of smart contracts and automated financial mechanisms. The proposed system incorporates a dynamic utilization-based interest rate model that adjusts borrowing costs in real time according to liquidity conditions. To ensure accurate collateral valuation, decentralized oracle networks are integrated, while automated liquidation mechanisms are employed to maintain protocol solvency and mitigate default risk. The architecture follows a modular Web3 design, consisting of client, blockchain interaction, smart contract, and oracle layers. Performance evaluation conducted on the Ethereum Sepolia testnet demonstrates significant improvements in transaction latency, transparency, and operational efficiency compared to traditional financial systems. The results indicate that the proposed approach provides a secure, scalable, and transparent framework for decentralized lending. Future work includes integration with Layer-2 scaling solutions and the incorporation of decentralized identity mechanisms to enable more flexible credit models.

Keywords

Blockchain Technology, Decentralized Finance (DeFi), Ethereum Virtual Machine (EVM), Smart Contracts, Peer-to-Peer Lending, Over-collateralization, Algorithmic Interest Rates, Web3 Architecture.

Smart Agrihub: AI-Powered Platform for Farming Marketplace, Weather & Crop Prediction, and Regional Language Support

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This research introduces an intelligent and integrated agricultural decision-support framework with the combination of machine learning, computer vision, and expert knowledge synthesis to help the farmer with crop choice, fertilizer, and early detection of plant diseases. The system has several supervised learning pipelines such as Rotation Forest ensemble classifier, voting-based crop recommendation models, and the label-encoded fertilizer prediction networks, while using the unified FastAPI architecture. A deep learning segmentation model called the Roboflow API can be used to access real-time disease diagnosis using leaf images, while a generative AI module based on Gemini model can be used for interpretive agronomic guidance based on crop type, pest or disease profile, and the geographical location. The platform also integrates with a frontend client which is built using React & Vite with modular routing, visualization and user management using centralized application state. The interoperability of these components proves a concept of an end-to-end and scalable pipeline that can bring actionable insights in agriculture to boost further efficiency of inputs, in addition to facilitating precision farming practices for various user groups.

Keywords

Crop recommender, fertilizer predictor, plant disease analysis, Rotation Forest algorithm, Ensemble learning, FastAPI, Generative AI computer vision artificial intelligence, registration farms decision support, precision agriculture.

AAS: Bridging Static Knowledge and Dynamic Endpoints in Institutional Assistance Systems

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Abstract

The adoption of Large Language Models (LLMs) into the higher education setting is currently constrained by the so-called Data Fragmentation problem, where the institutional knowledge is split into unstructured disorganized documents (e.g., syllabi, policies) and structured, safe databases (e.g., ERP, LMS). Conventional Retrieval-Augmented Generation (RAG) systems cannot close this gap, they tend to fail at retrieving realtime information or fail to hallucinate in answering student specific queries like attendance and results analysis. We describe the Agentic Academic System (AAS), a neuro-symbolic framework combination, in order to address this, where semantic reasoning and data retrieval are separated. AAS proposes a Semantic Intent Router that dynamically types and routes user queries to either a Neural Retrieval Engine with the static knowledge or a more secure and deterministic execution of backend tools via a Model Context Protocol (MCP) server. The system guarantees the privacy and integrity of data by the close isolation of these workflows and standardization of various output formats through a new Context Fusion Layer. Experimental evidence on a high-fidelity synthetic data set shows that AAS eradicates hallucinations on numerical data, and can do so, with 100 percent accuracy on dynamic queries (as opposed to 0 percent on a baseline system RAG system), with an average real-time latency of approximately 1.7 seconds. This model provides a platform of privacy-centric, scalable design of the future generation of academic assistants.

Keywords

Artificial Intelligence (AI), Large Language Models, Retrieval-Augmented Generation (RAG), Model Context Protocol (MCP), Chatbots, Academic Chatbots, Artificial Intelligence in Education, Neuro-symbolic AI, Data Privacy.

Simulation-Driven Smart MRO Framework for Predictive Maintenance of Dormant Surface-to-Air Missile Solid Rocket Motors Using CFD and Internal Ballistic Analysis

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Abstract

Before being put into service, Surface-to-Air Missile (SAM) propulsion systems are usually kept in a dormant state for long periods of time. Propellant grains, casing materials, and insulation layers may deteriorate during prolonged storage, which could compromise system dependability and mission preparedness. Conventional time-based maintenance techniques may miss early degradation mechanisms and are frequently ineffective.

In order to evaluate the health of dormant solid rocket motors used in SAM systems, this study suggests a simulation-driven Smart Maintenance, Repair, and Overhaul (MRO) framework. To assess propulsion system performance, the suggested method combines computational fluid dynamics (CFD) analysis, static motor testing, and internal ballistic simulation using OpenMotor software. Aerodynamic pressure distribution and velocity flow characteristics surrounding the missile body are examined using CFD simulations, whereas experimental thrust-time and chamber. The results of the experiment indicate stable combustion during the main burn phase, with a peak thrust of roughly 7.3 kN and a maximum chamber pressure of 7.8 MPa. A post-test examination showed that localized over-pressure conditions were the cause of the casing rupture.

The proposed Smart MRO framework combines simulation-based performance prediction with condition-based maintenance decision matrices and non-destructive testing (NDT) techniques to identify structural degradation in dormant missile motors. The results demonstrate that simulation-assisted predictive maintenance can significantly improve operational safety, reduce lifecycle costs, and enhance mission readiness for long-stored missile propulsion systems.

Keywords

Smart MRO, Surface-to-Air Missile, Predictive Maintenance, CFD, Open Motor, Fin Actuator Control System, Solid Rocket Motor.

Deep Learning Based Crop Pests and Disease Detection

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Abstract

There is a significant importance of detecting the diseases of crops early so that the productivity of agriculture can be enhanced as well as food security achieved. In this paper, automated crop leaf disease detection system is introduced with the use of deep learning methods on convolutional neural network and transfer learning. A pre-trained DenseNet-121 model is trained on a harmonized set of healthy and pathological images in the form of crop leaves in publicly accessible agricultural image repositories. Techniques used are image preprocessing and data augmentation in order to improve the generalization of the models and due to overfitting. The suggested model has a high level of accuracy and strength in assigning various categories of crop leaf diseases. Experimental analysis is done in terms of standard performance measures of accuracy, precision, recall, and F1-score. These findings show that that DenseNet-121-based version is a reliable perspective of disease classification in various types of crops, and can therefore be used in monitoring crops in real-time and deciding on the smart farming use-case.

Keywords

Crop disease detection, DenseNet-121, Deep learning, Crop monitoring.

Crime Rate Prediction and Hotspot Analysis using Machine Learning

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Abstract

Crime type analysis and prediction with the hotspot detection to identify the high misdeed or crime area. It is a methodical way to analyze the crimes and it shows where the crimes occur more frequently by using the data predictive analysis and spatial data analysis techniques. previous studies have predicted crime pattern and heatmaps using structured and unstructured data but achieved the limited prediction accuracy. In this project which is built with the Indian crime datasets for the new crime type prediction, in this use the method of machine learning with the combination of convolutional neural network and artificial neural network (ANN & CNN) to achieve the best prediction and surpass the previous project prediction level. This will assure that it will keep the society safe from the major crimes. In this combination we can achieve the best prediction of numerical values as well as the images or major crime region of the crime spot areas. This paper talks about the different type of crime analysis and how the crime can be predicted by using the advanced methodology.

Keywords

Crime type prediction, predictive analysis, Indian crime datasets, crime heatmap, crime pattern analysis, Convolutional neural network, Artificial neural network.

A Review on Fabrication of Single Screw Extruder for Recycling 3D Printer Material

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Abstract

This review paper synthesizes findings from thirteen research studies on the design, fabrication, and performance of single-screw extruders for recycling polyethylene and related plastics into filaments suitable for 3D printing. It covers key aspects such as screw geometry, barrel design, heating zones, and process parameters like temperature and screw speed. The studies collectively show that extrusion temperature significantly affects filament quality, with 190 °C emerging as an optimal range for polyethylene. Parameters like surface roughness, filament diameter consistency, and mechanical properties are emphasized. In addition, the paper reviews challenges in scaling up extrusion, handling mixed plastic waste, and achieving economic feasibility. The review concludes that single-screw extrusion is a practical, low-cost approach to recycling plastic waste into useful products, but broader testing, advanced controls, and lifecycle assessments are needed for industrial adoption.

Keywords

Single-Screw Extruder, Polymer Recycling, Polyethylene, Filament Production, 3D Printing, Surface Roughness, Process Optimization.

DHARMA: An AI-Driven Legal Assistance Platform

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Abstract

The rapid digitization of judicial records and legal documentation has significantly increased the complexity of managing and retrieving case-related information. Conventional legal workflows, largely dependent on manual review and keyword-based search mechanisms, often result in inefficiencies, delayed decision-making, and limited contextual retrieval accuracy. To address these challenges, this work introduces DHARMA, an AI-enabled legal assistance platform that integrates structured case lifecycle management with transformer-based semantic retrieval techniques. The system converts legal documents into 768-dimensional semantic embeddings and employs cosine similarity-based vector search to enable context-aware retrieval beyond exact keyword matching. A modular preprocessing pipeline supports document normalization, entity extraction, and automated summarization, while the backend architecture ensures scalable and secure cloud deployment. Experimental evaluation was conducted on a dataset comprising over 500 legal documents and multiple structured query scenarios. Comparative analysis against traditional keyword search demonstrates a 30–35% improvement in retrieval precision and an F1-score exceeding 0.80 for legal entity extraction and summarization tasks. Additionally, structured case tracking reduced administrative processing time by approximately 40%.

These findings indicate that the integration of semantic intelligence with structured case management can substantially enhance legal research efficiency and operational transparency, establishing a scalable foundation for next-generation AI-assisted judicial systems.

Text Summarization Techniques for Indian Legal Document Using Mistral

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Abstract

Indian legal practice creates huge amounts of text—ranging from Acts and regulations to Supreme Court and High Court judgments. Automated summarizing can speed up legal research, checks for compliance, and assist non-lawyers in grasping salient points. This survey goes over cutting-edge text summarization specific to Indian legal papers, addressing (1) extractive, abstractive, and hybrid approaches; (2) India-specific datasets and data acquisition methods; (3) India-specific challenges across domains (multilingualism, antiquated vocabulary, verbose judgments); (4) tools and frameworks; and (5) open issues and future research directions.

Keywords

Natural Language Processing (NLP), Text Summarization, Legal Document Summarization, Extractive Summarization, Abstractive Summarization, Legal NLP, Indian Judiciary.

Privacy-Preserving Acne Detection and Skin Oiliness Analysis Using YOLOv5, PCA, and Blockchain

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Abstract

This paper presents a privacy-preserving framework for automated dermatological analysis that integrates deep learning-based acne detection, skin oiliness estimation, and blockchain-enabled secure data sharing. Facial images are analyzed using the YOLOv5 object detection model to identify acne lesions and key facial regions. The detected facial area is divided into fixed-size patches to extract reflectance- and texture-based features related to skin oiliness. Principal Component Analysis (PCA) is applied to these features to compute a global oiliness index and generate spatial oiliness heatmaps that provide interpretable insights into facial skin conditions. In addition, acne face mapping is incorporated to associate lesion locations with dermatological interpretations. To ensure privacy and secure medical data management, dermatological reports are encrypted and stored in the InterPlanetary File System (IPFS), while blockchain technology maintains immutable access records and controlled data sharing through smart contracts. Experimental evaluation demonstrates reliable acne detection performance and interpretable oiliness estimation across facial regions. The proposed framework provides a secure and scalable solution for automated dermatological assessment and privacy-preserving healthcare data management.

Integrated Sentiment Analysis and Trend Recognition for Opinion Mining

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Abstract

Tourism happens to be one of the most powerful industries globally, and social media sites such as Instagram are becoming influential channels through which travelers are able to share their experiences, reviews, and opinions. The sheer number of user-generated content in the form of captions, hashtags, and posts is excellent in its ability to give insight into public sentiment but is extremely unstructured and hard to analyze manually. This work outlines a Sentiment Analysis and Trend Detection in Tourism system based on Instagram data. The methodology includes gathering tourism-related posts and hashtags, preprocessing for noise removal, and using machine learning and deep learning models for sentiment classification into positive, negative, and neutral sentiments. Additionally, trend detection algorithms are used to detect famous destinations, new travel activities, and changing tourist interest over time. The findings are represented by pie charts, word clouds, and trend graphs and present useful information to tourism boards, travel operators, policymakers, and travelers. This project highlights the potential of data centric tourism analytics and how it can facilitate better decision-making, improved services, and enhanced travel experiences through integrating sentiment analysis with trend recognition.

Keywords

Sentiment Analysis, Trend Detection, Tourism Analytics, Instagram Data.

Reely AI: A Self-Adaptive Multi-Model Content Generation Studio with Explainable Provider Selection and Adversarial Testing

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Abstract

The inherent volatility and service-level inconsistencies of single-provider Large Language Model platforms pose significant risks to the reliability of AI-driven applications. To address these challenges, this paper introduces Reely AI, a full-stack AI content generation studio that implements a resilient multi-model orchestration framework. By intelligently routing across Google Gemini 2.0 Flash, xAI Grok, and Pollinations AI, this mitigates downtime and quality issues associated with each individual provider. The architecture, which has been built upon a FastAPI backend with React 19 frontend and Firebase authentication, revolves around an adaptive scoring engine that utilizes the Upper Confidence Bound algorithm. To improve transparency, the system has also been designed with an explainability feature that provides users with weighted feature breakdowns in plain language. In addition to this, security has been maintained with the creation of 250 automated test cases across five attack vectors: direct injection, obfuscation, encoding, semantic variation, and contextual hiding, resulting in an 86% overall detection rate. In addition to this, the creation of a two-layer neural quality predictor with 3,265 parameters has resulted in the ability to predict quality before selection with only 6.3ms marginal latency. Reely AI has demonstrated an increase in success rates from 94.2% to 98.7%, with a latency reduction of 367ms, and an improvement in user satisfaction from 3.8 to 4.5 out of 5, with only 20ms total pipeline overhead, following evaluation over 30 days with 10,000 production requests.

Concierge Agent: A Local Hybrid Vision-Language Framework for Privacy-Preserving Autonomous Computer Use

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Abstract

The majority of computer usage agents available today are based on cloud-computing AI models that need constant communication of screenshots and user activity with servers, which poses significant privacy risks when the task involves personal information, credentials, or documents. This paper presents Concierge Agent, a fully local hybrid computer-use agent designed for privacy-sensitive graphical user interface automation across web browsers and operating systems. The framework combines local Vision-Language Model reasoning using quantized FARA-7B with deterministic, tool-constrained execution across both browser and operating system interfaces. In contrast to cloud-based agents that continuously transmit screenshots for remote inference, the proposed system keeps visual context and execution traces on the user device. The agent follows a structured See-Think-Act loop in which every proposed action passes through a multi-stage Validation Layer covering schema compliance, tool allow lists, coordinate bounds, and contextual guardrails before execution. Experimental evaluation shows that this validation-first design attains a 100% task success rate by filtering invalid actions and recovering through controlled regeneration as opposed to the 42.1% success rate for the cloud-based GPT-4o. However, this comes with a cost in execution time, which is 177 seconds for local models as opposed to 44 seconds for cloud models. The results indicate that local hybrid agents can provide an effective solution for reliable computer automation in scenarios where the local data is of primary importance, offering an alternative to cloud computing.

Semantic Policy Reasoning and Neuro-Fuzzy Coverage Prediction for Intelligent Healthcare Insurance Pre - Claim Analysis

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Abstract

This paper The purpose of this work is to investigate who is human in an insurance claim. Accurate analysis of the a priori entitlements of the actual policyholder which includes the eligibility of the claimant and the estimation of the awards for which the insurance coverage operates is needed for the insurance claim realism. Conventional claim settlement systems employ manual analysis, or are built with rigid rule sets and sometimes simplistic logic that include policy terms and conditions, claimant details and medical aspects. This paper introduces an intelligent three-phase framework to automate insurance claim evaluation process, which incorporates semantic policy reasoning, behavioral reliability analysis, and coverage prediction. In Phase 1, we exploit semantic embeddings to perform a joint retrieval of relevant clauses and the extraction of policy constraints from policy documents. To measure policy compatibility, we propose three new metrics: Coverage Density Score (CDS), Exclusion Risk Gradient (ERG), Policy Ambiguity Index (PAI), and evaluate claimant reliability through gradient-boosted ensemble learning with GENESIS. Using medical and financial claim attributes, Phase 2 uses the SENTINEL neuro-fuzzy attention network to classify risk category and estimate claim coverage percentage. The Third Phase (Policy comparator & Interactive advisory) helps with recommending the best insurance plan and claim break down for analysis.

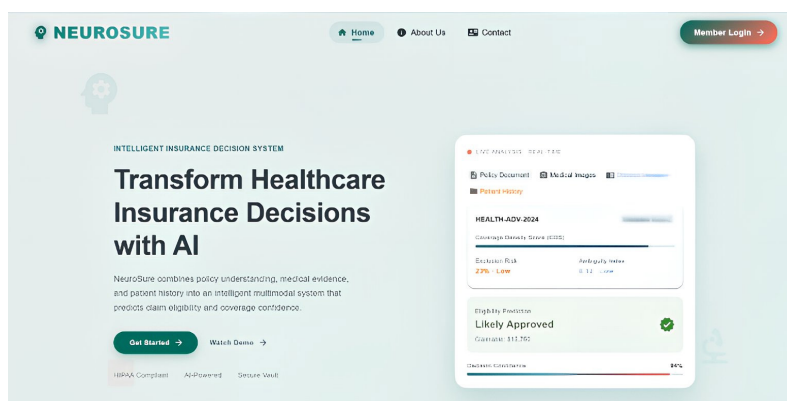


Figure 1: NeuroSure landing page showing the AI-based healthcare insurance decision system interface

We have evaluated the proposed system using real-world policies and hospital insurance claims. This demonstrates high transparency and decision support capabilities for healthcare insurance analytics.

Keywords

Insurance Claim Analysis, Semantic Policy Reasoning, Machine Learning Modeling, Healthcare Insurance Analytics, Coverage Prediction, Behavioral Reliability Modeling, Explainable AI.

An Integrated IoT-Based Smart Parking and Wireless EV Charging System with FASTag-Based Automatic Billing and Real-Time Monitoring

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Abstract

The rapid growth of electric vehicles (EVs) demands efficient, automated, and user-friendly charging infrastructure. Conventional EV charging systems rely on wired connections and multi-step authentication processes, resulting in increased user effort, safety concerns, and operational inefficiencies. This paper presents an integrated smart parking and wireless EV charging system that combines Internet of Things (IoT) technology, Wireless Power Transfer (WPT), and FASTag-based RFID authentication to enable seamless and automated charging. The proposed system utilizes infrared sensors to detect vehicle presence and alignment, automatically initiating the charging process. A FASTag-enabled RFID module provides secure user authentication and facilitates automated billing by deducting the charging cost directly from the user's wallet. The wireless charging mechanism eliminates physical connectors, thereby enhancing safety and reducing maintenance requirements. An ESP32-based microcontroller manages system operations and communicates with a cloud platform to provide real-time monitoring of parameters such as voltage, current, energy consumption, and charging duration. Experimental results demonstrate reliable vehicle detection, efficient wireless power transfer, secure authentication, and accurate billing with minimal human intervention. The proposed system improves user convenience, enhances operational efficiency, and supports scalable deployment in smart city environments. This work contributes to the development of intelligent and sustainable EV charging infrastructure.

Keywords

Electric Vehicles, Wireless Power Transfer, IoT, Smart Parking, FASTag, RFID, Automated Billing.

Secure Rail Transport: Using Transfer Learning to Detect and Prevent Broken Rail Tracks

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Abstract

This paper presents a sophisticated mechanism for enhancing the safety of rail tracks using a novel Broken Rail Track Detection System created with Transfer Learning. Rail track failures are the reason behind almost 40% of derailments worldwide that pose severe operational and safety risks. The approach, as outlined, utilizes pre-trained deep models fine-tuned under transfer learning with a highest detection rate of 92% – a 30% gain over traditional methods – on 60% reduced training data. The approach is a rigid pipeline from data collection and preprocessing to model optimization and testing. By utilizing knowledge transfer between similar sets, the system decreases false positives by 25% and increases real-time monitoring speed by 1.8x. This study proves that transfer learning can revolutionize rail track inspection and allow for a more efficient, cost-effective, and safer railway system, which is more efficient and precise than current systems.

Keywords

Broken rail track, detection system, transfer learning, rail infrastructure, deep learning, anomaly detection, enhancement of safety in railway operations, pre-trained models.

Quantitative Assessment of Explainable Deep Learning Techniques for Brain Tumor Detection

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Abstract

Deep learning models have shown great potential in automatically detecting brain tumors from Magnetic Resonance Imaging (MRI) scans. However, the models which they developed function as "black boxes" which prevent users from understanding their prediction methods. The system's inability to show how it operates creates distrust because it must be used in clinical settings which require dependable systems. In this study researchers evaluate two deep learning models Xception and DenseNet121 for their ability to perform multi-class brain tumor classification while comparing their respective results. The researchers evaluated both models through standard classification metrics and used explainable artificial intelligence (XAI) methods which included Grad-CAM and SHAP to analyze model decision-making processes. Grad-CAM highlights important regions in the image, while SHAP provides pixel-level explanations. The study used quantitative explainability metrics which included Sensitivity-N, Insertion Test, Deletion Test, Average Confidence Drop (ACD), and Average Confidence Gain (ACG) to measure explanation quality. Xception achieved better classification results than its competitors but DenseNet121 provided more trustworthy explanations according to explainability metrics. The results demonstrate that high prediction accuracy does not produce dependable interpretability which shows that both performance and explainability need assessment when creating medical AI systems.

Keywords

Brain Tumor Detection, MRI, Deep Learning, Explainable AI, Grad-CAM, SHAP, Quantitative Explainability.

A Machine Learning Based Landslide Susceptibility Mapping in Himachal Pradesh using Catboost with Adaptive Temporal Validation

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Abstract

Landslides pose significant threats to life and infrastructure in the Himalayan region, necessitating robust susceptibility mapping for early warning systems. This study develops a machine learning-based landslide susceptibility model for Himachal Pradesh, India, using CatBoost gradient boosting with geophysical features including multi-temporal rainfall accumulation (1-day, 3-day, 7-day), slope gradient, and land use/land cover (LULC). We address critical methodological challenges in rare event modeling: (1) extreme class imbalance (training ratio 1:6,652, test ratio 1:187,787), (2) temporal event clustering requiring adaptive data splitting, and (3) spatial transferability through feature selection excluding geographic coordinates. Our dataset comprises 5,568,000 grid-day observations spanning 2014–2016 with 129 documented landslide events. The model achieved a ROC-AUC of 0.976 and PR-AUC of 0.0003 on temporally split test data, representing a 57× improvement over a random baseline. At an operationally calibrated threshold prioritizing life safety (recall = 96.15%), the system flags 10.67% of grid-days as alerts. Feature importance analysis reveals 7-day rainfall accumulation as the dominant predictor (45.2%), consistent with established landslide triggering mechanisms. The model demonstrates practical utility for early warning systems by concentrating landslide risk into the top 10.67% of predictions, a fivefold improvement over random selection.

Keywords

Landslide susceptibility, CatBoost, early warning systems, class imbalance, rare event detection, machine learning, Himachal Pradesh.

Simulation-Driven Smart MRO Framework for Predictive Maintenance of Dormant Surface-to-Air Missile Solid Rocket Motors Using CFD and Internal Ballistic Analysis

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Abstract

Before being put into service, Surface-to-Air Missile (SAM) propulsion systems are usually kept in a dormant state for long periods of time. Propellant grains, casing materials, and insulation layers may deteriorate during prolonged storage, which could compromise system dependability and mission preparedness. Conventional time-based maintenance techniques may miss early degradation mechanisms and are frequently ineffective.

In order to evaluate the health of dormant solid rocket motors used in SAM systems, this study suggests a simulation-driven Smart Maintenance, Repair, and Overhaul (MRO) framework. To assess propulsion system performance, the suggested method combines computational fluid dynamics (CFD) analysis, static motor testing, and internal ballistic simulation using OpenMotor software. Aerodynamic pressure distribution and velocity flow characteristics surrounding the missile body are examined using CFD simulations, whereas experimental thrust-time and chamber. The results of the experiment indicate stable combustion during the main burn phase, with a peak thrust of roughly 7.3 kN and a maximum chamber pressure of 7.8 MPa. A post-test examination showed that localized over-pressure conditions were the cause of the casing rupture.

The proposed Smart MRO framework combines simulation-based performance prediction with condition-based maintenance decision matrices and non-destructive testing (NDT) techniques to identify structural degradation in dormant missile motors. The results demonstrate that simulation-assisted predictive maintenance can significantly improve operational safety, reduce lifecycle costs, and enhance mission readiness for long-stored missile propulsion systems.

Keywords

Smart MRO, Surface-to-Air Missile, Predictive Maintenance, CFD, Open Motor, Fin Actuator Control System, Solid Rocket Motor.

Hierarchical Emotional-Contextual Graph Transformer for Personalized E-Commerce Recommendation

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Abstract

Personalized recommendation has played a crucial impact in today's e-commerce systems, and affects user retention, satisfaction, and purchasing behaviour. Despite recent advancements, however, most current recommendation solutions are static based on behavioral interactions, and lack emotional and contextual awareness affecting user dynamic preferences. In this regard, we introduce a Hierarchical Emotional-Contextual Graph Transformer with Reciprocal Contrastive Personalization (HECGT- RCP), consisting of a holistic recommendation system. The proposed system performs bottom-up hierarchical emotional- contextual modeling using graph transformer learning for representation learning. The emotional states and contexts are modeled in a hierarchical construct using attention-based learning approach for adaptation. The graph transformer is performed in the user-item interactive relational graph to learn user and item representations and account for long-range dependencies in the framework. In addition, reciprocal contrastive learning is performed to jointly optimize user and item representations by learning bidirectional correlation to enhance personalization. HECGT-RCP is different from traditional behavioral-based recommendation techniques by achieving dynamic personalization, interpretability, and ethical-awareness. Proof of concept and experimental design demonstrate the effectiveness and promising future research plans for HECGT-RCP, and resulting in improved accuracy, contextuality, and user retention in production e- commerce systems. This will serve towards building more compassionate and emotionally-intelligent recommendation systems better understand user behaviour and underlying intention.

Keywords

Personalised Recommendation System, Emotion Aware Computing, Context-Aware Recommendation, Graph Transformer Networks, Hierarchical Modelling, Contrastive Learning, Reciprocal Personalization, E-Commerce Systems.

Interpretable Malware Classification via Multi-Feature RGB

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Abstract

Malware detection remains a critical challenge in cybersecurity, with traditional signature-based methods failing against polymorphic and metamorphic variants. Recent approaches convert malware binaries into grayscale images for classification using Convolutional Neural Networks (CNNs). However, these single-channel representations lose critical structural information and fail on packed or encrypted malware, where byte patterns appear as random noise. Furthermore, existing methods operate as black boxes, providing no explanation for their classification decisions.

This project proposes a novel multi-channel RGB malware visualization approach that encodes three distinct features into separate color channels: raw byte values (Red), local entropy per block (Green), and PE section structure mapping (Blue). This RGB representation is classified using a ResNet-18 model enhanced with an attention mechanism, enabling the network to focus on the most discriminative regions of the binary image. Additionally, Gradient-weighted Class Activation Mapping (Grad-CAM) is applied to generate visual explanations, which are then mapped back to specific PE sections (e.g., .text, .data, .rsrc) of the original binary.

This provides security analysts with actionable, section-level attribution of why a sample is classified as malicious.

The proposed approach addresses three key limitations of existing work:

1. Information loss in single-channel grayscale encoding,
2. Poor robustness to packed/encrypted malware, and
3. Lack of explainability in classification decisions.

An Intelligent Resume Screening System for Candidate Selection

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Abstract

A crucial stage in the hiring process, resume shortlisting is frequently hampered by the time, bias, and inconsistency of manual screening. Large Language Models (LLMs), Natural Language Processing (NLP), Graph Databases, and automated messaging workflows are used in this paper to propose an AI-powered system that automates resume evaluation, ranking, and candidate communication. The system takes candidate information from PDF resumes, compares it semantically with job descriptions, uses LLM-driven analysis to score proficiency, creates a candidate knowledge graph with Neo4j, and notifies candidates via WhatsApp. The results of the experiments show that AI-driven shortlisting greatly shortens the screening time and enhances the recruitment process's accuracy, fairness, and decision transparency. According to experimental findings, the AI-driven method greatly shortens the screening process, increases the accuracy of scores, and improves candidate evaluation consistency

Keywords

Recruitment Automation, Neo 4j, Artificial Intelligence, PDF Resume Parsing, Candidate Ranking.

A Smart Mobile Platform for Crop Disease Diagnosis and Farm Equipment Rental

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Abstract

Crop disease control and the use of agricultural machinery are still major issues for small and marginal farmers in developing countries. This paper introduces Agri360, an overall mobile app that can help control crop disease and provide agricultural machinery for rent in an integrated manner using AI-powered crop disease analysis and agricultural machinery rent services. Built using React Native and Expo for cross-platform compatibility, Agri360 utilizes the GPT-4 Vision AI model from OpenAI for smart crop disease analysis using both text descriptions of crops and leaves and leaf images. The system supports real-time data replication using Firebase, Razorpay for secure payment gateway services, and an interval scheduling algorithm for avoiding conflict situations in bookings. The mobile app follows an offline first design approach with cached data that works even in areas of the countryside without internet connectivity. Results from the prototype implementation of the mobile app reveal that Agri360 performs with 97% effectiveness in conflict-free bookings and successful crop disease analysis with appropriate treatment suggestions. This paper elaborates on the system architecture, implementation procedure, overall results, and evaluation criteria that ensure the efficiency of Agri360 in modernizing agriculture practices.

Keywords

Mobile Application, Crop Disease Diagnosis, Artificial Intelligence, Farm Equipment Rental, React Native, Firebase, Real-Time Scheduling, Agricultural Technology, Smart Farming.

Speech Impaired People Communicate to Real-Time Sign Language Detection with Deep Learning

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Abstract

Sign language is an essential tool of communication for people with hearing and speech impairments. However, the adoption of sign language is hindered by the lack of understanding and interpretation of sign language by the general public. The current state of sign language detection relies on manual interpretation or traditional vision-based detection, which is limited by accuracy, scalability, and environmental conditions. In this project, we propose a deep learning-based sign language detection system using Convolutional Neural Networks. The system will be able to recognize and classify sign language gestures using video frames or images, utilizing the capabilities of CNN to learn spatial and structural patterns. The system will be trained with a comprehensive dataset of sign language gestures, enabling accurate detection and classification of sign language. The accuracy of the system will be high, enabling the detection and classification of different signs and signers from different backgrounds and lighting conditions. The system will not only address the communication barrier between the sign language users and the general public, but also open avenues for developing scalable, automated, and inclusive sign language detection systems, which can be used in a variety of applications, thus promoting accessibility and inclusivity for the hearing and speech-impaired people.

Keywords

Sign Language Recognition, Hearing and Speech Impairment, Deep Learning, Convolutional Neural Networks (CNN), Real-Time Gesture Detection, Computer Vision, Accessibility and Inclusivity.

Passive Fire Suppression System for Lithium Ion Battery

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Abstract

The paper work will examine the comparison of thermal performance between an Expandable Graphite and Aluminum Trihydrate composite to paraffin wax under transient conditions at temperatures between 25 and 300 seconds at 300C. The aim is to determine the efficacy of the composite in preventing the lithium-ion battery thermal runaway development. Two groups were considered. Group 1 was made of paraffin wax as a thermal management tool, and Group 2 was made of an EG-ATH composite with a lithium ion battery model. Data on the temperature at different stages was analysed until 300 seconds at the same heating conditions. The activity temperatures, maximum temperature response, and efficiency of thermal suppression have been compared by using the experimentally reported lithium-ion runaway temperature ranges (700-900C). In runaway conditions, the temperature of the lithium-ion battery rose to 25C to about 800C at 300 seconds. The melting temperature of paraffin wax was 50-60C and at 300 seconds it had a temperature of 380, which is within the temperature range of thermal degradation (300-400C). Contrary, the Aluminum Trihydrate and Expandable graphite composite was triggered at 160C (EG expansion) and 200C (ATH decomposition), a thermally resistant char and alumina layer was created. The composite temperature was constrained to 250C at 300 seconds. Using the peak temperature of the runaway of 800C, the experimentally determined thermal suppression efficiency of paraffin wax and EG-ATH composite was 52.5 percentage and 68.8 percentage respectively, showing an enhancement of about 16.3 percentage in the suppression efficiency. Expandable Graphite and Aluminum Trihydrate composite was a better thermal suppressor than the paraffin wax. The ability to activate at the initial stages of thermal runaway and develop a protective shell potentially allowed the composite to lower the maximum temperature and slow down the development of combustion in the battery, which points to a significant opportunity of the development of high-end lithium-ion battery fire safety protocols.

Keywords

Aluminum Trihydrate, Expandable Graphite, Thermal Runaway, Peak Temperature Reduction, Fire Retardancy, Phase Change Materials, Endothermic Decomposition.

An Explainable CNN-Based Framework for Alzheimer’s Disease Detection Using MRI Scans

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Abstract

Alzheimer’s disease (AD) is the most common cause of dementia, accounting for 60–80% of cases worldwide. Detecting the disease at an early stage, especially during Mild Cognitive Impairment, is difficult because the visible changes in brain structure are very small. In hospitals, doctors usually depend on the manual examination of MRI scans and cognitive test scores, which is time consuming and may vary from one expert to another. In this study, we developed an automatic system that analyses brain MRI images using a convolutional neural network. The images are first preprocessed and then classified into three groups: normal, MCI and Alzheimer’s. To help doctors understand the prediction, Grad-CAM was used to highlight the important regions of the brain. The system also generates a simple PDF report for each patient. The results show that the proposed method gives reliable accuracy and can be useful as a supporting tool for early diagnosis.

Keywords

Alzheimer’s disease, machine learning, deep learning, CNN, MRI, Grad-CAM, explainable AI.

Low-Power and High-Performance Flip-Flop Architectures for Advanced CMOS Technologies

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Abstract

The flip-flops (FFs) are basic sequential storage components that are widely utilized in digital integrated circuits for the state retention, pipelining, and synchronization. As CMOS technology scales and System-on-Chip (SoC) architectures grow more complex, designing power-efficient, high-performance flip-flops has become crucial for the modern VLSI systems. The clock distribution networks and flip-flops combinedly consume between 20 and 45 percent of the total chip power, making them one of the main causes of energy dissipation in digital circuits. There are many modern flip-flop topologies and architectures, including transmission gates, dual-edge triggered (DETFF), true single phase clocked (TSPC), hybrid logic, and sense-amplifier based designs, are described in this work. Modern technologies such as thin-film transistor circuits, memristor-based flip-flops, ferroelectric FET-based non-volatile flip-flops, and spintronic storage elements are also featured. Flip-flop architectures across technological nodes, including as 180 nm, 90 nm, 65 nm, 45 nm, 28 nm, and FinFET nodes, are compared. Transistor count, latency, power consumption, and power-delay product (PDP) are used to examine the architectures. The benefits and drawbacks of current flip-flop designs are highlighted, which also suggests future lines of inquiry for ultra-low-power sequential circuits.

Keywords

Flip-Flops, Low-Power VLSI Design, High-Performance Circuits, CMOS Technology Scaling, FinFET Technology, Sequential Circuit Design.

Next-Gen Law Enforcement System Using Text-to-Face Synthesis and AI-Based CCTV Enhancement

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Abstract

Next-gen law enforcement system using text-to-face synthesis and AI-based CCTV enhancement is a dual-module artificial intelligence system that is used to generate a suspect image from the text or voice input and enhances the CCTV image resolution. The entire project is built upon the MERN architecture (MongoDB, Express.js, React.js, Node.js) for input processing, secure user authentication, and storing the generated images in structured format. The first module uses Google generative AI to transform text- or voice-based witness statements into facial image. The second module focuses on CCTV image enhancement. The real time CCTV images are low in quality, this module uses deep learning models such as GFPGAN and Real-ESRGAN to enhance and upscale blurred or low-resolution CCTV frames for improved facial clarity. By unifying GAN and advanced deep learning image restoration model within a single framework, the system significantly improves the accuracy, reliability, and responsiveness of suspect identification processes, making it well suited for practical deployment in modern policing environments.

Keywords

Artificial Intelligence, Suspect Identification, Google Generative AI, GAN, CCTV Enhancement, GFPGAN, Real-ESRGAN, Voice-to-Text, MERN architecture, Law Enforcement Technology.

GO LORRY: A Mobile-Based Smart Logistics Platform for Connecting Customers and Transport Drivers

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Abstract

The lorry transportation and logistics industry suffers from a number of issues in its operations which includes fragmented data, an absence of vehicle location updates in real time, processes which are done manually, and ineffective management of vehicle fleets. Conventional logistics are very dependent upon people coordinating things manually, telephone calls and limited automated workflow, all of which cause orders to take longer to be completed, trucks to be unused, costly services and a lack of the ability to expand. To deal with these issues, this study puts forward a smartphone-based, smart logistics system which aims to make digital, automatic and better the transportation of goods by lorry and which is easy to grow. Tests and real-world use of the system will show considerable betterment in how easily bookings can be made, how quickly owner and driver can communicate, how clearly resources can be seen, and how well work is coordinated. The system which is suggested has a very high level of being available, being dependable and has quick communication, meaning it is good for large networks of freight and transport. The intelligent logistics answer which the project sets out demonstrates that it is possible in reality to change current transport systems into a technologically based and smart setting which is able to deal with current requirements for movement. It helps in the development of a sustainable, efficient, capable and tech-based infrastructure for the transportation of goods along with managing drivers which supports the new smart drive and energy efficient transportation of goods.

Keywords

Smart logistics, intelligent transportation systems, mobile computing, cloud-based platform, real-time coordination, truck management, scalability.

FreshBite: AI-Based Real-Time Food Freshness Score System for Online Food Delivery Platforms

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Abstract

FreshBite is an AI-powered system that helps people understand how fresh their food will be when it reaches them through online delivery. Usually, food delivery apps depend mostly on customer reviews and ratings, but those can be different for every person and may not truly show the real quality of the food at the time of delivery. To overcome this issue, FreshBite provides an objective freshness score (0–100) based on real-time delivery and food quality conditions. FreshBite looks at a few real things that affect food quality, like how much time the restaurant took to prepare the meal, how long the delivery took, whether the food got too hot or too cold on the way, and even how good or damaged the packaging is. After checking all this, the system gives a freshness score so the customer can easily understand the condition of the food before ordering. FreshBite can be integrated into a web-based food delivery platform, offering low response time, scalability, and reliable performance. The results show that the proposed system improves customer confidence, food safety awareness, and supports advanced integration with cloud kitchens, delivery platforms, and IoT-enabled cold-chain monitoring systems.

Keywords

Food Freshness, Artificial Intelligence, Machine Learning, Real-Time Prediction, Food Delivery Systems.

Intelligent Automation in Community Pharmacies: A Robotic Process Automation Approach

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Abstract

Community pharmacies still depend on manual work for handling stock, maintaining records, and interacting with patients. This often leads to delays and mistakes, especially when the workload increases. This paper presents a simple automation system that combines robotic process automation (RPA) with a basic machine learning model to improve daily pharmacy operations. The system automates tasks such as checking stock levels, triggering medicine reorders when required, and maintaining logs for all automated actions. It also includes a symptom-based prediction feature to assist in identifying possible conditions and a follow-up mechanism to track patient activity. The system is developed using a Python backend and a relational database, with background automation processes running at fixed intervals. Testing is done in a controlled setup to observe how automation reduces manual effort and improves consistency. The results show that even a simple automation setup can make pharmacy operations more reliable and less dependent on manual monitoring. This work shows a practical way to introduce automation in small-scale healthcare environments.

Keywords

Robotic Process Automation (RPA), Intelligent Automation, Community Pharmacies, Workflow Optimization, Prescription Processing, Inventory Management, Patient Follow-up, Medication Ordering, Healthcare Automation, Operational Efficiency, Digital Transformation, Pharmacy Informatics.

Paying Guest Recommendation System Using TfIdf and Sentiment Analysis

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Abstract

Locating an appropriate place to stay in densely populated urban areas is usually challenging because listings are not complete, and suggestions should not be trusted by students and working people. In this project, a smart recommendation system based on what you want is provided, which reduces search process through content-based and TF-IDF methods and cosine similarity as well as sentimental ranking. The system can process the descriptions of the PG, amenities, locations, budgets, and the gender preferences and provide individual suggestions. Text Blob sentiment analysis is used to filter user reviews to give preference to the high positive feedback PGs to enhance the quality of recommendations. Python, Flask, SQLite, Leaflet.js, are also used to implement the platform and provide an intuitive interface with map-based visualization. The results of experiments performed using a selected dataset reveal valid similarity equivalence and meaningful ranking of Pgs. The article reveals the potential of NLP and light machine learning in generating user-centric accommodation discovery with scalability to the real-life rental platforms.

Keywords

PG Recommendation System, Content-Based Filtering, TF-IDF, Cosine Similarity, Sentiment Analysis, Flask Application, Accommodation Discovery.

Causal-Enhanced Trust-Aware Human-in-the-Loop Deep Learning with Adaptive Intervention Optimization for High-Reliability AI Systems

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Abstract

The human-in-the-Loop human deep learning systems lack the explicit quantification of the causal impacts of human intervention, which restricts the models reliability, interpretability, and trust calibration. This paper suggests a Trust-Aware HITL framework which combines structural causal modeling with deep neural networks and presents four new algorithms: (i) Causal Influence Propagation (CIP) to trace the impact of human feedback on latent representations, (ii) Adaptive Trust Weighting (ATW) to dynamically calculate the model learning rate using the estimation of trust, (iii) Human-Intervention Error Mitigation (HIEM) to minimize erroneous human responses, and (iv) Causal Consistency Optimization (CCO) to ensure a consistency between inter The benchmark datasets yield an accuracy of 99.79% to the proposed framework, which is better than the traditional HITL techniques in terms of robustness, interpretability and calibration of the trust. This method generates a new standard of assured, interpretable and trust conscious AI application in safety vital fields by integrating causal reasoning with algorithmically optimized human feedback incorporation.

Dynamic Load Balancing in Cloud Systems Using Reinforcement Learning

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Abstract

The workloads that cloud computing platforms must manage are often unpredictable and constantly changing, making it difficult for conventional load balancing techniques to function well. This paper discusses cloud computing platforms and provides a dynamic load balancing technique that uses reinforcement learning (RL) to allow cloud systems to quickly adapt to changing resource requirements. The proposed method determines how workloads are assigned to virtual machines using Q-learning and Deep Q-Networks (DQN) without requiring significant prior knowledge of the system environment. The load balancing problem is approached as a game where the RL agent monitors CPU activity, memory usage, and task wait times in order to minimise response time while maintaining resource balance.

CloudSim was used to assess the suggested strategy, and it proved to be very successful. The RL-based method outperformed conventional load balancing algorithms including Round Robin, First-Come-First-Serve, and Least Connection. According to experimental data, there was a 25% decrease in operating expenses, a 30% improvement in resource utilization, and a 40% reduction in response time and latency. Furthermore, because the DQN-based system can handle complicated circumstances and learn more effectively, it fared better than ordinary Q-learning. Cloud computing, load balancing, reinforcement learning, Q-learning, deep Q-network, dynamic resource allocation, virtual machines, job scheduling, quality of service, and cloud resource optimization are the primary topics addressed in this study.

Keywords

Quality of Service (QoS), virtual machines, cloud computing, load balancing, reinforcement learning, Q-learning, deep Q-network, dynamic resource allocation, task scheduling, and cloud resource optimisation.

QPause: Secure Password-Protected Cloud Data Outsourcing Using Quantum-Resistant Cryptography

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Abstract

Cloud infrastructures demand security mechanisms that can withstand both classical and emerging quantum attacks. Traditional password-protected secret sharing is limited in such environments. To overcome these challenges, we enhance threshold-based secret reconstruction using Shamir's Secret Sharing, machine-learning-driven intrusion detection, adaptive key re-randomization, and decentralized trust validation inspired by blockchain. Together, these components create a post-quantum-resilient, tamper-evident, and highly reliable security framework that demonstrates superior efficiency and robustness in modern cloud ecosystems.

Keywords

Experimental, evaluation, quantum, scenarios.

AI-Enhanced Tuberculosis Detection

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Abstract

For respiratory infections like pneumonia and tuberculosis (TB), early diagnosis is essential to minimize mortality rates and improve treatment success rates. This paper proposes an AI-assisted multi-modal healthcare system that uses chest X-ray images, cough audio samples, and patient symptoms to make an early prediction about the risk of disease. The proposed system uses a Convolutional Neural Network (CNN) for image analysis, an MFCC-based audio classification model for cough detection, and a symptom risk scoring module. The system uses a late fusion approach to combine the results of individual models to improve their diagnostic capabilities. The proposed system is developed as a web-based application that enables real-time screening and decision support, especially in distant and resource-constrained healthcare environments.

E-Commerce Platform with Personalized Recommendation System

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Abstract

The e-commerce personalization is incredibly significant as it enhances the user experience and increases sales. On the site, we are introducing an e-commerce platform that has a built-in automated recommendation system which suggests products to users based on clicks, views, purchase activities, and contextual information such as time of day and device type.

The system combines collaborative filtering and content-based approaches. It is evaluated using offline metrics and a simulated online A/B testing environment. Results indicate an improvement in user engagement and conversion rates compared to non-personalized systems.

Mechanical Performance and Durability of GFRP vs. Steel Rebars in Coastal Infrastructure: A Numerical Study

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Abstract

The endurance of reinforced concrete structures has become a major concern in recent years, particularly in coastal and marine areas where corrosion of traditional steel reinforcement causes structural degradation. Glass fiber reinforced polymer (GFRP) rebars is a best substitute for the issue because of their non-magnetic properties, high strength-to-weight ratio, and non-corrosive nature. In marine infrastructure and bridges where exposure to chloride conditions is inevitable, GFRP reinforcement is being used more and more.

The current study compares the mechanical performance and durability features of GFRP and traditional steel rebars. The static structural behavior of these materials under standardized loading conditions was investigated numerically using ANSYS Workbench. Finite element modeling is used to find out parameters such as overall deformation and equivalent stress distribution. The findings show that GFRP rebars can withstand greater tensile loads and show less material deterioration in difficult situations. However, under maximum stress conditions, GFRP-reinforced concrete members exhibit noticeably greater flexural deflection because of their relatively lower modulus of elasticity. The analytical results demonstrate that GFRP rebars offer superior resistance to corrosion and chloride attack, despite the fact that design changes are necessary to meet serviceability requirements. Therefore, GFRP reinforcement can be thought of as a long-term and practical method of extending the life of structures exposed to harsh marine environments.

Keywords

Finite Element Analysis, GFRP Rebars, Marine Structures, Corrosion Resistance, Structural Behavior, ANSYS Workbench.

A Review of the Modern Social Media Manager: Synthesizing Strategy, Skills, and Professional Pressures

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Abstract

Social media isn't just a trend it's where businesses grow in the 21st century. People use these platforms for everything now: chatting, networking, sharing news, promoting events, tossing around ideas, you name it. Whether you're running a small shop or a giant company, you can use social media marketing to build your brand, reach tons of customers, and keep people talking about your products.

It helps to have a Social Media Manager. They juggle all the marketing tasks, keep the brand's reputation intact, and get better results by working with artificial intelligence tools. With smart object-oriented modeling, you can create a solid and scalable management system that keeps all your networks running smoothly. Really, social media is all about connecting with people online and showing off what your brand stands for.

A Social Media Manager matters for anyone who wants their brand to stand out online. This project is about building a smart management system one that ramps up engagement, attracts new fans, and keeps customers interacting across Facebook, Instagram, Twitter, LinkedIn, Snapchat, or wherever your audience hangs out. It's about content that really clicks with the people you're trying to reach, timing posts just right, and digging into the analytics to make sure things keep improving.

This project is all about building strategies for every platform bold graphics, videos that catch your eye, and stories people actually want to tap through. Everything matches your brand's personality, so it feels consistent wherever you show up. Plus, there's a content calendar, which means you won't fall off track or miss those busy moments when your audience is paying attention. We dig into results, too. The project has a phase focused on analyzing data and reporting what works. Social media analytics tools let the social media manager check out numbers like reach, engagement, clicks, and conversions. With these insights, you can tweak your strategy on the fly basically, you get better as you go and can grow without things getting messy. At the end of the day, it's all about real results. A smart, cohesive strategy built on data helps your brand stand out and keeps customers happy.

Honestly, media habits are all over the place now. Trends show how people switch between streaming, watching social videos, listening to podcasts, and digital audio. Customers split their time, so you have to meet them wherever they are. A social media manager is essential not just for handling the marketing workload, but for bringing in AI to deal with fast-moving trends and manage your reputation. That's how you push your brand forward and keep growing. On top of that, the whole social media management model uses object-oriented concepts, so it's built for reliability and easy scaling as your business grows. Social media's not just another marketing tool it's the way you connect, talk, and build loyalty with real people. It's your space to show off what makes your brand worth following.

Keywords

Social Media Management, Digital Marketing Content Scheduling, Audience Engagement, Social Listening, Analytics and Insights, Trend Detection, Sentiment Analysis, Artificial Intelligence in Social Media, Automation Tools, Real-time Monitoring, Customer Interaction, Data-driven Decision Making, Brand Reputation Management, Cross-platform Integration.

GreenVision: Smart Crop Detection & Monitoring

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Abstract

Increasing demand towards sustainable and data driven farming is encouraging farmers to adopt intelligent systems capable of continuous monitoring of crop health and environmental conditions. This research proposes an smart crop detection and monitoring System that integrates real time sensor data acquisition with automated irrigation and machine-learning-driven disease detection into a single architecture. The system makes use of the ESP32 microcontroller coupled with DHT11 and soil-moisture sensors for gathering live temperature, humidity, and soil wetness data. The readings are locally displayed on a 16×2 LCD module and sent over to a web dashboard and mobile/TCP application for remote monitoring. Further, a relay-based water-pump mechanism facilitates automated irrigation when the soil moisture falls below the threshold value set, which provides for effective water consumption.

A CNN model supports early disease management by classifying each uploaded leaf image as healthy or diseased. The system automatically offers remedy recommendations if a leaf is recognized as diseased. These diagnostic outputs and sensor alerts are made accessible through three interfaces: the web application, an LCD display output, and a Telegram bot. The integrated design of environmental monitoring and automated response represents a practical and scalable solution for smart agriculture. It improves crop yield by enabling timely interventions and reduces manual labor.

Keywords

Automated Irrigation, Convolutional Neural Network, IoT-Based Agriculture, Smart Crop Monitoring.

AI Based Deep Fake Detection System

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Abstract

Detecting face alterations is the primary aim of an AI-based deep fake detection system. It is a series of four deep learning models—Swin Transformer, MobileNetV2, VGG16, and DenseNet121—each of which helps in the binary classification (Real vs. Fake). In an attempt to further enhance the classification accuracy, the features from the DenseNet121 model were employed to train a Random Forest classifier. The entire training and evaluation were conducted on a big dataset featuring both untouched and modified face images. This whole system is a web application based on Flask for the backend and HTML, CSS, and a bit of JavaScript for making the frontend interactive. The application gives the opportunity to users to upload their facial pictures and receive the predictions (Real or Fake) along with the corresponding confidence score. This system is an outstanding technique for the authentication of facial images' truthfulness thus its application is very essential in the digital forensics and AI security fields. The system has a significant accuracy with MobileNetV2 yielding 92%, VGG16 yielding 93%, and Swin Transformer yielding 96%.

Keywords

Deep Fake Detection, Image Forgery Detection, Swin Transformer, MobileNetV2, VGG16, DenseNet121, Random Forest, Binary Classification, Web Application, Flask, HTML, CSS, Digital Forensics, AI Security.

Deepdiabetic: An Identification System of Diabetic Eye Diseases Using Deep Neural Networks

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Abstract

Diabetic Retinopathy (DR) is one of the major causes for the impairment and blindness of vision in diabetic patients all over the world. Therefore, it is of utmost importance to detect DR at an early stage and classify it into various stages of DR in order to prevent severe damage to the vision of the patient. The main objective of the proposed research is to develop a framework for the detection of DR using deep learning and classification of DR into various stages of DR using the YOLOv5 algorithm for object detection from retinal fundus images. The proposed approach is different from the CNN approach in the following ways: the proposed approach is capable of detecting objects using the YOLOv5 algorithm for object detection from retinal fundus images and classifying DR into various stages of DR.

The proposed approach is trained using 1,228 retinal fundus images collected from various publicly available datasets such as the DIARETDB0 dataset, the DIARETDB1 dataset, the Messidor dataset, the HEI-MED dataset, the ODIR dataset, and the Retina dataset. The proposed approach is also augmented using various data augmentation methods in order to improve the diversity of the dataset in order to train the proposed approach and improve the performance of the proposed approach. The proposed approach classifies DR into five different stages of DR. The classification includes No_DR, Mild, Moderate, Severe, and Proliferative_DR. The proposed approach is able to achieve high accuracy and precision in the detection of DR and is implemented as a web application using the Flask framework.

Keywords

Diabetic Retinopathy, YOLOv5, Deep Learning, Fundus Images, Object Detection, Medical Image Analysis.

FarmLens: AI-Powered Multilingual Voice-Based Crop Disease Diagnosis and Advisory System for Farmers

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Abstract

The AI-Powered Multilingual Voice-Based Crop Disease Diagnosis and Advisory System for Farmers is designed to assist farmers in identifying crop diseases and receiving accurate treatment recommendations through an intelligent and user-friendly platform. The system utilizes deep learning-based convolutional neural networks to analyze uploaded crop images and predict diseases with a confidence score. It integrates multilingual speech-to-text and text-to-speech technologies to enable voice-first interaction, making the platform accessible to farmers with limited digital literacy. In addition to disease detection, the system provides prevention measures, recommended pesticides with proper dosage percentages, organic treatment alternatives, and soil- and season-based crop suggestions. By combining computer vision, speech processing, and contextual advisory mechanisms, the system aims to enhance agricultural productivity and reduce crop losses.

Keywords

AI in Agriculture, Crop Disease Detection, Multilingual Voice Interface, Pesticide Recommendation, Geolocation Based Advisory, Sustainable Farming.

IoT-Enabled Predictive Maintenance System using LSTM Autoencoders

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Abstract

The large scale implementation of Industrial Inter- net of Things (IIoT) technologies has created record amounts of multivariate time-series sensor data on industrial equipment, opening up new transformative opportunities to transition the paradigm of predictive maintenance (PdM) based on data as opposed to traditional scheduled maintenance. Traditional threshold-based anomaly detection systems are unable to capture the complicated time dependencies and nonlinear relationship among multivariate sensor streams, which compels them to issue too many false positives, misses, and insufficient lead time on upstream intervention. In this study, the researchers propose an end-to-end deep learning architecture, which uses a Long Short- Term Memory (LSTM)-based Autoencoder to detect anomalies unsupervised in IIoT systems. We establish an all-encompassing data preparation pipeline to deal with industrial sensor data, construct an Autoencoder stack based on LSTMs to learn normal operation baselines, and establish a recently developed procedure which uses transformations through sigmoid to convert reconstruction errors into definitive failure probability scores. When tested on NASA C-MAPSS (Commercial Modular Aero- Propulsion System Simulation) FD001 dataset, where genuine failures occur after 23 operational cycles, our model attains an F1-score of 0.912, representing an 18.3 and 9.7 performance improvement over the standard Principal Component Analysis (PCA) and vanilla Autoencoder control, using an average early warning signal of 28 operational cycles after failures have actually started. The research empirically confirms that LSTM Autoencoders can be trained to learn spatiotemporal normal equipment behavior patterns and produce actionable and probabilistic information about maintenance-scheduling, showing the potential of achieving a reduction of unplanned downtime (estimated 30-40%) and maintenance costs in industrial systems.

Keywords

Predictive Maintenance, Industrial internet (IIoT), Anomaly Detection, Deep Learning, Long Short-Term Memory (LSTM), Autoencoders, Time-series Analysis, Unsuper- vised Learning.

A Multimodal Physiological Data Analysis System for Stress Detection Using Ensemble Based Machine Learning

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Abstract

Stress detection using multimodal physiological signals has proven to be an efficient approach for understanding human psychological states. Physiological signals such as ACC, ECG, BVP, TEMP, RESP, EMG, and EDA can be used for stress detection, as well as for understanding other states such as baseline, stress, amusement, and meditation. The existing machine learning and deep learning models have shown high accuracy and F1-score for stress detection on the WESAD dataset. In this paper, the performance of different ensemble-based machine learning models, namely Voting Classifier, LightGBM, AdaBoost, Extra Trees, and CatBoost, for stress classification using multimodal physiological signals is presented. In addition, a transformer-based model named Stressense-X is used for stress classification, which can be used for understanding the performance of a deep learning-based approach for stress classification with the help of SHAP-based explainability for understanding the contribution of different physiological features. Out of the models considered, the best model for the proposed system is the Extra Trees classifier, which is used as the core model. This is because, out of all the models considered, the Extra Trees classifier performs best in making predictions and identifying the key factors of stress, and at the same time, it also prevents overfitting, making it an efficient system for making predictions for different subjects.

FinOptix: Gemini-Based AI Financial Advisory Platform

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Abstract

Artificial intelligence driven financial advisory systems are gaining importance due to the increasing complexity of stock markets and the growing need for timely and reliable investment guidance. This project introduces an AI powered financial advisor that leverages Google Gemini, a multimodal large language model, to provide stock analysis and personalized investment recommendations tailored to user needs. The system is developed using Python and deployed as a Django based web application, ensuring both flexibility and scalability. It combines AI capabilities with real time market data to analyze stock performance, technical indicators, financial trends, and market sentiment. In addition, the system is designed to interpret patterns and correlations within the data to generate meaningful insights. Based on this analysis, the advisor provides simple and actionable recommendations such as Buy, Sell, or Hold, helping users make more informed and confident investment decisions. By reducing the need for manual analysis and presenting insights in a clear and accessible manner, the system supports both beginners and experienced investors. It also improves efficiency by minimizing the time and effort required for market evaluation. Overall, the project highlights how AI based solutions can be used to build practical, scalable, and user friendly financial advisory platforms, demonstrating the potential of large language models in modern financial decision support systems.

Keywords

AI Financial Advisor, Google Gemini, Stock Recommendation System, Buy-Sell-Hold Prediction, Django Web Application, Python, Stock Analysis, Market Sentiment, Investment Decision Support.

Smart IoT Ceiling Fan with Auto-Cleaning and Dust Monitoring

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Abstract

There is considerable dust accumulation on ceiling fans, which affects the efficiency of circulating air significantly. There are various safety risks and physical efforts associated with manually cleaning ceiling fans, which may be a cause for concern in residential and institutional surroundings. This paper proposes a concept for IoT-based ceiling fan cleaning and dust monitoring using the ESP32 microcontroller. Inspired by automation, Bluetooth control is included for the Android mobile application using the .NET MAUI desktop application. This proposed IoT-based solution uses a motor device for cleaning the ceiling fan. In addition, the safety feature for the ceiling fan is addressed by integrating a relay module to disconnect the fan during operation. The dust monitoring feature has been included to improve the effectiveness of the cleaning process. Such a proposed system has greater potential for being implemented efficiently and safely.

Keywords

ESP32, IoT, Smart Cleaning, Embedded Systems, Bluetooth Control, Dust Monitoring, Relay Module, Automation.

Air Quality Classification and Analysis Using Rule-Based Threshold Techniques for Environmental Monitoring

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Abstract

Air pollution is still an issue of great concern globally and has significant implications for the health and environment of humans. The present paper provides an explanation for air quality measurement based on specific rules and criteria by analyzing the levels of air pollution and weather conditions such as CO, NO₂, Benzene, PM_{2.5}, and PM₁₀. The rules and criteria help in understanding the changing levels of air pollution over time and provide an insight into how particulate matter affects air quality more than other pollution levels. Unlike other complex models that involve machine learning algorithms, this paper provides an explanation and transparency in air quality measurement and is more flexible and adaptable to regional standards. The results obtained from the paper clearly indicate that particulate matter has an impact on air quality.

VLSI Implementation of an Efficient Multi-Algorithm EEG Signal Compression Framework with Adaptive LMS-Based Prediction

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Abstract

The EEG signals produce much biomedical data during continuous EEG recordings, hence there is need for efficient compression of the data during storage and transmission via wireless media. In this research work, four methods of compressing EEG signals have been presented and compared with the use of the Discrete Cosine Transform (DCT) with Run Length Encoding (RLE), Differential Pulse Code Modulation, Fast Fourier Transform Threshold Compression, and the use of Adaptive Linear Prediction with the LMS algorithm. These methods have not used any proprietary toolboxes in the implementation of the algorithms in order to ensure simplicity in the algorithm implementation. The methods have been tested and compared based on the Mean Square Error (MSE), Percent Root Difference (PRD), Signal to noise ratio (SNR) and Compression Ratio (CR) values. Adaptive Linear Prediction demonstrated superior reconstruction fidelity while maintaining feasible hardware complexity. A Verilog HDL predictive hardware design has been created in order to test the feasibility of the implementation of the algorithm in hardware devices.

Keywords

EEG Compression, Adaptive Linear Prediction, DCT, DPCM, FFT, LMS Algorithm, Biomedical Signal Processing, FPGA Implementation.

Temporal Sentiment Analysis and Crisis Detection in Conversational Agents using Large Language Models

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Abstract

This research paper presents a comprehensive system for temporal sentiment analysis and crisis detection in conversational agents leveraging Large Language Models (LLMs). The system analyzes user conversations in realtime to track sentiment patterns over time and detect potential crisis situations such as mental health concerns, emergency situations, or high-stress scenarios. By employing state-of-the-art open-source LLMs, the system provides accurate sentiment classification, temporal trend analysis, and early warning mechanisms for crisis intervention. The implementation utilizes Python-based frameworks including Streamlit for the user interface, Hugging Face Transformers for LLM integration, and various NLP libraries for text processing. The system architecture incorporates multiple components: a conversation handler, temporal sentiment analyzer, crisis detection module, and visualization dashboard. The solution addresses the growing need for intelligent conversational systems that can understand emotional context and provide timely interventions in critical situations. It include real-time sentiment tracking across conversation history, multi-dimensional emotion analysis (valence, arousal, and dominance), crisis probability scoring with configurable thresholds, temporal pattern recognition using sliding window analysis, and interactive visualizations for sentiment trajectories. The system achieves high accuracy in sentiment classification and demonstrates effectiveness in early crisis detection through comprehensive testing on diverse conversational datasets.

Keywords

Sentiment Analysis, Crisis Detection, Conversational Agents, Large Language Models, Real-Time Monitoring, Emotion Analysis, Natural Language Processing.

Deep Learning Techniques for Face Recognition in Missing Persons Detection

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Abstract

Finding the missing persons is also a problem for the police and the organizations that help people. The old methods of searching the missing persons like asking people what they have seen and searching certain places are too slow and not all the times successful. This process also requires time, and sometimes the correct person is not found. We also have a lot of pictures, the pictures taken by the security cameras, and we can view the pictures on the internet using the computer to assist us in locating the missing persons. The police and the other organizations can view the pictures, and this will help us locate the missing persons, which will be a big help to us. The problem of locating the missing persons is still an issue, but the computer will make it a little easier for us. In this paper, a face recognition system will be created to assist in locating missing persons using the computer. The computer will look at the pictures and recognize the faces and make sure they are upright. The computer will make use of programs to learn the uniqueness of each face. The programs used will be FaceNet, VGG16, and ResNet. The programs will be able to recognize the face and make sure that the face is unique, even if the angle of the picture is different, the pictures are old, or if the face is smiling or not. Lots of things can be handled by the face recognition program, for example, if there is poor lighting and the angle of the face is different. The face recognition program can be used for the location of missing people using face pictures. The face recognition program can be tested using VGGFace2 and CASIA-WebFace. The experimental results show that the proposed system using deep learning is better compared to the conventional ones.

Keywords

Missing Persons Detection, Face Recognition, Deep Learning, Convolutional Neural Networks, FaceNet, ResNet, LFW Dataset.

Professional Loan Management System using React and Spring Boot

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Abstract

This project is about building a professional loan management system using new libraries of JavaScript and Java frameworks like springBoot to enhance user experience, user friendly interaction, end to end communication with frontend and backend, and also it makes the whole loan process, from applying and checking to approving and paying back, much smoother. It even handles credit scoring. The system uses things like PAN-based credit scores, automatic document checks, and helps manage how loans are given out and paid back. You can also generate EMI and try out digital payments. The system has an easy-to-use frontend, a secure backend made with Spring Boot, and a PostgreSQL database. This system gets rid of paper, speeds things up, makes credit decisions better, and keeps applicants in the loop. It's made just for people with a salary who want a safe, easy personal or professional loan.

EmoCare AI: Glass-Box Affective Intelligence for Clinical Mental Health Triage via Dual-Pathway Acoustic-Semantic Fusion

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Abstract

Mental health triage by clinical sites is constrained by the absence of qualified people and the opacities peculiar to machine learning systems. We present the neural network named EmoCare AI a dual-pathway transparent chat-based neural network that simultaneously analyses both the semantic tone of speech transcripts and paralinguistic acoustic cues of the speech to categorize patient utterances into three risk levels, Neutral, Anxiety and Depression. The semantic pathway air-tunes RoBERTa-large with the help of a balanced corpus of goemotions, dair-ai/emotion, and a corpus of Reddit-depression. WavLM-Large is trained with an attentive pooling head in a personalized manner trained on four evaluation speech emotion recognition corpus (RAVDESS, CREMA-D, TESS, SAVEE). These two paths are combined each by a weighted rule of late-fusion ($w_{\text{text}} = 0.55$, $w_{\text{audio}} = 0.45$). Contrary to opaque systems, all predictions come with gradient based token saliency maps, temporal occlusion sensitivity heatmaps, Shannon entropy uncertainty scores, and JensenShannon cross-modal divergence scores, which is what makes a black box a mathematically auditable glass box. The semantic model results in 92.4 macro- F1; the acoustic model results in 87.82 macro- F1; and the fused ensemble results in 90.1 macro- F1 providing the diagnostic value of paralinguistic cues using lexical content alone.

Keywords

Mental health triage, speech emotion recognition, RoBERTa, WavLM, SHAP explainability, affective computing, temporal occlusion, acoustic-semantic fusion, clinical-decision support.

A Blockchain Based Trusted Platform for Influencer Marketing

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Abstract

As influencer marketing has exploded in popularity, new opportunities for brand awareness/advertisements have been created. However, there are serious problems associated with this industry such as: fake followers; engaging fraud; lack of full transparency; and a distrustful relationship between brands and influencers. This recommendation proposes to solve these problems by creating a blockchain-based solution to help restore trust and transparency, as well as decouple both parties from the currently centralized digital marketing ecosystem. The proposed platform would leverage blockchain's immutable record-keeping capabilities to securely and accurately capture all influencer activity and campaign transaction data. It would allow brands and influencers to verify if they received proper engagement from their respective audiences for each influencer. Utilizing smart contracts would automate many of the critical processes within a campaign, including; executing the campaign, confirming the influencer's perceived (or actual) level of engagement with the brand and the payment to the influencer, thus reducing disputes and delays, and eliminating dependence on a central entity to facilitate the transactions. The result of using blockchain and smart contracts in this influencer marketing context would result in a safer environment for both sides to work together seamlessly and receive equitable compensation. Ultimately, the platform would address the many issues of influencer marketing, which would create a new, more credible, efficient and reliable digital marketing ecosystem for all stakeholders involved.

Keywords

Influencer Marketing, Blockchain, Smart Contracts, Transparency, Decentralization, Engagement Verification, Fraud Prevention, Digital Marketing.

Mechanism-Based Data-Driven Optimization of Rubber-Fiber Hybrid Concrete to Improve Structural Performance

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Abstract

Recycled rubber and fibers are mostly combined with concrete, and it is believed that the compressive strength is lower than that of concrete, which restricts its applications in the structural world. The paper introduces a data-driven design and optimization framework of pre-mixed rubber-fiber hybrid (CRH) concrete based on a conceptualization of a mesoscale stress-modifying composite. Systematic variation of CRH inclusion levels (0–30%) in M30 and M40 grade concretes is done and a volumetric approach of design is used to investigate the redistribution of stress, crack propagation, and energy dissipation mechanisms in a controlled manner. Results of the experiment are explained in terms of the dimensionless performance indices which are Flexural Strength Recovery Index (FSRI), Stress Redistribution Efficiency (SRE), and Energy Dissipation Potential Index (EDPI). To increase predictive effectiveness, the machine learning models such as Artificial Neural Networks (ANN) and Support Vector Machines (SVM) are used to learn the non-linear relationships that exist between mix parameters and performance indices. The outcomes indicate that there is a trade off behaviour as indices related to strength decline as CRH content rises, but energy dissipation capacity increases substantially. ANN model has a better predictive performance than SVM, which allows determining the best inclusion range of various structural functions. The study has defined a mechanism-directed and data-driven paradigm of sustainable hybrid concrete which could be utilised in the structure of structures with absorbing energy and with fatigue to reduce its application in energy-absorbing and fatigue-resistant structural systems.

Legal Document Summarization Using Large Language Models: LoRA-Based Fine-Tuning of Gemma-3 on Indian Legal Texts

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Abstract

The growing volume and complexity of legal documents in the Indian judicial system have created a need for automated tools that support efficient legal document analysis and summarization. In this work, we present a domain-adapted language model fine-tuned specifically for Indian legal text using the Gemma-3 instruction-tuned architecture combined with the Unsloth framework. To enable resource-efficient and scalable training, we employ Low-Rank Adaptation (LoRA), allowing parameter-efficient fine-tuning without compromising performance.

The model is trained on a curated “Indian Legal” dataset sourced from HuggingFace, consisting of legal case documents paired with human-written summaries. This enables the model to learn domain-specific legal terminology as well as the structural and argumentative patterns typical of judicial decisions. To better align with real-world legal interactions, the data is preprocessed using multi-turn chat templates that simulate user–assistant conversations, improving the model’s ability to handle conversational legal queries.

Training is performed using HuggingFace’s TRL SFTTrainer with a selective loss function focused on assistant responses, ensuring concise and contextually accurate summary generation. Additionally, comprehensive data filtering techniques are applied to remove noisy and incomplete samples, thereby improving training quality and output reliability.

Model performance is evaluated using BERTScore to assess semantic similarity with reference summaries. The proposed approach achieves an average BERTScore F1 of 0.8947, indicating strong semantic alignment and effective capture of key legal facts, arguments, and conclusions. Overall, this work demonstrates an efficient and modular pipeline for domain-specific adaptation of large language models in legal NLP, with potential applications in court record summarization, legal research assistance, and e-governance systems to enhance legal accessibility and transparency.

Analogue Gauge Detection and Digitization using OpenCV: A Robust, Computationally Efficient Framework for Industrial Retrofitting

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Abstract

Despite the rapid proliferation of Industry 4.0 and the Industrial Internet of Things (IIoT), analogue gauges remain deeply entrenched in critical industrial infrastructure due to their inherent robustness, passive operation, and zero electrical dependency. Their continued use, however, creates significant data silos, impeding real-time monitoring, predictive maintenance, and operational efficiency. This paper presents a comprehensive computer vision framework for the automated digitization of circular analogue gauges using the OpenCV library. The proposed pipeline employs the Hough Circle Transform (HCT) for gauge localization and the Probabilistic Hough Line Transform (PHLT) for pointer segmentation, augmented by adaptive image preprocessing and angular interpolation for value computation. Unlike data-hungry deep learning architectures requiring specialized GPU hardware, the proposed classical approach employs a semi-automated human-in-the-loop calibration strategy that ensures generalizability across diverse gauge types and configurations. Experimental evaluation demonstrates real-time performance at approximately 28 frames per second on a Raspberry Pi 4 Model B (4 GB RAM) with a mean reading error between 0.1% and 0.5%. The system achieves competitive accuracy relative to state-of-the-art deep learning methods while operating at a fraction of the computational and financial cost, making it a viable solution for retrofitting legacy industrial facilities.

Keywords

Computer Vision, Industrial Automation, OpenCV, Hough Transform, IIoT, Edge Computing, Analogue Gauge Reading, Image Processing, Raspberry Pi, Predictive Maintenance.

Securing Social Media Platforms Using Face Recognition and Liveness Detection

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Abstract

The rapid growth of social media platforms has led to a significant rise in fake and duplicate accounts, which are often exploited for malicious activities such as spamming, phishing, and cyberbullying. Traditional authentication mechanisms, including passwords, email verification, and one-time passwords (OTPs), are increasingly vulnerable to security breaches. This paper proposes a lightweight and efficient face-based authentication system that integrates multi-frame verification and duplicate face prevention to enhance security. The system utilizes the Haar Cascade algorithm for real-time face detection and the Local Binary Pattern Histogram (LBPH) method for facial recognition. To ensure robustness against spoofing attacks, a multi-frame liveness detection mechanism is incorporated, where multiple frames are analyzed to confirm user authenticity. Additionally, duplicate account creation is prevented by validating both username and facial identity during registration. The system is evaluated using a real-time dataset collected from users under varying conditions, with an 80:20 training and testing split. Experimental results demonstrate that the proposed approach achieves an authentication accuracy of **90.3%**, with reduced False Acceptance Rate (FAR) of **4.8%** and False Rejection Rate (FRR) of **3.1%**, while maintaining low computational complexity suitable for real-time applications. The proposed system effectively enhances authentication security and provides a practical solution for preventing unauthorized access and fake account creation in social media platforms.

Keywords

Face Recognition, Liveness Detection, Social Media Security, Spoof Detection, MultiFrame Verification, Duplicate Detection.

Semantic Communication: An AI Driven Transport Layer Approach for Ultra Low Latency 6G Applications

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Abstract

With 6G networks, ultra-reliable and ultra-low latency communication (URLLC) is to be made possible in mission-critical applications including remote surgery, autonomous transportation, smart grids, and emergency response systems. Conventional transport layer protocols like TCP are reliability-based and retransmission-based that enhance the latency in situations of packet losses. Nevertheless, the 6G services of the future require intelligent adaptive communication systems which focus on meaning rather than delivery of raw data. The following paper presents and analyzes the simplified model of an AI-based semantic transport layer that will prioritize the packets on the fly depending on their semantic importance instead of considering all packets to be equal. A Python simulation is done to compare between a traditional retransmission based transport and a semantic aware transport mechanism. In the proposed model, the high importance (emergency) packets are given priority and are sent with minimum latency and low-importance packets might be dropped when there is congestion. The simulation findings of 1000 packets with 10 per cent packet loss show that the average latency decreases by 45.27 per cent with the semantic transport approach over the traditional transport mechanisms. The cumulative graph in latency also depicts significant progress in the ranking of the transmission efficiency. According to the findings, semantic-aware transport mechanisms can provide significant benefits to latency performance of 6G applications without prejudice to the delivery of critical data. This study will be used to advance the design of smart transport layers to future AI-native wireless networks.

Keywords

Network Simulation, Intelligent Protocols, AIDriven Networking, 6G Networks, Semantic Communication, Transport Layer, Ultra-Low Latency.

AI-Based Real-Time Monitoring of E-Governance Certificate Services

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Abstract

Birth, Income, caste, and residency certificates are among the e-governance certifications required for citizens to access public services and government programs. Despite the fact that these services are provided online, there are still fake applications, document forgeries, inconsistent data, and delays caused by manual verification. To solve these problems, this study proposes an AI-based real-time monitoring system for e-governance certificate services. The proposed technique automatically verifies application details by using Optical character recognition (OCR) to retrieve information from Aadhaar and PAN card pictures. While rule-based validation is used to confirm the accuracy of crucial variable like Name, date of birth, and cell number, machine learning algorithms help find suspicious patterns and abnormalities in the data. If all provided information is verified and found to be correct, the system generates the certificate automatically and allows the user to download it. Applications with incomplete or erroneous information are either rejected or flagged for further review. Based on sample inputs, the system performance is assessed using accuracy, Mean Absolute Error (MAE), and mean Squared Error (MSE), including an efficient verification capability. Because it reduces human labor, improves accuracy, ensures transparency and significantly reduces processing time, this system is a successful solution for safe and efficient real time e-governance certificate issuing.

Keywords

E-Governance, Certificate Services, Optical Character Recognition (OCR), Rule-Based Validation, Machine Learning, Real-Time Monitoring, Accuracy, MAE, MSE, Automatic Certificate Generation.

Spectral Discrimination and Separable Analysis of Crops and Weeds Using Deep Learning Techniques

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Abstract

Weeds are a big problem for farming because they compete with crops for water, nutrients, and sunlight, which lowers yields. Using herbicides and manually pulling weeds are two common ways to control weeds, but they are expensive, time-consuming, and bad for the environment. This research introduces an automated system for crop and weed detection, developed using the YOLOv3 deep learning framework.

The model was trained on a set of 1,300 labeled agricultural images that showed sesame crops and different types of weeds. The system uses YOLOv3 and OpenCV to find crops and weeds in real time, making bounding boxes and confidence scores for each class. Using confidence thresholds and non-maximum suppression in post-processing makes sure that predictions are strong.

The system is available on a number of platforms to make it easier to use. These include a command-line tool, a Flask-based web app with interactive features, a demo app for people who aren't tech-savvy, and an OpenCV Jupyter notebook for research and teaching. This ecosystem works on many platforms and helps farmers, researchers, and teachers. It encourages sustainable precision agriculture.

Exploring YOLO-Based Object Detection to Enhance Flood Disaster Response

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Abstract

Floods are one of the most devastating natural events that endanger human life, the infrastructure, and the general environment. Fast flood recognition is therefore necessary for the rescue teams to carry out their operations effectively and it also helps in the allocation of resources. In this work, we look into a YOLO-based object detection system that can identify people, vehicles, and objects in the flood scene from the pictures using Generative AI techniques. The suggested system is a fusion of real-time computer vision, visibility estimation, and the user's spatial relationship with the help of an interactive web interface. The users can upload their pictures, see the detections, and understand the contextual information in a convenient way. This system, unlike existing methods, which have low accuracy, poor scalability, and limited real-time integration, intends to provide reliable detection under different environmental and lighting conditions [1], [3]. The project, by localizing the objects in images using deep learning and making the system available on the web, thus, can be a great tool in enhancing the situational awareness and speeding up the decision-making process in the case of a flood disaster response.

Keywords

Generative AI, You Only Look Once (YOLO), Object Detection, Flood disaster response, Synthetic data, Flood image generation.

Energy-Adaptive SNNs with Real-Time Power Feedback for Edge AI

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Abstract

Edge AI applications can be differentiated by tight energy and resource constraints, and thus energy efficiency is a fundamental design goal rather than a secondary optimization. Although Spiking Neural Networks (SNNs) and neuromorphic architectures provide natural energy benefits through event-driven processing, most existing solutions are based on statically optimized parameters or hardware-focused energy management strategies such as Dynamic Voltage and Frequency Scaling (DVFS). These solutions do not have the ability to dynamically adjust neural processing to match actual real-time power conditions.

The goal of this research is to make progress on a closed-loop, power adaptive SNN architecture that combines real-time power control with neural adaptation. The proposed system adjusts the neuron thresholds, spiking activity, and inference time steps at runtime to maintain operation within a specified power budget while maintaining inference accuracy and latency. In contrast to DVFS-based methods, the proposed system tightly couples power control with neural dynamics for fine-grained power control.

The method is compared with static SNNs, DVFS-only approaches, and TinyML CNN baselines in terms of energy per inference, classification accuracy, inference time, and power stability. The experimental results show that the adaptive SNN provides a dramatic energy savings and average power consumption while maintaining competitive accuracy and real-time performance. Moreover, the system has a graceful degradation with limited power budgets, making it suitable for battery-powered and energy-harvesting edge computing applications.

These results highlight the success of closed-loop, power-aware adaptation in SNNs and confirm its potential as a reliable software-level approach for energy-efficient edge AI inference.

Keywords

Edge AI, Spiking Neural Networks, Neuromorphic Computing, Power Aware Inference, Closed-Loop Control, Energy-Efficient AI.

Image Based Waste Classification and Soil Recommendation Using Machine Learning

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Abstract

This project focuses on using Machine Learning techniques to identify different types of waste through images and suggests suitable use for soil or otherwise through disposal recommendations. The system basically extracts important visual features such as colour, texture, and shape from the input image of waste using image processing methods. The extracted features are then provided as input to the Support Vector Machine (SVM) classifier, which classifies the waste into two major categories: biodegradable and non-biodegradable. The biodegradable group includes organic material like food scraps, leaves, and paper, while non-biodegradable wastes are made up of plastic, metal, and glass.

Based on the classification result, the system develops appropriate recommendations to help in environmentally responsible waste management. In the event that the garbage is classified as biodegradable, it suggests utilizing garden soil or compost soil for natural decay and recycling of organic refuse. On the other hand, if the garbage is non-biodegradable, the system recommends its recycling or proper methods of disposal to avoid pollution of the environment. This intelligent approach ensures that users make an accurate decision on the best way of waste disposal without requiring any technical knowledge in that field. Overall, this project enhances eco-friendly activities by reducing pollution, promoting better waste segregation practices, and providing a simple, automated, and intelligent decision-making system.

LearnSphere: An AI Powered Classroom Platform for Smarter Learning

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Abstract

Access to and control of learning resources over a period of years is a shared dilemma for college students, which mostly involves tedious searching from broken sources. LearnSphere is suggested as one integrated e-learning system that aims to meet the challenge of addressing this dilemma by concentrating study materials and offering intelligent learning support. The platform supports AI-enhanced summarization to summarize long notes, study buddy matching to enable peer learning, and semantic search to effectively retrieve relevant resources. Developed on a scalable architecture with the MERN stack and modular AI services, LearnSphere provides seamless and engaging user experience. LearnSphere plans to offer an integrated, smart learning environment that maximizes academic productivity, collaboration, and access during the college experience.

Keywords

E-learning, MERN, semantic search, AI summarization, recommendation engine, study buddy matching.

SecureVote: A Blockchain-Integrated Facial Recognition Framework for Tamper-Proof Electronic Voting

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Abstract

SecureVote is a next-generation electronic voting framework designed to address the major weaknesses of both traditional paper-based elections and centralized e-voting systems. Its architecture rests on two core components: a deep learning-based facial recognition system enhanced with real-time liveness detection, and a permissioned blockchain network that manages vote storage and counting through automated smart contracts.

The biometric module verifies each voter by capturing a live facial image, generating a compact feature embedding using a Convolutional Neural Network (CNN), and matching it with a pre-registered cryptographic hash. A liveness detection mechanism distinguishes genuine users from spoofing attempts such as photographs, replayed videos, or 3D masks, achieving a False Acceptance Rate (FAR) below 0.5.

Within the blockchain layer, each vote is recorded as an immutable transaction on a distributed ledger, making tampering computationally impractical. Smart contracts automatically handle voter eligibility checks, vote tallying, and overall election management, minimizing human intervention and associated risks. Biometric images are not stored; only salted SHA-256 hashes are retained, maintaining separation between identity information and voting data. Experimental evaluation shows that the complete authentication-to-vote recording process completes in under three seconds on standard hardware, demonstrating its suitability for practical deployment.

Keywords

Blockchain, Facial Recognition, Liveness Detection, Smart Contracts, Electronic Voting, Voter Authentication, Biometrics, Cryptographic Hashing.

Smart Agriculture Applications for Predicting Soil Moisture in Farming

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Abstract

Agriculture is rapidly adopting modern technologies to enhance productivity and sustainability. Contemporary farming integrates advanced tools such as sensors, automated machinery, and information technology systems. These innovations in precision agriculture and robotics enable farms to operate more efficiently, safely, profitably, and sustainably. A critical factor influencing agricultural productivity is maintaining optimal soil moisture levels. Soil moisture refers to the amount of water present in the soil, which plays a vital role in providing nutrients to plants, supporting transpiration, and promoting strong root development. Accurate prediction of soil moisture levels assists farmers in selecting suitable crops and improving overall yield.

To achieve precise soil moisture estimation, this study employs multiple machine learning algorithms, including Long ShortTerm Memory (LSTM) networks and Extreme Gradient Boosting (XGBoost), and proposes a novel hybrid approach. The proposed model enhances prediction accuracy and computational efficiency by effectively analyzing complex patterns within the dataset. Overall, the smart agriculture framework contributes to sustainable farming by optimizing resource utilization, increasing crop productivity, and promoting environmentally responsible agricultural practices.

Keywords

Agriculture, Machine Learning, Soil Moisture, LSTM, XGBoost, Smart Farming.

Smart Foreign Student Monitoring

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Abstract

The proposed system is a secure web-based application designed to modernize and safeguard crime and investigation records within police departments. Currently, many crime-related processes rely on manual paperwork or partially automated systems, which are vulnerable to unauthorized access and data breaches. The new system aims to digitize and secure critical records such as crime complaints, investigation reports, criminal profiles, and terrorist activity logs. In addition, the application will address the growing need to monitor foreign students, some of whom may be involved in criminal or suspicious activities. It integrates key stakeholders—Passport Departments, Colleges, and Police Stations—into a single platform that enables real-time access to foreign student information, including passport details and identity verification. This collaboration ensures continuous monitoring, quick verification, and secure data sharing while preserving privacy and preventing unauthorized third-party access. By enhancing transparency, accountability, and data protection, the system strengthens national security and modernizes law enforcement infrastructure.

Keywords

Foreign student Monitoring, Crime Records, Web Security, Passport Verification, Law Enforcement.

HVT-CNN-SVM RetinalNet: A Hybrid Vision Transformer-CNN-SVM Framework for Automated Multi-Class Retinal Disease Classification

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Abstract

The identification of diseases in a timely and accurate manner is essential in averting irreversible loss of vision in patients with ocular diseases. However, traditional methods of identification are based on a labor-intensive examination of fundus images of the retina of patients, and despite recent breakthroughs in deep learning algorithms with convolutional neural networks, they may lack effectiveness in perceiving and analyzing global features in patients with similar ocular diseases with distinct features that are visually similar. Therefore, this report proposes HVT-CNN-SVM RetinalNet Vision Transformers and CNNs combined with a Support Vector Machine classification system that effortlessly classifies patients with multi-class ocular diseases with improved class separability and distinct boundaries between related diseases with remarkable accuracy based on a hybrid system that incorporates Vision Transformers and CNNs that perceive global and local features of patients with ocular diseases influenced by optic disc deformation, micro-aneurysms, and diseases with cataracts that cause light-induced opacities of patients with ocular diseases identified by adaptive contrast enhancement of patients with ocular diseases that may result in hidden inconsistencies within patients with limited lighting conditions of patients with ocular diseases. To counter the issues arising from class imbalance during multi-class training, the process of balanced loss is included during training. Additionally, the use of Grad-CAM-based visual explanation techniques helps to focus attention on the relevant retinal area, hence enhancing the interpretability and trustworthiness of the model. Based on the experimental studies conducted on the retinal images, the proposed integrated model HVT-CNN-SVM RetinalNet establishes its significance by ensuring better classification, interpretability, and trustworthiness than the existing standard approaches based on CNN. This concludes the reliability and efficiency of HVT-CNN-SVM RetinalNet for real-time eye screening.

Keywords

Retinal Disease Classification, Vision Transformer, Convolutional Neural Network, Support Vector Machine, Hybrid Deep Learning Model, Fundus Image Analysis, Automated Ophthalmic Diagnosis, Explainable Artificial Intelligence.

Smart Menstrual Health Assistant

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Abstract

Development of accurate predictions of menstrual cycle is an issue since it contains disparities depending on lifestyle, physiological elements not considered and consequently unfamiliar to the conventional calendar-based method. This proposal is a research project of Vylora, a full stack web application which integrates a three step machine learning pipeline in enhancing personal prediction. The algorithm includes a Random Forest Regressor that estimates the cycle length, an XGBoost Classifier that identifies the probability of the lifestyle disruption, and a Logistic Regression model that achieves the adjustment of the confidence rates. It relies on dynamically adjusted predictions on real-time behavioral data such as stress, sleep, travel and disturbance of routines. The experimental study reveals that a higher accuracy is developed as compared to the baseline procedures involving coined down prediction error and stable classification. The architecture includes React as a frontend and Node.js as a backend and database, MongoDB and Flask inference engine. Vylora is a flexible, privacy-aware architecture that can be adapted to support future applications in embarking on menstrual health tracking and make additional applications in fertility tracking and reproductive health analytics.

Keywords

Machine Learning, XGBoost, Predicting Menstrual Cycle, Random Forest, Digital Health, Lifestyle Analytics, Personalised Healthcare.

Multi-Platform Social Media Post Scheduler

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Abstract

The proliferation of social media platforms has imposed significant operational overhead on digital content creators and marketing teams, who must manage platform-specific publishing workflows simultaneously. Existing third-party scheduling tools are cost-prohibitive, architecturally fragile with respect to API compliance, and lack deeply integrated analytics. This paper presents the design, implementation, and evaluation of a Multi-Platform Social Media Post Scheduler—a unified, full-stack web application that automates cross-platform content publication across YouTube, Instagram, and X (formerly Twitter). The system employs a three-tier architecture comprising a ReactJS presentation layer, a Spring Boot application layer, and a relational database backend. Secure delegated authorization is achieved through the OAuth 2.0 protocol with AES-256 token encryption at rest. The scheduling engine adopts a database-backed polling mechanism that executes pending tasks within a target window of 60 seconds from the designated publish time. Platform-specific challenges—including YouTube's asynchronous video processing pipeline, Instagram's media format constraints, and X's character restrictions—are encapsulated within dedicated PlatformService abstractions. Evaluation results demonstrate a dashboard load latency of approximately 350ms, a scheduling accuracy within 30 seconds, and 95% unit test coverage for the scheduler and token management subsystems. An integrated analytics module provides visualization of engagement metrics including Views, Likes, Subscriber growth, and demographic distributions across connected accounts. This work establishes a modular, scalable baseline for future enhancements including AI-driven posting optimization and real-time event-driven analytics pipelines.

Keywords

Social Media Automation, Multi-Platform Scheduling, OAuth 2.0, Spring Boot, ReactJS, Content Management, API Integration.

Soil Moisture for Precision Agriculture using Machine Learning: A Survey

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Abstract

Soil moisture is a fundamental variable in controlling crop water and nutrient availability, as well as biophysical processes in farming. Timely and accurate soil moisture information at field and sub-field scales can support precision irrigation, yield prediction and climate-smart agriculture. There has been a recent surge in ML approaches to estimate and predict soil moisture by integrating in-situ sensors, Internet-of-Things (IoT) systems, remote sensing (radar/radiometer and optical), weather forecasts, and topographic/soil maps. This survey synthesizes the state of the art in ML-based soil moisture estimation and prediction for precision agriculture. We identify exciting opportunities: physics-informed networks, sensor data fusion with edge ML, federated learning for privacy-preserving farm data, uncertainty estimation, and active learning for optimal sampling. Finally, we provide guidelines for integrating ML soil moisture models into precision agriculture systems (data pipelines, feature engineering, model retraining, and validation). High-quality ML-based soil moisture products can help significantly save water in irrigation and boost resilience – but adaptation, interpretability, and validation are key before operational deployment.

Keywords

Precision Agriculture, Machine Learning (ML), Soil Moisture.

Bidirectional GRU Based Network Intrusion Detection System with Hybrid Deep Learning Techniques

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Abstract

Network Intrusion Detection Systems (NIDS) are essential for identifying and mitigating malicious activities in network environments. As cyber threats evolve in complexity, traditional NIDSs often struggle to detect sophisticated attacks effectively, especially those involving intricate temporal and spatial dependencies within network traffic. The ability to capture these dependencies is crucial for reducing false positive rates and improving detection accuracy. However, existing models face significant challenges, including handling varying sequence lengths and capturing long-range dependencies, which are essential for accurate anomaly detection. This system proposes a hybrid model that combines Sequence to Sequence (Seq2Seq) architecture with Convolutional Long Short-Term Memory (ConvLSTM) units to address these challenges. This hybrid model handles spatial and temporal dependencies by incorporating convolutional layers within LSTM cells. This enables the model to leverage the spatial feature extraction capabilities of Convolutional Neural Networks (CNN) alongside the sequential learning strengths of LSTM networks. In addition, to enhance the interpretability of the model, the proposed architecture integrates Explainable Artificial Intelligence (XAI) through Local Interpretable Model-agnostic Explanations (LIME). This approach provides insights into the model's decision-making process, highlighting the temporal and spatial features that influence predictions, and improving transparency in detecting anomalies. Experimental evaluations on benchmark datasets, including CIC-IDS 2017, CIC- ToN-IoT, and UNSW-NB15, demonstrate that the proposed hybrid ConvLSTM-Seq2Seq model outperforms existing methods in reducing false positives and achieving higher accuracy. This model offers a promising solution for NIDSs by improving detection capabilities and better handling complex temporal and spatial relationships in network data.

Keywords

Network intrusion detection, deep learning, Seq2Seq autoencoders, ConvLSTM, Bidirectional LSTM, GRU, hybrid architecture, explainable AI.

Multimodal Prediction of Omega-3 in Age-Related Macular Degeneration Using Transformers

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Abstract

Age-related macular degeneration (AMD) is a leading cause of permanent vision impairment among older adults. Although Omega-3 supplementation has been explored to slow disease progression, patient responses vary widely due to differences in clinical profiles and retinal structural features, making outcome prediction challenging. This paper presents a multimodal transformer-based framework to predict individual response to Omega-3 therapy by integrating structured clinical data with retinal fundus images. An FT-Transformer is utilized to capture complex interactions within tabular clinical variables, while a Vision Transformer (ViT) is employed to learn discriminative representations from retinal images. Features from both modalities are fused to estimate the likelihood of a positive treatment response. Experimental results indicate that the proposed multimodal approach outperforms conventional machine learning and single-modality models by effectively modeling nonlinear clinical patterns and fine-grained visual cues. The findings demonstrate the potential of multimodal transformers to support personalized nutritional guidance and assist clinicians in identifying AMD patients who are most likely to benefit from Omega-3 supplementation.

An API Gateway Architecture for Secure Query-Driven Access to Survey Microdata

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Abstract

Ministry of Statistics Programme Implementation (MoSPI) issues a immense repository of micro data of more than 170 macro scale surveys on socio-economic statistics. But the current dissemination process is based on manual download of files and processing of the surveys, which causes a major delay to access the data and has limited the use of the data by the researcher and the policymakers. In this paper, the researchers would suggest an Automated Data Dissemination Gateway which would allow to execute SQL queries on heterogeneous survey data dynamically with the help of a secure API gateway. The suggested system uses a metadata-based design in order to insert various survey designs into a single PostgreSQL database with a storage type of JSONB. A RESTful API is a dynamically generated SQL query that generates the SQL query as per user request, imposes constraints that protect privacy and responds in consumer-friendly formats like JSON. The architecture provides scalability, adherence to official statistical dissemination policies and fair access due to role-based controls. The suggested solution modernizes the microdata delivery through the transformation into a Stats-as-a-Service environment that would be consistent with the Digital Public Infrastructure vision of India.

Keywords

Data Dissemination Gateway, metadata-based design, PostgreSQL, RESTful API, Microdata Delivery.

Efficient Vision-Based Sign Language Gesture Detection and Landmark Extraction for Real-Time Applications

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Abstract

Automatic sign language understanding can be explained as a concept that is of interest to the research in assistive technology because sign language will be one of the key modes of communication between the hearing impaired and the speech impaired persons. Sign language recognition system has very much relied on proper and uniform visual preprocessing prior to any meaningful interpretation being done. However, most of the designs that are currently proposed just seek to make the best use of classification performance and do not focus much on the efficiency, robustness and real-time performance of the vision pipeline thereof particularly with systems with resource limitations.

The paperwork presents a viable vision-based system of real time identification of gestures of a sign language, landmarks using a normal RGB camera. It is hypothesized that the system will be capable of operating with both live video feeds and recorded feeds to offer the possibility of using gestures in real-time without any special sensors or wearables. The structure uses the processing of the image at the frame level to identify image hand and upper-body position and eliminates the spatial landmarks that define the gesture structure. The landmarks further generate the skeleton representations and the bounding boxes which can be effectively applied to observe and examine gestures in regions.

It dwells upon the discussion of real-life problems concerning the implementation of a real-time vision system which include camera positioning, frame rate synchronization, latency tolerance, and performance consistency on mobile systems. Lightweight processing strategies and frame handling mechanisms are in place to make the pipeline real-time responsive. Experimental testing deals with non-classification properties such as frame rate, detection continuity, and overlay synchronization behavior in real-life situations of use. These results indicate that the proposed vision pipeline can support the real time performance of the pipeline and produce a stable landmark representation that can be utilized in downstream sign language recognition applications. Overall, this contribution offers a solid and powerful foundation of visual preprocessing that can be applied to the creation of expandable and real time systems of sign language interpretation and gesture recognition.

Keywords

Sign Language Recognition, Vision-Based Gesture Detection, Hand and Pose Landmark Extraction, Real-Time Computer Vision, Skeleton-Based Representation, Mobile Vision Systems, Human Gesture Analysis, Assistive Communication Technologies.

RouteOptiX: Intelligent Multimodal Supply Chain Optimization Using Machine Learning and Deep Learning

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Abstract

The growing complexity of modern supply chains, driven by multimodal transportation networks, dynamic demand patterns, and cost fluctuations, necessitates intelligent and adaptive decision making systems. Traditional supply chain optimization methods often rely on static assumptions and lack predictive capabilities, leading to inefficiencies in route planning, resource allocation, and delivery execution. This paper proposes RouteOptiX, an intelligent multimodal supply chain optimization system that leverages Machine Learning (ML) regression models for transportation cost and delay prediction, combined with Deep Learning Long Short-Term Memory (LSTM) networks for demand forecasting. The system integrates predictive analytics with multi-objective optimization techniques to select optimal transportation modes (road, rail, air, sea) and routes while minimizing costs and delivery times. Deployed through an interactive Streamlit-based web application with secure authentication and database-backed storage, RouteOptiX demonstrates significant improvements in operational efficiency. Experimental results on New York City taxi trip data show 85-90% accuracy in trip duration prediction, substantial cost reduction in route optimization scenarios, and effective handling of weather integrated delay estimation. The system addresses critical supply chain challenges including demand uncertainty, transportation delays, inefficient resource utilization, and poor risk management. By combining ML, DL, and optimization algorithms, RouteOptiX provides a scalable, data-driven solution for modern multimodal supply chain management across retail, manufacturing, and e-commerce industries.

Keywords

Supply chain optimization, multimodal transportation, machine learning, deep learning, LSTM networks, demand forecasting, route optimization, cost prediction.

Career Connect: An AI-Powered Job Matching and College Assistance Platform Using Machine Learning and Retrieval-Augmented Generation

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Abstract

The modern digital age has brought a lot of problems in the process of making informed career choices by the students because of insufficiently personalized guidance, lack of platforms as a single job, and inadequate access to structured academic information. The activities and functions of conventional systems are mostly about job postings, lack of smart suggestions, skills analysis, and educational support. To tackle these constraints, this paper proposes Career Connect' which is an AI-based application that combines the three services of job matching, career guidance, and college support into one system.

The suggested system is based on the analysis of user profiles and similarity-based methods of matching them with the appropriate job descriptions using the methods of Machine Learning and Natural Language Processing. It establishes skills deficiencies and offers one-upon-one learning plans on how to become employable. Additionally, the portal can use Retrieval-Augmented Generation (RAG) to provide users with an AI chatbot that responds to their queries about the academic procedures, courses, hostel facilities, and other information about the institution with the help of the structured body of knowledge.

The system is composed in a full-stack architecture, i.e. a React-based front-end and a Django-driven backend with installed AI modules. The backend uses similarity search and embedding in vectors to retrieve the relevant contextual information that is then handled by a large language model to produce accurate and context-sensitive responses. It has also got a role based access to students, recruiters and administrators where they are able to post jobs, track their applications and monitor the systems.

The experimental analysis has allowed showing that the suggested system is efficient in terms of job matching, improves user engagement with personalized recommendations, and provides accurate responses during the management of queries based on academic queries. The system is very effective to both students and institutions since it combines both career guidance and institutional help under one platform. The proposed solution will add to the intelligent career development systems that integrate machine learning, conversational interface based on AI technologies, and real-life data integration.

Keywords

Career Guidance, Job Matching, Machine Learning, Natural Language Processing, Retrieval-Augmented Generation (RAG), Resume Analysis, Recommendation Systems, FAISS, AI Chatbot, Skill Gap Analysis, Full-Stack Web Application

Development and Evaluation of a Clinical Decision Support System Based on Machine Learning for Antibiotic Resistance Analysis

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Abstract

The World Health Organization estimates that if antimicrobial resistance (AMR) is not addressed, it would cause 10 million deaths annually by 2050, making it a significant global health concern. Because standard culture and sensitivity testing takes 48–72 hours, there is a dangerous empirical prescribing window. This work develops, trains, and assesses a machine learning-based clinical decision support system (CDSS) for predicting antibiotic zone of inhibition and recommending effective antibiotics based on structured patient and microbiological input qualities. An XGBoost regression model was trained using a dataset of 1,284 clinical isolates, comprising nine species and six antibiotics collected from four ward groups. Five-fold stratified cross-validation was used to assess the model against baselines for Support Vector Machine, Random Forest, and Logistic Regression. With a mean accuracy of 91.4% (SD: 0.8%), precision of 90.2%, recall of 91.7%, F1-score of 90.9%, and AUC-ROC of 0.95, XGBoost demonstrated the best performance. Organism identity and specimen type were found to be the most important predictive factors using SHAP-based feature importance analysis. The system, which offers real-time zone prediction, CLSI-based susceptibility interpretation, antibiotic recommendation, and population-level resistance analytics, is implemented as a full-stack web application (FastAPI backend, React frontend). Institutional approval, data anonymization, and ethical compliance are verified. The findings show that XGBoost-driven CDSS systems trained on local microbiology data provide a deployable, clinically significant method for quick antibiotic susceptibility recommendations in resource-constrained

Keywords

Zone of inhibition, SHAP interpretability, XGBoost, machine learning, antimicrobial resistance, and clinical decision support.

BERT-Enhanced Automated Pattern Recognition in Software Repositories Using Natural Language Processing and Machine Learning

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Abstract

The sheer volume of textual data created by software repositories (e.g., bug reports, developer comments, commit messages) is becoming increasingly challenging to manually analyze due to the increasing size and complexity of software projects. As such, existing text-mining and traditional machine-learning approaches to analyzing these datasets rely primarily on the frequency of keywords and do not capture the contextual meaning behind technical descriptions. In response to this challenge, this research presents an automated pattern-recognition approach using a Bidirectional Encoder Representations from Transformers (BERT)-based model to leverage advances in Natural Language Processing (NLP), and Machine Learning (ML) to analyze and effectively interpret software-repository data. Using contextual embeddings from the BERT model this proposed method can be used to automatically classify bugs, find common error patterns in the code base, predict severity of errors based on their frequency of occurrence, and even find duplicate bug reports by analyzing similarities between them. Additionally, the system includes confidence-scores, root cause-hints, and bug-trend insight at the repository level through a Web-Based User Interface. Experimental results show that the proposed framework enhances the developers' ability to semantically understand their source-code, reduces the manually required work, increases the speed and accuracy of software-maintenance activities. Therefore, the results of this research illustrate the practicality of utilizing transformer-based models to automate the analysis of software-repositories, and enhance decision-making by software-development teams.

Keywords

BERT (Bidirectional Encoder Representations from Transformers), Software Repository Mining, Bug Severity Prediction, Duplicate Bug Detection, Text Clustering, NLP-Based Software Maintenance.

Development and Design of Intelligent Web-Driven Decision Support Framework for Smart Agriculture

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Abstract

To improve executive, communication of information, and market accessibility for farming communities, this paper proposed a web-based agricultural support system. To facilitate individualized service delivery, the platform has a secure user registration and profile management module that records location, crop preference, and language settings. A Starter Kit subsystem helps new and small-scale farmers in particular by making it easier to find and purchase appropriate crops, seeds, fertilizers, and agricultural equipment. With scientific details on crop physiology, soil compatibility, cultivation techniques, and agronomic recommendations, the Farm School module serves as an organized information base. The system incorporates a Crop and agricultural Intelligence engine that evaluates soil properties, seasonal trends, and spatial location to produce crop plans and cultivation schedules to smooth data-driven agricultural decisions. To simplify operational planning, including planting, irrigation, and harvesting, this engine is closely linked with a real-time weather module. Crop-specific risks are identified, severity levels are estimated and suitable treatments, doses, and preventive measures are suggested by an intelligent Pest and Disease Management module. To smooth transparent transactions and feedback-based trust mechanisms, the Agri Direct module creates a digital marketplace that links farmers and buyers directly. To increase accessibility and uptake, local language assistance is integrated into every program. This makes the proposed system to support sustainable and financially feasible farming methods.

Keywords

Smart Agriculture (SA), Web-based agricultural support system, Starter Kit, Farm School module, Crop and agricultural Intelligence, Pest and Disease Management module, Agri Direct module.

Detecting Botnet Attacks in IoT Environments: An Optimized Machine Learning Approach

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Abstract

The project on "Detecting Botnet Attacks in IoT Environments: An Optimized Machine Learning Approach" addresses the growing threat of botnet attacks in Internet of Things (IoT) ecosystems. The project introduces an advanced machine learning-based solution designed to identify and mitigate botnet activities in IoT devices. The optimized approach focuses on improving accuracy, reducing false positives, and enhancing the overall efficiency of botnet detection in diverse IoT environments.

Tamil Character Identification from Palm Leaf Manuscript Using Deep Learning Models

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Abstract

Preservation of the ancient palm-leaf manuscripts has been considered increasingly essential in view of their historical, cultural, and linguistic importance, particularly in the context of classical Tamil literature. Digitization of such manuscripts is a challenging task as physical degradation, uneven background, scratches, and faded engraved text will badly affect the conventional OCR systems. This paper proposes an AI-based framework for digitizing Tamil palm- leaf manuscripts by using advanced image processing and OCR techniques. This approach integrates various modules, such as contrast enhancement, noise reduction, adaptive thresholding and binarization methods, to improve the visual quality of manuscript images before extracting the text. The framework utilizes multiple OCR engines and deep learning- based models to recognize Tamil text with high accuracy from the preprocessed images. Experimental results show that the proposed system improves the text recognition accuracy considerably compared with traditional OCR methods applied directly on raw images. The digitized output is further refined through post-processing and language-specific filtering to obtain clean and human-readable Tamil text. This paper explores the potential of AI-driven digitization systems in preserving the endangered manuscripts and improving their accessibility to the researchers, historians, and language scholars.

Keywords

Palm Leaf Manuscripts, Tamil OCR, Image Processing, Artificial Intelligence, Cultural Heritage Digitization, Optical Character Recognition.

A Lightweight Geometry-Aware Feature Preservation Approach for Inspection of PCB and PCBA Assemblies Using Residual and Channel-Guided Learning

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Abstract

Printed Circuit Boards (PCBs) and Printed Circuit Board Assemblies (PCBAs) inspection Automated defect inspection is important in ensuring quality in the contemporary electronics manufacturing. Current lightweight detectors operate by losing fine trace-level geometric detail via heavy downsampling and do not have explicit defect-sensitive channel recalibration. The article introduces a new detection framework with three carefully designed modules, including: (1) Lightweight Geometry-Aware Convolutional Backbone, which is a structural feature extractor, but with low-level spatial resolution; (2) two purpose-designed modules: (1) Dual-Attentive Channel-Spatial Recalibration (DACSR) that concatenates independent Squeeze-Excitation channel attention and convolutional spatial attention with learnable fusion in a single module; and (3) a Context-Aware Residual Fusion Transformer (C A Gradient-Balanced Localization approach that uses the IoU-regression stabilises the prediction of small structural defects in a bounding box. The Peking University Open Lab PCB defect dataset (1,386 images, 6 defect classes) is experimented on. Evaluation metrics such as precision, recall, mAP and analysis of confusion matrix are reported. Ablation experiments affirm autonomous efforts of both modules.

Keywords

PCB defect detection, geometry-aware backbone, channel attention, spatial attention, DACSR, CARFT, transformer neck, IoU loss, object detection, lightweight architecture.

Empowering the Gig Economy: Designing AI-Driven Job Platforms for Informal Workers

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Abstract

In developing economies specially India, blue-collar workers constitute a substantial portion of the labor force, yet because of various reasons like low literacy, inadequate sources, lower technical skills and mainly the absence of architecture catered to their specific needs. A large proportion of currently available systems cater to technically skilled workforce failing to address the limitations like specificity of skillset, their credibility, region-specific employment. This paper provides a socially inclusive view which is much more human-centered, of a job-matching platform assisted with AI for the informal workforce. The work focuses on the key design principles, accessibility considerations, and social impact factors over any algorithmic approach. The paper discusses multilingual interfaces, voice-assisted interactions, location-based matching, a policy-aligned system design that can foster greater opportunities in the informal labor market. With the help of AI-driven systems in the context of social and policy contexts, this paper provides a conceptual architecture for an inclusive, equitable and scalable digital employment system.

Keywords

Blue-collar workforce, Digital inclusion, Human-centered AI, Informal employment, Job-matching platforms.

Deep Learning-Based Indian Sign Language (ISL) Translation System

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Abstract

The Indian Sign Language (ISL) is important as it facilitates the communication of people with hearing and speech disorders. Nevertheless, there are still communication gaps because of the lack of awareness of the general population. This project is the Deep Learning-Based Indian Sign Language Translation System, which is used to automatically identify ISL gestures and transform them into a readable text through computer vision and Convolutional Neural Networks (CNNs).

The system is able to support character level and word level recognition and is flexible in use. Images, videos, or live webcam input are captured as the hand gesture and processed pre-adaptively by hand detection, resizing and normalization before being subjected to trained CNN models. In the case of the video-based input, the predictions of several frames are pooled to come up with smoother and more accurate output. The system is implemented in form of a Flask-based web application using a simple and easy-to-use interface to interact real-time.

In general, this project will be beneficial in minimizing communication barriers and offering an open and smart solution that may be advanced with such features as speech synthesis and sentence-level translation, which can be added later on.

Keywords

Indian Sign Language (ISL), Convolutional Neural Networks (CNN), Gesture Recognition, Deep Learning, Computer Vision.

Building AI Inside Enterprises: A Product Manager's Framework for Scalable AI Adoption

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Abstract

Artificial Intelligence is rapidly transforming enterprise software systems; however, many organizations struggle to transition from experimental AI prototypes to scalable, production-ready AI products. This challenge is particularly evident in large enterprises where data fragmentation, governance constraints, and cross-functional dependencies slow down AI adoption. This research explores the role of the Product Manager in bridging the gap between AI innovation and enterprise-scale implementation.

The study proposes a structured framework for building AI-enabled products within enterprise environments by focusing on five critical dimensions: data readiness, AI product lifecycle management, cross-functional collaboration, responsible AI governance, and continuous learning systems. The framework draws on industry practices and simulated case scenarios across sectors including healthcare, manufacturing, and financial services to illustrate how organizations can operationalize AI while ensuring scalability, compliance, and user trust.

The findings highlight how product managers can act as orchestrators between engineering, data science, and business stakeholders to deliver value-driven AI products. This research contributes a practical playbook for enterprises seeking to embed AI capabilities into digital products while maintaining strategic alignment, ethical standards, and long-term sustainability.

A Spatiotemporal Statistical Analysis of Dengue Burden and Mortality in Southern India (2005-2026)

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Abstract

Dengue fever has been a prominent public health issue in India because it propagates quickly, it is seasonal, and it recurs, which shows its powerful characteristic as a vector-borne disease. This paper is a detailed statistical data analysis of dengue incidence and mortality in four southern Indian states Kerala, Tamil Nadu, Karnataka, and Telangana between the period of 2005 and 2024 and thereafter provides short-term predictions (2025–2026) was collected from the National Centre for Vector Borne Diseases Control (NCVBDC), Government of India using HoltWinters exponential smoothing model.

The results show that the CFR is always highest in Kerala compared to the other four states, which implies that the disease severity or healthcare response problems are relatively high. In Karnataka, the incidence of dengue is increasing over the past few years which is indicative of the escalating intensity of transmission. Conversely, Telangana continues to record the lowest death rate, which means that the management of the disease is relatively efficient. Projections of the forecasts indicate that the dengue cases will keep increasing in majority of the states except in Telangana where the death rates are likely to be relatively low. ANOVA indicates statistically significant differences in dengue related deaths between states whereas differences in case counts are not statistically significant, suggesting that there could be differences between states in the effectiveness of healthcare services, environmental vulnerability, or a reporting dynamics.

In general, the paper highlights the role of specific approaches to public health and predictive models to reduce dengue cases among susceptible groups. There is a need to strengthen preventive and response mechanisms to tackle the changing epidemiological situation with dengue in India.

Keywords

Dengue fever, statistical analysis, forecasting, case fatality rate (CFR), ANOVA, time series modeling, public health, India.

AI-Powered Zero-Day Attack Detection using Deep Autoencoders

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Abstract

The increasing sophistication of cyber threats has made zero-day attacks one of the most critical challenges in modern network security. Zero-day attacks exploit previously unknown vulnerabilities, making traditional signature-based intrusion detection systems ineffective. This research proposes an AI-powered anomaly detection framework using deep autoencoders to identify previously unseen cyber intrusions without relying on labeled attack data.

The proposed system utilizes unsupervised deep learning to model the intrinsic behavior of benign network traffic. Network flow data undergoes preprocessing, including feature extraction, normalization, and encoding, before being fed into a fully connected deep autoencoder trained exclusively on normal traffic patterns. The model learns a compressed latent representation and reconstructs the input data. Reconstruction error is used as an anomaly score, where significant deviations indicate potential zero-day threats.

A dynamic thresholding mechanism enhances detection adaptability across varying traffic conditions while minimizing false positives. The framework is integrated with a real-time monitoring dashboard for visualizing anomaly scores, reconstruction error trends, and flagged attacks, improving operational transparency and response efficiency. Experimental evaluation on benchmark intrusion detection datasets demonstrates effective separation between benign and malicious traffic. The results confirm that deep autoencoder-based anomaly detection provides a scalable, adaptive, and intelligent defense mechanism for protecting modern digital infrastructures against emerging cyber threats.

Keywords

Zero-day attack detection, deep autoencoder, anomaly detection, unsupervised learning, cybersecurity.

Motion-Aware Vision Mamba with CNN-BiLSTM Framework for Suspicious Human Behavior Detection in Surveillance Videos

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Abstract

Suspicious human behavior detection in surveillance videos presents significant challenges due to motion blur, temporal complexity, and computational constraints in real-world deployment scenarios. This paper proposes a novel hybrid architecture, Motion-Aware Vision Mamba with CNN-BiLSTM (MAV-CB), that integrates motion blur handling, Vision Mamba for efficient temporal modeling, and CNN-BiLSTM for robust spatiotemporal feature learning. The framework introduces a motion deblurring preprocessing module, with spatial attention mechanisms for lightweight spatial feature extraction, Vision Mamba's selective state space modeling for long-range temporal dependency capture with linear computational complexity $O(T)$, and bidirectional LSTM for enhanced temporal context understanding. Comprehensive experiments on Violence Dataset, UT-Interaction, and New Action datasets demonstrate 97.14% accuracy while maintaining faster inference compared to transformer-based approaches. The framework exhibits remarkable resistance to severe blur degradation, surpassing baseline methods by a considerable margin and establishing selective state space models combined with motion blur mitigation as an effective solution for resource-constrained surveillance systems.

The Evolution of Precision Oncology: A Review of Deep Learning Architectures for Diagnostic Classification and Survival Prediction in Breast Cancer

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Abstract

The global burden of breast cancer continues to increase, with projections indicating that there will be over three million newly diagnosed cases each year by 2040. While traditional clinical interventions rely on manual histopathologic evaluation and known biomarkers, the aggressiveness of certain subtypes, like triple-negative breast cancer (TNBC), requires more targeted and automated diagnostics and prognostic interventions. This paper discusses a detailed review and analysis of recent advances in deep learning (DL) architectures for the analysis of breast cancer, focusing on the shift toward data-driven precision medicine and automated analysis of breast cancer. We test the effectiveness of convolutional neural networks (CNNs) and U-Net variants in lesion segmentation and classification and demonstrate the ability to reduce inter-observer variability and the rate of human errors. Moreover, this review examines the development of DL models as low-cost surrogates to molecular testing models that are able to predict estrogen receptor (ER) status and PAM50 intrinsic subtypes directly from hematoxylin and eosin (H&E) stained slides. Special attention is given to prognostic survival analysis in TNBC, where multiple instance learning (MIL) or the quantification of digital biomarkers, such as stromal tumor-infiltrating lymphocytes (sTILs) have been found to be superior for risk stratification. Finally, we discuss the integration of multimodal data (ultrasound radiomics combined with clinicopathologic features) which has been shown to have C-indices up to 0.93 in overall survival. The review concludes that, although challenges remain in the scarcity of datasets and the generalization of models, the integration of DL in clinical workflows is a paradigm shift in oncologic diagnostics.

EEG in Alzheimer's Disease Prediction Using Cognitive-Based Machine Learning Techniques

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Abstract

Electroencephalography (EEG) has become a potential non-invasive technique to predict Alzheimer disease (AD) at an early stage to identify the existence of some neural anomalies, and the clinical symptoms of the illness have not developed. This paper will suggest a machine learning model, which is cognitive-based and is built on EEG data to enhance the predictive accuracy of AD. The methodology consists of EEG preprocessing, feature extraction that can be related to cognition, and application of various machine learning classifiers that can differentiate between healthy controls and the individuals who have a form of AD in the initial stages of the disease. The experimental findings demonstrate that the given approach has higher classification results as compared to traditional techniques, which could be considered as the sign of its efficiency in the role of a diagnostic tool.

Lung Cancer Segmentation

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Abstract

One of the most deadly illnesses in the world is lung cancer, and increasing survival rates requires early identification. For the purpose of diagnosis and treatment planning, these lung tumours must be accurately segmented from computed tomography (CT) images. But manual delineation takes a lot of time, is subjective, and can be inconsistent. For reliable lung cancer segmentation, this research suggests a hybrid deep learning framework that combines convolutional and transformer-based architectures, specifically U-Net, DeepLabv3+, and Mask2Former. To improve segmentation performance, the suggested method combines attention-based learning, multi-scale feature extraction, and sophisticated preprocessing. Mask2Former outperforms U-Net and DeepLabv3+ with a test accuracy of 95.50%, according to experimental evaluation. The Outcomes Confirm how well hybrid deep learning models enhance segmentation accuracy and Dependability, enabling clinical Decision-making.

Keywords

Lung Cancer Detection; Lung Cancer Segmentation; Computed Tomography (CT) Imaging; Deep Learning; Medical Image Segmentation.

Leveraging Artificial Intelligence for Climate Forecasting and Carbon-Neutral Future

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Abstract

Growing intricacies surrounding climate change call for emerging strategies to forecast environmental trajectories and develop sustainable responses. This research explores the application of Artificial Intelligence (AI) to climate forecasting, underlining its importance in scrutinizing vast environmental datasets, predicting extreme weather events, and supporting policy decisions in reaching carbon neutrality. With the integration of machine learning algorithms, satellites, and sensor-climate monitoring, AI allows realistic simulations of atmospheric and ecological phenomena. The study further explores how knowledge drawn from AI can support renewable energy options, emission reduction plans, and climate-resilient infrastructure planning. Despite advances in technology, data integrity, algorithmic biases, and governance remain challenges, necessitating responsible AI deployment. The study traces a pathway from predictive analytics to practical climate action plans, providing an outline for governments, business organizations, and environment institutions to accelerate transformation to a carbon-neutral future.

Keywords

Artificial Intelligence, Algorithmic biases, Carbon Neutrality, Ecological.

Design and Implementation of a Hybrid Hardware-Software System for Enhanced Women Safety with Reliable Emergency Tracking

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Abstract

This study proposes a hardware-software hybrid solution that can overcome some of the most important shortcomings of the current women safety solutions. Although there are many mobile applications that may be used in assisting in case of an emergency, they are basically on the operational condition of the smartphone, its battery, and its network connection, which in the real emergency situations, is usually subdued. The paper suggests and realizes a twolevel safety net, which consists of a highly functional mobile application and a specific hardware component installed in a protective phone cover. The mobile application has conventional safety features such as one-tap SOS, live location sharing, geofencing, and silent alerts. The new hardware module, which provides unique GPS receiver, GSM modem, backup battery, and separate panic button will guarantee the constant functioning of the device even when the main smartphone is turned off, destroyed, or discharged. The prototype system was put through hard duress testing. It has been shown that with the hardware fallback mechanism a 99.2% alert success rate is reached with an average latency of 8.7 seconds to transmit a location message when the phone is in the disabled state. The hybrid concept of the Williams project having a Bill of Materials (BOM) cost of less than 25 dollars is a reliable, more affordable and more practical approach that will greatly increase personal safety infrastructure of women in adverse circumstances.

Keywords

Women Safety, Internet of Things, Emergency Response System, GPS Tracking, Hybrid Architecture, Embedded Systems, Fallback Mechanism, Mobile Application.

What Drives ROI in Social Media Campaigns? A Multicollinearity - Aware Regression Study

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Abstract

This study investigates the impact of key social media advertising metrics on Return on Investment (ROI) using regression modeling applied to a dataset of over 300,000 digital campaign records. The dataset consists of diverse demographic audiences and campaign characteristics, including impressions, clicks, engagement scores, conversion rates, and acquisition costs. The purpose of the analysis is to identify which metrics most strongly influence ROI within paid social advertising environments. Results indicate that Impressions are the strongest positive predictor of ROI, demonstrating that broader audience reach contributes substantially to improved profitability. There is a statistically significant negative correlation between clicks and ROI, meaning that increases in clicks, all else equal, would not increase ROI. Since more clicks mean spending too much on low-intent traffic, this suggests that the increase in clicks meant spending too much on low-intent traffic. The Customer Acquisition Cost is the most significant negative condition of ROI, which proves the place for a budget for efficiency and even perhaps expenditure quantity distinctions. The effect engagement score was interesting but small and conversion rate was not statistically relevant inside this data set; taken together with experience, this indicates that profitable reach optimization and cost-ineffective interaction minimization are important to successful ROI rather than purely trying to increase clicks. Again, these results lend themselves to actionable suggestions for marketers for managing digital advertising effectiveness.

Keywords

Social Media Advertising, Return on Investment (ROI), Digital Marketing Analytics, Regression Analysis, Campaign Performance Metrics, Impressions, Acquisition Cost, Engagement Effectiveness, Marketing Optimization, Predictive Modeling.

Smart Agriculture: AI-Driven Crop Yield Prediction and Farm Optimization

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Abstract

Global warming, unemployment of resources, and a growing population all making farming more harder are those that demand more food. Traditional agricultural activities are based on experience-based decision-making and which cannot be sufficient to deal with climate change and the complexities of modern farming practices. This paper would suggest an artificial intelligence-related system crop prescription relying on the environment and prediction of yield. The focus is to promote agricultural yield and sustainability. The proposed system is a combination of real-time weather, soil properties, and geographical data in order to predict the crops and potential yield results. Besides, the system suggests appropriate agricultural products to prevent failure of crops by determining the risk factors associated with environmental factors. Complex machine learning models, a Large Language Model (Gemini 2.5 Flash), various APIs like Metou API, the API of OpenStreetMaps, and Serper API are used to provide the accurate, understandable and practical conclusions. The backend is developed written in FastAPI and the frontend is written in HTML, CSS, and JavaScript, and a JSON storage to process data easily. The results indicate that the suggested system provides intelligent and scalable precision agriculture system, which enhances the decision-making process, minimizes the risk of crop failures and promotes environmental friendly farming.

Keywords

Accuracy agriculture, crop suggestion, yield forecasting, Artificial Intelligence, Machine Learning, LLM, sustainable farming.

A Comparative Analysis of Deep Learning Techniques for Smart Contract Security

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Abstract

The increasing use of smart contracts in decentralized finance ecosystems is examined in this study, along with the security risks that result from vulnerabilities. Although deep learning models like convolutional, recurrent, and graph neural networks have been used in earlier research to investigate vulnerability detection, there are still issues with scalability, consistency, and practicality. Effective deployment across large-scale blockchain environments is particularly hampered by a heavy reliance on source code, high computational complexity, and a lack of standardized datasets.

In order to overcome these obstacles, this paper suggests FusionNet, a novel hybrid deep learning framework that works directly on opcode-level representations inside the Ethereum Virtual Machine. The framework combines convolutional neural networks, bidirectional long short-term memory networks, and graph attention networks into a single architecture.

By combining structural and sequential analysis, it highlights both graph-based encoding using embeddings of opcode sequences. Furthermore, transfer learning improves adaptability to new vulnerabilities, and a multi-head attention mechanism is introduced to dynamically prioritize critical execution patterns.

The suggested method enhances detection performance, especially for complex vulnerabilities like reentrancy and timestamp dependency, according to experimental analysis. FusionNet outperforms current hybrid and graph-based models in terms of scalability, robustness, and generalization across a variety of smart contract datasets. The results emphasize how crucial it is to integrate temporal, structural, and semantic features into a single optimization framework. This work advances scalable and secure vulnerability detection techniques that are useful for high-throughput decentralized applications and real-time blockchain security.

Keywords

cnn: convolutional neural network, gnn: graph neural network, evm: ethereum virtual machine.

Long-Term Stock Price Forecasting Using Transformer Architecture

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Abstract

Financial markets are complex, nonlinear, and volatile; hence, stock price forecasting is a complex and a hard task to perform in the financial data analysis. Proper long-term forecasting can aid decision making and proper control of financial risks by the investors, financial analysts and institutions. Conventional statistical techniques such as ARIMA and ARMA have been widely used in prediction of time-based series but most of them are linear and would not in some cases be able to represent intricate nonlinear connections existing in data sets of stock markets. Deep learning, such as Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU), have improved the prediction by using sequential connections, however, it has flaws with extremely long-range temporal associations and still lacks the ability to efficiently work with these tremendous size of data and data mass. The study hypothesizes a Transformer-based architecture to make predictions of the stock price when predicting any long-term forecast based on the historical financial time-series data. The ideas are presented with the use of the self-attention mechanism of the Transformer model to effectively reveal the general patterns and long-term links within the stock market information. The system involves a number of steps like data of historical stocks, pre-processing of data, extraction of features, model training and forecasting. The Transformer architecture has enabled us to learn more effectively the temporal relationships by learning whole sequences simultaneously, as opposed to conventional recurrent models. The suggested model is supposed to provide a scalable and robust system of not only the financial time-series data analysis but also the creation of trustworthy long-term predictions of the stock prices and, thus, value in investment planning, portfolio management, and financial risk analysis.

Keywords

Stock price forecasting, transformer, forecasting time series, deep learning, prediction financial data, self attention mechanism, investment decision support by the long-term, feature extraction, financial markets, financial market investment decision support.

TrialSense – Agentic RAG for Clinical-Trial Eligibility Checking

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Abstract

It is hard and time consuming to find eligible clinical trial participants. It might involve a manual comparison of patient information and the attainment of the qualifying requirements. This screening stage can be an obstacle to research and a strain to clinicians. We provide TrialSense, which is an explainable patient-trial matching framework that uses a structured analysis of eligibility and semantic retrieval and is efficient and understandable. The process of TrialSense initially involves the use of a similarity search using vectors to locate desirable alternatives in massive trial libraries. Subsequently, it performs atomic eligibility checks to scrutinize the inclusion and exclusion criterion in fine detail and come up with explicit decisions. Clinical trial pre-screening is simplified with clear and rule-based reasoning and scalable retrieval.

Keywords

Clinical Trial Matching, Explainable AI, Large Language Models, Semantic Retrieval, FAISS, Eligibility Checking, Agentic RAG, Patient-Trial Matching.

Recent Advances in Vision and Sensor-Based Body Posture Analysis for Drowsiness Detection: A Comprehensive Review

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Abstract

The inability to drive due to fatigue has played a large part in road accidents, especially with increasing numbers of planes using partial automatic driving. The research presented here is an overview of the progress made over the past few years in relation to driver monitoring systems, focusing specifically on vision-based and sensor-based analysis of body posture to detect if the driver is fatigued, using drowsiness detection techniques. With traditional methods for determining driver impairment being reactive and more typically taking corrective actions instead of identifying early impairment in the driver, we can now look directly at the drivers' facial characteristics, head positioning and posture through the use of modern vision-based techniques, resulting in improved situational awareness of the driver and the driver's level of alertness. When it comes to using a physiological signal as part of detecting whether a driver is fatigued, these methods are able to accurately detect early indicators of fatigue; however, the physiological signal-based methods are usually very invasive due to the use of many electrodes and can be hard to use practically. New research has also shown that using a multi-modal approach to combine visual and physiological data will provide greater robustness and reliability to the DMS. The research illustrates that there are a number of ongoing challenges associated with current DMS's, including the inability to generalise across all of the different forms of real-world environments, occlusion of critical features of the body through typical vehicle configurations, limitations on the computing power required to process real-time output of DMS's and the trade-off between accuracy and comfort for drivers.

AI-Based Video Chaptering and Learning Support System

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Abstract

The increasing proliferation of educational videos on the internet has sparked the need to review and consume such content efficiently [12]. Moreover, the fact that reviewing such reviewed content manually is quite an arduous task has sparked the need for the conception of video understanding technology [10]. This can be done by leveraging AI technology, particularly by using the multimodal technology [1]. Generally, the multimodal model involves the use of Automatic Speech Recognition (ASR), Multi Model, and Large Language Models (LLMs) technology to review the content of the video [1] [2]. Moreover, the paper presents two advanced features: voice Q&A and video chaptering [4] [7]. The Q&A feature helps user to ask questions related to video [4] [13]. More so, the proposed model will provide the user with the desired response based on the asked question, either through text or voice [14]. An additional advanced feature that is showcased is video chaptering [7] [8]. This feature will segment the long video into semantic units while the chapter title is created based on the content [9]. The conventional video technology reviewed the content based on dialogue [5]. Conversely, the incorporation of the multimodal model is efficient since the content is reviewed based on audio- visual and linguistic information [1] [3].

Keywords

Multimodal Learning, Educational Video Analysis, Automatic Speech Recognition, Video Summarization, Video Models, Interactive Learning, Video Retrieval, Digital Education, Artificial intelligence.

AI-Based Self-Healing Electronics for Intelligent Fault Detection

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Abstract

Modern electronic and industrial systems should be able to run without any interruptions and should have very high reliability. The conventional approach to maintain the system involves performing routine inspections, which may result in delaying the detection of any faults and thus increasing the chances of risk. In this study, we propose a self-healing electronic system that uses Artificial Intelligence (AI) to detect any faults and restore the operation of the system automatically. The self-healing electronic system has several sensors that capture the values of the parameters such as temperature, vibrations, voltages, currents, and motions. These data are processed by an embedded machine learning algorithm and detect the faults. Once the fault is detected, the system isolates the faulted component and recovers from the fault automatically by communicating within the embedded components of the system. We have designed this system using ESP32 hardware, and experiments show promising results.

Keywords

Self-healing electronics, Embedded AI, Fault detection, Autonomous recovery, ESP32, Predictive maintenance, Industry 4.0.

Cerebral Analysis Using Eye Scanning Utilizing Machine Learning

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Abstract

The global prevalence of neurological and cognitive disorders has increased significantly over recent years; however, current diagnostic techniques such as Magnetic Resonance Imaging (MRI) and Electroencephalography (EEG), have been identified as expensive, invasive, and inaccessible in remote or resource-poor regions. In response, this research provides a framework to perform a cerebral analysis using eye-tracking technology in combination with machine learning which can detect and monitor neurologically related conditions at an early stage. Eye-tracking measures include fixation duration, saccade velocity, pupil dilation and blinking. To prepare these raw measurements for processing by machine learning techniques, they were subjected to a multi-stage preprocessing process consisting of median filtering and/or Kalman filtering followed by blink interpolation. Once cleaned, the processed gaze streams are used to derive ocular biomarkers that represent specific clinically relevant aspects of eye movements including attention, perception and motor control. A classifier is composed of multiple algorithms: CNNs (Convolutional Neural Networks) analyze the spatial distribution of gaze heatmaps; LSTMs (Long Short Term Memory) model the temporal characteristics of eye movement; SVMs (Support Vector Machine) classify boundaries. Validation of the proposed system was performed on a composite set of 4312 labeled datasets representing the gaze data from both healthy controls and individuals diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) and Alzheimer's Disease (AD). The proposed system achieved a top classification accuracy of 96% (AUC = 0.71); further, the average time required to process each sequence was 38 ms, providing sufficient speed for near-real time use in the clinic.

Multi-Layer Secure File System with RBAC and Biometrics

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Abstract

Modern organizations depend extremely on the internet for storing and sharing information. Therefore, the need of securing the digital files is very important. This importance led us to prepare and therefore are presenting multi-layer protected file storage and sharing system which ensures the organizations have top tier security. For authentication, facial authentication achieves nearly a 96% success rate while block chain logging delays only 15ms per logging. Alongside, strong encryption techniques, multi-factor authentication (MFA) and role-based access control (RBAC) strengthen the system. The system records all sensitive activities such as file uploads, downloads and administrative approvals inside an append only block chain ledger which ensures the auditing is tamperproof. Authentication workflow integrates password validation following RFC 6238 which reduces spoofing attacks. To confirm the user is real, the system is integrated with a facial liveness challenge which requires actions like blinking, turning left or right and smiling. The files are encrypted using AES-256 encryption which operates either in CBC or GCM mode. The encryption keys are generated through PBKDF2 which ensures the stored data is confidential. In our experiment, we concluded that encrypting a 10 MB file requires approximately 0.5 seconds in AES-CBC mode and 0.6 seconds in AES-GCM mode. The system achieved a zero false acceptance rate against spoofing attacks. We have enforced Access Control through combining detailed role policies with administrative approval mechanisms. Python and Flask models were used to implement the system. We also evaluated the system through experimental testing.

The system introduces only light computational load alongside improving data protection and system accountability as per the experimental testing conclusion. As we integrated block chain based audit logging and AES encryption, RBAC and biometric multi-factor authentication, the proposed system offers a unified and practical approach for a secure file storage system.

Real-Time AI Pose Estimation for Markerless Physiotherapy Assessment Using a Mobile Camera

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Abstract

Post-operative lower limb rehabilitation requires continuous monitoring of patient movement quality to ensure safe and effective recovery. Conventional physiotherapy assessment relies heavily on therapist supervision and subjective observation, limiting scalability and accessibility. This work presents an AI-based, markerless pose estimation framework for real-time tracking and analysis of human movement during physiotherapy exercises using a single RGB camera. A deep learning-driven pose tracking model identifies and tracks major body joints without the need for wearable sensors or physical markers. The system generates a skeletal representation of the patient's posture and movement, enabling objective assessment of exercise execution. Experimental results demonstrate reliable joint detection and real-time performance during common lower limb rehabilitation exercises. The proposed approach highlights the potential of artificial intelligence to support intelligent, accessible, and remote physiotherapy monitoring.

Keywords

Rehabilitation, Physiotherapy, Pose estimation, Pose tracking model, Joint detection.

Gain Improvement of Patch Antenna Using Frequency Selective Surface

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Abstract

Microstrip patch antennas are widely used in today's wireless communication systems because these types of antennas are small, flat, easy to manufacture, and are compatible with printed circuit board technology. However, antennas created from lower-cost dielectrics, like FR-4, due to the properties of these materials, have performance limitations due to (1) low efficiency, (2) reduced gain because of losses from the dielectric itself, and (3) surface wave propagation. The limitation caused by these factors can restrict the ability of this style of antenna to work well in practical applications. Elements of this paper include the design and increased performance of a hexagonal microstrip patch antenna (MPA) that operates at a frequency of 3.30 GHz through the use of slot loading and a frequency selective surface (FSS) meta-surface reflector. A 'baseline' antenna configuration, from the simulation return loss, radiation pattern, and gain, was established for a conventional hexagonal MPA manufactured on an FR-4 substrate. To enhance impedance matching and change the surface current distribution of the MPA, a rectangular slot was placed on the surface of the patch. To aid in further improving the radiating performance of the MPA, a 4×4 metasurface array (based on integrated frequency selective surfaces unit cells) was used beneath the MPA. Using ANSYS HFSS, a full-wave electromagnetic solver that uses the finite element method, simulated antennas show that slot modifications greatly enhance return losses and radiation characteristics. A FSS metasurface also enhances forward radiation and redirects back to the primary radiation direction reflected backward electromagnetic energy. The gain improved from -20.84 dB from a conventional antenna to -3.21 dB after slot loading and finally to 0.49 dB after a metasurface integrated. The results confirm that the combination of slot-based tuning and metasurface engineering is an effective method for enhancing the performance of antennas while keeping them compact in size and at low-cost manufacturing. The proposed antenna design is applicable to wireless communication devices operating near 3.30 GHz, such as WLAN and IoT.

Keywords

Microstrip patch antenna, hexagonal patch antenna, frequency selective surface (FSS), metasurface, gain enhancement, HFSS simulation, wireless communication.

Glacier Retreat Analysis Using Satellite Imagery and Machine Learning to Estimate the Impact of Global Warming

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Abstract

Glaciers are shrinking at an alarming rate, serving as powerful indicators of climate change. The proposed work utilizes satellite imagery and machine learning to monitor glacier ice loss over time and estimate the impact of global warming on this reduction. Multi-year satellite images of glaciers are collected and processed using image analysis techniques to detect and measure glacier areas. By comparing images across different years, the system quantifies ice loss accurately. Global temperature data is then used to train a machine learning model that correlates temperature increases with glacier retreat percentages. The result is a system capable of visually and quantitatively demonstrating the connection between rising temperatures and glacier shrinkage. This approach enhances understanding of the tangible effects of climate change and can contribute to environmental monitoring and informed policy planning. The integration of advanced technology and climate science makes otherwise invisible changes clearly observable.

Keywords

Glacier Retreat, Satellite Imagery, Remote Sensing, Machine Learning, Climate Change, Global Warming, Environmental Monitoring.

CivicGPT: An Explainable AI Framework for Citizen-Centric Interpretation of the Indian Income Tax Act

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Abstract

CivicGPT is an explainable AI (XAI) framework that enables working professionals to understand the intricacies of Indian Income Tax Act provisions. The system employs a Retrieval-Augmented Generation, or RAG, approach, which incorporates domain-specific knowledge from the entire Income Tax Act along with user-specific salary information from payslips. CivicGPT adopts BGE-base instruction-tuned embeddings (768-dim) and dual FAISS vector stores to search out relevant tax sections and form grounded explanations. A section-aware boosting method based on regex-based matching also boosts the retrieval by matching exact section references first. The document processing pipeline works for large policy documents (up to 1500 pages) using PyMuPDF with Tesseract OCR as a fallback. The system combines a Flask REST API backend, Firebase session management, and dual LLM inference utilising Groq Llama-3.3-70B, with Ollama as the fallback for privacy-preserving deployment. An experimental evaluation on 50 tax queries shows 89.2% section retrieval accuracy and 86% end-to-end response accuracy with an average response time of 2.8 s. Apart from CivicGPT, the tax sector relies on interpretable, citizen-friendly AI solutions that mitigate dependence on third-party tax professionals and grant access to difficult tax legislation.

Keywords

Retrieval-Augmented Generation, Explainable AI, Legal AI, Tax Analytics, BGE Embeddings, FAISS Vector Search.

Performance of Modular Local LLM Voice Assistants on Embedded Platforms

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Abstract

Embedded agentic voice assistants are being increasingly used for automating desktop tasks, home automation, and Internet of Things (IoT) applications owing to their capability of supporting natural and hands-free human-machine interaction. While several existing solutions have already showcased their functional capabilities of voice automation, there appears to be relatively less research work on systematic performance optimization, modular design, and efficient deployment on edge devices with limited computational capabilities. This paper proposes a modular design for an embedded agentic voice assistant system and analyzes its performance on edge devices like Raspberry Pi. The proposed design breaks down the system into key functional modules like voice input acquisition, speech-to-text processing, large language model (LLM) inference computation, task execution, and output generation, which can be replaced, scaled, and optimized independently. Specifically, local speech recognition models like Whisper and local LLM frameworks like Ollama are analyzed to determine the feasibility of edge intelligence without requiring constant connectivity to the cloud. The performance analysis is carried out based on parameters such as response time, CPU and memory usage, reliability of execution, and accuracy of task completion. The experimental outcome shows that the modular design method improves the maintainability of the system, makes it easier to optimize each component separately, and improves the overall system responsiveness, which is still possible in resource-limited embedded systems. Moreover, the system design is extensible to accommodate future upgrades in speech models, language models, or automation interfaces without requiring significant modifications to the overall system architecture. The results of this research work can serve as a reference framework for researchers and developers to design efficient, scalable, and privacy-preserving embedded agentic voice assistants for reliable automation in desktop and IoT applications.

Keywords

Agentic Voice Assistant, Embedded Systems, Raspberry Pi, Modular Architecture, Performance Evaluation, Local LLM.

Influencer Marketing: Shaping Brand Perception in the Digital Age

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Abstract

The rapid expansion of social media platforms has significantly transformed marketing communication, positioning influencer marketing as a dominant strategy in the digital era. This study examines the role of influencer marketing in shaping brand perception, with a focus on long-term brand outcomes rather than short-term engagement metrics. Grounded in Social Influence Theory and Source Credibility Theory, the research analyses how influencer attributes such as credibility, authenticity, and audience engagement influence consumer attitudes and brand perception. A qualitative and conceptual research design is adopted, supported by an extensive literature review and case-based insights. The findings suggest that influencer marketing plays a critical role in building trust, enhancing emotional connection, and strengthening brand identity. However, existing literature reveals key gaps, including the absence of integrated frameworks and limited focus on long-term brand perception. This study addresses these gaps by proposing a comprehensive perspective linking influencer marketing strategies with brand perception. The research offers practical implications for marketers and contributes to the academic understanding of digital marketing strategies.

Keywords

Influencer Marketing, Brand Perception, Social Media Marketing, Consumer Behaviour, Brand Equity, Digital Marketing, Social Influence.

An Intelligent IELTS Score Analyzer Using Machine Learning and Natural Language Processing

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Abstract

The AI Tutor is an AI-based intelligent system designed to automatically evaluate IELTS writing essays and predict corresponding band scores using supervised machine learning techniques. The system addresses the critical limitation of manual evaluation, which is time-consuming, expensive, and difficult to scale. User-submitted essays undergo a rigorous preprocessing pipeline including text cleaning, tokenisation, and stopword removal. Linguistic features such as word count, character length, and four IELTS rubric sub-scores are engineered alongside 500-dimensional TF-IDF vectors to form a 913-feature input space. Random Forest Classifier and Regressor models are trained to predict both the band class and exact band score. The system is deployed as an interactive Streamlit web application, providing students with instant, data-driven feedback including score breakdowns and performance insights. Experimental results demonstrate a classification accuracy of 85% and a regression R2 score of 0.76, validating the system as an efficient, scalable, and consistent assessment tool for personalised IELTS preparation.

Keywords

IELTS, Automated Essay Scoring, Machine Learning, Random Forest, TF-IDF, Natural Language Processing, Streamlit, Band Score Prediction, Educational AI.

Design and Assertion-Based Verification of APB Protocol with Functional Coverage

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Abstract

System-on-Chip (SoC) designs commonly use the Advanced Peripheral Bus (APB) protocol of the Advanced Microcontroller Bus Architecture (AMBA) in the design of buses that connect low-speed peripherals. The APB implementations are important in ensuring that there is correctness and reliability in the overall system functionality. In this paper, the author has provided a detailed verification environment of APB protocol based on the Universal Verification Methodology (UVM). The suggested verification framework will have a layered-testbench structure wherein the components that are reusable will be active and passive agents, monitors, scorecards, and coverage collectors. We make protocol-specific assertion of real-time error detection and constrained random stimulus generation, which is comprehensive validation of protocols. The verification environment has a total functional coverage of 76.39 percent statement coverage of 90.67 percent and a 100 percent assertion coverage. The results of the experiment indicate that the read and write operation, error handling mechanism and observance of the protocols are successfully verified.

Keywords

AMBA APB, UVM, Functional Verification, and Coverage Analysis, SystemVerilog, Protocol Verification, Design Verification, and SoC.

MedFedAI: Privacy-Preserving Federated Deep Learning for Medical Image Diagnosis

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Abstract

Due to the growing pace of medical imaging technologies, there is mass production of diagnostic data within healthcare facilities. Such datasets are vital in training deep learning models that can identify diseases and classify them with precision. Nonetheless, stringent privacy laws and organizational policies do not permit centralized exchange of patient information, which restricts the scale and generalization of AI-based diagnostic systems. In this paper, the author introduces a privacy-preserving federated deep learning system, MedFedAI, which is used to collaboratively diagnose medical images. In the suggested system, various hospitals train the deep neural networks locally on its own data, and only send encrypted model parameters to a central aggregation server. Optimization algorithms like Federated Averaging are used in an iterative manner to update the global model and are redistributed to the participating institutions. To guarantee the adherence to healthcare regulations including HIPAA and GDPR, the framework incorporates different privacy, secure aggregation, and encrypted communication. Through experimental assessment, it has been shown that MedFedAI can do better diagnostics and generalization to heterogeneous medical data, without exposing sensitive patient data. The suggested system will provide a scaled and secure way of collaborative healthcare diagnostics using AI.

Keywords

Federated Learning, Medical Imaging, Privacy-Preserving AI, Deep Learning, Healthcare AI, Distributed Learning, Secure Aggregation.

Artificial Intelligence-Driven Stock Market Forecasting Using Deep Learning Techniques

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Abstract

This project focuses on leveraging Artificial Intelligence and Deep Learning techniques to improve stock market price estimation accuracy. Financial markets are highly volatile and influenced by numerous dynamic factors, making price prediction a complex task. Traditional statistical approaches often fail to capture nonlinear relationships in stock price movements. In this work, a Long Short-Term Memory (LSTM) deep learning model is implemented to analyze historical stock price data along with derived technical indicators such as SMA, EMA, and RSI. The model is trained on time-series financial datasets after performing normalization, feature engineering, and data cleaning. Experimental results demonstrate that the LSTM model effectively learns temporal dependencies and provides improved predictive performance compared to conventional approaches. The project highlights the practical applicability of deep learning in financial forecasting and supports informed investment decision-making.

Keywords

Artificial Intelligence, Deep Learning, Stock Market Prediction, Long Short-Term Memory (LSTM), Time-Series Forecasting, Machine Learning, Financial Data Analytics, Technical Indicators, Sequential Modeling, Price Estimation.

Phishnet – A Browser-Native Hybrid Phishing Detection Framework with Real-Time Analysis and Human-Interpretable Reasoning

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Abstract

Phishing has evolved from being simple URLs to include scripts and code that are hidden from the user. Phishing, nowadays, can use a series of redirections and other techniques to pass of a fake site as a real one or even basic links that fetch, the confidential information of the users who click on them unknowingly and give them to the attackers. Earlier methods of phishing detection relied on using an analysis built with machine learning to identify platforms with just the links of them. The analysis was done offline and provided a version of the phishing attack in a static format. Therefore, the offline analysis of the attack limits the ability to detect complex attacks as well as zero- day attacks.

This paper introduces Phishnet, which is a browser-based detection framework that detects phishing in real time while you are still browsing. Phishnet provides a hybrid detection method that consists of heuristic approaches and also utilizes malware scanning methods, such as signature matching, to detect phishing as well as lightweight versions of traditional machine learning for quick analysis.

Phishnet gives a clear path of how it operates by offering an explainability component that displays to the user what rules have been invoked, and how the invoked rules contributed to the decision to flag or block a phishing site. The early prototype of Phishnet is designed in a way that it is modular and therefore, this feature could enable further development and subsequent applications as the sphere of security keeps changing. In the dynamic testing, Phishnet stood strong unlike existing solutions.

Keywords

Cybersecurity, explainable security, phishing detection, real-time analysis.

Brain Computer Interface Based Assistive Robotic Arm with Vision Guided Object Manipulation

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Abstract

Individuals with severe mobility impairments often face challenges in performing basic daily activities such as picking and placing objects. This paper presents NEURO ARM, a brainwave-guided assistive robotic system that enables hands-free control of a robotic arm using brain-computer interface (BCI) technology. The system integrates a low-cost electroencephalography (EEG) headset to capture brain signals, which are processed in real time to generate control commands based on user attention levels.

A wrist-mounted camera implementing an *eye-in-hand* configuration is used for real-time environmental perception. Object detection is performed using YOLOv11, allowing accurate identification and localization of target objects. The system employs a ROS2-based architecture to coordinate communication between perception, decision-making, and actuation modules. A 5-degree-of-freedom robotic arm with a two-finger gripper is controlled through inverse kinematics and precise PWM-based servo actuation. Additionally, a force-sensitive resistor (FSR) integrated into the gripper enables feedback-based grip control using a PID mechanism, ensuring safe and stable object handling.

Experimental results demonstrate reliable object detection, accurate positioning, and smooth pick-and-place operations. The system also incorporates safety features such as attention-based pause/resume control and joint motion constraints. The proposed solution provides a practical, low-cost assistive technology with potential applications in healthcare, rehabilitation, and independent living support.

AI-Based Disease Prediction and Cultivation Advisory System for Millets

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Abstract

Millet cultivation is widely practiced in dry and semi-arid regions due to its resilience and nutritional value. However, fungal diseases such as blast and rust cause significant yield losses when not detected early. Traditional disease identification relies on visual inspection, which is time-consuming, subjective, and often impractical in large or remote farming areas. To overcome these limitations, this study proposes Millet Guard, an automated millet leaf disease detection system based on deep transfer learning. The framework employs pre-trained convolutional neural networks, namely ResNet50, MobileNetV2, and DenseNet121, to classify millet leaf images into healthy, blast-infected, and rust-infected categories. Standardized image preprocessing and data augmentation techniques improve robustness under varying field conditions, and performance is evaluated using accuracy, precision, recall, F1-score, and confusion matrices. Experimental results show high classification performance across all models, with ResNet50 achieving a maximum accuracy of 99.79%. The trained models are integrated into a lightweight web-based application for real-time disease prediction, enabling early detection, reducing dependence on expert assessment, and supporting improved crop management and sustainable millet production.

Keywords

Millet leaf disease detection, Plant pathology, Deep learning, Transfer learning, Convolutional neural networks, Image classification, Precision agriculture, Computer vision, Crop disease diagnosis, Web based prediction system.

Time Series – Based Earthquake Frequency Estimation in India Using Multi-Model Machine Learning Approach

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Abstract

Forecasting of earthquakes is never an easy task as the seismic processes are very complex. The paper will postulate the use of machine learning to predict frequency of monthly earthquakes based on historical seismic material. Temporal patterns are captured using time-series characteristics like lag values and rolling averages, and predicted using a Gradient Boosting Regression model. In order to enhance regional adjustments, the model output is calibrated with the help of local seismic intensity. The system is incorporated into a geospatial platform of real-time analysis. The suggested approach offers an explainable scheme of the analysis of earthquake activity patterns, which promotes research and awareness instead of making the precise predictions of the occurrence.

Keywords

Earthquake Frequency Estimation, Machine Learning, Time Series Analysis, Gradient Boosting Regression, Seismic Data Analysis, Geospatial Analysis.

Bone Cancer Detection Using Deep Learning

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Abstract

Bone cancer, especially osteosarcoma, is a serious disease that can be life-threatening if not detected early. Early and accurate diagnosis is very important to improve patient survival and treatment success. X-ray images are commonly used in hospitals because they are affordable and easily available. However, checking X-ray images manually can take time and may lead to mistakes. To solve this problem, this study uses a hybrid deep learning method to automatically detect bone cancer from X-ray images. The system combines two models: ResNet-50 and Vision Transformer (ViT). Before giving images to the model, they are preprocessed using steps like resizing, normalization, noise removal, and data augmentation to improve image quality. ResNet-50 helps in finding detailed features such as bone structure and abnormal patterns, while the Vision Transformer helps in understanding the overall image by capturing global information. The features from both models are combined to classify images as cancerous or non-cancerous. The model is evaluated using accuracy, precision, recall, and F1-score. Results show that the combined model performs better than individual models, making it a useful and reliable tool for early bone cancer detection.

Keywords

Bone Cancer, Osteosarcoma, X-rays, Resnet-50, vision Transformers, Hybrid model, Deep learning.

A Structured Adversarial Graph Learning Approach For Cross-Subject Emotion Recognition

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Abstract

Recognition of emotion across subjects is one aspect of the topic of affective computing that has remained a obstacle in this area because there is also large inter-individual differences between physiological indicators, facial expressions and behavioral responses. Traditional machine learning and deep learning architectures tend to fail to make a good generalization between unseen topics due to them learning topic-specific representations. As a remedy to this shortcoming, this paper introduces Structured Adversarial Graph Learning (SAGL) framework which combines graph neural networks with adversarial domain adaptation to learn both subject-invariant feature learning and emotion-discriminative features learning. The framework builds a subject-conscious emotion graph where nodes can be identified as multimodal emotion feature and edge can be identified as intrinsic relationship between the emotional states of people. A discriminator that enforces domain alignment with a minimax objective and a structure-consistency regularization mechanism that enforces semantic consistency between similar emotions are used to achieve these goals. It has been shown that experimental results on benchmark multimodal emotion datasets are more accurate, have higher F1-score and robustness than traditional methods, indicating the effectiveness of the framework in supporting emotion-aware intelligent systems in the real world.

Keywords

Cross-subject emotion recognition, Affective computing, Graph neural networks, Adversarial domain adaptation, Structured graph learning, Multimodal emotion analysis, Domain generalization, Emotion-invariant representation learning.

Employee Attrition Forecasting through Data Analysis Using Feature-Weighted Random Forest and Explainable AI

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Abstract

Employee turnover is a problem for companies. It costs them a lot of money. Makes it hard for them to work efficiently. When an employee leaves the company has to spend a lot of money to find and train someone. This can be one and a half to two times the salary of the person who left. Employee turnover also disrupts the work. Makes it hard for other employees to do their jobs. It also means that the company loses a lot of knowledge. This paper is about a system that uses data to predict when employees are going to leave. The system uses information from the IBM HR dataset, which has information about 1,470 employees. The system looks at 35 things about each employee like how old they are and how long they have been working at the company. The system uses a kind of algorithm called Feature-Weighted Random Forest to make predictions. This algorithm is good at predicting when employees are going to leave because it looks at which things are closely related to employee turnover. The system can also explain why it made predictions. This is helpful because it means that companies can understand what is causing their employees to leave. The system can also try out ways of keeping employees and see what might work best. It can even look at employees and predict how likely they are to leave over the next few years. The system is also good at comparing values of a company to see which ones are best at keeping employees. The system was able to predict employee turnover with 72% accuracy, which's very good. Overall, the system is a tool, for companies that want to keep their employees and make their businesses run more smoothly. The Employee turnover system is very helpful for companies to understand Employee turnover The Employee turnover system can help companies to reduce Employee turnover.

Keywords

Employee attrition, Feature-Weighted Random Forest, SMOTE, SHAP, LIME, Explainable AI, HR analytics, attrition timeline, intervention simulation, department comparison, FastAPI, Streamlit.

Software-Defined Networking Controller with Enhanced Traffic Management

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Abstract

Software Defined Networking (SDN) has emerged as a modern approach to simplify network management by separating the control plane from the data plane. However, many existing SDN solutions rely on reactive mechanisms, where traffic decisions are made only after congestion occurs, leading to performance degradation under dynamic conditions. This paper proposes an enhanced SDN controller that integrates real-time traffic monitoring with predictive traffic analysis to enable proactive network management. The system continuously collects network statistics such as bandwidth utilization, packet rate, and flow count from OpenFlow-enabled switches using the Ryu controller and analyzes traffic trends to predict congestion proactively. Based on these predictions, routing decisions are dynamically updated to balance network load and minimize latency. The proposed system is implemented in a Mininet emulation environment and evaluated using metrics such as throughput, latency, and packet loss. Experimental results demonstrate improved traffic distribution, reduced congestion impact, and enhanced network performance compared to traditional SDN approaches.

Keywords

Software Defined Networking (SDN), Traffic Management, Congestion Prediction, Ryu Controller, Mininet, Network Monitoring, Adaptive Routing, Throughput.

Edge Computing-Based Fault Detection in Solar Photovoltaic Systems

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Abstract

Solar photovoltaic (PV) systems have become increasingly vital for sustainable energy generation worldwide. However, detecting faults in real-time remains a critical challenge due to the complexity of distributed PV installations and the computational limitations of traditional centralized monitoring systems. This paper presents a comprehensive framework for edge computing-based fault detection in solar PV systems, leveraging machine learning algorithms deployed on IoT edge devices for localized, real-time analysis. The proposed approach enables early fault identification, reduces maintenance costs, and minimizes system downtime. Our framework demonstrates significant improvements in fault detection accuracy (up to 97.5%) and reduced latency compared to cloud-based solutions. The integration of edge computing with advanced ML models provides a scalable, cost-effective, and sustainable solution for modern solar energy infrastructure.

InsightX: An Intelligent Predictive Maintenance and Condition Monitoring System Using Ensemble Learning and Deep Neural Networks

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Abstract

Predictive maintenance has become a critical strategy in modern industrial operations, enabling proactive identification of potential equipment failures before their occurrence. This paper presents *InsightX*, an intelligent web-based predictive maintenance system that integrates ensemble machine learning techniques with deep neural networks for comprehensive machinery health monitoring. The system utilizes Balanced Bagging and Balanced Random Forest classifiers to predict five distinct failure modes in rotating machinery, while an Artificial Neural Network (ANN) is employed for vibration-based bearing fault diagnosis. The proposed approach effectively addresses class imbalance and achieves over 94% accuracy in failure prediction, along with robust performance in classifying seven bearing fault categories. A Django-based web interface enables real-time monitoring, historical data analysis, and automated report generation using Google Gemini AI. Experimental results demonstrate the system's effectiveness in reducing unplanned downtime and optimizing maintenance operations, making it suitable for Industry 4.0 applications.

Automation Testing of E-Commerce Web Application Using Automation Software with AI-Based Product Recommendation

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Abstract

In this paper we have tried to make the intensive growth of online stores to create more demands on the use of smart systems capable of aiding the users to find the right products easily. The paper provides the automation testing of an e-commerce web application and an artificial intelligence product recommendation system that are able to read user requirements in real time and integrate them into the product. The following system takes a website address, the number of recommendations requested and description of the product as the input. It has a semantic analysis part that is enabled using the Stanford CoreNLP pipeline, which analyzes the description of the user more deeply and allows getting a better understanding of what is needed in a product. It also uses web scraping, which is done with the use of the JSoup system to obtain product information in the given website. The Cosine similarity is used to match the processed input to the scraped product data and the items that are most relevant are identified. The user interface presents the recommended products in the form of a graphical interface. To test every module, automation testing techniques are used to test modules to verify that they work correctly, are reliable, and dependable. The experimental assessment confirms that natural language understanding along with real-time data extraction is more relevant in enhancing a recommendation and less reliant on past user information. The solution suggested makes intelligent product discovery in e-commerce settings a scalable and realistic solution.

Keywords

E-commerce, Product Recommendation System, Natural Language Processing, Stanford CoreNLP, Web Scraping, JSoup, Cosine Similarity, Automation Testing, Artificial Intelligence.

Intelligent Hospital Resource Optimization System

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Abstract

Hospitals operate in highly dynamic environments where patient inflow, emergency cases, and resource demands fluctuate continuously. Managing critical resources such as beds, ICU units, medical staff, and equipment manually often leads to inefficiencies, overcrowding, and delayed patient care. This paper proposes an Intelligent Hospital Resource Optimization System that integrates machine learning techniques with real-time monitoring to improve hospital operational efficiency. The system collects hospital data including admissions, discharges, bed availability, ICU occupancy, and staff schedules. After preprocessing and feature engineering, predictive models are trained to forecast patient inflow and resource demand. An optimization module then recommends efficient allocation strategies. The system is deployed through a web-based dashboard that provides real-time visualization and alert notifications. Experimental results demonstrate improved prediction accuracy and better resource utilization. The proposed system supports data-driven decision-making, reduces operational bottlenecks, and enhances overall healthcare service delivery.

MVM²: A Neuro-Symbolic Multi-Agent Framework for Mathematical Reasoning Verification

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Abstract

The MVM² (Multi-LLM Math Verification System) is a way to check if everyone agrees on a solution by using five Large Language Models (LLMs) at the same time to solve math problems. The system is built on the idea that accuracy is more important than speed. It uses step-by-step reasoning and SymPy symbolic computation to check solutions instead of string matching. The framework can handle inputs from more than one mode, such as image-based Optical Character Recognition (OCR) using vision models. It also solves logical problems through an automated multi-agent discussion mechanism. The final product is a validated answer, a confidence score, and a PDF report on the quality of the publication that was made with LaTeX.

Keywords

Multi-Agent Debate, Neuro-Symbolic Verification, Large Language Models, Mathematical Reasoning, Symbolic Equivalence.

Depression Severity Assessment and Personalized Recommendation Using Structured Data and Random Forest Algorithm

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Abstract

Seeking depression assistance is not as easily as it is supposed to be. Mental health workers are not sufficiently available in most areas of India, and available instruments tend to simplify the situation of a person into one number. The paper is about MindTrack, a web-based screening tool that uses PHQ-9 answers, demographic and lifestyle characteristics, such as sleep patterns, physical activity and self-reported stress, to categorize users into four levels of severity, based on a Random Forest classifier that was trained on 500 fake patient records. Its symptom level Recommendation Engine looks at the highest items on PHQ-9 and gives a recommendation based on those specific triggers as opposed to the level of severity. There is a hard-coded safety override, which pops up four national crisis contacts as soon as self-harm ideation is reported on Question 9. On an 80/20 test split with 5-fold cross-validation, the model achieved 92.4% accuracy and a 91.1% F1-Score ($\sigma = \pm 1.3\%$). It is an experimental prototype not a clinically proven product, which is intended to provide individuals with a personal preliminary step into the healing pathway. It shows that interpretation of machine learning and symptom-level personalisation can be implemented into digital mental health services, even though there are limitations to this approach.

Keywords

Machine Learning, Random Forest, PHQ-9, Depression Severity, Mental Health Screening, Personalized Recommendation, Streamlit, KNN Imputation.

From Monolith to Microservices: A Strategic Blueprint for Enterprise-Scale Modernization

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Abstract

Businesses are having increasing in importance trouble with standardized monolithic designs due to how they make it impossible to scale, slow down normal release cycles, and simply make it hard to respond to changing company demands. Microservices building design, on the other hand, divides standard programs down into more manageable services that are capable of being deployed on a standalone basis. This makes it an increasingly flexible, scalable, as well as robust approach to design standard software. This essay addresses the main distinctions between monolithic and microservices (standard) designs. It shows that these traditional techniques are straightforward to set up at first, but they can get in trouble as businesses develop. Technological progress is becoming important considering that it is happening with increasing speed in virtually every one of these domains. Companies have to rethink their architectural plans if they would like to stay competitive, get products on the market faster, and stimulate new ideas all the time. This paper gives an efficient and strategic plan for moving from traditional monolithic architectures to microservices. It focuses on both technological and organizational challenges, as well as data governance and incrementally based migration approaches like strangler patterns and domain-oriented design. The proposed approach focuses on lowering disturbances while raising value, and this lets businesses modify old processes without losing quality and dependability. The study uses solid evidence and methodical methods to define the predicted results, such as better scalability, stronger systems, faster deployment schedules, and better alignment with cloud-based based methods. The most significant items this research adds are a full framework to help with their modernization, practical ways to move information, and an improved understanding of problems like management of services, data consistency as well as complex operations. This article aims to serve as a pragmatic reference to businesses navigating the difficulties of modernization, offering strategic recommendations and practical recommendations to successfully convert their enterprise underlying structures into agile, ready for the future architectural models.

Keywords

Microservices, Monolithic Architecture, Enterprise Modernization, Cloud-Native, DevOps, Scalability, Distributed Systems, API Gateway, Containerization, Kubernetes, Digital Transformation, System Integration.

Solar Panel Cleaning and Maintenance Robot

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Abstract

Regular maintenance is essential for sustained energy generation, as the efficiency of solar photovoltaic panels can decrease significantly due to dust accumulation, grime, and environmental pollutants. This paper presents the design and development of an AI-driven autonomous solar panel cleaning and maintenance robot aimed at enhancing energy efficiency while minimizing manual intervention. The proposed system integrates infrared and ultrasonic sensors to enable edge detection, obstacle avoidance, and adaptive surface navigation. A motor-driven rotating brush mechanism is employed to effectively remove surface impurities without causing damage to the panels. Intelligent control techniques are utilized to analyse environmental conditions and cleaning requirements, allowing for optimized cleaning schedules and efficient navigation. The robot operates on a rechargeable battery system with solar charging support, ensuring energy-efficient and continuous operation. Experimental evaluation demonstrates improved power output, reduced maintenance time, and consistent performance across different solar panel installations. The proposed solution offers a low-cost, scalable, and sustainable approach for the maintenance of solar energy systems, making it suitable for smart energy infrastructure applications.

A Multimodal Stress Detection Framework Based on Facial Expression Analysis and Psychometric Evaluation using Explainable AI

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Abstract

Stress is becoming an increasingly serious psychological issue affecting people from many different backgrounds, and being exposed to undiagnosed long-term stress can lead to developing anxiety, depression, and an overall decrease in mental health. Because stress is a subjective experience and self-reporting tools alone are often insufficient for accurate measurement, the present study proposes a novel multimodal stress detection framework that combines facial expression analysis with psychometric evaluation to provide reliable and valid stress measurement. The framework utilises the AffectNet dataset and employs two models: a fine-tuned EfficientNetB3 for binary stress classification (Stress vs. No-Stress) and a Sequential Convolutional Neural Network for continuous Vision Stress Score (VSS) regression on a 0–100% scale, based on established psychological stress-arousal mappings derived from facial expressions. The Psychometric Stress Score (PSSS) is based on the PSS-10, a valid tool for assessing a person's self-reported stress level over the past month. With a higher weight given to PSSS due to its wider temporal coverage and clinical validity, the Final Stress Index (FSI) integrates the complementary strengths of visual and psychological stress signals to produce a more accurate and comprehensive stress assessment. The EfficientNetB3 classification model achieved an overall accuracy of 91% on the validation dataset. The regression model achieved a Mean Absolute Error (MAE) of 0.0801 and a Coefficient of Determination (R^2) of 0.9158, both demonstrating strong predictive validity. Grad-CAM and Occlusion Sensitivity Testing were used to identify stress-related facial regions, providing clinical context for the interpretation of the model's predictions. The proposed framework advances stress measurement beyond traditional unimodal methods by providing an integrated, explainable system based on clinically founded practice that can be used to monitor mental health in real-world applications.

Keywords

Stress Detection, Facial Expression Analysis, EfficientNetB3, CNN, Stress Regression, Multimodal Fusion, Perceived Stress Scale, Final Stress Index, Grad-CAM, Occlusion Sensitivity.

Smart Agrihub: AI-Powered Platform for Farming Marketplace, Weather & Crop Prediction, and Regional Language Support

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Abstract

This research introduces an intelligent and integrated agricultural decision-support framework with the combination of machine learning, computer vision, and expert knowledge synthesis to help the farmer with crop choice, fertilizer, and early detection of plant diseases. The system has several supervised learning pipelines such as Rotation Forest ensemble classifier, voting-based crop recommendation models, and the label-encoded fertilizer prediction networks, while using the unified FastAPI architecture. A deep learning segmentation model called the Roboflow API can be used to access real-time disease diagnosis using leaf images, while a generative AI module based on Gemini model can be used for interpretive agronomic guidance based on crop type, pest or disease profile, and the geographical location. The platform also integrates with a frontend client which is built using React & Vite with modular routing, visualization and user management using centralized application state. The interoperability of these components proves a concept of an end-to-end and scalable pipeline that can bring actionable insights in agriculture to boost further efficiency of inputs, in addition to facilitating precision farming practices for various user groups.

Keywords

Crop recommender, fertilizer predictor, plant disease analysis, Rotation Forest algorithm, Ensemble learning, FastAPI, Generative AI computer vision artificial intelligence, registration farms decision support, precision agriculture.

Improved Architecture for a Personal Data Security and Analysis System in Banking

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Abstract

Background: The banking sector faces escalating cybersecurity threats that compromise sensitive personal customer data. Traditional authentication mechanisms – including password-based access and symmetric encryption – are insufficient to withstand modern attack vectors such as phishing, session hijacking, zero-day exploits, and zero-click attacks. Existing architectures lack unified frameworks that combine federated identity, immutable auditability, and real-time anomaly detection.

Aim: This research aims to design and empirically evaluate an improved layered security architecture for personal data protection and analysis in banking environments.

Methods: The proposed system integrates OpenID Connect (OIDC) for federated identity management, JSON Web Tokens (JWT) with SHA-256 hashing for stateless session control, and a private Hyperledger Fabric blockchain for immutable audit logging. Role-based access control (RBAC) is enforced across microservices, and behavioral fingerprinting is implemented at the API gateway layer to detect anomalous session patterns.

Key Findings: Empirical evaluation demonstrated a reduction in authentication breaches from approximately 50 to fewer than 5 incidents – a decrease exceeding 90%. MFA adoption reached 90%, fraudulent login attempts dropped below 2% of total traffic, and transaction latency remained under 90 ms across all security enforcement configurations.

Conclusions: The proposed architecture provides tamper-proof auditability, fine-grained access control, and scalable identity verification for both browser-based and mobile banking clients. It complies with OWASP MASVS standards and offers a forward-compatible foundation for emerging enhancements including AI-driven anomaly detection and privacy-preserving federated learning.

Keywords

Banking security, personal data protection, blockchain, jwt, openid connect, hyperledger fabric.

Image-Based Breed Recognition for Cattle and Buffaloes in India

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Abstract

India serves as a native habitat for multiple indigenous cattle and buffalo breeds which support agricultural activities and dairy farming operations and the economic development of rural communities. The indigenous breeds of livestock on Indian farms serve to protect food supplies while supporting environmentally friendly farming methods. The process of accurate breed identification enables effective management of livestock resources and the implementation of selective breeding programs and the protection of essential genetic resources. Identification through traditional methods depends on expert manual observations which require significant time and contain subjective elements that lead to errors because experts are not easily accessible in rural regions. This project develops an image-based breed identification system which uses traditional image processing methods but concentrates on Canny Edge Detection as its main algorithm. The system processes animal images to extract important features such as body contours and facial outlines and horn shapes and edge patterns which differ between breeds. To improve accuracy, preprocessing steps like resizing and grayscale conversion and Gaussian smoothing are applied to enhance image quality. Edge detection detects important structural elements after the preprocessing phase. The system employs a rule-based classification method which enables it to identify different breeds. The system functions as an affordable solution that needs no training data because it operates with basic functions which make it appropriate for actual use cases while helping farmers manage their livestock better and protect animal species.

Keywords

Image processing, cattle and buffalo breed identification, Canny edge detection, feature extraction, rule-based classification, and livestock management.

Smart Multilevel Inverter Systems for Renewable Energy Sources and Electric Vehicle Charging Infrastructure

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Abstract

Multilevel inverters (MLIs) integrated with renewable energy sources and electric vehicle (EV) applications represent a transformative approach to modern power conversion systems. With the rapid growth of solar photovoltaic, wind energy, and EV adoption, MLIs provide enhanced power quality, reduced total harmonic distortion, and improved efficiency compared to conventional converters. Their ability to generate stepped voltage waveforms using multiple voltage levels makes them highly suitable for interfacing renewable energy systems with the grid and for EV drive systems. In EV applications, MLIs enable efficient motor control, regenerative braking, and battery management, thereby improving overall vehicle performance and energy utilization. When combined with renewable sources, MLIs facilitate bidirectional power flow, supporting vehicle-to-grid (V2G) operations and smart charging infrastructure. Advanced control strategies and emerging topologies further enhance reliability, scalability, and fault tolerance. Overall, MLIs serve as a key enabling technology for sustainable energy integration and next-generation electric mobility solutions.

Keywords

Renewable Energy Integration, Multilevel Inverter (MLI), Electric Vehicles (EVs), Bidirectional Power Flow, Smart Charging Infrastructure.

Modeling the Spreading of Social Movements through Network Cascades

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Abstract

This paper provides an advanced holistic framework for unraveling how social movements ignite and expand within the digital landscape. By embedding the structural power of Graph Convolutional Neural Networks (GCNN) into deep network cascade analysis, we move beyond mere observation toward truly modeling the heartbeat of digital influence. Unlike other, more static models, this one is explicitly designed to discover today's social networks' "hidden" complex dependencies, allowing us to predict the propagation of influence with a level of detail previously unattainable. The most significant step forward that this approach takes toward graph-based learning is that, while classical diffusion models are fundamental, they cannot keep pace with the messy, nonlinear reality of human interaction and are blind to many subtle structural patterns that drive the real momentum of a movement. Our framework directly responds to those specific inadequacies by treating the network as a living, breathing map of connections. Learning from those structural patterns directly means that this approach yields a much richer and more valid explanation of how digital social movements evolve in real-time. In other words, it provides a high-tech instrument with which the invisible forces that shape our collective societal dynamics can be finally viewed.

Keywords

Social Networks, GCNN, Cascades, Influence Propagation.

DeepSight - An AI Driven Identification and Welfare Management System for Missing Children

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Abstract

The DeepSight System is an AI system intended to aid in the identification and welfare of missing children. Every year, there are thousands of missing children, and identification is often slow, which is why DeepSight has been created. DeepSight is an AI system that combines Deep Learning (CNN) and Face Recognition to compare suspicious images of children sent to it by the public with images of missing children in its database. The system can identify images of children, classify images, and show the user an image of the child, allowing for prompt action to be taken.

In addition, DeepSight System utilizes powerful CNN models for feature extraction and accurate face matching even in different environmental conditions, such as lighting, occlusions, and expressions. The system is also able to learn and improve through updates to its dataset, thereby making it flexible enough to handle any cases. The incorporation of efficient image pre-processing, feature embedding, and scoring mechanisms ensures that DeepSight System has minimal false positives and high recall, which is essential in cases such as missing children.

Apart from the technical capabilities of the system, DeepSight also stresses the importance of accessibility and the use of the system in real-time by the citizens and authorities. The system can be integrated with the databases of law enforcement agencies and child welfare agencies to form a collaborative system. The system has the potential to increase the rates of recovery of missing children and help in the formation of a more efficient and responsive society.

Keywords

Deep Learning, Convolutional Neural Network (CNN), Face Recognition, Missing Children Identification, Image Classification, Computer Vision, Pattern Recognition, Biometric Authentication, Artificial Intelligence, Public Safety Systems.

Implementation and Performance Evaluation of an Efficient Automatic Code Evaluator for Erroneous and Partially Executed Programs

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Abstract

Automated code evaluation systems play a crucial role in modern programming education and large-scale coding platforms. However, traditional systems rely heavily on test case execution and fail to evaluate programs that contain syntax errors or incomplete logic. This paper presents the implementation and performance evaluation of a machine learning-based automatic code evaluator capable of assessing erroneous and partially executed programs.

The proposed system leverages a transformer-based model, CodeBERT, to extract semantic and structural representations of source code. These representations are processed using a regression-based scoring mechanism to assign partial scores based on code quality, even when the program fails to compile or execute. The system also incorporates an error detection and feedback generation module to provide meaningful insights into student mistakes.

The implementation is carried out using Python, PyTorch, Flask, and Firebase to ensure scalability and real-time evaluation. Experimental results demonstrate that the system achieves high accuracy in identifying partially correct solutions and provides reliable feedback compared to traditional evaluation methods. The proposed approach significantly improves fairness in grading and enhances the learning experience by enabling intelligent, execution-independent code assessment.

Keywords

Automatic Code Evaluation, CodeBERT, Machine Learning, Partial Code Analysis, Error Detection, Educational Technology, Program Assessment.

Sonour AI: A Scalable LLM-Driven Conversational Framework for Intelligent Patient Triage, Clinical Routing, and Automated Appointment Scheduling

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Abstract

Rising trend towards developing intelligent systems that can help automate patient engagement tasks in healthcare facilities. In this paper, we introduce Sonour AI, an AI-powered virtual hospital assistant, which can assist in symptom-based triaging, automate patient conversations, and schedule appointments in real-time. Sonour AI uses LLMs, interfaced via Groq API and OpenAI API, for processing natural language inputs and producing semantically-rich and contextual outputs. Multi-step triage is utilized in the architecture design for iteratively improving symptom detection and mapping patients to relevant medical departments. In terms of performance evaluation, our system was tested against various healthcare benchmark datasets such as MedDialog Dataset (1.1M doctor-patient dialogues) and Symptom-to-Diagnosis Dataset (15K symptom records of 40+ disease classes) combined with artificially created data. Our system exhibited impressive performance with Accuracy of 94.3%, Precision of 92.8%, Recall of 93.6%, and an F1-score of 93.2% in triage classification. On average, Sonour AI produced a response within 1.2 seconds per request and maintained high usability, with a user satisfaction score of 4.5/5. Moreover, Sonour AI's appointment scheduling capability outperforms manual booking procedures by reducing booking time by 35%.

Keywords

Conversational AI, Virtual Healthcare Assistant, Symptom-Based Triage, Natural Language Processing, Large Language Models, FastAPI, MongoDB, Appointment Scheduling, MedDialog Dataset, SymCAT Dataset, Accuracy, Precision, Recall, F1-Score, Healthcare Automation.

Machine Learning-Based Demand Forecasting and Cost Optimization in Multi-Echelon Supply Chains using LSTM, Ridge Regression, and SSMD

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Abstract

Demand uncertainty in modern supply chains, particularly in non-perishable industries such as consumer electronics, remains a persistent challenge that directly impacts inventory levels, operational efficiency, and total system cost. Traditional statistical forecasting methods such as ARIMA and exponential smoothing fail to capture the complex nonlinear temporal dependencies inherent in real-world demand data, leading to the bullwhip effect, chronic stockouts, and excessive inventory holding costs. This paper presents a comprehensive integrated machine learning framework for demand forecasting and cost optimization across a three-echelon supply chain comprising a supplier, manufacturer, and retailer. Ridge Regression is employed as a regularized linear baseline, and a Bidirectional Long Short-Term Memory (LSTM) network—augmented with Batch Normalization and Dropout regularization—serves as the primary temporal demand prediction model, trained on the Walmart retail dataset with 421,570 weekly sales records across 45 stores. Forecasted demand is propagated through a structured multi-echelon model via multiplicative amplification factors, and the Single Setup Multiple Delivery (SSMD) policy minimizes total supply chain cost by optimizing across ordering, holding, production, transportation, and investment components simultaneously. Experimental results demonstrate that the LSTM model achieves RMSE = 1,070 and MAPE = 6.2% (accuracy 93.8%), significantly outperforming Ridge Regression (RMSE = 1,629, MAPE = 9.1%, accuracy 90.9%). SSMD with optimal delivery frequency $n_r^* = 6$ and optimal manufacturer investment $I_m^* = \$7,850$ reduces total supply chain cost by 71.1% relative to the single-delivery no-investment baseline, conclusively demonstrating that accurate ML-based forecasting tightly coupled with SSMD optimization yields substantial and measurable improvements in inventory planning and operational cost reduction.

Keywords

Demand Forecasting, Long Short-Term Memory (LSTM), Ridge Regression, Multi-Echelon Supply Chain, Single Setup Multiple Delivery (SSMD), Cost Optimization, Machine Learning, Bullwhip Effect, Walmart Dataset, Inventory Management, Investment Strategy, Supply Chain Coordination.

NeedServe: AI-Powered Welfare Scheme Allocation System

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Abstract

Efficiently targeting government welfare schemes continue to be a significant issue especially in large culturally and economically heterogeneous countries where differences in situations across areas and the lack of good predictive planning tools are the main reasons. Most of the conventional methods of distributing funds are either completely based on population or made uniform between the regions and hence do not have contextual prioritization or transparency. Here, we introduce NeedServe, a transparent AI, driven framework that analyses multi, domain socio, economic indicators from data.gov.in to carry out welfare prioritization at the state level and fund requirement forecasting. We use ensemble machine, learning methods like Random Forest and XGBoost in our framework that help us produce a Scheme Prioritization Index (SPI) and Fund Allocation Forecast (FAF). Incorporating SHAP, based feature attribution and decision audit mechanisms provide a mechanism to satisfy the governance transparency. According to the results, the suggested model has better prediction performance and fairer prioritization than the traditional allocation models. NeedServe thereby aids transparent, scalable, and data, driven welfare planning which is in line with the principles of modern digital governance.

Keywords

Welfare Analytics, Explainable AI, Random Forest, XGBoost, Governance Intelligence, Fund Forecasting, Public Policy AI.

Image Forgery Detection Using Deep Learning with ResNet50 and Error Level Analysis

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Abstract

The integrity of digital images is increasingly threatened by the widespread availability of advanced image manipulation tools, making automated forgery detection a critical necessity in digital forensics. This paper presents a deep learning-based system for detecting and localizing image forgeries, specifically targeting copy-move and splicing attacks. The proposed approach employs Error Level Analysis (ELA) as a preprocessing technique to amplify compression inconsistencies introduced by tampering, followed by a fine-tuned ResNet50 CNN for binary classification. The model achieves 97% detection accuracy on CASIA v1.0 and v2.0 benchmark datasets, outperforming several state-of-the-art methods on precision, recall, F1-score, and AUC.

Keywords

Image Forgery Detection, Deep Learning, CNN, ResNet50, Copy-Move Forgery, Error Level Analysis (ELA), Manipulation Localization, Digital Forensics, CASIA Dataset.

A Scalable AI Framework for Diabetic Retinopathy Detection Using Deep Learning

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Abstract

Diabetic Retinopathy (DR) is a complex disorder that, if not detected in time, can lead to severe complications including complete vision loss. Focusing on AI-enabled retinal imaging methods, this study explores the role of precision ophthalmology in the detection and management of DR. The work emphasizes the integration of Artificial Intelligence (AI) and Machine Learning (ML) techniques with widely used ophthalmic imaging modalities, such as fundus imaging and Optical Coherence Tomography (OCT), within a data-driven analytical framework. The objective is to enhance diagnostic accuracy and support scalable, automated screening, which is essential in modern healthcare systems. We analyze the effectiveness of pre-trained Convolutional Neural Networks (CNNs) within hybrid deep learning models for feature extraction and classification of retinal images. The study underlines the increasing importance of data science and AI-based analytics in healthcare by showing how automated image analysis can minimize diagnostic errors, enhance operational efficiency, and assist clinical decision-making. The proposed framework contributes to the advancement of scalable and cost-efficient healthcare analytics systems for early detection and management of diseases.

Keywords

Artificial Intelligence, Retinal Image Analysis, Diabetic Retinopathy, Convolutional Neural Networks.

Development of a Buckling-Resistant Above-Knee Prosthesis - A Review-Based Approach

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Abstract

Above-knee amputees often experience knee buckling when walking, which impairs gait stability, raises the risk of falls, and limits mobility. A thorough examination of lower limb prosthetic technologies created between 2016 and 2025 is presented in this report, with an emphasis on the development and significance of powered prostheses. With its actuated knee and ankle joints and real-time adaptive control, powered prosthetic limbs have the potential to improve joint dynamics and actively support gait while reducing knee buckling. Biomechanically inspired structures, variable stiffness joints, biarticular mechanisms, and electromyographic (EMG)-driven control systems are only a few of the many design approaches covered in the paper. The case studies are examined critically and also the clinical results. The goal of this research is to guide future developments towards prosthetics that are more user-centered, intelligent, and responsive to improve ambulation of knee prosthesis with a better angle extension to prevent buckling of knee.

Keywords

Powered prosthesis, above-knee amputation, knee buckling mitigation, lower limb biomechanics, prosthetic joint control, gait stabilization, EMG-based control, adaptive locomotion, robotic prosthetics, amputee rehabilitation.

DigiLand: A Secure and Transparent Digital Land Registry System

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Abstract

Land registry system is significant in keeping and monitoring land ownership records. Nevertheless, with traditional land registry systems, a number of issues can be identified, which include inaccurate data, lack of transparency, time wastage and risk of frauds and manipulation of data. These problems render the system unreliable and lower trust among the users. To address these issues, the present paper proposes a digital land registry system, called DigiLand, based on blockchain technology, which is a secure and transparent approach to managing land records. The system will store the land information in a decentralized location in the Ethereum blockchain, which means that after the information is entered within the blockchain it cannot be changed or deleted. There is also a multi level verification process which is part of DigiLand to boost security. This involves the use of Aadhaar based identity verification for seller and buyer, biometric face verification for officer. This aids in avoiding unauthorized access and forged transactions. Moreover, the process of transferring the ownership of land is automated by smart contracts to be written in Solidity. These smart contracts are automatically executed under all the conditions necessary and do not require middlemen, which reduces the number of intermediaries and human mistakes to a minimum. Thus, providing a decentralized, secure and transparent platform for ownership of land, DigiLand provides a more efficient process while helping reduce fraud and increasing confidence in transactional dealings regarding ownership of land.

Novel Control for Electric Vehicles with Hybrid Energy Storage System

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Abstract

Energy management in electric vehicles (EVs) plays a vital role in optimizing the performance and efficiency of hybrid energy storage systems (HESS), which typically combine batteries and supercapacitors to ensure smooth power delivery. Effective energy management is essential for maintaining system balance, improving battery life, and minimizing energy losses. This paper introduces an advanced energy management strategy based on the Improved Seeker Optimization Algorithm (ISOA) to control HESS in electric vehicles. The proposed ISOA-based control system dynamically allocates energy between the battery and supercapacitor, ensuring optimal utilization and improving overall system performance. By implementing real-time adjustments, the system adapts to changing energy demands, enhancing vehicle performance across different operational scenarios. Moreover, the proposed approach significantly enhances system response by reducing settling times, allowing the energy system to stabilize quickly. Additionally, it minimizes ripple content, which reduces voltage fluctuations, further improving the reliability and smoothness of power delivery.

Keywords

Electric vehicle, Hybrid energy storage system, Induction motor, Energy management system, Improved Seeker Optimization Algorithm.

A Retrieval-Augmented Framework for Multi-Source Knowledge Retrieval and Question Answering

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Abstract

Retrieving precise answers from data distributed across heterogeneous sources – PDF documents, dynamic websites, and relational databases – remains a significant challenge for existing question-answering systems. Conventional keyword-based retrieval returns document links rather than direct answers, most systems address only a single source format, and natural language interaction with structured databases is unsupported in lightweight deployments [1][8].

Retrieval-Augmented Generation (RAG) substantially reduces hallucination by grounding model responses in retrieved evidence rather than parametric memory. However, most RAG systems address a single source type, require GPU infrastructure, and lack native structured database interaction as a retrieval pathway [4][5].

This paper proposes a unified lightweight multi-source RAG system comprising three specialised retrieval channels for PDF, web, and SQL database sources within a single CPU-deployable interface, together with a cosine-similarity fallback mechanism ($\theta = 0.35$) for hallucination prevention. Evaluation using RAGAS across 150 queries yields 91.7% Faithfulness, 88.3% Answer Relevancy, 86.5% Context Precision, and 84.8% Context Recall, with 83.4% retrieval accuracy and a hallucination rate of 8.3%, outperforming all five baselines. Evaluation on standard public benchmarks such as HotpotQA is planned as part of future work.

Keywords

Retrieval-Augmented Generation, Question Answering, Semantic Retrieval, Hallucination Reduction, SQL Query Generation, RAGAS Evaluation.

Zero-Day Sentinel: Intelligent Anomaly Detection and Adaptive Classification for Emerging Cyber Attacks

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Abstract

The growing complexity of cyber-attacks and especially the zero-day attacks require intelligent detection systems that extend past the conventional signature-based techniques. This paper presents a hybrid model, Zero-Day Sentinel based on simulation, as an effective method of detecting and classifying new cyber-attacks. The proposed model combines the autoencoders-based anomaly detection and Bidirectional Long Short-Term Memory (BiLSTM) to learn the temporal features, and then a softmax classifier to classify the attacks. The strategy of a controlled zero-day simulation is utilized by avoiding the selected attack classes in training and testing the system in unknown attack scenarios. As is shown by the experimental analysis, the proposed framework performs better than the traditional models (Random Forest, CNN, and LSTM) in terms of various performance indicators. To be more specific, in its current form, the model has an accuracy of 93.6%, precision of 0.92, recall of 0.91 and F1-score of 0.915 with the false positive rate being very low at 0.055. Comparatively, the performance of baseline models is lower, and the accuracy is between 88.0% and 91.8% and the false positive rate is greater to 0.10. The findings suggest the steady and balanced increase in all metrics, which shows the strength of the model and its possibility to generalize well to new patterns of attack previously. The term adaptive classification in this study refers to the model's ability to generalize to unseen attack patterns through learned feature representations, rather than performing online or incremental weight updates during deployment. All in all, the suggested framework offers a stable and scalable approach to detecting zero-day attacks in dynamic networks and it is shown to have better detection rates and lower false discoveries without overfitting or exaggerations in performance.

Keywords

Zero-Day Attack Detection, Anomaly Detection, Intrusion Detection System (IDS), Autoencoder, BiLSTM, Cybersecurity, Machine Learning.

A Framework for Agentic AI, Taxonomy-Aligned Tutoring Systems

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Abstract

This paper presents an agentic AI-powered system developed to address the persistent gaps and need for evolution in traditional teaching methods in education and resolves the gaps identified in Python education. Through an analysis of existing Python learning platforms, several limitations were identified, including dynamic structured tutoring, limitation in mediums of study and insufficient support for diverse learning needs. To address these challenges, an GenAI with agentic AI modelled system is proposed to deliver a structured, institution-ready platform that enhance the accessibility and learning effectiveness. The platform incorporates multiple intelligent components and custom tools that support code understanding, conceptual learning, enhance debugging skills and adaptive content delivery. By enabling learners to engage with course material through various interactive mediums, the system significantly improves comprehension and supports a more personalized learning experience.

Keywords

AI in education, Virtual Tutor for python, Generative AI in education, AI agents in tutoring.

PhishGuard V2: Hybrid AI-Based Real-Time Phishing Detection Using a Multi-Modal Browser Extension Framework

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Abstract

Phishing attacks exploit social engineering to bypass security infrastructure, with attackers generating thousands of URL variants to evade static blacklist defenses. While machine learning classifiers improve detection accuracy, standalone models relying on URL features alone miss HTML-level deception patterns and lack interpretability—critical barriers to enterprise deployment. We present PhishGuard V2, a hybrid detection framework integrating multi-modal feature extraction (URL structure, domain metadata, DNS-TLS infrastructure, HTML content), ensemble machine learning (XGBoost champion model), and SHAP-based explainability within a real-time browser extension architecture. On the PhiUSIIL dataset (50K samples), PhishGuard V2 achieves 99.52% accuracy, 99.86% recall, and 0.9984 AUC—significantly outperforming V1 (97.3% accuracy, 38-feature expansion). Integration of explainable AI enables end-users and security administrators to understand threat classifications through top-K feature attribution, addressing the transparency–performance tradeoff. Real-time latency under 200ms with <2ms for cached predictions validates deployment feasibility. This work demonstrates that hybrid, multimodal architectures with interpretable ML create practical, high-performance phishing defenses for production systems.

Keywords

Phishing detection, Explainable AI, Multi-modal analysis, Browser security, Machine learning.

Low-Cost Temperature Control Techniques for Mass Concrete in Building Raft Foundations: A Field Monitoring Study

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Abstract

This paper presents a low-cost, combined approach to regulating the temperature of mass concrete raft foundations in tropical environments through field testing, thermal modeling, and adaptive control. Additional cementitious material (20–40%) and realistic cooling method- pre-cooled aggregate, chilled water, surface insulation, PVC pipe cooling, and night-time concreting were used and tested using real-time monitoring. The combined method decreased the peak temperature to 72°C to 54°C and minimized the temperature gap by 17.2°C, which was within safe temperature limits to prevent cracking. The innovative Cost-Temperature Efficiency Index (CTEI) has found night-time concreting the most cost-effective technique and combined strategies as the most efficient in terms of thermal reduction. The thermal model developed was very accurate (RMSE = 1.82°C, $R^2 = 0.95$). The algorithmic complexity cut the cost by 12% with equivalent performance and the adaptive algorithm cut the cost an extra 3°C. The research paper shows that the application of low-cost methods, coupled with real-time monitoring, provides an efficient and scalable solution to enhance thermal control in mass concrete.

Keywords

Mass Concrete, Raft Foundation, Temperature Control, Thermal Cracking, Heat of Hydration, Low-Cost Cooling Techniques, Cost-Temperature Efficiency Index (CTEI).

Design and Performance Analysis of a Datapath Processing System on Artix - 7 FPGA

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Abstract

Pipelining is a key technique used in modern processor design to improve performance. Instead of executing one instruction at a time, pipelining allows multiple instructions to be processed simultaneously at different stages. This helps increase the speed of operation and improves overall system efficiency compared to non-pipelined designs. However, increasing the number of pipeline stages is not always ideal. While deeper pipelines can achieve higher operating frequencies, they also lead to increased hardware usage, higher power consumption, and more complex routing. So, there is always a trade-off between performance and design efficiency. In this project, a 16-bit pipelined datapath processor is designed using two different architectures: a standard 5-stage pipeline and a simpler 3-stage pipeline. Both designs are developed using Verilog HDL and implemented on an Artix-7 FPGA using Xilinx Vivado. To evaluate their performance, important parameters such as critical path delay, maximum operating frequency, resource utilization, and power consumption are analyzed. The results show that the 5-stage pipeline provides better speed and lower delay, whereas the 3-stage pipeline is more efficient in terms of area and power usage. Overall, this comparison helps in understanding the trade-offs between performance and hardware efficiency, making it easier to choose the right architecture for embedded and low-power applications.

Keywords

16-bit Processor, Pipelined Architecture, FPGA Implementation, Verilog HDL, Performance, Low-Power Design.

Customer Churn Prediction and Explainable Retention Strategies in the Telecom Sector

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Abstract

Customer churn has emerged as a critical challenge for the telecom industry due to intense market competition, low switching costs, and increasing customer expectations. While machine learning techniques have demonstrated strong predictive capabilities for churn prediction, many high-performing models lack interpretability, limiting their adoption in real-world business environments. This paper proposes an explainable machine learning framework for predicting customer churn and deriving actionable retention strategies in the telecom sector. The study utilizes the publicly available Telco Customer Churn dataset and performs data preprocessing and feature engineering using SQL and Python-based libraries. Multiple predictive models, including Logistic Regression, Random Forest, and XGBoost, are evaluated using standard classification metrics.

Explainable artificial intelligence techniques such as SHAP and LIME are integrated to identify key factors influencing churn behavior. Experimental results demonstrate that XGBoost achieves the highest predictive performance, while explainability enhances trust and supports data-driven retention decision-making.

Keywords

Customer Churn Prediction, Machine Learning, Explainable Artificial Intelligence, SHAP, LIME, Telecom Analytics, Retention Strategies.

A Dynamic Cost-Frequency Aware Caching Framework Using Redis for Microservices-Based Systems

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Abstract

Microservices architectures commonly deploy in-memory data stores such as Redis as an intermediate caching layer to reduce backend database load and sustain system scalability under increasing traffic. Conventional caching configurations assign a fixed Time-To-Live (TTL) value to each cache entry or evict the Least Recently Used (LRU) item upon memory exhaustion. These static policies are inherently insensitive to workload fluctuations and database update events, resulting in underutilized cache slots, stale data persistence, and unnecessary database round-trips. This paper proposes an Adaptive Cache Manager (ACM) that evaluates each query individually to determine both cache admission eligibility and an appropriate retention duration. The admission decision is governed by a composite score derived from four normalized runtime metrics: query execution cost, recent request frequency, data volatility, and memory footprint. The score is bounded within the interval $[0, 1]$; entries achieving a high score are assigned an extended TTL, while entries with a low score receive a reduced TTL or are excluded from the cache entirely. The ACM is implemented as a component within a Spring Boot REST layer, operating over Redis as the caching tier and a legacy SQL system as the primary data store. The objectives of the framework are to increase the cache hit ratio, reduce mean response latency, and utilize cache memory more efficiently than static policies permit. The architecture employs stateless components to support horizontal scaling without manual reconfiguration, targeting high-throughput microservices environments.

Keywords

Adaptive Caching, Redis, Microservices Architecture, Query Optimization, Dynamic Time-To-Live (TTL), Energy Cost Score, In-Memory Databases, Aspect-Oriented Programming, Spring Boot, and Workload-Aware Cache Management.

Smart Water Quality Monitoring and Automated Leak Management System

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Abstract

Water is the most important resource, essential for all living organisms, and plays a major role in health, agriculture, industry and the environment. The Water supply chain faces a major setback due to the quality of water and leakage in pipelines due to both internal and external factors. Our research presents an IoT-based system for water quality monitoring and water leak detection in supply pipelines. The system is equipped with pH, turbidity, TDS, and water flow sensors that aid in measuring water quality and pipeline leaks in the water supply chain. The result of the quality check and the flow rate of supplied water is monitored through the Blynk cloud, and if the system detects an abnormality in the supply rate or quality of supplied water, the water flow through the pipeline is stopped, and a buzzer is sounded to alert the user. The system ensures the best quality of water supply, enhances the longevity of pipelines, aids in detecting leaks in supply lines, lowers water losses and minimises the cost of structural maintenance.

Keywords

Water quality monitoring, pipeline leakage detection, IoT, pH, turbidity, TDS, water supply.

Chat Oriented Secure Workflow Orchestration Model for Reducing Tool Fragmentation in Collaborative Work Environments

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Abstract

Modern workplaces, particularly in the age of hybrid work, rely significantly on a variety of digital applications for scheduling, task management, communication, and document sharing. This results in disjointed workflows, frequent window switching, and decreased productivity. Data silos, cognitive fatigue, and context loss are the outcomes of this "tool fragmentation," often known as the "Toggle Tax." In order to overcome these obstacles, this study proposes a secure workflow orchestration system that uses chat as the main collaborative workspace. The suggested solution, which was created with the MERN stack (MongoDB, Express, React, Node.js), combines end-to-end encrypted messaging, task coordination, document management, meeting initiation, and AI-based debate summarisation into a single interface. Local Small Language Models (SLMs) provide privacy-preserving creation of Minutes of Meetings (MOM) directly on the client side, and a distinctive Drawer UI makes it easy to access tasks and documents without ever leaving the chat environment. Creating short-term, project-based groups that automatically dissolve upon project completion or inactivity, the technology reduces long-term clutter and enhances communication spaces. The proposal decreases tool fatigue, maintains discussion context, and increases productivity by enabling work-related actions to come straight from talks. The findings show that while preserving enterprise-grade security and data integrity, context-switching overhead may be greatly decreased by combining workflow and communication activities into a secure chat-based interface.

Keywords

Chat-Centric Workflow Orchestration, Tool Fragmentation, End-to-End Encryption (E2EE), Collaborative Work Environments, Secure Messaging Systems, Local AI Summarizations, Context-Aware Collaboration, Mern Stack Architecture.

Smart Crop Cultivation System Using IoT and Automation

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Abstract

Traditional farming methods lack real-time farming monitoring and wise resource management which results in wastage of water and lower crop productivity. This paper presents Smart Crop Cultivation System based on IoT which automates irrigation and uses soil moisture, temperature, humidity and air quality as environmental parameters to be monitored. The system operates by means of sensors connected with microcontrollers such as Arduino and ESP32 to gather real-time data and send it to a cloud (Firebase). Based on the sensor data, an irrigation is triggered automatically which reduces the manual effort and optimizes the water consumption. The system also offers real-time monitoring using a mobile application. This approach helps to increase the yield of crops, cut down waste of resources, and aid precision farming.

Keywords

IoT, Smart Agriculture, Automated Irrigation, ESP32, Arduino, Soil Moisture Sensor, Firebase, Real-Time Monitoring, Automation.

A Study on Carbon Credit Trade Mechanisms and its Impact on Environmental Sustainability

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Abstract

Climate change has become one of the most pressing challenges of our time, pushing governments and organizations to explore innovative ways to reduce carbon emissions. Among these efforts, carbon credit trading has emerged as a market-based mechanism designed to encourage environmentally responsible behavior by assigning economic value to emission reductions. This study examines the structure and functioning of carbon credit trade mechanisms and evaluates their effectiveness in promoting environmental sustainability.

The paper explores how carbon markets operate, including compliance and voluntary trading systems, and analyzes their role in incentivizing industries to adopt cleaner technologies. It also highlights key challenges such as regulatory gaps, price volatility, and issues related to transparency and accountability. Through a review of existing literature and secondary data, the study assesses whether carbon credit systems genuinely contribute to reducing greenhouse gas emissions or merely shift the burden across regions. The findings suggest that while carbon trading has the potential to support sustainable development, its success largely depends on strong regulatory frameworks, global cooperation, and accurate monitoring systems. The study concludes that carbon credit mechanisms can be a valuable tool in achieving environmental sustainability, but they must be continuously refined to ensure fairness, effectiveness, and long-term impact.

Keywords

Carbon credit trading, carbon markets, greenhouse gas emissions, environmental sustainability, climate change mitigation, emission reduction, cap and trade system, carbon pricing, sustainable development, regulatory frameworks, voluntary carbon market, compliance market, climate policy, emission allowances, carbon offsetting, global warming, environmental governance, market-based mechanisms.

CLARA: Multimodal Agentic AI System for Real-Time Adaptive Education

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Abstract

This paper introduces CLARA (Cognitive Learning Agent for Real-Time Adaptation) an innovative multimodal educational AI solution that establishes connections between fundamental mathematical education principles and abstract concepts that students do not comprehend. The agent provides an autonomous system which enables educational instruction through direct teaching methods that use visual diagrams and written content, but result in students developing learning habits without achieving actual conceptual mastery of subject matter. The system uses advanced large language models as its core reasoning engine to analyze multiple input types which include voice and text and hand-drawn sketches and document-based queries. The agent uses a context-aware orchestration framework to adjust explanation levels while monitoring student understanding and supporting their learning through Socratic dialogue and scaffolded teaching methods. The agent creates an on going human-like teaching process through its combination of real-time generative visualization and understandable audio narration which avoids delivering content through either fixed elements or disconnected parts. The research demonstrates that students need to overcome the abstraction barrier in STEM education through educational methods which depend on their perception-based learning process that takes place through adaptive educational systems.

Automated Brain Tumor Detection in MRI Images Using Convolutional Neural Networks

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Abstract

Brain tumors are considered one of the most dangerous kinds of cancer, requiring early detection to improve patient outcomes. This research proposes an approach for the automatic detection and classification of brain tumors using Convolutional Neural Networks (CNNs) from magnetic resonance imaging (MRI) images. This research utilizes the publicly available "Brain Tumor Data Set," which consists of a variety of images from MRI scans classified into tumor and non-tumor images. The images are divided into training, validation, and testing sets with a ratio of 70:15:15 to ensure comprehensive evaluation of the proposed system. The proposed system employs comprehensive data preprocessing techniques to improve the quality of images. The proposed CNN architecture is capable of learning hierarchical features from images, thereby distinguishing between healthy and tumor tissues. The proposed system is evaluated using TensorFlow, with optimized parameters to achieve high accuracy. The proposed system is found to achieve promising results with high accuracy, sensitivity, and specificity, outperforming traditional machine learning techniques. In addition, the study further discusses the effect of different architectural decisions and data augmentation techniques. Visualization of feature maps and classification results helps in understanding the thought process of the model. The study has demonstrated the potential of deep learning techniques, especially CNNs, in helping radiologists detect brain tumors quickly and accurately. For future study, the dataset will be extended, and multi-class classification for tumors will be included. Advanced deep learning architectures will be explored to improve accuracy. This study is a part of the increasing number of studies supporting the application of AI in medical image analysis for better patient care.

Keywords

Brain Tumor, MRI, Deep Learning, Convolutional Neural Network (CNN), Image Classification, Medical Imaging, Glioma, Meningioma, Pituitary Tumor, Supervised Learning, Data Augmentation, Multi-Class Classification, Computer-Aided Diagnosis, Artificial Intelligence, Image Preprocessing.

Design and Development of an Automated Spring Constant Measurement System

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Abstract

This paper presents the design, development, and implementation of an automated spring constant measurement machine developed by retrofitting an existing conventional spring testing system. The proposed system transforms a manually operated analog setup into a digitally controlled, accurate, and efficient measurement platform suitable for industrial quality control applications.

The system integrates multiple load cells of capacities 100 g, 700 g, and 5 kg to accommodate a wide range of spring stiffness values. A Raspberry Pi-based embedded system is used for control, data acquisition, and processing. The mechanical compression is achieved using a stepper motor-driven mechanism, enabling controlled and repeatable displacement.

Force and displacement are measured simultaneously and used to compute the spring constant in real time using Hooke's law. A PyQt-based graphical user interface provides live visualization of force, displacement, and stiffness, along with control functionality. Test data is stored in a PostgreSQL database, and barcode-based label printing ensures traceability in industrial environments.

Experimental validation demonstrates that the system achieves measurement accuracy within 2% of theoretical values and completes a full testing cycle in less than 10 seconds. The developed system significantly improves testing speed, repeatability, and data management compared to traditional methods.

Keywords

Spring Constant, Load Cell, HX711, Stepper Motor, Raspberry Pi, Automation, Industrial Testing.

A Person Re-Identification via Multi Feature Fusion with Adaptive Graph Learning

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Abstract

This Person re-identification (Re-ID) is a critical task in intelligent video surveillance that aims to match individuals across different camera views. This task is challenging due to variations in illumination, viewpoints, human poses, and occlusions. Traditional approaches relying on single feature representations often fail to capture complex appearance variations. To address this issue, this paper proposes a novel Re-ID framework based on multi-feature fusion with adaptive graph learning. The proposed method extracts diverse visual features, including color, texture, and semantic information, and fuses them to obtain robust and discriminative representations. Furthermore, an adaptive graph learning module is introduced to model relationships among person samples based on feature similarities. The graph is iteratively updated during training to learn context-aware representations. Experimental results demonstrate that the proposed framework improves matching accuracy and enhances performance under challenging surveillance conditions.

Keywords

Person Re-identification (Re-ID), Multi-feature Fusion, Deep Learning, Feature Representation, Graph Neural Networks, Visual Surveillance, Cross view Matching, Context-aware Learning, Human Identification.

Development of Integrated Inventory Optimization Model with Demand Forecast and Lead Time Uncertainty: Study Case from a Food Packaging Plant in Indonesia

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Abstract

In the food packaging industry, managing raw material inventory has become a challenge due to downstream demand volatility and supplier lead-time uncertainty. It frequently results in stockout or excessive inventory which is costly. Traditional forecasting methods often fail to capture structural demand shifts driven by planned external events. This research aims to develop an integrated inventory optimization model that combines advanced demand forecasting with inventory control to mitigate the risks of uncertain lead times. The data used in this research is historical material consumption from 2021-2025, the data is then evaluated using three frameworks: SARIMAX, ANN, and LSTM. The models also used exogenous variables of: Factory shutdown, Promotion buildup, and Plant effective working days. The best-fit model is then embedded into a continuous-review inventory simulation targeting a 95% service level under lead time variance of 0.5-1 months, which will give the order quantity and timing to maintain the required service level. Evaluation revealed that SARIMAX achieved the lowest Mean Absolute Error (MAE) for most of the datasets, showing excellence in capturing seasonal demand via the exogenous factors. Conversely, LSTM showed superior predictive accuracy specifically for dataset exhibiting complex. Non-linear demand patterns. The integrated inventory simulation showed the need to calculate safety stocks using forecast RMSE to prevent stockout risks from compounding over the extended supply horizons. This research concludes that while deep learning offers advantages for highly non-linear data, models such as SARIMAX, fortified with deterministic exogenous variables can provide a more robust solution for mid-term industrial inventory optimization.

Keywords

Inventory, forecast, lead time, uncertainty, optimization.

AI Driven Optimization Tools to Transform Millet into a Smart and Sustainable Future Food: A Conceptual Framework and Integrative Review

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Abstract

Millet is a climate resilient, nutrient dense cereal with significant potential to address global challenges related to food security, malnutrition, and sustainable agriculture. However, their large scale adoption remains constrained by low productivity, climatic variability, inefficient post harvest processing, and limited technological integration. This study presents a conceptual and integrative framework that examines how Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) techniques can be systematically deployed across the millet value chain—from seed selection and cultivation to harvesting and post harvest processing. Drawing on an extensive review of recent agricultural AI literature, the paper maps specific AI algorithms such as Genetic Algorithms, Convolutional Neural Networks, Long Short Term Memory networks, and ensemble learning models to distinct stages of millet production and processing. The proposed framework emphasizes precision farming, resource optimization, climate resilience, and supply chain transparency through blockchain enabled traceability.

The analysis demonstrates that AI enabled approaches have the potential to enhance yield stability, reduce post harvest losses, improve nutritional retention, and strengthen farmer livelihoods while aligning millet production with global sustainability goals. By consolidating fragmented research into a unified framework, this study contributes a structured foundation for future empirical validation and policy driven implementation of AI based millet farming systems.

Keywords

AI millet farming, Machine learning, Deep learning techniques, Sustainability metrics, Global food systems.

Simulation and Analysis of Post-Quantum Cryptography: Transitioning from RSA/ECC to Hybrid CRYSTALS-Kyber Architectures

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Abstract

The imminent advent of large-scale fault-tolerant quantum computing presents a catastrophic risk to the global cryptographic infrastructure. Widely deployed Public Key Cryptography (PKC) standards, specifically RSA and Elliptic Curve Cryptography (ECC), rely on integer factorization and discrete logarithm problems. These mathematical foundations, while intractable for classical architectures, are solvable in polynomial time by quantum processors utilizing Shor's Algorithm. With the "Harvest Now, Decrypt Later" strategy employed by adversaries, a transition to quantum-resistant standards is required immediately. This paper presents a comprehensive simulation framework demonstrating the "Quantum Threat" and validates the efficacy of Post-Quantum Cryptography (PQC). A modular web application was developed to simulate a quantum attack on RSA encryption, effectively deriving private keys through period finding. Subsequently, the NIST-standardized CRYSTALS-Kyber (ML-KEM-768) algorithm was implemented to demonstrate resistance. Results confirm that while classical algorithms fail under simulated quantum adversary conditions, the lattice-based Kyber algorithm maintains confidentiality. Furthermore, this study analyzes the performance overhead of hybrid ECC+Kyber handshakes, integrating true quantum backend connectivity via Qiskit, and outlines the energy efficiency and memory footprint required for constrained environments.

Keywords

Quantum Computing, Post-Quantum Cryptography (PQC), RSA, Shor's Algorithm, CRYSTALS-Kyber, ML-KEM-768, Network Security, Lattice-based Cryptography, Hybrid Handshake.

AI Against Fraud Revolutionizing Financial Transaction Security

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Abstract

Financial fraud within digital banking platforms continues to increase in scale and complexity, driven by high-volume transactional data and evolving adversarial behaviors. Traditional supervised learning techniques require large, accurately labeled datasets, which are often unavailable in real-world financial environments. This limitation has motivated the adoption of unsupervised anomaly detection approaches. In this study, we present a comprehensive fraud detection framework that leverages Isolation Forest for unsupervised anomaly identification in bank transaction data, supported by extensive feature engineering, skew-aware transformations, temporal behavior extraction, and interactive visualization.

The proposed system begins with an advanced preprocessing pipeline that converts timestamp information into meaningful cyclic and temporal features, including Hour, Month, Day-of-Week, UnixTime, Time-Since-Last-Transaction, and sinusoidal encodings capturing periodic patterns. To address the heavy tailed and zero-inflated nature of financial variables, we apply a skew-handling methodology that incorporates Yeo-Johnson transformations, logarithmic scaling, and binary sparsity indicators. These transformations reduce distributional irregularities and enhance the Isolation Forest's ability to separate normal and anomalous behaviors. The core anomaly detection module employs the Isolation Forest algorithm to compute anomaly scores and classify suspicious transactions. A two-dimensional PCA projection is then used to visualize separability between normal and fraudulent instances, enabling interpretable inspection of model behavior. Additionally, a 3×3 fraud-behavior dashboard provides multifeature comparisons—including transaction amount, customer age, transaction type, channel usage, occupation, account balance, and regional patterns—highlighting structural differences between normal and anomalous groups.

To support real-world deployment and user interaction, the entire pipeline is integrated into a Streamlit-based application that accepts raw banking datasets, performs end-to-end preprocessing, trains the Isolation Forest model, and generates visual analytics in real time.

Overall, the proposed system provides a scalable, interpretable, and data-driven approach for detecting fraudulent financial transactions without requiring labeled data, making it suitable for modern digital banking ecosystems.

Digital Front Desks in Healthcare: Adoption, Architecture, and Growth of eKiosk Systems

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Abstract

The escalating burden on global healthcare infrastructure has created a strong need to shift from traditional, labor intensive reception systems to automated and patient centric digital front desks. This research paper examines the adoption, technical architecture, and future scope of hospital eKiosk systems, which act as a primary interface in this transformation. Increasing patient volumes, frequent overcrowding, administrative inefficiencies, and the demand for contactless services in the post pandemic era have accelerated the need for such solutions.

Hospital eKiosks combine robust industrial hardware with advanced software frameworks to streamline patient interactions. These systems are designed using a multi layered architecture that includes components such as IoT based input mechanisms, application processing layers, and secure data management systems. The study also explores how eKiosks integrate with national healthcare initiatives like Ayushman Bharat Digital Mission, enabling better patient identification, record management, and interoperability across healthcare providers.

From a Computer Science perspective, the research focuses on efficient data handling techniques, including structured database design using Entity Relationship models and the adoption of standardized healthcare data exchange protocols such as HL7 FHIR. These technologies ensure accurate, consistent, and secure data flow within the system while maintaining scalability and flexibility. In addition to the technical analysis, the paper highlights current market trends and growth potential. The Asia Pacific region shows significant expansion due to increased digital awareness, government support, and improvements in healthcare infrastructure. The study concludes that hospital eKiosks are not just supplementary devices but essential components of modern smart hospitals. They enhance operational efficiency, reduce waiting times, and provide a more personalized and accessible healthcare experience for patients.

Keywords

eKiosk, Smart Hospitals, Digital Healthcare, Patient Engagement, Hospital Automation, Self-Service Systems.

A Wavelet Vision Transformer for Cost-Efficient Multi-Modal Image Fusion

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Abstract

Multi-modal image fusion will play a critical role in synthesizing essential information from diverse sensor modalities to generate informative and coherent visual representations. This capability will be pivotal in applications such as autonomous driving, medical diagnostics, and remote sensing, where rapid and accurate fusion is required. However, achieving a balance between computational efficiency and effective feature extraction, while ensuring robust integration of salient cross-modal features, will remain a key challenge. Additionally, a dual-aggregation attention mechanism will be used to enhance both inter-modal complementarity and intra-modal coherence. A dynamic saliency-informed selective loss function will further optimize the training process by prioritizing critical feature retention and promoting visual consistency across modalities.

Wave Fusion will be evaluated on diverse tasks including infrared-visible and medical image fusion. Experimental results are expected to validate its superior performance in both fusion quality and computational cost-efficiency, while also improving downstream tasks such as multi-modal object detection and semantic segmentation.

Glacier Growth Detection and Risk Assessment System Using YOLO Segmentation and Computer Vision Technology

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Abstract

Glaciers are among the most reliable indicators of climate change, and tracking their growth or retreat over time is essential for environmental monitoring and hazard assessment. This paper presents a glacier growth detection and risk assessment system that uses a YOLO-based segmentation model to analyse two satellite images of the same glacier taken at different points in time. The system compares the images at the pixel level to separate glacier regions into three categories: areas that remained stable, areas that grew, and areas that retreated. From this comparison, it computes key metrics including initial area, final area, growth area, decrease area, and net growth percentage. Risk is then classified into three levels – Low, Medium, and High – based on growth percentage thresholds of 25% and 60%, giving users a straightforward and interpretable hazard indicator rather than a black-box prediction. The segmentation model achieves a precision of 0.92, a recall of 0.90, and an IoU of 0.88 on glacier boundary detection. The system is deployed as a web application using the Streamlit framework, with user authentication, persistent analysis storage, and historical trend visualisation built in, making it usable for long-term multi-user monitoring without requiring specialised GIS software or remote sensing expertise.

Keywords

Glacier Growth Detection, YOLO Segmentation, Image-Based Analysis, Climate Monitoring, Risk Assessment, Streamlit Application.

Blockchain Technology in Healthcare

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Abstract

Blockchain has emerged as one of the promising paradigms to deal with patient issues in healthcare information systems, such as data fragmentation, sequestration leakage, absence of interoperability, and limited control of cases over electronic health records (EHRs). In this paper, I put forward a mongrel institute-blockchain armature that incorporates out-chain translated storehouse, smart-contract-based concurrence operation based on non-transferable patient credentials, sequestration-saving analytics, and nonsupervisory inspection mechanisms to empower secure multi-institutional data sharing. This study investigates how consortium-governed hybrid on-chain/off-chain blockchain architectures can improve scalability, security, and regulatory readiness in healthcare data ecosystems. The aim of this work is to design, implement, and experimentally evaluate a patient-centric blockchain framework under realistic electronic health record and Internet-of-Medical-Things workloads. This is inspired by recent checks and case-centric token fabrics and the system is implemented as an experiment over distributed sanitarium nodes and estimated to run under realistic EHR and Internet-of-Medical-Effects workloads. The experimental outcomes indicate superior outturn, lower sale expenses, and managed tally growth over previously implemented public-chain designs, and with no loss of robust security assurance by multi-factor authentication and inflexible access logs. Comparative examinations to existing blockchain-enabled healthcare systems show gains in governance support, nonsupervisory preparedness, and scalable data processing, with remaining obstacles in clinical execution, interoperability with legacy systems, and computaional outflow of translated analytics. The results imply that institute governance together with mongrel on-chain/off-chain designs can considerably promote the practicability of blockchain relinquishment in healthcare and they encourage unborn massive airman deployments, adaptive agreement protocols, and legal-specialized co-design fabrics to enforce civil healthcare designs.

Keywords

Self-supervised learning, electronic health records, tabular data, early disease detection, clinical prediction, sparse data, representation learning, healthcare AI.

Skillbridge – Micro Internship & Skill Matchmaking Platform

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Abstract

The employment landscape is evolving rapidly, demanding practical skills and work-ready graduates. Traditional internships often fail to provide flexible, verified, and accessible learning opportunities for all students. This research introduces SkillBridge, a web-based platform designed to connect students with short-term, mentor-guided micro-internships based on verified skills.

The system leverages AI-based skill matching, adaptive profiling, and real-time feedback mechanisms to enhance employability. Built using the MERN (MongoDB, Express.js, React.js, Node.js) stack, SkillBridge integrates digital badges via the Open Badges API to provide verifiable credentials.

This paper discusses the motivation, architecture, algorithmic approach, implementation details, and evaluation metrics used to validate the system. Experimental results show that SkillBridge improves internship matching accuracy, engagement levels, and satisfaction from both students and mentors compared to conventional keyword-based methods.

Keywords

Skill Matchmaking, Micro Internship, Mern Stack, Talent Acquisition, AI Matching Algorithm, Digital Badges, Online Learning Platform.

AI-Driven Medical Image Diagnosis Using Optimized CNN and MobileNetV2 with Cloud Integration

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Abstract

The increase in the volume of medical images has led to an increase in the complexity of manual medical diagnosis. This is because the conventional methods of analyzing medical images are time-consuming and prone to human error. This research aims to design and implement an artificial intelligence-based medical diagnosis system that uses deep learning techniques to automatically diagnose diseases using medical images. The proposed method uses a combination of Convolutional Neural Networks (CNN) and MobileNetV2 to perform efficient and accurate image classification. Medical images are retrieved from a cloud-based dataset and preprocessed using resizing, normalization, and augmentation techniques. The system is trained using labeled data to perform multi-class classification of diseases. MobileNetV2 is used as the primary feature extractor due to its efficiency and low computational complexity. The system integrates convolutional and fully connected layers with a SoftMax classifier to provide accurate predictions. Overall, the proposed model improves diagnostic accuracy, reduces manual effort, and supports scalable healthcare solutions through cloud integration.

NLP Based Smart E-Learning Platform

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Abstract

Traditional e-learning platforms often deliver a static, one-size-fits-all educational experience, failing to cater to individual student needs and learning paces. This limitation can lead to decreased engagement and suboptimal learning outcomes. This paper proposes a novel framework for a smart e-learning platform that leverages advanced Natural Language Processing (NLP) techniques to create a dynamic, personalized, and interactive learning environment. The core of our system utilizes state-of-the-art Transformer-based models, such as BERT and T5, to enable three key functionalities: automatic question generation from educational texts, abstractive text summarization for concise content review, and intelligent scoring and feedback for student responses. We detail the system architecture, the NLP pipeline, and the methodologies for training and fine-tuning the models on educational datasets like the Stanford Question Answering Dataset (SQuAD) and various open-source text corpora. The objective is to automate formative assessment, provide immediate, meaningful feedback, and adapt learning pathways to individual student performance, thereby enhancing both the efficiency and effectiveness of online education.

Keywords

Natural Language Processing (NLP), E-Learning, Personalized Learning, Transformer Models, Bert, Automated Assessment, Question Generation, Text Summarization.

Threat Intelligence-Driven IP Threat Detection, Analysis, and Visualization Platform

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Abstract

DDoS attacks are among the most critical threats to the current network infrastructure and disrupt the service availability by bombarding targets with significant amounts of malicious traffic. Conventional threshold-based tools and signature-based detection tools have difficulties with detecting the changes in attack patterns and zero-day variants. This paper presents DDoS Watch, an intelligent, multi-layered detection and analysis platform that integrates machine learning-based IP threat classification, external threat intelligence, and interactive visualization. Unlike prior approaches that rely on pre-built benchmark datasets, this work constructs a custom ground-truth dataset of 5,000 IP addresses like 2,500 malicious from IPsum, Feodo Tracker, and Blocklist.de; 2,500 low-risk from curated domains and the Tranco top-100K list enriched with infrastructure metadata from Team Cymru, Shodan InternetDB, and reverse DNS. A binary XGBoost classifier trained on 38 transformed features achieved a ROC-AUC score of 0.9882 and a Brier score of 0.0354, outperforming Random Forest (ROC-AUC 0.9852) and Logistic Regression (ROC-AUC 0.9742) baselines. Leakage-aware validation using /24-grouped train-test splitting and 5-fold StratifiedGroupKFold cross-validation, followed by a compact grouped hyperparameter search, confirmed robust generalization. A three-band decision system maps model probabilities to low-risk, monitor, and high-risk operational categories with 95%+ purity in the extreme bands. In this work, low-risk does not imply guaranteed benign behavior; it denotes infrastructure associated with ordinary, legitimate public services at collection time. The system further incorporates live IP reputation scoring from AbuseIPDB, global DDoS trend intelligence from Cloudflare Radar, and geolocation and ownership context from ipwho. The platform is deployed as a modular, service-oriented web application with an interactive visualization dashboard, providing almost real-time situational awareness and decision support for network security analysts.

Keywords

DDoS detection, machine learning, XGBoost, threat intelligence, IP reputation, network security, custom dataset construction, three-band decision system, leakage-aware validation.

Regulatory-Compliant XAI for Insurance Fraud Detection: A Quantitative Evaluation of SHAP and LIME Interpretability

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Abstract

The rapid adoption of complex, non-linear machine learning models in insurance fraud detection has significantly improved predictive accuracy but introduced a “black-box” challenge that conflicts with emerging regulatory mandates. Under the EU AI Act and GDPR, insurance providers must ensure that automated decisions are transparent, non-discriminatory, and auditable. This paper presents a rigorous quantitative evaluation of two leading model-agnostic Explainable AI techniques: SHAP and LIME. Using a highly imbalanced real-world insurance fraud dataset, we evaluate these methods across four key dimensions: fidelity, stability, sparsity, and regulatory alignment. Our results demonstrate that while LIME offers computational efficiency and sparser explanations suitable for end-user communication, SHAP provides superior mathematical stability and consistency required for legal audit trails. We further propose a standardized framework for integrating XAI into production insurance systems to ensure compliance with the “Right to Explanation” while maintaining high detection performance. This study provides a foundational benchmark for actuaries and compliance officers to select appropriate interpretability tools in high-stakes financial environments.

Keywords

Explainable AI (XAI), Insurance Fraud, SHAP, LIME, Regulatory Compliance, Machine Learning.

Ethical Recruit: An Auditing System for Algorithmic Fairness

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Abstract

A machine learning approach to recruitment is becoming increasingly automated, but issues related to bias and fairness remain critical. This paper presents Ethical Recruit, an auditing system designed to ensure transparent and unbiased hiring. The system uses the XGBoost algorithm to predict candidate selection based on multiple attributes such as age, gender, education, and performance. The model achieves an accuracy of 98.29% while maintaining fairness by evaluating bias across sensitive features. The results show balanced precision, recall, and F1-scores, ensuring fair decision-making. This system helps organizations make ethical, data-driven hiring decisions while promoting diversity and inclusivity.

Keywords

Algorithms, Fairness in AI, Recruitment System, XGBoost, Bias Detection, Hiring Automation.

HomeMind: An AI-Based Smart Home Automation System Using Natural Language Processing and Voice Interaction

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Abstract

In this paper, we present a hybrid natural language processing (NLP) pipeline named HomeMind to enable natural language control of household devices in smart home environments. This system combines several NLP tools to classify user intents (rule-based intent classification via regular expressions), extract user entities (spaCy), detect user's emotions (Transformer-based emotion detection using DistilRoBERTa), and generate responses for ambiguous commands (Flan-T5 fallback). HomeMind supports voice interaction in multiple languages across six different languages and does not require the use of proprietary cloud-based NLP services to provide transparency and offline capability to users. The full-stack implementation of HomeMind consists of a React-based dashboard, a FastAPI backend, and utilizes JWT with OTP verification for secure authentication. Additionally, HomeMind provides real-time energy analytics, and has eight predefined automation modes for use among several rooms and devices. The HomeMind framework has been evaluated with a dataset of 600 annotated utterances belonging to 11 different intent categories. Results show a macro F1-score of 0.797 and an end-to-end accuracy of 0.652 with an average processing time of 0.201 seconds per command processed. Based on the results of this study, the hybrid approach achieved a balance between interpretability and performance thus making it a promising candidate for transparent and customizable smart home environments. Future work will include benchmarking against fine-tuned transformer-based models and advancing to multi-intent understanding.

Keywords

Smart home automation, natural language processing, voice interaction, hybrid NLP, IoT, explainable AI, energy analytics.

Multi-Metric Ensemble Model for Real-Time Driver Drowsiness Detection Using EAR, PERCLOS, and Yawning Analysis

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Abstract

The prevalence of driver fatigue as a factor in road accidents has been well researched. This paper proposes a multi-metric ensemble model that enables the real-time detection of drowsiness using computer vision and deep learning. The single metric-based systems currently available are adversely affected by variations in lighting conditions and differences in people's faces. The system based on multiple metrics (EAR, PERCLOS and yawning analysis) provides accurate drowsiness detection.

The system utilizes cameras and a CNN based architecture to produce facial feature extraction with higher accuracy. With the model having been trained using the MRL Eye dataset, YawDD, and Eyeblink databases the detection rate is demonstrated through significant enhancement of detection sensitivity and specificity. Novelty comes from the integration of multiple metrics rather than the individual metrics traditionally used; therefore, there are fewer false-positives and negatives compared to the traditional system. Once drowsiness is detected, an immediate auditory and visual alert will occur. The system is cost-effective; has high computational efficiency; and can be easily integrated into a vehicle's infotainment system as well as deployed within an intelligent transportation network. The proposed ensemble method establishes a new standard for real-time drowsiness detection for all levels of autonomy, including semi-autonomous driving.

Smart Emergency Chain – AI Based Automatic Accident Detection Ambulance Dispatch and Hospital Readiness System

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Abstract

Road traffic accidents remain a major cause of fatalities and injuries worldwide, where delayed emergency response significantly increases the risk of loss of life. This paper presents a **Smart Emergency Chain – AI Based Automatic Accident Detection Ambulance Dispatch and Hospital Readiness System** designed to automatically identify traffic accidents in real-time using computer vision and machine learning techniques. The system uses deep learning and computer vision to analyze images or video frames, detect accidents, and assess severity in real time.

It integrates a FastAPI-based AI module with a Spring Boot backend for efficient data handling and emergency coordination. The proposed system achieves high accuracy with low latency, enabling faster response and improved patient outcomes. This approach enhances road safety and supports future integration with intelligent systems.

Keywords

Accident detection, computer vision, machine learning, real-time alerting, Fast API, Spring Boot, emergency response, deep learning, road safety, intelligent transportation systems, REST API, severity assessment.

Correlation Between the Cheiloscopy and Dactyloscopy Patterns in Young Adult Population

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Abstract

Human identification remains a crucial aspect in forensic science, utilising biometric identifiers that play a vital role in personal recognition. Fingerprints (dactyloscopy) are well established due to their permanence and individuality. In contrast, the lip prints (cheiloscopy) had emerged as a complementary identifier (tool) owing to their unique groove patterns. The present study, titled **“Correlation Between Cheiloscopy and Dactyloscopy in Adult Population,”** aims to find the possible significant association between the lip print patterns and fingerprint types in individuals aged between 18 and 25 years.

This observational cross-sectional study involves a sample size of 100 participants. The lip prints are collected using lipstick and cellophane tape, and then they are classified based on the Suzuki and Tsuchihashi classification system. While the fingerprints are recorded using ink methods, and categorized according to the Henry classification system. The analysis includes the statistical analysis, primarily the Chi-square test, which is employed to evaluate the presence of any significant correlation between the two biometric identifiers.

This study explores whether any predictable relationships exist between lip print patterns and fingerprint types. That can increase the reliability of human identification in forensic investigations. Such a correlation, if exist, it may be particularly useful in cases where one form of evidence is unavailable or partially recovered.

The study summarises the potential of integrating cheiloscopy with dactyloscopy as a multimodal biometric approach, thereby strengthening forensic identification methods.

Keywords

Cheiloscopy, Dactyloscopy, Lip prints, Fingerprints, Forensic identification, Biometric correlation, Statistical analysis.

Utilization of Construction Waste Materials for Green and Sustainable Concrete Development

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Abstract

The aim of this project is to create environmentally and sustainable concrete by partially substituting ingredients with 'rice husk ash' and building materials. To assess its durability and strength in relation to traditional concrete.

Keywords

Sustainable, rice husk, durability, traditional.

Knee Osteoarthritis Severity Assessment Using Knee X-Ray Images

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Abstract

Knee osteoarthritis (OA) is prevalent worldwide, and its signs include deterioration of the cartilage between the joint surfaces, degradation of the underlying bone, and discomfort from the condition, which affects a large number of people. Accurate assessment (grading) and proper grading of the disease will allow for better management of the condition in a clinical setting; therefore, it is important to find and develop techniques that will help clinicians provide an accurate and timely assessment of The overuse of the joint is a problem. Having bone density and weak muscles is also not good. Doctors look at the patients condition based on a knee OA severity scale. This research is about finding ways to help with this problem. People with OA have joints. OA mostly affects the joints that carry our weight like the knees and hips. A lot of people have OA in the knees and hips. We want to use learning technology to help with this. We will use something called neural networks or CNNs, for short and X-ray images to figure out how bad the knee OA is and we want to do this automatically using these X-ray images and knee OA is the main thing we are looking at. We further investigate a variety of CNN architectures, such as MobileNet and InceptionV2, among other architectures. The results from the performance of these two models validate that these CNNs can classify knee OA severity and demonstrate that our systematic methodology and processes can be utilized as a definitive and accurate health assessment for knee OA. As a result, this research shows how deep learning can be utilized to increase diagnostic accuracy in the diagnosis of knee OA, allowing for improved clinical decisions to be made.

Keywords

Knee osteoarthritis, severity grading, MobileNet, DenseNet, InceptionV2.

Linearity Analysis of a Three Step AlGaIn/GaN HEMT for 6G Applications

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Abstract

As the evolution towards sixth generation (6G) wireless communications continues to grow in magnitude, there is a need for higher frequency semiconductors with improved linearity and power-added efficiency. In this paper, a detailed investigation of linearity improvement on a three-step gate field plate (FP) AlGaIn/GaN HEMT is presented. With the use of TCAD physical simulation, a depletion mode AlGaIn/GaN HEMT with a threshold voltage (V_{th}) of -2.5V was calibrated and optimized using a triple-stage FP design structure. In order to ensure optimal operation, the multi-stage FP design has been deliberately simulated to minimize the gate electric field and spread out the potential in the drift region. Studies have shown that the three-stage modulation technique considerably minimizes the field-dependent trap phenomenon and gate-drain capacitance nonlinearity. This paper mainly concentrates on optimizing the extrinsic transconductance flatness and lowering the third-order intermodulation distortion (IMD3). These parameters are essential in implementing the sophisticated modulation techniques needed for 6G communication systems. This new design presents outstanding results, especially concerning the higher value of the gate swing voltage and better breakdown characteristics compared to the conventional single FP structure. By eliminating the electric field concentration problem, the three-step AlGaIn/GaN HEMT provides the best possible option for mm-wave front-end components with great linearity and power handling ability.

Assessment of Indoor Thermal Comfort in Alternative Construction Techniques: A Case of Lighthouse Projects in Indore and Ranchi, India

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Abstract

This research studies indoor thermal comfort in alternative construction techniques of prefabricated housing in India. With rapid urbanization, prefabrication is widely used for affordable housing due to its speed and efficiency. The intent of this study is to evaluate how these houses perform in real conditions and to understand the gap between designed and experienced comfort, while exploring ways to improve livability. The study focuses on Light House Projects in Indore and Ranchi constructed under government pmya yojana, both located in composite climates but using different construction systems. Indore uses an EPS sandwich panel system, while Ranchi uses 3D volumetric precast construction. The methodology includes field measurements, occupant surveys, and simulations. Temperature, humidity, and air velocity were recorded in selected units across multiple floors. Simulation tools like DesignBuilder and Grasshopper were used to compare predicted and actual performance. The study is based on adaptive thermal comfort theory and evaluates passive design factors such as orientation and ventilation. The findings show that prefabricated systems do not always ensure comfort. A clear gap exists between simulated and real performance, highlighting the need for better integration of passive design strategies in affordable housing with the emerging of new construction techniques.

A Fragment Oriented Approach to Pipeline Optimization by Subscalar Computing for RISC-V

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Abstract

The target of present work is to explore and implement sub scalar computation to enable execution of operations at fragment-level. While traditional scalar processors operate on complete data words, Sub-scalar architectures decompose operations into smaller fragments that execute sequentially while allowing dependent instructions to overlap. This paper presents the design of a Sub-scalar RISC-V processor supporting the RV32IMAC instruction set architecture. The promoted process or decomposes the 32-bit operands into decided set of valency fragments in the set of valency-4, 8, and 16. And executes them across a valency-stage pipeline consisting of Fetch and Fragment Decode, Fragment ALU and Short Operations, Memory and Atomic Memory Operations (AMO) Unit, and CSR Writeback and Commit stage. The architecture provides integer, memory, atomic, and control operations while preserving ISA compatibility. The design demonstrates how fragment execution can improve instruction-level data flow while maintaining architectural correctness. The proposed architecture improvises a scalable framework for implementing Sub-scalar computation in open instruction set processors.

Automatic Road Damage Extraction and Alert Generation

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Abstract

The road infrastructure monitoring system uses its two main functions to enhance traffic safety while it reduces expenses for road repairs. The project develops an automated system that uses deep learning technology to identify road damage through the combined application of YOLOv9 and Detection Transformers (DETR) algorithms. The Roboflow Road Damage Detection dataset includes seven types of road damage, which the model uses to identify alligator cracking, edge cracking, longitudinal cracking, transverse cracking, patching, potholes, and rutting. The system uses high-resolution road images to perform real-time surface defect analysis because YOLOv9 enables object detection while DETR-based models extract features and perform classification. The researchers can study the road extraction process because it creates road sections that they can study with complete focus. Damage assessment establishes permanent maintenance recommendations through its ability to assess both the damage extent and the damage type. The system shows major progress in inspection speed compared to traditional manual inspection methods. Django uses Google Colab as its training and inference platform, while Python operations run on the platform and results display through its front end. The system uses an automated alert mechanism that sends email alerts to the administrator when it detects vital damages because this allows for immediate action and scheduled maintenance work.

Keywords

Road Damage Detection, YOLOv9, DETR, Deep Learning, Road Extraction, Pothole Detection, Alert Notification System, Python, Smart Infrastructure.

Rapid Construction Solutions for India's Mass Housing: Designing Repeatable Precast Infill Modules for Affordability and Scalability

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Abstract

With the increasing Demand of urbanization in India, As more and more people move to cities in India, there is an ever-growing need for faster, efficient, and scalable construction technologies. But due to the labour-intensive and time-consuming nature of traditional construction technologies, they fail to keep up with the demand for inexpensive buildings. In order to overcome the problems related to speed, there have been newer construction technologies proposed such as precast and semi-prefab methods. With regard to mass housing constructions, AAC block technology has become the most common technology due to its lightweight and ease of workability. However, the current AAC technology used for fabricating the blocks involves cutting of the blocks, inserting the reinforcements, and installing electrical components, all of which increase labor cost and extend time period of the construction. In the current research, a modular wall made from AAC blocks is proposed with niches incorporated into the module design to lower the weight of the whole block system and improve its workability and performance. The niches will improve thermal and acoustic performance and allow for incorporating the reinforcements and electrical installations without additional labour. In addition to functional improvement, The wall will be a way to express yourself because it can have niches built into the outside and inside of the building. The current research has entailed the development of a full-size (1:1) scale prototype using the AAC material in cooperation with the industry partner Phenix Procon company in Bagodara. Various improvements for the AAC technology were considered such as steel chicken mesh reinforced, fiber chicken mesh reinforced and non-reinforced AAC. Basic tests were performed, including lifting, edge, and handling.

Keywords

Pre-cast modules, rapid construction, modular construction, mass housing and product development.

Agricultural Pest Classification Using Deep Convolutional Neural Networks and Transfer Learning: A Comparative Study of Custom CNN and EfficientNetB4

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Abstract

Agricultural pest management is a persistent challenge that directly impacts crop yield and food security across the globe. Timely and accurate identification of pest species is essential for reducing the dependence on indiscriminate pesticide use and enabling targeted, eco-friendly interventions. This paper presents a deep learning-based pest classification system that compares two distinct architectural strategies: a custom-designed five-block Convolutional Neural Network (CNN) trained from scratch and a fine-tuned EfficientNetB4 model trained with transfer learning from ImageNet weights. The dataset comprises 4,602 images distributed equally across six agriculturally significant pest classes, namely aphids, beet army worm, blister beetle, *Cicadella viridis*, Cicadellidae, and corn borer. Both models are trained using the AdamW optimizer coupled with a Cosine Annealing learning rate schedule and Automatic Mixed Precision (AMP) for computational efficiency on an NVIDIA RTX 3050 Ti GPU. The custom CNN, trained over 30 epochs, achieves a peak validation accuracy of 56.23%, while the EfficientNetB4 transfer learning model, trained over only 20 epochs, achieves 86.23% validation accuracy – a margin of approximately 30 percentage points. The experimental results confirm that transfer learning with a compound-scaled backbone significantly outperforms a custom-built CNN for fine-grained agricultural image classification, especially under constrained dataset sizes. The proposed system provides a reliable, computationally efficient, and practically deployable solution for real-time pest detection in precision agriculture environments.

Smart UV Based Room Sanitization System

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Abstract

In recent times, the global health issue has revealed the importance of finding proper methods of disinfecting spaces indoors like hospitals, offices, and school institutions. Traditional methods of sanitization are highly dependent on manual chemical spray which might be ineffective, cumbersome, and hazardous to the user performing it. This research highlights a smart sanitization system through utilization of UV-C radiations for dynamic/real-time sanitization. The sanitization method involves a microcontroller unit embedded with built-in safety mechanisms; motion detector and intensity detector. Various sensors, display units, and wireless communication facilitate the task by allowing the user to perform real time monitoring activities and maintain data logging within the sanitization period. From experimental analysis, it can be confirmed that the smart sanitization system is able to perform at a faster rate than a manual method, taking minutes to accomplish while at the same time ensuring that the user is safe by having automatic shutting-off components. Thus, from the results, the sanitization system provides a feasible mechanism of providing exposure of controllable UV-C radiation for food microbial treatments within hospitals, laboratories, offices, and home use porch surfaces.

Keywords

UV-C Disinfection, Smart Sanitization, IoT, Automation, Room Hygiene.

Deep Learning–Based Severity Grading of Knee–Osteoarthritis Using X-Ray Images

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Abstract

Knee osteoarthritis (KOA) is a common degenerative muscle and skeletal disorder that significantly contributes to pain and functional disabilities worldwide. Radiographic imaging, especially X-rays, is widely used to clinically assess the severity of the disease; however, standard classification methods such as the Kellgren–Lawrence (KL) scale are manual in nature, inherently subjective and often exhibit variability between observers, especially in early and medium-term stages of the disease. In order to overcome these limitations, this study proposes an automated, deep-learning framework for estimating the severity of knee radiographics. A number of convolutionary neural network (CNN) architectures have been systematically evaluated, including the conventional CNN model, VGG16, ResNet50V2, Xception, EfficientNet variants (B0 and B3), MobileNetV3Small, and a hybrid ResNet architecture. Experimental analysis showed that the hybrid ResNet model and several base architectures produce relatively lower performance. In contrast, DenseNet-based models (DenseNet121 and DenseNet201) along with MobileNetV3Small showed superior and more stable classification performance. DenseNet architecture, with its dense interlayer connectivity, facilitates improved characteristics propagation and reuse, allowing the model to effectively capture subtle radiographic patterns associated with osteoarthritis progression. Similarly, MobileNetV3Small achieved competitive accuracy by maintaining computational efficiency due to its lightweight design. Overall, the results indicate that DenseNet-based and MobileNet-based approaches provide a robust, objective and scalable solution for automating the assessment of KOA severity from X-ray images, with potential clinical application.

Keywords

Knee osteoarthritis, deep learning, convolutional neural networks, radiographic image analysis, DenseNet, MobileNetV3Small, EfficientNet, ResNet, X-ray classification, Kellgren–Lawrence grading, medical image classification, computer-aided diagnosis.

A Public Infrastructure Model Involving Blockchain Technology for Direct Farm-To-Consumer Supply Chains in India

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Abstract

India's paddy supply chains are characterised by deep-rooted intermediation that suppresses farm-gate price realisation smallholders typically capture only a fraction of the final consumer price while simultaneously inflating consumer costs through opaque, multi-tier handling. This paper proposes a dual-layer, direct-to-consumer (D2C) framework designed to address these structural inefficiencies. The first layer is a permissioned blockchain transparency system that records immutable, end-to-end provenance from cultivation plots to retail, enforces role-based access control, and executes incentive-compatible smart contracts for near-real-time farmer settlement. The second layer is a Hyperlocation Engine that optimises physical logistics through a six-stage pipeline employing H3 spatial indexing, DBSCAN demand clustering, Haversine-based K-Nearest Neighbour asset matching, multi-criteria route scoring, Vehicle Routing with Time Windows (VRPTW), and Capacitated Facility Location Problem (CFLP) optimisation for micro-hub siting. Simulation on a 25-farm dataset (Nandyal and Guntur districts, Andhra Pradesh), calibrated against published benchmark data, yielded a 32.4% route-efficiency gain, a 33.1% reduction in average delivery time, a 30.5-percentage-point improvement in farmer price share (48.7% → 79.2%), and a 24.7% logistics cost reduction through CFLP-guided hub placement. These simulation-based estimates, calibrated against government and academic benchmarks, demonstrate the architectural feasibility of the proposed system as a foundation for scalable, trust-augmented agri-food D2C networks in India; field validation is identified as the essential next step.

Keywords

Blockchain, Public Distribution System (PDS), Agri-tech, E-commerce, Smart Contracts, Rural Logistics, Azure Confidential Ledger, Farm-to-Consumer Model, Supply Chain Transparency, Government Infrastructure, FPO.

A Data-Driven Sales–Criticality–Inventory (SCI) Framework for Pharmaceutical Inventory Classification with Machine Learning Validation

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Abstract

The pharmaceutical distributors need to have efficient inventory management that will reduce the operational costs without causing any shortage of medicine. The conventional methods of inventory classification like ABC Analysis, VED Analysis mostly subdivide drugs according to cost and clinical significance but does not consider the volatility of demand and inventory exposure in the distribution channels. This paper presents a Sales–Criticality Inventory (SCI) framework as a suitable proposal that can enhance inventory classification of a pharmaceutical distribution firm that operates in Kerala. The research on one-year pharmaceutical inventory transactional data of 31,524 stock-keeping units (SKUs) is examined. Preprocessing of data involves calculation of seasonal demand index, normalization of features and calculation of key measures like Adjusted Sales Variance (ASV), Coefficient of Variation (CV) and Days-On-Hand (DOH). The framework categorizes inventory into four operational classes: Urgent Reorder, Monitor, Maintain, and Overstock. Statistical validation using ANOVA and Kruskal–Wallis tests confirm significant differences across categories, while machine learning models, particularly XGBoost, demonstrate strong predictive performance. Those findings show that the SCI framework offers a more comprehensive and data-intensive solution than the traditional ABC–VED classification, which allows making better decisions related to replenishment and minimized stock outs and surplus inventory in pharmaceutical distribution networks.

Keywords

Pharmaceutical Inventory Management, Supply Chain Analytics, SCI Framework, Demand Variability, Machine Learning, ABC–VED Analysis Integration.

A Hybrid Intelligent Decision Support System for Higher Education Recommendation

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Abstract

As a result of the impressive growth of global higher education opportunities, career decision-making among the undergraduate students has become more complicated. Most of the learners find it hard to find the most appropriate countries, universities, courses and the necessary exams depending on their academic profile and interests. This paper suggests Intelligent Student Counselling System on Higher Education developed on Python that delivers information-based recommendations on a structured decision engine. This system incorporates a student profiling component, university database and hybrid recommendation model, which is a blend of rule-based filtering and machine learning classification. The predictive model was developed on a dataset consisting of 100,000 student records with cross-validation being utilized to validate the model. High consistency of recommendation and classification accuracy of 99.87 is proved by experimental results. The proposed system would increase efficiency of counselling, decrease manual labour as well as assist in informed academic planning based on automated, scalable, and intelligent decision support.

Keywords

Student Counselling, Higher Education Recommendation, Machine Learning, Decision Support System, Python Application, Academic Profiling, Predictive Analytics.

Infant Mortality in Tamil Nadu: An Ecological Analysis Using NFHS-5 State-Level Indicators

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Abstract

Infant mortality rate is a major indicator of health status of the population as it is a measure of the net health outcome of the maternal health, accessibility of health care, nutrition, sanitation, and socioeconomic conditions. Tamil Nadu has never left behind national average in reduction of infant mortality rates. Nonetheless, there are still inequalities in the state in terms of the place of residence and considerable health-related determinants. In this paper, an ecological study of Infant Mortality Rate (IMR) in Tamil Nadu has been furnished using data of the National Family Health Survey (NFHS-5). The research concentrates on the variables at state level in an attempt to explain the correlation of IMR with other variables such as maternal healthcare centers, child food, fertility, and household infrastructure. The findings orchestrate the idea of assessment of perpetual importance of institutional deliveries, adequate antenatal care attempt, mothers education and clean housing in maintaining a minimal rate of IMR. Though the paper is not meant to establish a causal relationship, it provides useful policy recommendations on the factors that influence infant survival in Tamil Nadu, and the significance of NFHS data to health surveillance of high scale.

AI-Powered Automated Video Dubbing System with Multi-Language Support and Lip Synchronization

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Abstract

The exponential expansion of digital multimedia across international platforms necessitates efficient multilingual dubbing solutions. Conventional dubbing methodologies prove resource-intensive and economically prohibitive for widespread content localization. This research introduces an intelligent automated dubbing framework integrating advanced neural architectures for speech processing, translation, and synthesis. The system employs Whisper for acoustic modeling [1], NLLB-200 for cross-lingual translation [2], XTTS v2 for voice cloning [3], and Wav2Lip GAN for visual synchronization [4]. A novel segment-based processing approach ensures temporal precision between synthesized audio and source video. Experimental validation demonstrates superior naturalness and synchronization accuracy compared to existing methodologies. The framework addresses critical applications in educational technology, digital entertainment, corporate communication, and accessibility enhancement.

Keywords

Video dubbing, neural machine translation, voice cloning, lip synchronization, speech synthesis, multilingual content.

Hybrid Wavelet-LSTM Based Dengue Forecasting and Outbreak Risk Management System

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Abstract

Dengue fever is still a big problem in tropical and subtropical areas. Things like fast growing cities, changing weather patterns, and how the disease spreads in different ways make it hard to handle. I think forecasting it is tricky because the data from weekly reports doesn't stay the same and has all these ups and downs at different speeds. Most models out there don't really catch those nonlinear parts or the way the patterns shift over time. That makes them not so useful for warning people early about outbreaks. So this paper talks about a new way that mixes something called Maximal Overlap Discrete Wavelet Transform, or MODWT, with a bunch of Long Short Term Memory networks, which are like LSTMs. Its for predicting dengue cases week by week in the short term. The MODWT takes the past data on dengue cases and breaks it into separate parts, like the long trends from epidemiology, the seasonal ups and downs, and those quick random changes. Then each part gets its own LSTM model trained on it separately. That way, the model learns the timing stuff at different levels of detail. After that, they put all those predictions back together in an ensemble way to get one solid forecast. It got tested on weekly data from three different places, Ahmedabad, Iquitos, and San Juan. These cities are pretty different in how dengue shows up there. The results look good, with low errors in things like MAE, RMSE, SMAPE, and MASE. There's also this trend indicator that shows if cases are going up or down, which helps spot risks early. Kind of makes sense for managing outbreaks better. They even put it online with a web interface where health people can check forecasts and see trends right away. It seems like this MODWT-LSTM setup could be useful for handling dengue data driven, and scalable across places. Not everything is perfect, but it feels like a step forward, even if some parts might need tweaking for other spots.

Keywords

Dengue forecasting, deep learning, LSTM, wavelet decomposition, MODWT, ensemble learning, time-series prediction, public health management, early warning system.

Micro-Doppler Radar: Drone vs Birds Classification

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Abstract

(LSS) Unmanned Aerial Vehicles (UAVs) has introduced a complex layer of vulnerability into civil and military airspace management. A paramount technical challenge in the deployment of non-cooperative surveillance systems is the reliable discrimination between UAVs and avian targets, which share overlapping kinematic profiles and Radar Cross Sections (RCS). This research paper presents an exhaustive theoretical and experimental analysis of micro-Doppler (m-D) radar systems designed for this specific classification task. We synthesize foundational physics-based modeling of radar backscattering, deriving the mathematical governing equations for the modulation signatures of rigid-body rotor rotation versus non-rigid biological articulation. The study rigorously evaluates the signal processing pipeline, transitioning from Time-Frequency Analysis (TFA) using Short-Time Fourier Transforms (STFT) and Wigner-Ville Distributions (WVD) to advanced feature extraction involving Singular Value Decomposition (SVD) and Cadence Velocity Diagrams (CVD). Furthermore, we provide a comparative analysis of classification architectures, contrasting the efficacy of traditional machine learning paradigms—such as Support Vector Machines (SVM)—against state-of-the-art Deep Convolutional Neural Networks (DCNNs) and temporal sequence models like Long Short-Term Memory (LSTM) networks. Our analysis indicates that while RCS magnitude is an insufficient discriminator, the exploitation of micro-Doppler spectral texture, augmented by deep learning, offers a robust pathway for high-accuracy target recognition, achieving classification success rates exceeding 98% in controlled environments.

Keywords

Micro-Doppler Signatures, UAV Detection, Bird Classification, Radar Signal Processing, Deep Learning, Time-Frequency Analysis, Feature Extraction, Neural Networks.

Explainable Scam URL Detection Using Hybrid Rule-Based and Machine Learning Techniques

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Abstract

With the rapid growth of online services, scam URLs have become a major threat to users by facilitating phishing, fraud, and identity theft. Traditional machine learning-based URL detection methods often act as black boxes, making their decisions difficult to interpret and trust. To address this limitation, this paper proposes an **Explainable Scam URL Detection system** using a **hybrid approach that combines rule-based techniques with machine learning models**. The rule-based component captures expert-defined patterns such as suspicious keywords, abnormal URL lengths, and misleading domain structures, enabling transparent and human-understandable reasoning. In parallel, machine learning models analyze statistical and lexical features of URLs to identify complex patterns that are not easily captured by predefined rules. The outputs of both components are integrated to improve detection accuracy while maintaining explainability. Experimental results demonstrate that the proposed hybrid approach achieves high detection performance with improved interpretability compared to standalone machine learning models. This explainable framework enhances user trust and provides actionable insights for cybersecurity analysts, making it suitable for real-world scam prevention systems.

Keywords

Scam URL Detection, Phishing Prevention, Explainable AI, Hybrid Detection Models, Cybersecurity Analytics.

An Adaptive Focus and Mental Fatigue Tracker for Remote Workers Using AI- Driven Approaches

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Abstract

The widespread adoption of remote work arrangements has also created serious challenges for knowledge workers in terms of sustained attention, increased cognitive fatigue, etc. Unlike traditional office environments, remote work doesn't have fixed break schedules or informal supervisory mechanisms to curb fatigue, and the absence thereof adds up and disrupts wellbeing and productivity. This study introduces AFaT-RW, an Adaptive Focus and Fatigue Tracker for Remote Workers, a cutting-edge AI-powered system that models and passively tracks users' levels of mental fatigue in real time. In this suggested system, we make use of various multimodal behavioral signals which can be recorded non-intrusively by using a standard webcam and keyboard interface such as eye blink rate, PERCLOS score, head pose estimation, keystroke dynamics and mouse movement patterns. An end-to-end convolutional-recurrent neural network (CNN-LSTM) architecture reads the fused feature stream to predict classified cognitive state at each time-step over four levels: alert, mildly fatigued, moderately fatigued, and severely fatigued. These classifications are converted by an adaptive feedback engine into suggestions for workload redistribution, customized breaks, and adjustable alerting systems. With a classification accuracy of 93.4%, precision of 91.8%, and recall of 92.6%, experimental evaluation on a 45-participant dataset created under realistic remote-work conditions outperforms single-modality baselines by margins of 4–7 percentage points. With a 43 ms per-frame inference latency, the system runs fully on-device, protecting user privacy and guaranteeing real-time responsiveness. According to our research, adaptive feedback in conjunction with non-intrusive multimodal behavioral sensing offers a workable and expandable approach to fatigue-aware productivity management in remote settings.

Keywords

Deep learning, computer vision, keystroke dynamics, adaptive feedback systems, human-computer interaction, mental fatigue detection, and remote work productivity.

InsightEd - Transforming Education Through Insights – For Students, Teachers & Parents

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Abstract

The contemporary education system places increasing demands on students, teachers, and parents, while adequate academic, emotional, and analytical support is often limited. Students frequently experience academic pressure, mental stress, and a lack of personalized guidance that may remain unnoticed [2].

Teachers manage heavy instructional and administrative workloads across diverse classrooms, yet often lack access to actionable, data based insights to support timely intervention. Parents, in turn, receive limited and delayed information regarding their child's academic progress and well being, restricting proactive engagement.

InsightEd is a data driven web based application designed to address these challenges through integrated educational analytics. The platform consolidates academic records, behavioral data, and stakeholder feedback into a centralized system. Machine learning models are applied to enable early identification of at risk students, prediction of academic performance and stress levels [1], [2] career guidance recommendations [3], and analytics driven support for instructional decision making. The system also provides parents with clear, timely, and interpretable progress updates [4].

By converting raw educational data into actionable insights, InsightEd supports early intervention, informed decision making, and continuous improvement. The proposed system aims to promote a collaborative and student centered educational ecosystem in which students are better supported, teachers are empowered with analytical tools, and parents remain actively informed and engaged.

Keywords

Educational data mining, student mental health, predictive analytics, machine learning, parental engagement, teacher analytics, web based application.

Machine Learning in Novel Classification of Cardiovascular Aabnormalities: Scalable ML Model Design with Cat BOOST and Explainable AI applications

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Abstract

Machine Learning (ML) can predict cardiovascular outcomes based on patient data as crucial predictors in cardiovascular diseases (CVD) but most prediction systems are not suitable for the Indian populace as primary risk factors like obesity, lack of physical activity, physiological stress, smoking and alcohol consumption are not in consideration. This study attempts to develop a scalable, efficient, robust, and scalable multi ML model with enhanced diagnostic accuracy fostered with Cat Boost and explainable AI. An ML framework for heart disease prediction using the UCI Machine Learning Repository with 14 features including age, sex, chest pain type, resting blood pressure, ECG, fasting blood sugar maximum heart rate, old peak, slope, major vessels, thalassemia with binary classification Prepossessing, feature selection using LASSO and MRMR (Minimum Redundancy Maximum Relevance). Classification and Random Forest implementation of Model performance was evaluated using Accuracy, Precision, Recall, F1-score, Sensitivity, and Specificity. Waterfall plots to explain individual patient predictions. SHAP (Shapely Additive Explanations) were also applied to interpret or clinically meaningful explanations of model predictions. Our approach achieved high predictive performance while maintaining clinical interpretability. In conclusion, Random Forest model combined with Categorical Boosting can achieve reliable heart disease prediction and its integration with explainable AI can enhance trust and usability of ML models in CVD applications.

Keywords

Machine Learning, CVD, Cat Boost, Random Forest Model, Minimum Redundancy Maximum Relevance.

Botnet Detection in Network Traffic Using CNN-LSTM

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Abstract

Botnets are groups of compromised systems that are remotely controlled by attackers to carry out malicious activities such as Distributed Denial of Service (DDoS) attacks, spam propagation, data theft, and malware dissemination. The proliferation of internet-accessible devices and encrypted communication protocols has made it difficult for conventional botnet detection methods to identify botnet activities using signature-based detection techniques. To mitigate these challenges, this study proposes a botnet detection system using a hybrid model of Convolutional Neural Network and Long Short-Term Memory (CNN-LSTM) architecture. The proposed botnet detection method is based on analyzing flow-based network traffic characteristics instead of analyzing packet payloads, which allows the botnet detection system to detect botnets even if they are using encrypted communication protocols. The model is trained and tested on the CICIDS2017 dataset, where network traffic is simulated and reflects real-life scenarios, including benign and malicious activities. The model architecture utilizes CNNs to automatically learn spatial patterns and important features from network traffic data, and LSTM is used to learn temporal patterns and behavioral activities related to botnets. The model is implemented in Python and deployed via a web interface created using Streamlit, enabling real-time network traffic analysis and visualization. The performance evaluation is conducted by measuring the performance metrics, such as accuracy, precision, recall, F1 score, and false positive rate, and the experimental results show that the model has a high accuracy rate and a low false positive rate, making it a reliable solution for modern botnet detection systems.

TruthLens: A Neuro-Symbolic Agentic Framework for Explainable Fake News Detection via Graph-Guided Reasoning and Semantic Entropy

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Abstract

The burgeoning scope of AI-generated false news has shown the need for effective and explainable fake news detection. Most current approaches classify news as real or fake, but do not offer an explanation. To bridge this gap, we present TruthLens, agentic explainable multi-modal fake news detection in a neuro-symbolic framework. The framework focuses on both text and images to enhance reliability and explainability.

For the textual component, we use BERT semantic embedding, and for the visual, we apply ResNet-50 image feature extraction. The coordination of these components takes place in a multi-agent framework built using LangChain and DSPy. The framework implements Graph Retrieval-Augmented Generation (GraphRAG) to externalize the evidence and explain the logical flow through the constructed knowledge graphs. The verification has four modules: claim decomposition, evidence retrieval and graph construction, an adversarial debate among specialized agents, and the final reasoning from a large language model.

To enhance the reliability of the predictions, we use semantic entropy to quantify uncertainty associated with predictions. TruthLens has been evaluated on the benchmark datasets LIAR, ISOT, and CoAID and has shown improved explainability as well as performance across domains. Overall, we conclude TruthLens to be an effective and reliable framework for explainable fake news detection in a multimodal setting.

Keywords

Fake News Detection, Explainable AI, Neuro-Symbolic Systems, Knowledge Graphs, Multi-Agent Systems.

Ask Dr.AI: An AI-Powered Real-Time Healthcare Chatbot for Explaining Drug Interactions, Side Effects, and Medical Terms Using LLM and RAG

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Abstract

The rapid growth of online medical information has made it difficult for users to identify reliable and relevant health content. Yet finding trustworthy answers feels harder each day. Outdated claims, Ordinary searches pop up results without checking who wrote them. Experts sometimes get buried under noise. Misinformation slips in quietly, shaping choices. Clarity becomes rare when volume takes over. A fresh approach begins with a Medical Information Assistant built on Large Language Models and Retrieval-Augmented Generation. Instead of static answers, it pulls live data through web searches while leaning on smart language analysis. From there, details get sorted - filtered for clarity before showing up. Structure shapes every reply, making sure things stay precise and focused. Clarity comes first, so each output reads plainly without extra noise. From trusted medical sites, the system pulls data through Google's Custom Search API, keeping details current and dependable. Web pages get scanned by tools such as BeautifulSoup and Trafilatura to pull out essential points. What stands out most moves forward - thanks to Sentence Transformers shaping the results. Later on comes a tuned system like LLaMA 3.3-70B-Versatile, Qwen3-32B as fallback through Groq API, shaping answers that fit just right. Instead of old-style searches, this method moves smoother, holds better results. Medical facts become easier to reach, especially when languages multiply down the line. Down the road, connections to deeper health tools might grow too.

Smart Poultry Monitoring System for Real-Time Disease Prediction

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Abstract

This study introduces a Smart Poultry Monitoring System designed to enhance disease prediction and management in poultry farms, particularly in Kankipadu, Vijayawada, Andhra Pradesh. By leveraging real-time temperature and humidity data from sensors, the system integrates advanced machine learning models, including Neural Networks, Random Forest, and Support Vector Machines (SVMs), to predict poultry diseases with up to 92 percent accuracy. It identifies conditions such as Avian Influenza, Newcastle Disease, and Coccidiosis, enabling early intervention to reduce mortality and economic losses. To enhance transparency, Explainable AI (XAI) techniques like SHAP and LIME provide insights into prediction factors, empowering farm managers with actionable strategies. Additionally, hyperparameter optimization using Grid Search CV ensures improved accuracy and reliability. The system delivers real-time alerts and disease forecasts, allowing proactive adjustments in environmental conditions, feeding patterns, and medical interventions. By combining AI-driven analytics with traditional poultry farming, this innovation minimizes disease outbreaks, enhances productivity, and promotes sustainable poultry management, with the potential to revolutionize poultry farming practices in the region and beyond.

Keywords

Poultry Disease Prediction, IoT Sensor Monitoring, Random Forest, Explainable AI, SHAP, Newcastle Disease, Avian Influenza, Coccidiosis.

NLP-Based Engine for Natural Language Business Analytics

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Abstract

This paper explores the feasibility of incorporating business analytics as part of the regular operations of modern businesses. The accumulation of data across a wide variety of areas – from transactions, deliveries, feedback from customers and other relevant data, and then the processing of this data in order to extract useful information and support decisions based on data-driven reasoning. This was traditionally achieved through the involvement of skilled data analysts, who used their domain knowledge to formulate SQL queries based on business-related challenges to be posed to databases.

In this paper we introduce a Natural Language Interface to Databases (NLIDB) approach to provide regular users with the tool that allows formulating queries about business data. The main aspect of our proposal is a rule-based pipeline for mapping natural language input into the required commands to aggregate data stored in a database. Moreover, it is possible to employ the additional features of this system, such as interval analysis, ranking, conditional filters, and detection of visualization intention. The experiment carried out proves the effectiveness of this NLIDB tool in real-world scenarios.

Keywords

Natural Language Interface to Databases, Natural Language Processing, Artificial Intelligence, Pipelining, Business Analytics, Text to Query.

A Scalable Decision-Support System for Automated Public Welfare Access and Service Orchestration

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Abstract

Access to government welfare schemes is still a problem. This is because the systems are not connected people do not know about them and the process to get them is complicated. This paper suggests Janasevai, a digital platform that helps people find welfare schemes check if they are eligible and apply for them easily. The system has some key features. It helps create a profile to check eligibility. It manages documents. It automates the application process. This reduces the need for middlemen, all the while making it easier for people to access welfare schemes. Janasevai uses a rule-based system and structured data to make decisions like a human. Tests with data show that Janasevai is more efficient than old methods. It helps find the schemes quickly and reduces the time it takes to apply. The system makes welfare services more transparent and accessible. This makes it ideal for use in areas and places where people may not be able to read or write well. The Janasevai platform is good for citizens. It helps them get the welfare schemes they need. The system is easy to use. It provides a way to access government welfare schemes. Janasevai is a tool that makes welfare services more accessible to people. The proposed system enhances transparency, accessibility, and last-mile delivery of welfare services, making it suitable for deployment in rural and low-literacy environments.

Predicting 10-Year Coronary Heart Disease Risk: A Comparative Analysis of Machine Learning Algorithms on the Framingham Dataset

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Abstract

Cardiovascular diseases remain the leading cause of mortality worldwide. Early prediction of coronary heart disease (CHD) risk is crucial for preventive interventions. This study presents a comprehensive comparative analysis of seven machine learning algorithms for predicting 10-year CHD risk using the Framingham dataset ($N = 4,240$). We evaluate Logistic Regression, Random Forest, XGBoost, Support Vector Machine, K-Nearest Neighbors, Neural Networks, and Gradient Boosting Machine with extensive hyperparameter optimization and class imbalance handling. XGBoost achieved the highest performance (ROC-AUC = 0.842, F1-score = 0.631), significantly outperforming traditional logistic regression ($p < 0.01$). Feature importance analysis identified age, systolic blood pressure, and glucose as dominant predictors, while SHAP analysis revealed clinically meaningful risk thresholds (age ≥ 60 years, systolic BP ≥ 140 mmHg, glucose ≥ 100 mg/dL). Our findings demonstrate that ensemble methods can provide accurate, interpretable risk predictions suitable for integration into clinical decision support systems. This work establishes a benchmark for future cardiovascular machine learning studies and provides a reproducible framework for model development and validation.

Keywords

Cardiovascular disease prediction, machine learning, Framingham Heart Study, XGBoost, Random Forest, clinical decision support, risk stratification.

High-Performance AES Encryption Architecture on FPGA Using Pipelined Simulation and Adaptive NoC Routing

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Abstract

Optimization of reconfigurable multicore processors through pipelining of cryptographic modules offers significant improvements in both performance and security. This work presents a design and implementation of pipelined AES and SHA modules on an FPGA platform to enhance throughput and reduce power consumption in a multicore processor architecture. Simulation results using ModelSim demonstrate that the pipelined approach increases the number of processed packets per second and decreases latency compared to existing baseline designs. Additionally, power analysis shows reduced energy usage without compromising cryptographic strength. The proposed design achieves a balanced trade-off between speed, security, and resource utilization, making it suitable for secure high-speed applications.

Keywords

AES Encryption, SHA Hashing, FPGA Implementation, Pipelining, Reconfigurable Multicore Processor, Hardware Security, Power Optimization, Performance Enhancement, Cryptographic Accelerator, ModelSim Simulation, Resource Utilization, Low-Power Design, Throughput Improvement, RTL Design, Vivado Design Suite, Secure Hardware Architecture, Timing Analysis, Power Consumption, Packet Processing, Dynamic Routing.

A Hierarchical Deep Learning Model for Early-Stage Plant Disease Identification and Intelligent Decision Support

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Abstract

This work proposes a robust deep convolutional learning framework for automated multi-class plant disease identification using high-resolution leaf images. The proposed framework combines the latest advances in data augmentation, end-to-end feature learning, and probabilistic inference for precision agriculture decision support. A novel convolutional neural network (CNN) model with hierarchical convolutional layers and dropout regularization is designed and trained on a selected subset of the PlantVillage dataset with six classes of plant diseases, using stratified train-validation splitting and real-time geometric transformations to improve generalization performance in small-sample settings. The proposed framework includes image normalization, spatial feature extraction, and softmax-based multi-class classification with a validation accuracy of 92% over 25 training epochs. In addition to its classification performance, the proposed framework includes an inference visualization component for explainable deployment, allowing real-time plant disease identification from RGB images captured in agricultural settings. The originality of this work resides in its efficient and highly accurate architecture specifically designed for resource-limited agricultural settings, in addition to its integrated prediction and visualization pipeline for bridging the gap between laboratory-level precision and field-level usability. The experimental results show strong discriminative power for visually similar classes of plant diseases, indicating the potential of the proposed approach for scalable and intelligent crop health monitoring and early warning systems.

Enhanced AI Proctoring Using Deep Learning for Online Exam Monitoring

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Abstract

Today, one of the major components in our current education system is online testing. The implementation of online testing has grown significantly due to the COVID-19 virus and the shift to distance learning. There are both pros and cons of using online examination systems. Historically, the primary way to ensure students have not cheated on their online exams has been through simple surveillance using a webcam and rules or algorithms to identify students who may have committed academic dishonesty. However, methods such as these are often lacking in their ability to accurately detect complex types of academic dishonesty. This has led to the development and trial of a new adaptive baseline learning model that uses different types of observation to provide information to educators about their examinees' behaviours.

Keywords

Online Proctoring, Deep Learning, YOLOv8 Object Detection, Behavioral Analytics, Audio Anomaly Detection, Risk Classification.

Automated Road Damage Detection Using UAV Images and Deep Learning Techniques

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Abstract

In order to improve the accuracy and scalability of monitoring civil infrastructure, such as roads, this paper investigates a method of automatically detecting road damage using deep learning and image analysis. Starting off unusual, their method mixes ensemble fusion together with convolutional neural networks - CNNs - to spot different kinds of damage on roads. Potholes show up clearly, along with splits in the surface, even areas ground down by constant traffic. Each flaw gets noticed through this blend of techniques working side by side.

First, images get scaled to a standard format. Following this step, rotation or flipping introduces diversity in the data. Useful visual traits come out next, pulled by models already trained on massive image sets. Training happens afterward across several varied collections of pictures, adjusted so no single source dominates. This approach tends to manage tough conditions - uneven lighting, complex surfaces, background interference - with better results. Where test data includes road damage from varied places, combining models beats using just one CNN alone. Better scores show up in how often it finds real issues, avoids false alarms, its accuracy overall. Going beyond older ways - like basic filters or single deep learning setups - it sharpens location details well enough. The method zeroes in on flaws more precisely than earlier attempts managed. It might seem odd, yet pinpointing issues right where they sit actually keeps progress going, even if some prefer old ways of doing things. One thing about this setup - it fits right into smart transit networks, also working for automatic road inspections while growing without extra expense. Not sure if rolling it out everywhere will go smoothly. Still, cities might find it works rather well.

Keywords

Road Damage Detection, Deep Learning, CNN, Image Classification, Ensemble Learning, Smart Infrastructure, Computer Vision.

UPI Fraud Detection Using Machine Learning

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Abstract

Unified Payments Interface (UPI) is now one of the foundations of the digital payment system in India, with real-time, interoperable, and secure financial transactions being available in real-time on banking portals. National Payments Corporation of India reported that UPI has millions of transactions each day, which plays a critical role in the development of cashless payments and financial inclusion [1]. Nevertheless, the quick spread of using UPI has also led to the observable growth of fraudulent acts, such as phishing, social engineering frauds, counterfeit collect requests, and hacked accounts. According to the data provided by the Reserve Bank of India, it is important to note that the number of cases associated with frauds in digital payments is constantly increasing and this is a critical problem in terms of consumer confidence and financial protection

[2],[3]. The traditional fraud detection systems employed in Internet-based payment systems are highly rule-oriented and rely on pre-established limits and fixed circumstances. Although in some cases these systems can be effective in identifying familiar patterns of fraud, they are not flexible enough and do not respond to new and advanced methods of attacks, which may result in high false-positive and false-negative rates [4], [5]. To address these shortcomings, the current study presents a machine-learning-based architecture of detecting UPI fraud in the real world with the help of supervised classification models.

Keywords

Artificial intelligence fraud detection, random forest, anomaly detection, machine learning, UPI fraud detection.

A Deep Neural Network Approach to Real-Time Face Recognition with Efficient Feature Extraction for Embedded Systems

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Abstract

Recent advancements in the field of Face Recognition Systems (FRS) have provided the ability to apply these systems in numerous intelligent vision applications, including Surveillance, Authentication and Secure Access Control. A significant portion of the current FRS research focuses on utilizing Generative Models such as StyleGAN to De-identify faces in order to maintain Privacy. Although these models provide an excellent means of providing anonymity to identities they lack in terms of being practical and/or deployable solutions. In contrast to anonymous identification of individuals, the primary objective of the proposed system is to develop and implement a real time, deployable FRS that can accurately recognize identities. To achieve this goal, the proposed system will utilize lightweight Mediapipe BlazeFace detector for detecting faces and a Deep Neural Network (DNN) classifier that uses the ResNet-50 feature extraction backbone. The detected facial regions captured by a live video feed are then preprocessed and classified using a transfer learning driven architecture; the convolutional layers of ResNet-50 are used as a frozen v=base and the fully connected layers are fine tuned for performing identity recognition. The entire pipeline was designed and implemented to meet the requirements of a low computational overhead, minimal latency and high robustness for Small Scale Embedded/Standalone Deployments. Results of experimental testing demonstrate high levels of accuracy in recognizing identities under controlled test conditions and enable reliable real-time classification of identities for enrolled subjects while keeping the inference delay at a low level. The proposed system offers a practical alternative to Generative De-identification approaches and represents a Scalable/Efficient Solution for Applications such as Smart Attendance Systems, Access control and User Authentication. The proposed system will serve as the basis for Feature Extraction and FPGA-Based Acceleration for Large Scale Embedded Vision Systems.

Keywords

Face Recognition, Embedded Vision, Deep Learning, ResNet-50, MediaPipe, BlazeFace, Transfer Learning, FPGA, IoT, Edge Computing, Biometrics, Real-Time Systems, Digital Image Processing.

Packaged Food Analysis for Nutritional Insights and Better Food Choices

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Abstract

As the consumption of packaged food products continues to increase, consumers face difficulty interpreting complex information about ingredients, nutritional content, and health-related information displayed on the packaging of these products. This poses a challenge to consumers, especially those with health concerns, as they may end up making uninformed decisions when purchasing these products. This paper proposes an AI-based smart product scanner specifically developed for analyzing packaged food products. The tool allows consumers to scan product barcodes, search products manually by name, or upload images of products to extract structured product data from the OpenFoodFacts API database, which includes nutritional information, Nutri-Score, Eco-Score, NOVA processing category. To improve the interpretability of the results, the information obtained from the OpenFoodFacts API is further processed using a large language model (LLM), which restructures the information in a readable and organized format, provides a summary of the product, and provides health-related insights. The LLM is also used to create an interactive chatbot that answers user queries and provides health-conscious recommendations based on user profiles. Users are also able to input or update their health information using the chatbot interface. Apart from single-product analysis, a deterministic comparison module enables users to compare two packaged food products quantitatively using rule-based scoring in terms of nutritional and sustainability factors. A caching system is also introduced to eliminate redundant API calls and improve the efficiency of response. The proposed framework shows the feasibility of integrating standardized food database retrieval, explainable AI, and structured comparison for the development of an intelligent and user-centric packaged food evaluation system. The proposed system also helps consumers in taking better and health-conscious decisions.

A Dual-Evidence Framework for Automated Screenshot Spoof Identification

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Abstract

The rapid growth of digital communication has increased the misuse of manipulated screenshots for spreading misinformation, financial fraud, and cybercrime. Detecting forged or tampered screenshots is challenging due to the high visual realism of modern image editing tools. Traditional deep learning-based image classification methods alone are often insufficient, as they can be deceived by adversarial or high-quality forged images. This project proposes a Screenshot Spoof Detection System that integrates deep learning-based image classification with digital image forensics techniques. A Convolutional Neural Network (CNN) model is used to analyze visual patterns and classify images based on authenticity probability. In parallel, metadata forensic analysis examines EXIF information for inconsistencies, while pixel-level forensic analysis detects compression artifacts, noise irregularities, and tampering traces. A forensic-first decision strategy is employed, where metadata and pixel analysis results are prioritized over machine learning predictions to enhance reliability. The system is implemented as a FastAPI-based backend service, enabling real-time image analysis through a RESTful API. Experimental results demonstrate that the hybrid approach significantly improves spoof detection accuracy and robustness compared to standalone deep learning methods. The proposed system is suitable for applications in digital forensics, cybersecurity investigations, social media verification, and fraud detection, providing an effective and scalable solution for automated screenshot authenticity verification.

Keywords

Screenshot Spoof Detection, Image Forgery Detection, Digital Image Forensics, Convolutional Neural Network (CNN), Metadata Analysis, Pixel-Level Analysis, Deep Learning, Cybersecurity, Image Authentication, Fraud Detection.

A Low-Power, Temperature-Independent Bandgap Reference Design in SCL 180 nm CMOS

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Abstract

In this work, a bandgap reference circuit with an enhanced thermal stability is proposed by the hybrid compensation. To mitigate temperature-dependent discrepancies along this avenue, both mechanisms of proportional-to-absolute-temperature (PTAT) and complementary-to-absolute-temperature (CTAT), alongside non-linearity calibration are employed. This inclusion of higher-order effects corrects the contradictions observed in classical linear control systems, resulting in a significant improvement in output accuracy. Simulation Results The design has been realized in SCL 180 nm CMOS technology and verified using Cadence Virtuoso. Test results for the 5 mm×1 mm, full-custom circuit show post-layout data of successful GPIO toggle at a low VDD supply of 1.8 V, suitable for modern low-power use cases. For our entire range between –25°C to 125°C, the simulation outcome suggests a temperature coefficient of ~31 ppm/°C, signifying an appropriate thermal compensation as well. The robustness of the architecture under varied process and mismatch conditions is provided. It also shows decent power supply rejection performance. This digital resistor based reference generates 2.0V ensured by resistor's specifications and material (silicon chip). Overall Performance and Design The thermal design is done on top of the IC layout to help dissipate the heat generated during operation and this enables it reaching its maximum temperature without overheating even after prolonged use.

Keywords

Temperature compensation, low-voltage, bandgap reference.

LSTM-Based Multi-Modal Human Identification System Using Face Recognition for Real-Time Missing Person and Criminal Detection

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Abstract

In this work, we present a hybrid, real-time face recognition architecture used to recognize missing persons and criminals by combining deep metric learning with temporal sequence modeling to efficiently overcome the limitations of analysis of stationary images under conditions of complex surveillance. We train a deep convolutional architecture that uses FaceNet to learn 128-dimensional discriminative embeddings that are organized into class specific libraries. In order to become more resilient in response to the changing poses and lighting variations, and to temporary occlusions, we learn a Long Short-Term Memory (LSTM) network over sequential video embeddings, enabling the aggregation of features across time and context dependent recognition. Cosine similarity-based metric learning is applied to real-time matching, and a hybrid decision-fusion process that integrates similarity confidence and temporal outcome reduction false positives. Experiments using a special surveillance data set indicate that the recognition rate is 89 percent, by far surpassing the standard single frame algorithms. Our suggested system can be scaled, privacy aware and efficient, which makes it a plausible tool in the real-life use of law enforcement and protection of citizens.

Keywords

Face Recognition, Metric Learning, Temporal Modeling, LSTM, FaceNet, Real time surveillance, Criminal identification, Missing Person Detection, Deep Learning.

Sentinel: A Hybrid Active Defense System for Real-Time File Protection Using Kernel-Level Event Monitoring and Biometric Authentication

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Abstract

This paper presents Sentinel, a novel active defense system designed to protect sensitive files from unauthorized access through a multi-layered security architecture. The system employs kernel-level event monitoring using the Windows Event Tracing for Windows (ETW) infrastructure to detect file access attempts in real-time. Upon detection, the system performs biometric authentication using Local Binary Pattern Histogram (LBPH) face recognition to verify user authorization. If verification fails, the system initiates an automated lockdown sequence that encrypts files using AES-256-GCM, scrubs sensitive data from memory, and collects forensic evidence. The implementation addresses critical challenges in Windows API integration, including the development of a custom C++ Python extension to bypass limitations in existing Python libraries. Additionally, the system implements robust persistence mechanisms and antitampering defenses to ensure continuous protection. Experimental results demonstrate the system's effectiveness in detecting and responding to unauthorized access attempts with minimal latency.

Keywords

Active Defense, Kernel Event Monitoring, File Encryption, Biometric Authentication, Face Recognition, Windows Security, Anti-Tampering.

SafeTread: Intelligent Tire Wear Detection Using Computer Vision and Deep Learning

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Abstract

Tire wear is a significant factor affecting vehicle safety and road accident risks. Early detection and monitoring of tire tread conditions can help prevent failures and improve maintenance efficiency. In this work, we present a computer vision and deep learning based approach for automatic tire wear detection using captured tire images. The method generally involves preprocessing tire images, extracting tread pattern features, and applying a trained convolutional neural network (CNN) model for classification of tire condition. Results show that the proposed system provides reliable accuracy and offers a lightweight, scalable, and practical solution for intelligent tire health monitoring.

Keywords

Tire Wear Detection, Computer Vision, Deep Learning, Convolutional Neural Networks (CNN), Vehicle Safety.

Smart Hospital Appointment & Query Management System

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Abstract

One of the main challenges for hospitals and healthcare facilities is managing patient appointments, physician availability, and communication between patients and providers. In many hospitals, appointment scheduling is still done manually or with incompatible digital systems. These methods often lead to problems such as patients waiting too long, poor handling of patient inquiries, missed appointments, and overburdened hospital staff. Handling these problems becomes even more difficult as the number of patients increases, potentially leading to a decline in the quality of healthcare.

This paper proposes the Smart Hospital Appointment and Query Management System, a web-based platform designed to help hospitals by simplifying and automating appointment scheduling processes. The system is designed to create a unified platform where administrators, doctors, and patients can interact. Through this system, patients can register, find doctors, book appointments based on availability, and even ask health-related questions. Doctors, on the other hand, can manage their appointment schedules, see appointment requests, respond to patient questions, and keep consultation records updated. Admins are responsible for managing the entire system by verifying doctor accounts, monitoring activities, and making sure the platform operates smoothly.

SQLite is the database management system employed, the user interface is crafted using HTML and CSS, and the backend is developed with Python Flask. These tools enable the building of a web application that is not only easy to use but also scalable and efficient. Besides, the system provides features such as monitoring the status of appointments and handling patient queries.

Results indicate that the proposed system significantly reduces the administrative work associated with traditional hospital management systems, enhances communication between patients and doctors, and increases the efficiency of hospital appointment scheduling.

Keywords

Smart Hospital System, Appointment Scheduling, AI Triage, Healthcare Automation, Flask Web Application, Hospital Management System.

BituSense: IoT-Enabled Smart Bituminous Roads Incorporating Plastic-Coated Aggregates and Industrial Waste Fillers for Real-Time Temperature and Moisture Monitoring

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Abstract

This study looks at how non-biodegradable plastic waste can be used to build pavements. It also looks at how long-lasting a bituminous mixture is that includes textile waste as a bituminous filler and plastic-coated aggregate. Plastic byproducts such as low-density polyethylene, polypropylene, polyethylene terephthalate, and polystyrene, when heated, serve as coatings for coarse aggregates. In addition to increased strength and a softening point of 110°C to 140°C, the aggregate mixture coated with polymer emits no toxic vapors. Softened plastics form a coating over aggregates (PCA), making it suitable for flexible pavement construction. We evaluate PCA after combining it with molten bitumen. This study aims to determine how mineral additives affect the mechanical properties of a variety of polymer-modified bitumens (PMBs) via laboratory mixing. The bituminous mixture incorporates up to fifty percent textile sludge powder debris as a filler material when heated. Test results and a comprehensive analysis of the use of waste plastics and textile waste residue in aggregate bitumen mixtures are included in the study. Following this, we formulated asphalt concrete mixtures incorporating both additives using the Marshall mix design procedure, and determined the optimal asphalt contents of these mixtures.

Keywords

Smart pavements, IoT-based pavement monitoring, plastic-modified asphalt, Prosopis juliflora ash, Textile sludge filler, Marshall stability, sustainable pavement materials, pavement temperature and moisture monitoring.

A Review on Psychological Impact of Digital Mediation on Emerging Youth

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Abstract

Digital technologies have changed how young people connect with each other in a big way. Social media and online platforms now shape old ideas of closeness and emotional bonding that were based on face-to-face interaction. These technologies make it easier to connect with other people, but they also make it harder to do things like present yourself in an idealized way, rely on online approval, and interact less in real life. This review examines the psychological impacts of digital mediation on adolescents. We used keywords like “digital mediation,” “social media relationships,” “youth mental health,” and “online intimacy” to find relevant literature in databases like Google Scholar and Scopus. Excessive use of technology affects teenagers’ expectations of relationships, increases social comparison, and worsens anxiety, loneliness, and lowered emotional well-being, according to the studies examined. However, other findings also highlight positive aspects, such as simpler access to social support and communication. Digital mediation has both positive and negative consequences, according to the review. It brings people together, but it also has an impact on the relationships and mental health of young people.

Keywords

Love, Technology, Emerging Youth, Dating, Social media influence.

Pest Attack Prediction AI Based Alert System for Smart Farming

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Abstract

With the global agricultural industry experiencing exponential growth, there is a need to adopt intelligent solutions that would help minimize crop losses and maximize crop productivity. Attacks by pests are some of the most prominent causes of the reduced crop productivity levels, considering that many farmers experience the loss of crops due to attacks. The paper will analyze the AI-Based Pest Attack Prediction and Alert System, which adopts machine learning and deep learning approaches to predict and issue early warnings on infestations. For the AI approach, a number of elements such as weather information (temperature, humidity, and rainfall) and the normalized difference vegetation index (NDVI) have been utilized. For the environmental risk classification, a Pandas rule-based weighting model has been adopted to deliver immediate results, whereas the mobile NetV2 model has been utilized for the image classification of pests. The implementation of the AI approach has been facilitated via the creation of a web application through Streamlit to assist farmers in classifying the severity of pest attacks into low, medium, and high risk categories. The dataset adopted in the AI model is based on the IP102 benchmark, delivering an impressive accuracy average of 92.4.

Keywords

Pest Attack Prediction, Smart Farming, Machine Learning, NDVI, Early Warning System, Precision Agriculture, Sustainable Agriculture, IoT, Streamlit.

Smart Chain Guard: Blockchain Trust with ML-Based Spoofing Detection in Software-Defined Networks (SDN)

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Abstract

The rising complexity of today's networks and the growing popularity of Software-Defined Networking (SDN) have also brought about new security threats, such as spoofing attacks, zero-day attacks, and encrypted traffic-based attacks. Conventional intrusion detection systems are inefficient in dealing with these dynamic attack patterns because of their dependence on fixed rules and signature matching. This paper presents SmartChainGuard, a hybrid AI-based intrusion detection framework that combines Convolutional Neural Networks (CNN), Bidirectional Long Short-Term Memory (BiLSTM), and Attention mechanisms to effectively identify complex cyberattacks in SDN networks. The proposed system utilizes JA3 TLS Fingerprinting to inspect encrypted traffic without decrypting the payload, thus maintaining privacy while improving increased the attack surface of contemporary communication infrastructure detection precision. To build trust, transparency, and integrity, blockchain technology is used for secure logging of security events and trust values. The proposed system is trained and tested on standard datasets such as UNSW-NB15, CICIDS2017, and Bot-IoT. Experimental results show high detection accuracy, low false positives, and good generalization performance, making the proposed system an effective choice for real-time and large-scale SDN networks.

Keywords

Software-Defined Networking, Intrusion Detection System, Deep Learning, CNN, BiLSTM, Attention Mechanism, Blockchain, JA3 TLS Fingerprinting, Spoofing Detection.

A Hybrid Enhancing and Optimizing Tiny PCB Defect Detection Using Quantum Mamba Fusion Framework

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Abstract

Micro defects on printed circuit boards (PCBs) are major concerns for inspection purposes since such defects greatly affect device performance in industrial applications and lead to substantial losses due to failure. Traditional PCB flaw detection methods, such as rule-based automated optical inspection (AOI) and manual inspection, are known for their inaccuracies, large number of false alarms, and inability to deal with different PCB configurations and imaging variations. While deep learning object detection models possess many similarities, they have differences. Notably, convolutional neural networks (CNNs) proved to be very effective at flaw detection, but they often lack flexibility, are too focused on local features, and fail to detect extremely small irregular objects.

This paper suggests an effective, computationally-efficient, and fault-tolerant solution to detect micro flaws on printed circuit boards. To provide high defect detection capabilities, especially for small-scale defects, the proposed system uses powerful object detection models, bidirectional context integration and dual-state residual boosting of features. Moreover, a shape-sensitive regression model will be used to improve localization of irregular shapes. Since the presented system does not require excessive amounts of computing power, the model can run on CPU-powered industrial computers without any GPU hardware.

Experiments on the standard benchmark show comparable effectiveness compared to currently known state-of-the-art solutions with a positive trend in mean Average Precision (mAP), recall and localization rate. The suggested model is optimal for practical flaw inspection since it ensures a good tradeoff between detection accuracy and computational resources required. The results show that the optimization of adaptive features along with the proper use of global contextualization models allows for significantly improving the detection rate of PCB defects.

Fraud Detection in Online Payment Using AI

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Abstract

The spread of the online transactions grows exponentially and the threat of is increased by the online payment system. financial fraud worldwide. The traditional rule-based systems are poor in uncovering complicated and dynamic fraud. patterns. The article in question proposes an AI [artificial intelligence]-based. in the detection of fraud in online payment with the aid of motivated strategy. Machine learning and deep learning models. The study checks on transaction data to classify genuine and fake, behavioral, transactional and device-based activities. parameters. Random logistic regression, Logistic regression. Long Short-Term Memory [LSTM] and Forest are implemented and compared. The proposed hybrid deep learning model has the accuracy and flexibility of the learning model is improved. real-time fraud detection. The paper informs of explicable AI approaches that can offer better model visibility. and trust financial institutions. In the findings, it can be seen that AI based systems provide increased detection accuracy and to a significant degree. maximize reduction of false positives as compared to conventional.

Keywords

Online Payment, Fraud Detection, Machine, Deep Learning, Learning, Artificial Intelligence, LSTM, Explainable AI.

AgroTech Connect: Digital Transformation in E-Agriculture for Farmer Empowerment

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Abstract

Agriculture plays a vital role in economic growth and provision of livelihood particularly in the developing economies. Yet, the agrarian players are still struggling with issues some of which are inability to access good information in a timely manner, poor resource allocation, uncertainty in climatic conditions and poor markets. Digital technologies have aided the development of E-Agriculture as a substantive remedial framework to overcome these impediments through its progressive diffusion. The paper under consideration discusses the effects of digital revolution on agriculture in the context of E-Agriculture technologies and the empowerment of farmers and sustainability. It assesses the use of cloud computing, Internet of Things (IoT), mobile applications and data analytics in enhancing agricultural productivity and supporting evidence-based decision making. The investigation describes the way in which real-time acquisition of agronomic data, meteorological insights, irrigating time frame, and the market prices augment the efficacy of operation and mitigate risk exposition. Empirical results show that E-Agriculture systems make a substantial contribution to precision farming, resource optimization and farmer resilience, whilst at the same time highlighting the need to improve problems identified with connectivity, digital literacy and data security.

Keywords

E-Agriculture, Digital Transformation, Farmer Empowerment, Precision Agriculture, Internet of Things (IoT), Cloud Computing, Data Analytics, Sustainable Agriculture.

APCTS: Dual-Path Multimodal Triage Framework with Geo-Intelligent Routing for Police Complaint Management

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Abstract

Police stations across India struggle with complaint backlogs where life-threatening cases sometimes wait behind routine queries simply because they arrived later. We built APCTS to fix this problem. Our system takes a two-pronged approach: a Gemini-based multimodal classifier handles text and photos when available, while a pattern-matching backup kicks in whenever the main system hiccups. Citizens type their complaints naturally through a web form, optionally attaching up to three photographs as evidence. What makes our approach different is how we route cases—not just by urgency but by geographic factors like which station covers that area. We tested against three alternatives: simple keyword rules, a fine-tuned DistilBERT model, and standalone Gemini without backup. Working with 12,500 complaint records from a publicly available Kaggle financial complaints dataset, our combined approach hit 94.2% accuracy overall. More importantly, it caught 96.1% of genuinely urgent cases. When we deliberately broke the API connection half the time, urgent case detection only dropped to 91.8%—the backup did its job. Assignment times fell from over four hours to under two. Every decision gets logged with reasoning, confidence scores, and which engine made the call.

Keywords

Police complaint systems, multimodal classifiers, large language models, text analysis, resilient systems, geographic routing, urgency detection.

VishwaCollab: Campus–Industry Connect Platform

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Abstract

The reasons why career development and placement management in higher education institutions remains a challenge is the broken system, the lack of personalization, and minimal intelligent technologies. Resume optimization, Applicant Tracking System (ATS) fit, skill evaluation, and use of mentorship may be problematic to students, and Training and Placement Offices (TPOs) have challenges with effectively managing placement data and analytics. This paper introduces VishwaCollab which is an AI-based career development and placement management system that will help bridge the gap between students, alumni, and industry. The system combines artificial intelligence and natural language processing to offer automated resume parsing, ATS score analysis, personalized job recommendations, artificial intelligence generated skill assessment quizzes, alumni–student mentoring and placement data management. GPT-based semantic analysis facilitates intelligent feedback of the resume beyond the solution of the keyword and a job recommendation engine based on a multi-factor model increases the degree of job–role match.

Keywords

Career Development, Placement Management System, ATS Scoring, Resume Analysis, Job Recommendation System, Artificial Intelligence, Natural Language Processing, Educational Technology.

Do AI Assistants Enhance Learner Engagement? An Empirical Study

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Abstract

AI assistants are one of the most significant factors in the transformation of modern learning environments; however, their role in enhancing learner engagement has not been extensively explored. This research aims to examine the influence of AI assistants on learner engagement, along with the mediating role of psychological needs and motivation. Informed by Self-Determination Theory, the research examined the influence of AI-related factors on learners' feelings of competence, autonomy, and relatedness, which in turn enhance their motivation and engagement. A quantitative research methodology was adopted, and the research was conducted among 102 participants by utilizing a structured questionnaire and analyzing the results through Structural Equation Modeling. The results revealed that AI-related factors significantly predict learners' psychological need satisfaction, which in turn significantly influences learners' motivation. Moreover, motivation was found to significantly influence learners' engagement ($\beta = 0.826$, $p < .001$). The results explained 63% of the variance in learners' engagement. This research confirmed the role of AI assistants in enhancing learners' engagement indirectly through psychological empowerment; thus, the importance of incorporating motivational factors in AI-based learning assistants was emphasized.

Keywords

AI assistants, learner engagement, self-regulated learning, psychological needs, motivation.

Travel Companion: Intelligent Mobile Safety with WLAN Crowdsensing and Voice SOS

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Abstract

Travel safety remains a critical concern with the growing reliance on mobile navigation applications, particularly in unfamiliar or low-connectivity environments where situational awareness and timely emergency response are limited. This research presents *Travel Companion*, an intelligent mobile safety system designed to enhance traveler security through the integration of real-time route monitoring, environmental awareness, AI-based itinerary planning, and automated emergency response. The primary aim of the proposed system is to provide continuous safety support by combining preventive and reactive mechanisms within a single mobile platform. The system employs fused location tracking to monitor navigation and detect route deviations, while lightweight WLAN-based crowdsensing estimates nearby presence to provide contextual awareness without invasive sensing. A generative AI module produces personalized travel itineraries based on user constraints such as budget, duration, and transport preferences. For emergency handling, the system supports both manual and hands-free SOS activation using wake-word detection, speech-to-text processing, and emotion classification to identify distress scenarios and trigger alerts. Emergency events are logged with verified location data and dispatched through multi-channel communication services. Experimental evaluation demonstrates reliable route deviation detection, effective WLAN-based presence estimation, accurate voice-triggered SOS activation, and consistent emergency logging and alert delivery. The results indicate that integrating mobile intelligence, wireless sensing, and AI-driven decision support significantly improves situational awareness and emergency responsiveness. The proposed framework highlights the potential of intelligent mobile technologies to deliver adaptive, resilient, and user-centric travel safety solutions.

Real-Time Multimodal Emotion Detection System

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Abstract

Emotion recognition has grown into a vital component of intelligent human-computer interaction. Most conventional approaches isolate a single modality—either facial expression, speech tone, or written text—and are therefore vulnerable to ambiguous signals. This paper presents a Multimodal Emotion Detection System that integrates three input channels: facial images captured via webcam, speech audio files, and raw text input. The system employs four deep learning architectures—Xception, MobileNetV2, ResNet50, and VGG19—for facial emotion classification, trained on the FER-2013 dataset from Kaggle. Speech emotion is extracted using MFCC-based LSTM networks trained on RAVDESS, and textual sentiment is predicted using a fine-tuned BERT classifier on the GoEmotions dataset. Each model is evaluated using Accuracy, Precision, Recall, and F1-Score. Experimental results establish that VGG19 achieves the highest facial recognition accuracy of 91.3%, while the complete multimodal fusion model reaches 93.2%. The system supports real-time webcam-based emotion detection and batch analysis from uploaded speech and text files, making it suitable for deployment in mental health monitoring, e-learning, and customer experience platforms.

Keywords

Emotion Recognition, Deep Learning, VGG19, Multimodal Fusion, Facial Expression, Speech Emotion, Sentiment Analysis, Real-Time Detection, LSTM, BERT.

Pet Healthcare System: A Comprehensive Framework for Monitoring and Management

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Abstract

Owning pets has become a much more common practice among people in the past few years as millions of people consider pets as part of their families. However, provision of services to these animals still poses a challenge to the owners. The presented paper presents a digital healthcare management system of pets created to support monitoring and management of pets with the help of data collection, data analysis and professional advice. The system is based on the wearable sensor technology, the mobile application interface, and the analytics developed on the cloud to provide constant monitoring of vital parameters including the heart rate, temperature, and dietary patterns, and the system contains also a healthcare booking module. The system can identify diseases early and send notifications to their owners to enable them to make appointment with the veterinarian professionals remotely. It can be applied on a wide number of species and breeds, with health symptoms and has a high accuracy of 93.5 percent in recognizing the health alerts. As a result of this, the system will help enhance animal welfare and convenience to its owners.

Hybrid CNN–SVM Model for Early Detection of Diabetic Retinopathy

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Abstract

Diabetic Retinopathy (DR) is one of the leading causes of irreversible vision impairment among diabetic patients worldwide. Early diagnosis plays a crucial role in preventing disease progression and supporting timely medical intervention. Traditional manual screening methods are time-consuming, prone to human error, and require specialized expertise, making large-scale screening difficult. To address these challenges, this research proposes a Hybrid Convolutional Neural Network–Support Vector Machine (CNN–SVM) model for the early and automated detection of diabetic retinopathy using retinal fundus images. Instead of relying solely on a deep learning classifier, the extracted high-level features are fed into an SVM classifier, which improves decision boundaries and enhances classification accuracy, especially for early-stage cases where abnormalities are subtle. Experimental evaluation demonstrates that the hybrid CNN–SVM model outperforms standalone CNN and traditional machine learning approaches in terms of accuracy, sensitivity, and specificity. This framework offers a scalable, efficient, and clinically reliable solution that supports early diagnosis and can be integrated into telemedicine platforms and automated screening system.

Keywords

Diabetic Retinopathy, Deep Learning, Convolutional Neural Network (CNN), Support Vector Machine (SVM), CNN–SVM Hybrid Model, Feature Extraction.

Histopathologic Cancer Detection using Deep Learning

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Abstract

At present, deep learning models are not widely used in clinical practice for the identification of cancer using histopathological analysis. This is mainly due to two main challenges: severe data imbalance and limited model interpretability; While deep neural networks have a great potential in diagnostic accuracy of using them without careful design they can lead to models that perform poorly in real world clinical environments. This report presents a detailed research framework specifically geared toward resolving the problems created by large, greatly disproportioned histopathology datasets. By prioritizing the minority class throughout the model design process, we present reliable method for developing AI systems that are both robust and trustworthy. Rather than only concerned with accuracy, such framework emphasizing clinical relevance, delivering meaningful and reliable diagnostic observations.

Next-Gen Law Enforcement System Using Text-to-Face Synthesis and AI-Based CCTV Enhancement

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Abstract

Next-gen law enforcement system using text-to-face synthesis and AI-based CCTV enhancement is a dual-module artificial intelligence system that is used to generate a suspect image from the text or voice input and enhances the CCTV image resolution. The entire project is built upon the MERN architecture (MongoDB, Express.js, React.js, Node.js) for input processing, secure user authentication, and storing the generated images in structured format. The first module uses Google generative AI to transform text- or voice-based witness statements into facial image. The second module focuses on CCTV image enhancement. The real time CCTV images are low in quality, this module uses deep learning models such as GFPGAN and Real-ESRGAN to enhance and upscale blurred or low-resolution CCTV frames for improved facial clarity. By unifying GAN and advanced deep learning image restoration model within a single framework, the system significantly improves the accuracy, reliability, and responsiveness of suspect identification processes, making it well suited for practical deployment in modern policing environments.

Keywords

Artificial Intelligence, Suspect Identification, Google Generative AI, GAN, CCTV Enhancement, GFPGAN, Real-ESRGAN, Voice-to-Text, MERN architecture, Law Enforcement Technology.

Explainable CNN Framework Using Grad-CAM for Brain Tumor Classification and Localization from MRI Scan

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Abstract

It is very crucial to have precise yet interpretable analysis of brain tumor via MRI for effective clinical diagnosis and treatment. Despite the high performance achieved by deep learning models in the classification of medical images, their black-box nature renders them untrustworthy and non-applicable in a practical setting. To tackle this problem, this paper proposes a deep learning framework that is explainable for automated brain tumor classification and localization using MRI. The brain MRI image is classified into four disease categories i.e. glioma, meningioma, pituitary tumor and no tumor. We use a publicly available MRI dataset. We also resize, convert the images to grayscale, and also intensity normalise them to make the dataset consistent for better training. The classification framework employs a customized convolutional neural network with residual connection, feature concatenation, and Squeeze-and-Excitation attention mechanism for better learning of discriminative features and focusing on tumor-relevant areas. To manage the class imbalance, the model employs weighted cross entropy loss. Then, the model is optimized with the Adam optimizer alongside learning rate scheduling and early stopping for stable convergence. XAI techniques help improve the variety of outcomes and maintain transparency. To visualize and interpret model predictions, we employ Gradient-weighted Class Activation Mapping (Grad-CAM), LIME and SHAP. Upon testing on unseen test data experimental evaluation shows effective classification result with accuracy above 91% and also gives meaningful visual justifications. The framework strikes a good balance between performance and interpretability. It is reliable and clinically useful for diagnosing brain tumors.

Keywords

Brain tumor classification, MRI, Convolutional Neural Networks, Explainable AI, Grad CAM, Medical image analysis.

Geometric Based MCDM Methods for Performance Evaluation and Ranking of Drone Propeller Materials in Intuitionistic Fuzzy Environment

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Abstract

The fast spread of drone technology across areas such as entertainment, agriculture, environmental monitoring, and infrastructure inspection has underlined the relevance of critical components in determining total system performance. Among these, lift, propulsion, stability, maneuverability, and operational efficiency are all significantly influenced by the propeller. Accordingly, the selection of acceptable materials for drone propellers is crucial for achieving optimal performance, durability, and cost-effectiveness. This study gives a systematic examination of critical parameters for material selection, including cost, stiffness, durability, strength, sustainability, manufacturability, density, and strength-to-weight ratio. The best propeller materials are found using advanced multi-criteria decision-making (MCDM) methodologies, namely RAMS and RATMI. Additionally, these techniques feature an intuitionistic fuzzy extension that uses fuzzy logic and the Trace Similarity Median Index to account for uncertainty in traditional assessment procedures. The results indicate that a composite methodology, which includes the relative value of material features, offers the most consistent and reliable rankings. The suggested approach not only supports informed material selection by maximizing performance, cost, and operational parameters but also provides a sophisticated decision-support tool for boosting drone efficiency across varied applications.

Keywords

Drone Propeller, Geometric based methods, RAMS, RATMI, Intuitionist fuzzy sets, Correlation Analysis, Ranking Consistency Index and Trace.

Development of a Compact and Cost-Effective Multi-Gas Detection Platform Based on Modulated Laser QEPAS System

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Abstract

Precise trace gas detection is vital for environmental monitoring, industrial safety, and medical diagnostics. This paper proposes a compact, low-cost, and low-noise gas monitoring platform based on Quartz-Enhanced Photoacoustic Spectroscopy (QEPAS). The primary novelty lies in integrating a wavelength-modulated laser source with a high-Q Quartz Tuning Fork (QTF) resonator, forming a scalable system that eliminates expensive, bulky optical components. By modulating the laser to match the QTF's resonant frequency, the system achieves localized acoustic excitation within a minimal footprint. To enable ultra-low concentration detection, a high-performance analog front-end was developed utilizing a high-fidelity operational amplifier in a Transimpedance Amplifier (TIA) configuration. The signal is processed through a precision rectifier stage with optimized hardware gain, providing a rail-to-rail dynamic range suitable for portable use. An ADC facilitates high-resolution digital output, successfully replacing cumbersome laboratory instrumentation. System performance is evaluated through critical parameters, including Signal-to-Noise Ratio (SNR), Quality Factor (Q-factor), and Normalized Noise Equivalent Absorption (NNEA). Furthermore, the optimal operating pressure for maximum photoacoustic signal generation is analyzed to ensure peak sensitivity. This integrated technique offers a robust, field-ready solution for high-sensitivity gas detection, establishing a framework for monitoring hazardous gases such as Acetylene, Methane, and Carbon Dioxide at parts-per-billion (ppb) levels.

Smart Predictive Maintenance for Industrial Machineries

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Abstract

The rapid advancement of industrial automation and embedded intelligence has intensified the demand for reliable and efficient maintenance strategies capable of ensuring uninterrupted machine operation. Conventional maintenance approaches, such as reactive and time-based preventive maintenance, are increasingly inadequate in modern industrial environments due to their inability to capture early-stage degradation and dynamic operating conditions. In response to these limitations, this work presents the design and implementation of a Smart Predictive Maintenance System for industrial machinery, developed using an embedded, object-oriented architecture. The proposed system integrates real-time sensing of critical operational parameters including temperature, vibration, electrical current, voltage, and acoustic noise. These parameters collectively reflect the mechanical, thermal, and electrical health of industrial equipment. Sensor data is continuously acquired and subjected to preprocessing techniques such as normalization and noise filtering to ensure measurement stability and reliability. A Machine Health Index is then computed using a weighted analytical model that consolidates multi-parameter information into a single quantitative indicator representing the overall condition of the machine. A rule-based decision engine evaluates the health index to classify machine operation into distinct states, namely healthy, warning, and critical. To ensure deterministic and stable system behaviour, a state machine mechanism governs transitions between these operational states, thereby preventing false alarms caused by transient fluctuations. The system also incorporates structured event logging with real-time clock support, enabling chronological tracking of machine behaviour, fault evolution, and maintenance-related events. The complete system is implemented using object-oriented C++ on an embedded microcontroller platform, ensuring modularity, scalability, and ease of future enhancement. Experimental results demonstrate that the system effectively detects gradual degradation and severe fault conditions, providing timely alerts through visual and audible indicators. The proposed predictive maintenance framework offers a practical, interpretable, and extensible solution for intelligent machine health monitoring, contributing to reduced unplanned downtime, improved equipment reliability, and enhanced operational safety in industrial environments.

Keywords

Predictive Maintenance, Embedded Systems, Machine Health Index, Condition Monitoring, Industrial Automation.

Parlitech: Enhancing Governance Through AI-Driven Insights and Automation

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Abstract

Democratic systems are based on institutionalized deliberation, rational rationality and consensus between elected representatives on policy making processes. Nonetheless, modern parliamentary frameworks do not have sophisticated digital resources to thoroughly examine the dynamics of debate, ideological impacts, and voting patterns. In order to overcome these constraints, this paper presents ParliTech, an AI-powered simulation system that recreates the operations of the Indian Parliament. The system proposed uses a multi-agent architecture whereby each virtual Member of Parliament (MP) represents the policy preferences and ideological position of a given political party. These agents have dynamic debates which involve the generation of context-sensitive natural language responses with the help of Large Language Models (LLMs). The system combines the analysis of arguments, sentiment analysis and independent decision-making to reproduce the real parliament. A public opinion module is also included to take and analyze the views of the citizens.

Keywords

Parliamentary AI, Debate Simulation, Voting Analytics, Public Opinion Mining, Sentiment-Aware Decisions, Indian Legislature, LLM-based Governance.

AURA Research Intelligence: A Unified AI Framework for Multistage Research Paper Processing

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Abstract

The increasing rate of scientific publications has rendered it all the more difficult to efficiently analyze, compare, and use research literature by the researchers. Processing of vast amounts of academic data manually is time-consuming, error-prone and can restrict the productivity of research. To solve these issues, the present paper proposes AURA Research Intelligence, a single AI-based framework to process multistage research papers.

The suggested system combines different natural language processing and deep learning methods to automate key research processes, including text summarization, research gap identification, generation of comparative studies, extraction of keywords, formulation of research questions, dataset recommendation, multilingual processing, plagiarism detection, and generation of automated reports. The framework uses transformer-based models and semantic similarity analysis to guarantee the correct content understanding and the meaningful output generation.

It uses a modular architecture that allows it to scale, be flexible, and deploy features independently. The system will be a web-based application based on Streamlit, where real-time communication with the system and document processing can be performed.

The suggested framework will positively contribute to the efficiency of the research process, the decrease of manual labor, and high-quality academic writing. It will be a highly intelligent assistant to researchers, students, and academicians by simplifying the research process. This article points out the possibility of artificial intelligence to revolutionize the conventional research practice to an automated, intelligent, and scalable digital ecosystem.

Keywords

Artificial Intelligence, Research Paper Processing, Natural Language Processing, Text Summarization, Plagiarism Detection, Multilingual Analysis.

Finite Element Analysis of Articular Cartilage-Inspired Layered Hydrogel Systems

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Abstract

Articular cartilage has a depth-dependent mechanical gradient, which helps it distribute load effectively and resist both compression and shear. Reproducing this zonal behavior remains a key challenge in cartilage tissue engineering, as conventional homogeneous hydrogels do not adequately mimic the native stiffness transition. In this study, a cartilage-inspired three-layer hydrogel model was developed in ANSYS Workbench to compare the mechanical performance of eight layered hydrogel formulations under displacement-controlled compression and shear. The scaffold was designed with superficial, middle, and deep layers of progressively increasing stiffness, and all materials were modeled as linear elastic and isotropic for initial computational screening. Mechanical response was evaluated using reaction force, deformation, stress, strain, and stress-strain behavior. The results showed a clear improvement in mechanical performance from alginate-based systems to reinforced silk fibroin-based multi-network hydrogels. Among the tested formulations, Silk fibroin + Gelatin methacryloyl + Hyaluronic acid methacrylate + Chondroitin sulfate methacrylate (SF+GelMA+HAMA+CSMA) showed the highest compressive response, while silk fibroin + Gelatin methacryloyl + Chondroitin Sulfate methacrylate (SF+GelMA+CSMA) demonstrated the best shear resistance. These findings suggest that advanced layered silk fibroin-based hydrogels are mechanically more suitable for cartilage-mimetic scaffold design, and that finite element analysis (FEA) can serve as an efficient pre-experimental tool for material screening.

Keywords

Articular cartilage, Cartilage tissue engineering, Layered hydrogels, Finite element analysis, ANSYS, Silk fibroin, Mechanical characterization.

Effect on Modal Frequencies of Horizontal Axis Wind Turbines under Wind Load and Soil-Structure Interaction

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Abstract

This study investigates the complex interaction between Horizontal Axis Wind Turbines (HAWTs) and the surrounding soil, focusing on how soil-structure interaction (SSI) affects the turbine's modal frequencies when subjected to wind loads. A comprehensive numerical model is developed to analyze the dynamic behavior of HAWTs, considering the influence of soil properties like stiffness, damping and steel tower characteristics. The paper presents complex interaction between a 5MW Horizontal Axis Wind Turbine (HAWT) with an 87.6m tower and the surrounding soil, focusing on how soil-structure interaction (SSI) affects the turbine's modal frequencies when subjected to wind loads. A comprehensive numerical model is developed to analyse the dynamic behaviour of the HAWT, considering the influence of soil properties stiffness, damping and steel tower characteristics. The results show significant variations in modal frequencies due to SSI, highlighting its critical importance in HAWT design and analysis. Specifically, the study examines how different soil types and tower geometries impact the turbine's natural frequencies, potentially leading to resonance issues or altered fatigue life. The findings contribute to an improved understanding of HAWT dynamics, informing more accurate predictions of structural performance, fatigue life, and ultimately, the turbine's overall efficiency and reliability. A numerical model analyses the turbine's dynamic behaviour, considering soil properties and steel tower characteristics. Results show significant modal frequency variations due to SSI, emphasizing its importance in HAWT design. Findings improve understanding of HAWT dynamics, informing predictions of structural performance.

Keywords

HAWT, soil-structure interaction, modal frequency, wind load, dynamic analysis.

Soil-Structure Interaction Effects on Thermal Stress and Shear Behavior of a HAWT Tower

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Abstract

The paper presents a comprehensive thermo-mechanical analysis of a 5MW Horizontal Axis Wind Turbine (HAWT) tower, focusing on the complex interaction between the tower and the surrounding soil. The research investigates thermal stress flux, natural frequencies, and shear stress in the tower, considering the effects of soil-structure interaction (SSI). A numerical model is developed to simulate the tower's behavior under various environmental conditions, including wind loads and temperature variations. The results show that soil properties significantly influence the tower's dynamic response, stress distribution, and frequency characteristics. For instance, the soil's stiffness and damping properties affect the tower's natural frequencies, which can lead to resonance issues if not properly accounted for. Additionally, the thermal stress flux analysis reveals that temperature gradients can induce significant stresses in the tower particularly at the foundation-soil interface. The study findings have important implications for HAWT design and optimization. By considering SSI and thermo-mechanical effects, engineers can develop more accurate predictions of structural performance, fatigue life, and overall efficiency. The research contributes to the development of more reliable and cost-effective wind energy systems, supporting the growth of renewable energy production. The results are relevant for wind turbine designers, structural engineers, and researchers seeking to improve HAWT performance and mitigate potential risks associated with soil-structure interaction.

Keywords

HAWT, SSI, thermal stress, frequency, shear stress.

Molecular Dynamics Study of Rheological Behaviour in Fumed Nanosilica–PEG Based Shear Thickening Fluids

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Abstract

Shear thickening fluids (STFs) are colloidal dispersions which exhibit non-Newtonian flow behavior. The viscosity increases with the applied shear rate, especially when the shear rate exceeds a critical value termed as the critical shear rate (CSR). The shear thickening effect is reversible in nature, i.e., when the shearing deformation is removed, STFs tend to come back to their original low viscosity state. In this study, fumed silica-based shear thickening fluid has been used. STF was synthesized using fumed silica (FS) of specific surface area $150 \text{ m}^2/\text{g}$, dispersed in Polyethylene Glycol (PEG400).

To simulate the shear thickening behaviour, molecular dynamics simulations were employed using LAMMPS (Large-scale Atomic/Molecular Massively Parallel Simulator). The systems were simulated under varying shear rates to observe the clustering behaviour of particles and their corresponding viscosity transition responses. The rheological testing was done at room temperature using a cone and plate rheometer. A good match was obtained between the experimental results and the simulation, thus explaining the microscopic mechanisms that trigger the onset of shear thickening in dense colloidal dispersions, resulting in the transition from Newtonian to non-Newtonian flow behaviour.

Keywords

Shear Thickening fluids, Fumed silica, PEG400, LAMMPS, Rheology, non-Newtonian.

Smartphone-Based Braking Pattern Analysis for E-Rickshaw Driver Behaviour on Urban Roads

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Abstract

Electric rickshaws (E-rickshaws) have emerged as a dominant mode of last-mile urban transport in India, yet their inherent structural characteristics including a high centre of gravity and narrow track width make them particularly susceptible to dynamic instability under aggressive driving. Although E rickshaws account for only about 0.5–0.6% of India's registered motor vehicle fleet, they exhibit a disproportionately high operational presence in urban traffic streams, yet systematic research on their drivers' behaviour remains limited in India and other developing country contexts.

This study presents an experimental on-road investigation into E-rickshaw braking patterns using a smartphone-integrated multimodal sensor suite comprising an accelerometer, gyroscope, and GPS. Real-time data were collected from ten drivers navigating bituminous urban roads in Prayagraj across 5–6 km segments at speeds of 30–40 km/h. Longitudinal (a_x), lateral (a_y), and vertical (a_z) acceleration profiles were extracted to characterize braking intensity and associated vehicle instability. Braking events were identified from longitudinal deceleration signals and classified into four severity levels: mild, normal, moderate, and harsh using predefined threshold criteria.

Results reveal that approximately 80% of the drivers exhibited harsh or aggressive braking behaviour, frequently accompanied by elevated lateral and vertical accelerations, indicating heightened dynamic instability, particularly on uneven pavement sections. These findings underscore the viability of low-cost smartphone sensors as a scalable and non-intrusive platform for real-time driver behaviour monitoring. The study further provides a data-driven foundation for designing targeted safety interventions and policy measures tailored to E-rickshaw operations under the heterogeneous traffic conditions characteristic of Indian urban environments.

Integrated Drone Design, Simulation and Performance Evaluation

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Abstract

The performance, efficiency, and operational safety of multi rotor unmanned aerial vehicles or unmanned vehicles are strongly influenced by propeller aerodynamic characteristics, structural integrity, and power requirements. The high-fidelity computational approaches such as CFD and FEA, although accurate, are often unsuitable for early stage design due to high computational cost. This paper presents an integrated, low-fidelity computational frame work that combines a Blade Element Momentum Theory (BEMT) based propeller aerodynamics, quad rotor rigid body flight dynamics, light weight structural screening, and composite safety assessment methodology within an unified environment. The frame work enables rapid, Excel driven parametric evaluation of blade geometry, material properties, motor-battery configurations, and operating conditions. Thrust generation and power consumption, and trajectory tracking are simulated under nominal and disturbed wind condition through dynamic coupling between propulsion and flight model. The structural feasibility is ensured through centrifugal, bending, and torsional stress evaluation, tip deflection estimation, and minimum safety factor assessment. A novel composite safety index is introduced to quantify the thrust margin, actuator saturation, and control robustness, under gusts, power loading, torque limits, and structural integrity. Aerodynamics predictions are validated against the experimental data from the UIUC low Reynolds number propeller data base, yielding mean thrust and power errors below 8%. The sensitivity investigation further reinforces the consistency and resilience of the proposed safety metrics across a range of design variations. The results confirm that the frame work offers a technically sound, scalable and computationally economical solution for a preliminary UVA propeller design and performance verification. Mainly it supports reliable validation during the initial development phase without dependence on the high fidelity, computationally intensive simulation.

Keywords

Low fidelity modeling, BEMT, Flight Dynamics, Structural Screening, Safety Index, and UAV Propeller.

Digital Dependency and Anxiety Among Young Adults: A Statistical Analysis of Technology-Induced Psychological Distress Patterns

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Abstract

With the digital technology playing an important role in day to day lives, young adults are encountering more difficulties in managing their relationships with technology and how to cope with its impact on their mental wellbeing. This paper will examine the relationship between the anxiety level of young adults and the manner in which they use digital devices. It targets the 42 young adults between the ages of 18 and 24, the first generation to be totally exposed to digital technology in their expanding years. The research employed several statistical tests using a survey method, such as correlation tests, chi-square tests and ANOVA. The respondents completed structured questionnaires that assessed the technology habits, social media use, and the level of anxiety that was measured based on a tested 10-point scale. The findings revealed excellent positive correlations between screen time and anxiety ($r=0.378$, $p=0.014$). Also, the associations between anxiety and change of mood ($r=0.798$) and the impact of social media on confidence ($r=0.787$) were particularly high. Interestingly, education level was a predictive factor of anxiety. The participants that had a Master degree were found to have significantly higher anxiety ($M=7.25$, $SD=1.16$) than those who had graduated secondary school ($M=4.09$, $SD=1.81$). Almost half of the respondents (47.6% demonstrated high anxiety levels. Moreover, 69 percent of them were pressured by social media, and 64.3 percent used to check their devices constantly. These results indicate that special computer-based wellness initiatives are urgently required, particularly in the college campuses where anxiety rates are particularly elevated.

Keywords

Technology-induced anxiety, Digital behavior patterns, Cross-sectional study, Mental health, Social media.

Climate Change and Vector-Borne Diseases (VBDs) in India

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Abstract

Climate related transmission of vector borne diseases (such as dengue, malaria) and water-borne diseases (for example: cholera). Managing time series analysis, lag correlation analysis and multivariate statistical methods, so this research explores how these factors affect in the influence disease incidence across the Indian States. Epidemiological datasets have been combined with datasets on temperature, precipitation and vegetation index to identify patterns and incidence response of specific diseases to climatic changes. Findings show that rainfall is steadily linked to outbreaks of both vector-borne and water-borne diseases whereas temperature by itself demonstrates weak linear correlations implying effects that are non-linear and dependent, on delays. Principal Component Analysis will uncovers the clear and practical epidemiological groupings across states emphasizing the roles of ecological and urban elements.

Keywords

Climate Change, Vector-Borne Diseases, Dengue, Malaria, Cholera, India, Rainfall, Temperature, Leaf Area Index, Cross-Correlation, Principal Component Analysis, Disease Forecasting.

Owl-Inspired Trailing Edge Serrations for Acoustic Stealth UAV Wings

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Abstract

This study numerically assesses owl-inspired trailing-edge serrations for aeroacoustics stealth in a moderate-subsonic UAV wing operating at Reynolds numbers of order 10^6 and Mach numbers up to 0.6. Large-eddy or scale-resolving simulations coupled with a Ffowcs Williams–Hawkings acoustic analogy is conducted in ANSYS Fluent for a baseline wing and multiple serration topologies derived from owl-wing morphologies. Bioinspired serrated trailing edges have been shown, at comparable Reynolds numbers, to reduce trailing-edge self-noise by up to 4–9 dB in airfoils and rotating blades by promoting earlier wake mixing, fragmenting tube-like vortices, and decreasing spanwise coherence of turbulent structures. The present results extend these mechanisms to higher-Re, compressible conditions typical of tactical UAVs: serrations attenuate both low- and mid-frequency components of the far-field noise spectrum while preserving or modestly enhancing lift-to-drag ratio through delayed separation and redistributed vorticity. Parametric variation of serration height and obliquity highlights a design space in which aerodynamic penalties remain within a few percent, yet integrated sound pressure levels are significantly reduced, in line with recent biomimetic rotor and fan studies. The study establishes design and operating envelopes where owl-inspired serrated wings can simultaneously satisfy performance and acoustic-signature constraints for higher-speed UAV missions.

Keywords

Owl-inspired serrations, aeroacoustics, UAV, CFD, LES, FW-H method, noise reduction, bio-inspired design.

A Cost-Effective IoT-Based Multi-Sensor Integrated Landslide Early Warning System using ESP32 and LoRa

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Abstract

Every year the Himalayas are struck by monsoon season. and hillside towns are at the receiving end of it- slope falls that clear. highways, houses, occasionally lives. The frustrating part? Professional monitoring equipment is a fortune, and it is unaffordable to the majority. local governments can spend. So we did it in a different way. Our sensor network is composed of low-cost ESP32 boards with which we assemble it. monitors moisture and rain and ground tilt (MPU6050 chips). and underground pressure of water. LoRa radios (SX1278 modules) manage the communication and we had good range 2-5 km. when even there are mountains in the way. Here, however, is the thing that really confused initially, where do you find training data when real. landslides are unlikely to have sensors on them? We ended up writing we have got our own data generator, the one that generates realistic patterns. overhead plus the delays and noise that you would see with actual equipment. Practically 604,800 synthetic readings had passed when we had sufficient to train. a 200-tree Random Forest. It scored 86AUC, and rainfall history: which woke up our belief that we were on the right path. Best part? Each sensor node runs maybe INR 6,000- 7,000. Compare that to lakhs for proper equipment. We made a sudden surveillance on those unprepared. hillsides is nothing so impossible.

Keywords

Slope monitoring, internet of things sensors, machine learning, artificial data, Low-range networks, simulated data, Lisinopril networks, geotechnical geometers. geotechnical monitoring.

Mechanistic Investigation into the Ausferritic Transformation and Tensile Evolution of Carbodic Ductile Iron

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Abstract

This research investigates the optimization of tensile performance in Carbodic Austempered Ductile Iron (CAD) via systematic isothermal control. CAD offers a unique microstructural equilibrium, embedding stable primary carbides within a high-strength ausferritic matrix. This study evaluates the mechanical response across varying austempering temperatures (375°C, 400°C, and 425°C). Utilizing Taguchi's L9 orthogonal array and ANOVA, we determine that tensile integrity is predominantly governed by the isothermal temperature, which dictates the refinement of acicular ferrite. Experimental results reveal a peak Ultimate Tensile Strength (UTS) of 505.6 MPa at 375°C, offering a 20% enhancement over the as-cast baseline.

Keywords

CAD, Ausferritic Transformation, Taguchi Optimization, ANOVA, Tensile Evolution.

AI-Powered Voice-to-Sign Language Translator Using DeepSpeech and Alphabetic Gesture Visualization

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Abstract

Communication accessibility remains a major challenge for people with auditory and verbal challenges limitation. To address this issue, our proposed system introduces a live voice-to-sign language interpretation model that transforms verbal voice input into text and related sign language alphabet characters. The system captures live audio through a microphone interface, which is processed using the DeepSpeech speech recognition algorithm to accurately transcribe speech into text. The recognized text is then mapped to its respective American Sign Language (ASL) alphabet signs represented as static image symbols (A–Z). This dual-output approach enables clear, accessible exchange of information between hearing and non-hearing people. The system is designed for real-time execution, integrating audio preprocessing, acoustic modeling, and visual sign rendering with minimal latency. By leveraging deep learning-based conversion of speech-to-text conversion and static gesture mapping, the model achieves high accuracy and responsiveness even under variable acoustic conditions. This research advances the creation of AI-driven assistive communication tools, promoting inclusivity and establishing a connection between spoken language and sign-based communication.

Keywords

Deep Speech, sign language translation, speech recognition, live microphone input, real-time communication, assistive technology.

Economic Feasibility Assessment of Highway Expansion Projects Using Cost-Benefit Analysis: A Data-Driven Approach

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Abstract

Due to rapid urbanization, increasing traffic volumes, and growing pressure on existing transportation infrastructure, highway expansion has become a critical necessity. However, such projects require substantial capital investment, making economic feasibility assessment essential prior to implementation. This paper presents a cost-benefit analysis (CBA) of highway expansion projects using secondary data obtained from published research, government reports, and transportation databases. The study quantifies key cost components such as construction, land acquisition, and maintenance, and compares them with major benefits including travel time savings, vehicle operating cost reductions, and accident reduction benefits over the project lifecycle. Standard economic indicators such as Net Present Value (NPV), Benefit-Cost Ratio (BCR), and Internal Rate of Return (IRR) are employed to determine project viability. Microsoft Excel is utilized for data organization, computation, and graphical representation to enhance clarity and interpretability. The findings indicate that while initial capital costs are high, the long-term benefits consistently outweigh the costs, particularly with increasing traffic growth. The use of secondary data combined with Excel-based analysis offers a transparent, efficient, and reproducible framework for informed decision-making in highway infrastructure planning.

Keywords

Cost-Benefit Analysis, Highway Expansion, Economic Feasibility, Net Present Value, Benefit-Cost Ratio, Internal Rate of Return, Traffic Growth, Vehicle Operating Cost.

Financial Inclusion and Enterprise Evolution in India's SHG Ecosystem: A State-Level Analysis of Women-Led MSME Readiness (2020–2022)

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Abstract

The Self-Help Group (SHG)–Bank Linkage Programme, India's flagship microfinance initiative, has connected over 13.4 million women's Self-Help Groups to formal banking channels by 2023, mobilizing more than Rs.7.68 lakh crore in cumulative loans. This study investigates how SHG-based financial inclusion correlates with enterprise readiness of women-led micro, small, and medium enterprises (MSMEs) across 34 Indian states and union territories from 2020 through 2022. We introduce two composite metrics: the Enterprise Readiness Score (ERS), combining average outstanding per SHG, credit utilization ratio, and NPA adjustments, and the Financial Inclusion Index (FII), integrating credit utilization, disbursement rate, and NPA adjustments. By using Tableau visualization and comprehensive Python-based data analytics on 102 state-year observations, we find clear regional differences: Central and Northern states lag considerably in ERS and FII, while Southern and Eastern states lead. The average loan amount per SHG and ERS have a nearly perfect correlation ($r=0.98$), whereas FII and credit utilization have a strong correlation ($r=0.98$). NPAs decreased from 13.38% to 9.08%, indicating better credit performance, while the national ERS increased by 40.7% between 2020 and 2022. Index stability is validated through sensitivity analyses and robustness tests across alternative weightings. Our results highlight the urgent need for coordinated policy interventions that combine customized MSME financing products, digital financial services, and capacity-building initiatives in order to replicate southern-region successes across the country and enable true enterprise graduation among Indian women entrepreneurs.

Keywords

Self-Help Groups, Financial Inclusion, Women Entrepreneurship, MSME Development, Enterprise Readiness Score, Regional Analysis, Microfinance, NABARD.

Detection of Online Fake Job Hiring through Deep Learning Approach by Integrating Bert and Gans Algorithm

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Abstract

The rapid expansion of digital recruitment platforms has significantly increased the occurrence of fraudulent job advertisements, posing serious risks to job seekers. This study presents a hybrid deep learning framework for detecting deceptive job postings by integrating contextual language modelling with advanced data balancing techniques. Context-aware textual representations are extracted using Bidirectional Encoder Representations from Transformers (BERT), enabling improved semantic interpretation of job descriptions. To mitigate severe class imbalance, a density-aware Synthetic Minority Oversampling Technique (SMOTE) is applied, followed by adversarial sample enhancement using Generative Adversarial Networks (GANs). The enriched dataset is utilized to train a classification model capable of distinguishing legitimate and fraudulent postings. Experimental evaluation on the Employment Scam Aegean Dataset (EMSCAD) demonstrates classification accuracy exceeding 90%, with notable improvements in recall and sensitivity for minority-class detection. The proposed architecture enhances robustness, generalization capability, and reliability in automated recruitment fraud detection systems.

Keywords

Fake job detection, BERT, GANs, SMOBD SMOTE, deep learning, online recruitment fraud, synthetic data generation.

AI Resume Based Resume Screening and Job Recommendation System

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Abstract

There has been a tremendous increase in the number of job applications that organizations receive because of the growing use of digital recruitment sites. This has made the manual screening of resumes ineffective, tedious and likely to be inconsistent. Resume screening and job recommendation systems which are driven by artificial intelligence have come out as viable solutions to these challenges. With the help of machine learning and natural language processing algorithms, such systems can recognize valuable data in unstructured resumes, assess the appropriateness of a candidate, and suggest the corresponding vacancies. The paper includes a general review of the current literature on the use of AI in screening resumes and job recommendations. It classifies widely used methods, evaluates datasets and metrics, as well as describes system architecture described in the literature. Moreover, the paper also presents some essential issues connected with bias, explainability, fairness, and data privacy as well as future research directions with an opportunity to create transparent and ethical recruitment systems.

Keywords

Resume screening, job recommendation, artificial intelligence, machine learning, natural language processing, recruitment automation.

IoT-Based Precision Hydroponics with AI Lighting and Nutrient Control

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Abstract

Hydroponic farming has proven to be a sustainable and efficient alternative to conventional soil farming. This paper proposes the development of an intelligent hydroponic system that integrates Internet of Things (IoT) technology with artificial intelligence for real-time monitoring and automated control. The proposed system uses temperature, humidity, pH, and nutrient sensors to monitor environmental and solution conditions in real time. An ESP32 microcontroller is used as the central processing unit for data acquisition, processing, and wireless communication. The proposed system uses a lightweight web interface to display the acquired data for remote monitoring and analysis. Automated control algorithms are used to control water circulation, nutrient delivery, and plant lighting to maintain favorable growth conditions. AI-based decision-making logic improves system efficiency by dynamically adjusting irrigation and nutrient control. The proposed system reduces manual intervention and water and nutrient losses. The proposed system is scalable and allows for future technological upgrades. The proposed system proves the feasibility of AI-enabled IoT systems in promoting smart sustainable agriculture.

Keywords

Hydroponics, Internet of Things (IoT), Artificial Intelligence, ESP32, Real-time monitoring.

AI/ML-Based Detection of Face-Swap Deepfake Videos

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Abstract

The surge in generative deep learning has led to the production of hyper-realistic face-swap videos, presenting substantial risks to digital forensics and individual privacy. Here we used machine learning framework for deepfake identification centred on Transformer-based architectures, specifically the Vision Transformer (ViT) and the Swin Transformer. The methodology involves a multi-stage pipeline where frames are systematically extracted from video sequences, followed by precise facial localization and an analysis of regional artifacts indicative of manipulation. Training and evaluation were conducted using the Celeb-DF benchmark dataset to ensure rigorous performance metrics. Rather than relying on isolated frame analysis, the proposed model implements a video-level classification strategy by using high-dimensional features and prediction scores across the temporal domain. While the ViT component excels at capturing global context and long-range dependencies across the entire frame, the hierarchical nature of the Swin transformer demonstrates a specialized capacity for isolating “stitching” inconsistencies. The micro-artifacts, which typically evade detection by standard convolutional neural networks (CNNs), are identified through a shifted-window approach that maps dependencies across patch boundaries. The framework has dual-transformer methodology establishes a scalable and dependable protocol for digital forensics. The resulting framework serves as a robust technical deterrent against the proliferation of sophisticated face-swap deepfakes, ensuring greater reliability in the verification of digital media.

Keywords

Deepfake Detection, Vision Transformer (ViT), Swin Transformer, Digital Forensics, Face swap.

AI - Assisted Memory Companion for Alzheimer's Care: A Multimodal Support System for Patients and Caregivers

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Abstract

Alzheimer's affects patients progressively, hindering their memory, communication, and functionality in daily tasks, which are beyond the capabilities of traditional digital assistants. This paper proposes a multimodal cognitive support assistant that combines speech processing, facial recognition, intelligent reminder, and cognitive evaluation functionalities. A comprehensive prototype has been developed that takes input from users in terms of voice as well as visual, utilizes natural language processing for understanding, recognizes patterns of repeated questions, and fetches customized data related to a memory book updated by a caregiver of a patient with Alzheimer's. A special care dashboard has also been designed, which displays real-time data, reminder, and cognitive trend analysis for a caregiver. Experimentation has been done, which showed encouraging results in intent identification, facial recognition, and user utility, establishing that multimodal AI-based solutions can contribute greatly to increasing autonomy and relieving care. Further research will involve personalizing, developing conversational components, and inculcating it with analysis of patient data.

Keywords

Alzheimer's disease, multimodal AI, cognitive assistance, speech processing, facial recognition.

CNN-Based Smart Drone System for Precision Pesticide Dispensing with Dosage Control in Agriculture

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Abstract

This project tackles the problem of inefficient fertilizer application in traditional agriculture. It does this by creating an automated, AI-based precision dispensing system. The system uses Convolutional Neural Networks (CNN), specifically a lightweight MobileNetV2 design, to identify plant health from images taken with an ESP32-CAM. The model is trained on a specialized dataset that classifies leaves into three groups: Healthy, Powdery Mildew, and Leaf Rust.

The "Dosage Control" part connects the CNN's output to a micro-dispensing unit. Depending on the detected condition, the system makes decisions in real time to operate a relay-controlled pump for specific durations. This delivers precise amounts, such as 10 ml for Powdery Mildew and 15 ml for Rust. This method ensures targeted treatment, which lowers chemical waste and reduces environmental impact while also improving crop recovery. Experimental results confirm that the system maintains high classification accuracy and precise volume control, showing it is a scalable solution for smart farming.

An Explainable and Resource-Aware Machine Learning Model Recommendation System

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Abstract

As machine learning is being utilized in a wide variety of fields and has many different use cases, it is considered challenging but vital to find the right model for datasets in order to ensure they are trained properly. Although AutoML systems assist in model selection, they often act as black boxes, with low transparency and practically ineffective assistance. So, to resolve these issues, we have proposed a 2-phase ML Model Recommendation System for more informed model selection. The first phase allows you to establish its core pipeline, where the system analyzes dataset characteristics such as size and feature types to recommend suitable algorithms using a heuristic-driven approach. Unlike conventional black-box systems, it provides clear and human-readable justifications for each recommendation. The second phase is essentially an improvement from the first phase, which offers more transparency and ease of use. This stage confirms which models to recommend, determines their real training times and memory usage to assess their computational feasibility, and provides learning resources for beginners in the field of AIML. The proposed system increases the trust and decision-making of machine learning workflows by including explainability, knowledge of the associated resources, and learning assistance.

A Low-Cost Real-Time Environmental Sound Detection and Direction Estimation System Using IoT Architecture for Deaf Individuals

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Abstract

This research paper demonstrates a low-cost Internet of Things (IoT) prototype for real-time environmental sound detection and directional estimation using a quad INMP441 microphone array on ESP32 for deaf and hard-of-hearing individuals. This system solves accessibility difficulties by providing real-time monitoring and alerts of surrounding sounds through a portable solution i.e. cap mounted with four INMP441 MEMS digital microphones oriented in different directions to collect audio signals that are processed using Generalized Cross-Correlation with Phase Transform (GCC-PHAT) algorithm and then Time Difference of Arrival (TDOA) estimation is implemented to determine direction of sound detected. For audio classification, a Convolutional Neural Network model is trained on ESC-50 data set deployed in the cloud, which gives 74.0% ($\pm 3.2\%$) precision in sound classification and 85.0% ($\pm 4.1\%$) precision in direction estimation in 30 independent trials. The ESP32 micro-controller is connected to cloud server via wifi which runs initial sound detection and TDOA calculation, while machine learning inference runs on cloud server. The category and direction of the predicted sound are sent to the user via the web application interface with real-time notifications. The complete hardware system costs approximately INR 1,000 (USD \$12), which is 10 $\times$ cheaper compared to existing solutions while delivering competitive performance. This work demonstrates the feasibility of accessible and affordable assistive technology for environmental awareness, with applications in healthcare, smart homes, and personal safety.

Keywords

IoT, INMP441 MEMS sensors, quad microphone array, ESP32 micro-controller, GCC-PHAT algorithm, TDOA, ESC-50 dataset, CNN, MQTT, ML, cloud-based inference.

Improved Shrinkage and Pretest Estimation Strategies for Linear Mixed Models under Multicollinearity

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Abstract

Linear mixed models (LMMs) have received considerable attention across a wide range of scientific disciplines for analyzing clustered, hierarchical, and longitudinal data, in which multicollinearity among predictors poses a serious challenge to the reliable estimation of the fixed-effects parameter vector. In this paper, we proposed ridge-type pretest, shrinkage, and positive shrinkage estimators for the fixed effects parameter vector in the LMM, accounting for the possibility that a subset of predictors may have negligible contributions to the response. The proposed estimators are evaluated analytically through their asymptotic distributional bias and risks, and numerically through relative efficiency with respect to the unrestricted ridge estimator using an extensive Monte Carlo simulation study. Our results demonstrate that the proposed estimators outperform traditional estimation techniques. To conclude this paper, we apply the proposed estimators to a real dataset exploring the relationship between effective brain connectivity in the default mode network and genetic factors in the context of Alzheimer's disease.

Keywords

Linear mixed models, pretest and shrinkage estimation, ridge estimation, multicollinearity.

Zero Trust Algorithm for Multi Cloud System Based on cp-AES

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Abstract

This project addresses the growing need for secure and accountable file protection as digital data continues to expand across networks and users. Existing systems largely rely on implicit trust, weak authentication, and limited auditing, which increases the risk of unauthorized access and data breaches. Many current frameworks follow traditional, network-centric security models and offer only basic encryption, resulting in poor traceability and weak verification of user actions. To overcome these gaps, the proposed system implements a Zero Trust-based file protection platform built with Streamlit and SQLite, featuring user registration, email-OTP verification, role-based access, continuous logging, and secure workflows for encryption, decryption, and deletion. Every sensitive action is authenticated, validated, and recorded with timestamps to support accountability and incident review. Functional testing confirms reliable performance, while identified future enhancements include stronger password hashing, authenticated encryption, and improved key derivation. Overall, the system improves security, transparency, usability, and auditability while remaining lightweight and adaptable. It can be applied in research labs, educational environments, small organizations, and personal setups for secure file management.

Vehicle Classification and Counting of a Vehicle for an Effective Traffic Control Using YoloV8

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Abstract

Traffic jams are a big issue in cities that are growing quickly, and they really need smart, data-driven monitoring and management. In this study, we introduce a real-time system for detecting, classifying, and counting vehicles using YOLOv8 along with OpenCV. This setup can spot different types of vehicles, keep track of their movements, estimate how crowded each lane is, and provide useful traffic data. Our evaluations show that this approach is accurate, works well in varying light conditions, and can adapt to the needs of smart city setups. Plus, it outshines older methods and previous YOLO versions, making it a solid choice for automated traffic monitoring, adjusting traffic signals, assessing safety, and easing congestion. By using techniques like background subtraction and object detection, the system can effectively identify and locate all kinds of vehicles—cars, trucks, motorcycles, and buses. This classification is crucial for understanding traffic flow and planning how to reduce jams. On top of that, the system includes a vehicle counting feature that tracks how many vehicles enter and exit specific areas or lanes. By keeping an eye on this in real time, it can deliver accurate information about traffic volume, helping authorities gauge how congested things are and pinpoint where the trouble spots are by integrating object detection with tracking algorithms, the system ensures accurate vehicle counting and traffic flow analysis.

Keywords

YOLOv8, Vehicle Detection, Deep Learning, Traffic Analytics, Smart Cities, OpenCV, Object Tracking.

Spatiotemporal Detection of Marine Oil Spills Using Automatic Identification System (AIS) and Satellite Datasets

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Abstract

Oil spills pose a serious threat to marine ecosystems, coastal economies, and global biodiversity. Early and accurate detection is essential to minimize environmental damage and support rapid response operations. This project presents a spatiotemporal oil spill detection framework that integrates Automatic Identification System (AIS) data with multi-source satellite imagery, including Synthetic Aperture Radar (SAR) and optical data. AIS data enables real-time monitoring of vessel movements to identify anomalous behaviors such as illegal discharges or abrupt route changes. Satellite imagery provides visual and spectral information for detecting ocean surface anomalies, including oil slicks. Advanced machine learning and deep learning techniques, such as convolutional neural networks, are applied to classify satellite features, while spatiotemporal data mining methods correlate vessel trajectories with detected spill patterns. Geographic Information Systems (GIS) are used for spatial analysis and visualization, and cloud-based platforms support scalable data processing. The integrated system improves detection accuracy, reduces false positives, and provides a cost-effective and scalable solution for real-time maritime environmental monitoring.

Keywords

Smart Classroom, Attendance Automation, Student Analytics, Emotion Recognition, Learning Management System, Educational Data Mining.

AI Based Lung Cancer Detection Using Deep Learning Techniques

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Abstract

Lung cancer is one of the leading causes of cancer-related mortality worldwide, primarily due to late-stage diagnosis and limitations of conventional screening techniques. Early and accurate detection of pulmonary nodules is essential for improving patient survival rates; however, manual interpretation of computed tomography scans is time-consuming, subjective, and dependent on radiologist expertise. This study proposes an AI-based lung cancer detection framework using deep learning techniques to automatically identify malignant lung nodules from CT images. A Convolutional Neural Network model is designed to learn discriminative and hierarchical features from preprocessed lung CT scans. Image normalization, noise reduction, and data augmentation techniques are applied to enhance model robustness and generalization capability. The proposed model is trained and validated on publicly available benchmark datasets such as Experimental results indicate that the deep learning-based approach achieves improved classification performance with reduced false positive and false negative rates compared to traditional diagnostic methods.

Rice Shield AI Smart Prediction and Management System

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Abstract

Rice cultivation plays an important role in global food production, serving as a primary food source for people in developing nations. However, rice plants face multiple diseases that cause significant damage to crop yield and quality. The process of detecting crop damage requires immediate action to stop its progression toward widespread destruction. The research introduces Rice Shield AI as an advanced agricultural support system that uses artificial intelligence to identify rice leaf diseases and create management solutions. Farmers can use the system to upload rice leaf images through mobile devices and web platforms. A deep learning model processes the uploaded images to determine possible diseases and their corresponding severity levels. The system uses the detected condition to recommend proper treatment methods which help farmers maintain their crop health. The proposed solution enables farmers to conduct early crop protection through its implementation of image analysis along with environmental data assessment and decision-making support systems.

AI-Driven Edge-Based Fault Detection in Underground Power Cables

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Abstract

Underground cable faults are hard to detect and may have to undergo time-consuming manual inspection. This paper proposes an AI driven edge-based underground cable fault detection system using ESP 32 controller with the functionality of fault localization and classification of all types of faults in real-time locally without cloud dependency. Voltage-drop measurements using a resistor based cable modelling are used in estimating the fault distance, and current sensing is used in identifying the type of fault as being open, short, or ground. Experimental results show that the proposed edge-based approach is a low-cost, fast, and reliable solution for the real-time underground cable monitoring with future scope of TinyML-based intelligent predictive maintenance.

Keywords

Underground Cable Fault Detection, Edge Computing, ESP32, AI-Driven Fault Classification, Voltage-Drop Method, Current Sensing, Fault Localization, TinyML Edge Intelligence.

A Hybrid Vision Transformer and CNN Framework for Automated Product Attribute Extraction from E-Commerce Product Images

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Abstract

As the online shopping reaches its current evolution in an enormous scale, a way of creating the metadata in a rough, programmatic way is required to deal with such enormous throngs of product catalogs. Most solutions in the industry currently are based either on Convolutional neural networks (CNNs) to obtain local information about a spatial region or Vision Transformers (ViT) to process global data. Nevertheless, the extensive part of visuals which may be perceived between different types of clothes that can be observed cannot be considered as fully covered by applying one of these methods. In order to enable these two networks to fully use and share their features as well as to bridge the disparities between the local features and the entire picture we also created a Bidirectional Cross-Attention (BCA) fusion module. The problem of data annotation is too time-consuming to resolve manually; therefore, we addressed the problem with the assistance of a pseudo-labeling pipeline that is trained on Contrastive Language-Image Pre-training (CLIP). Multi-template ensemble prompts and a hard cut on process performance was maximized to optimize this process. On Deep Fashion we tested the model in the 13,679 images, and the average accuracy was 72.85 percent, which is terrible in comparison with the scenario of having only one backbone. The improvement in performance of Xenium ablation experiments indicated that the neat bidirectional attention trick by itself correlates to a consistent 3.5% improvement in performance, which is that the results are amazingly good in the context of objectively cataloging fashion items.

Keywords

Vision Transformer, Residual Networks, Cross-Attention Fusion, Multi-Attribute Learning, Pseudo-Label Generation, Zero-Shot Transfer, Fashion Recognition.

Smart Micro-Finance Platform: (AI-Based Loan Assessment and KYC Validation System)

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Abstract

Micro-finance institutions have been playing an important role in supporting individuals and small-scale businesses that do not have access to formal banking systems. Such institutions have been helping in the promotion of financial inclusion. However, there have been many traditional micro-finance processes that have been carried out in a manual manner. This is causing inefficiencies in verification, delays in loan processing, documentation, and decision-making. This project is about creating a Smart Micro-Finance Platform. This platform is developed with the intention of modernizing traditional micro-finance operations. The platform is developed with features that include digital verification, automated loan assessment, multilingual support, and financial literacy. Such a platform is developed with the intention of making micro-finance operations more efficient, transparent, and user-friendly.

The proposed platform is developed with features that allow users to create digital profiles, apply for loans, and also allow users to submit KYC information using structured forms. The system is developed using a form-based approach for user verification. The system is developed with features that validate user inputs using defined rules. This approach is used for ensuring accurate, complete, and consistent user data. Such an approach is used for eliminating the need for manual verification, which often results in errors. The system has integrated the machine learning-based loan assessment module, which helps in the evaluation of the loan borrowers. This module considers the key financial parameters of the borrowers, including their income, occupation, repayment history, and loan amount, to provide fair and unbiased results. Further, the system has integrated the AI-based financial assistant feature, which helps in providing explanations about the loan to the users. This feature is helpful in increasing the user's understanding. The system has integrated the financial literacy feature, which helps in providing the users with the required knowledge about the loan and its usage. Real-time notifications are also available to keep the users informed about the loan through regular updates.

Moreover, it also provides support for multi-lingual functionality, where users can access it in both English and Tamil languages. This makes it more accessible and user-friendly for users in that region. The modularity of the system also makes it more scalable and flexible, which is beneficial in integrating it with other technologies in the future. Testing and evaluation of the system have also proved that it is beneficial in improving the speed of processing, reducing manual dependencies, and enhancing user experience. The integration of automation, machine learning, and user experience makes the Smart Micro-Finance Platform reliable.

Keywords

Digital Micro-Finance, KYC Validation, Loan Eligibility Prediction, Machine Learning, Financial Inclusion, Multilingual Interface, Financial Literacy, Online Loan Processing, FinTech, AI Assistant.

Predictive Analytics for Customer Churn in Subscription Based Services

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Abstract

Keeping subscribers from leaving has become one of the more pressing problems facing subscription-based businesses today, given how directly customer retention tries to sustained revenue. This paper talk about Churn IQ, a machine learning system designed that uses records of identify customers past actions to determine customers who will be more probable to cancel. These data based on information about their past behavior, including frequency of service usage, number of support calls, payment method, and subscription plan.. Before training, the data goes through cleaning, label encoding for categorical fields, and SMOTE to correct the imbalance between churners and non-churners. We tested Three types of classifiers models – Logistic Regression, Random Forest, and XG Boost – and examined at quality accuracy, precision, recall, and AUC-ROC scores with 81% accuracy, 82.32% along with precision, and an AUC-ROC values of 87.42%. The system also contains a Customer Lifetime Value (CLV) module so that designed to help businesses can work towards which at-risk clients are worth invest to the first place financially. In generally, the results prove that combining ensemble classifiers along with careful data preparation appears far better to recognize churn detection than simpler techniques, and the Flask-based interface further makes the system usable in real business settings without requiring lots of additional infrastructure.

Keywords

Customer churn, Machine learning, Random Forest, SMOTE, AUC-ROC, Subscription services, Customer Lifetime Value, Predictive analytics.

Avian Insights: Bird Identification through Sound

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Abstract

Birds are considered key indicators of ecological balance and biodiversity. However, manual recognition is time-consuming and heavily dependent on expert knowledge. To address this challenge, we introduce an audio-based bird identification and classification system that leverages deep learning techniques for accurate species recognition. The proposed framework focuses exclusively on acoustic analysis of bird vocalizations. For single-species recordings, the system employs the Audio Spectrogram Transformer (AST), which processes spectrogram representations to capture temporal and frequency-based patterns in bird calls. In scenarios involving overlapping or concurrent vocalizations from multiple species, Conv-TasNet is utilized to perform source separation, isolating individual bird calls from mixed-audio environments.

Due to the lack of publicly available mixed-species bird audio datasets, a synthetic mixed-bird audio dataset was generated by combining clean recordings of various species. This dataset enables effective training and evaluation of both the separation and classification components of the system.

By relying solely on auditory information, the proposed approach provides robust species identification even in noisy or acoustically complex environments. This work highlights the potential of artificial intelligence in ecological monitoring and offers a scalable, efficient, and reliable solution for automated biodiversity assessment and wildlife conservation.

Real Time AI Enabled Fitness Tracker and Chatbot

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Abstract

Recent developments in artificial intelligence mean that it is now possible to adapt guidance of fitness beyond static advice. This paper introduces a real-time artificial intelligence (AI) enabled, fitness chatbot that provides personalized recommendations on exercise and nutrition depending on user profiles, goals, dietary preferences and interactions. The hybrid system combines the methods of the rule-based personalization and the machine learning adaptation, with a multi-layer safety validation of the intensity of workouts, caloric balance and medical contraindications. Built with frontend using Vue.js, Backend using FastAPI, WebSocket communication, Relational DB, NLU/NLG intelligence core, it keeps improving the recommendations with the help of user's behaviour analysis. Evaluated using simulated scenarios and a 4-week study with 40 participants, against rule-based baselines, the chatbot exhibited 92 percentage safety (vs. 73 percentage), 84/100 of SUS score (vs. 69) and 80 percentage of retention (vs. 55 percentage), proving to be superior in terms of engagement, relevance and satisfaction in ensuring effective, reliable and user-centric digital fitness solutions.

Optimizing ETL for Hybrid Clouds: Leveraging AWS, DataStage, and Tivoli Workload Scheduler for Enterprise-Scale Workflows

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Abstract

A lot of businesses are embracing hybrid cloud systems to make their work easier, more flexible, and less expensive. This means that there is an increasing need for data integration that is both quick and dependable. This article talks about how to improve extract, transform, and load (ETL) tasks by combining the scalability of AWS cloud services, the full orchestration capabilities of IBM DataStage, and the exact scheduling features of Tivoli Workload Scheduler. We talk about how a well-designed hybrid ETL system may help with both operational efficiency and compliance by looking at real-world workflow issues including managing various data sources, intricate links, and keeping fault tolerance at scale. AWS provides a flexible infrastructure that makes it easy to add or remove compute and storage resources as needed. This implies you can work with large datasets without having to pay for them right away. DataStage, on the other hand, is built on metadata and features strong parallel processing that helps you combine diverse data pipelines into assets that are dependable and can be used again. Tivoli Workload Scheduler makes this even better by keeping an eye on dependencies across hybrid environments, which include on-premise systems, cloud-native services, and third-party apps, and making sure they execute with the least amount of delay. This helps businesses keep their service-level agreements. IT personnel can acquire important information from both dashboards and alerts when they blend them. This implies they don't have to do as much work by hand. This gives them time to make changes that will last instead of just fixing things as they go wrong.

Keywords

ETL, Hybrid Cloud, AWS, DataStage, Tivoli Workload Scheduler, Workflow Optimization, Cloud Integration, Big Data, Enterprise Architecture, Automation, Data Pipelines.

SafeguardHer: A Real-Time AI & ML Powered Web Platform for Women's Safety

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Abstract

Women's safety in urban environments remains a critical public concern in India, with incidents of harassment, stalking, and assault continuing to rise across Andhra Pradesh and other states. This paper presents SafeguardHer, a real-time AI and machine learning powered web platform built using Python and Streamlit that integrates five purpose-built computational modules. The Adaptive Bilingual Language Engine (ABLE) applies TF-IDF vectorization with Logistic Regression and bilingual Telugu–English keyword reinforcement to detect distress signals from text or voice input, achieving an F1-score of 0.925. The Multi-Factor Safety Scoring Model (MFSSM) computes composite safety indices from crime density, lighting, and traffic data across geographic zones. The Risk-Aware Dijkstra Navigator (RADN) employs NetworkX graph traversal and K-Means spatial clustering to identify and rank safe transit routes in real time. The Temporal Crime Anomaly Predictor (TCAP) uses Isolation Forest and Linear Regression to detect statistical outliers in historical crime data and forecast three-year crime trends. The Contextual Emergency Dispatch Protocol (CEDP) applies Haversine proximity ranking to locate nearest police stations, hospitals, and shelters, with optional Firebase Firestore logging for persistent alert tracking. The platform delivers interactive Folium heatmaps, Plotly dashboards, and one-tap emergency contact dispatch. Experimental results demonstrate sub-12ms routing performance and a mean absolute error of 0.42 on crime rate forecasting. SafeguardHer addresses a tangible gap in accessible, region-aware safety technology for women in South Indian urban contexts.

Keywords

Women safety, distress detection, bilingual NLP, safe route navigation, anomaly detection, machine learning, Streamlit.

AI-Based Urban Garden Management System

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Abstract

Urban agriculture is gaining strategic importance as cities seek food security, reduced carbon emissions, and community resilience. Despite this, urban farmers face challenges including unpredictable weather, rapid crop disease spread, volatile market prices, and restricted access to smart tools. This paper presents MBU Gardening, an AI-powered mobile and web platform designed for urban farming management. The system employs a MobileNetV2-based convolutional neural network for crop disease detection, achieving 94.0% classification accuracy across 48 disease categories spanning 14 crop species including Indian rice varieties. The model was trained via two-phase transfer learning on a combined dataset of 80,702 images (PlantVillage and Paddy Doctor) and optimized for CPU-only deployment through ONNX INT8 quantization, reducing the model to 2.4MB with inference times of 20-40 ms. A Random Forest crop recommendation engine attains 99.1% accuracy across 22 Indian crop varieties using soil nutrient and weather features. The platform integrates live weather forecasting, real-time market price monitoring, equipment booking, storage management, and a multilingual interface supporting Telugu, Hindi, Tamil, Kannada, and Marathi. Evaluation with 50 urban farmers demonstrated decision-making time reduction from days to under 10 minutes and 15-20% improvement in market selling prices.

Keywords

Urban agriculture, deep learning, MobileNetV2, transfer learning, ONNX Runtime, crop disease detection, smart farming, crop recommendation, FastAPI, microservices.

Intelligent Security System Using Computer Vision and IoT

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Abstract

The shortcomings of traditional manual and RFID- based systems, which are frequently socially disruptive due to lengthy delays, human error, and unauthorized access, have been brought to light by the growing need for secure and automated access control, particularly in academic institutions. The suggested project is an Internet of Things and computer vision-based intelligent security system with ID tag recognition. The YOLOv1 object detection deep learning model is used by the system to identify institutional ID tags in real time from video streams captured by surveillance cameras at campus entry points. To restrict access to only those who are authorized, the identified ID information is then compared to a central database containing staff and student records. The real-time transmission of results, the creation of alerts, and the updating of access logs on the web-based monitoring platform for security and administrative staff are all made possible by the Internet of things-based communication infrastructure. Without the need for manual surveillance or physical scanning, the developed solution is easy to scale up, inexpensive to deploy, and straightforward to implement. Additionally, well-organized data storage facilitates access pattern analysis, auditing, and attendance tracking. The system can be expanded in the future to cover numerous locations, such as gates, hostels, labs, classrooms, and transportation systems, thanks to its modular design. The experiments' findings demonstrate the effectiveness of AI-powered video surveillance systems for smart campuses by showing improved security performance with reduced operating costs.

Keywords

Intelligent security system, computer vision, ID tag recognition, YOLOv11, Internet of Things, access control, smart campus.

Smart Ambulance Emergency Coordination System Using Real-Time Distributed Communication

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Abstract

Emergency medical services often experience delays due to poor coordination between citizens, ambulance services, and hospitals. Traditional ambulance dispatch systems rely on manual communication, which can lead to increased response time, lack of hospital resource visibility, and inefficient patient routing. To address these challenges, this paper proposes a Smart Ambulance Emergency Coordination System, a real-time distributed platform designed to optimize emergency response and hospital resource management. The proposed system is developed using the MERN stack (MongoDB, ExpressJS, ReactJS, and NodeJS) and integrates Socket.IO-based WebSocket communication to enable real-time synchronization between citizens, ambulances, and hospitals. Citizens can raise emergency requests with their live GPS location, allowing the system to automatically assign the nearest available ambulance using geospatial queries. A rule-based hospital recommendation engine selects the most suitable hospital based on resource availability, distance, and hospital load factor. The system also performs temporary reservation of ICU beds, emergency rooms, or general beds before ambulance arrival to ensure hospital readiness. Real-time ambulance tracking and instant notifications improve coordination between emergency stakeholders. Experimental evaluation demonstrates that the proposed platform reduces emergency response delays and improves hospital resource utilization. The system provides a scalable solution for modern smart healthcare infrastructure and intelligent emergency management.

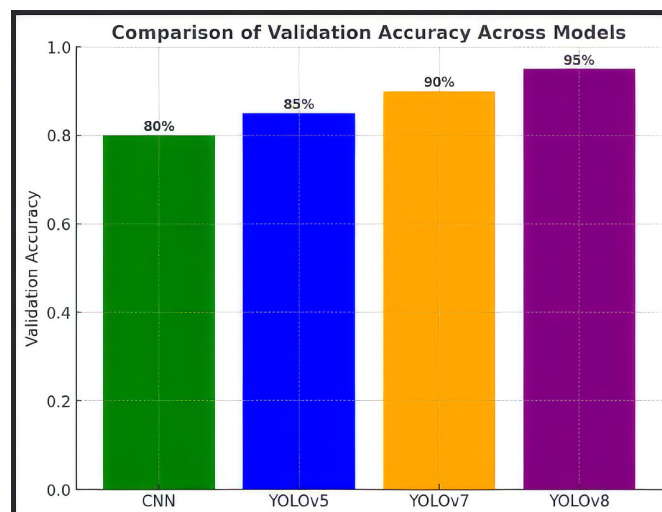


Figure 1. Bar Graph Comparing Accuracy Across Different Models

High Fidelity Image-Restoration using GAN'S

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Abstract

Medical image super-resolution is necessary in the healthcare diagnostics field, where accurate visual information is necessary in order to perform the analysis and make the decision. To enhance the quality of grayscale medical photographs, the current research is a deep learning approach based on Generative Adversarial Networks (GANs). The architecture of the proposed model includes a generator that relies on the batch normalization, LeakyReLU activation functions, and convolutional, upsampling layers to transform low-resolution (64 64 pixels) input to the high-resolution (128 128 pixels) output. The training of the discriminator network that compares the images generated by the generator and the original high-resolution ones train the generator to create images that are more realistic and detailed. Adversarial loss is enhanced by combining quantitative picture quality measures such as Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity Index Measure (SSIM) with the training process. The experimental findings indicate that the GAN- based framework performs better than traditional interpolation techniques in restoring high-fidelity medical images with maintaining important features. The proposed method has an enormous potential of enhancing diagnostic accuracy and reliability in such medical imaging procedures as radiology, pathology, and telemedicine.

Keywords

Medical Imaging, Super-Resolution, Generative Adversarial Networks (GANs), Deep Learning, Image Enhancement, PSNR, SSIM, Image Reconstruction, Grayscale Images, Diagnostic Imaging.

Disease Prediction Using Machine Learning Algorithms

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Abstract

Early and accurate disease prediction plays a vital role in improving healthcare outcomes and reducing treatment costs. With the rapid growth of medical data, machine learning (ML) techniques have become effective tools for disease diagnosis and prediction. This paper presents a review of a machine learning–based disease prediction system implemented using supervised learning algorithms. The system utilizes symptom-based datasets and applies multiple classification models, including Support Vector Machine (SVM), Random Forest, K-Nearest Neighbours (KNN), and Logistic Regression. Performance evaluation is conducted using standard metrics such as accuracy, confusion matrix, and classification reports. The review highlights the effectiveness of SVM for disease prediction and discusses the dataset, algorithms, evaluation techniques, and limitations of the approach.

Machine learning in healthcare is not only limited to prediction but also supports early diagnosis, personalized treatment, and clinical decision support systems (CDSS). With the rise of electronic health records (EHRs) and wearable devices, large-scale medical datasets have enabled more accurate predictive modeling.

Keywords

Disease Prediction, Machine Learning, Support Vector Machine, Random Forest, Healthcare Analytics.

Barriers to Adopting Social Commerce along Women MSMEs in Kollam, Kerala: A Study using TISM Method

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Abstract

Purpose: Female startups in the Kollam district of Kerala, under the Micro, Small, and Medium Enterprises (MSME), are operated in a paradox, as they are located in one of India's most literate states, but are not yet largely integrated with digital commerce ecosystems. The following paper plots the network of multi-layered structural relations between the various obstacles which do not yet allow these entrepreneurs to embrace fully social business. Going beyond a mere listing of challenges, the current research seeks to learn how these obstacles are stimulated and escalate into a domino effect on women led business.

Design/Methodology/Approach: This study was done using a four-step Total Interpretive Structural Modeling (TISM) construct. The ten unique barriers have been retrieved out of existing literature and then confirmed by the reviews by the expert panel consisting of twelve individuals through the use of single sample t-tests ($p < 0.01$). Hierarchical model was developed thereafter and interpreted by Structural Self-Interaction Matrix (SSIM) binary reachability matrices under checks of transitivity and by means of MICMAC analysis.

Results: The five-level hierarchy of constraints were raised by the TISM model. The driving forces are High Competition (B9) and High Marketing Costs (B5) that make all the further issues even more severe. Privacy/Safety Fear and Logistics failures serve as strategic loci on the next level, which is a direct driver of the credibility barrier Level III Threat of Level Visible Hand-in-the-middle Perceived Unprofessionalism and Customer Trust Issues. Level II is characterized by gaps in the operational capability such as 24/7 Availability pressures, Content Skills deficit, and Complexity of Algorithms. The most dependent variable is Family Resistance which implies that this variable is the consequence of systemic inefficiencies on the part of business and it does not imply that family resistance is a culture problem.

Practical Implications: Kudumbashree and other local stakeholders take out resources hosting digital literacy programs. The underlying barriers should rather be addressed by marketing cost subsidies, logistics corridors with state assistance and institutional trust-verifying systems that are women-focused enterprises.

Keywords

Social Commerce, Women MSMEs, TISM, MICMAC, Digital Adoption, Kerala, Kudumbashree, Technology Acceptance.

Design and Comparative Analysis of a Compact CPW-Fed Multi-Band Antenna Using Different Substrate Materials for CubeSat Applications

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Abstract

The rapid growth of small satellite missions and CubeSat platforms has created a strong demand for compact, lightweight, and multi-band antenna systems capable of providing reliable communication between satellites and ground stations [1], [2], [3]. Antenna designs for such space-constrained platforms must satisfy stringent requirements in terms of size, weight, integration, and stable performance across multiple frequency bands. This paper presents the design and simulation-based performance analysis of a compact coplanar waveguide (CPW)-fed multi-band planar antenna intended for CubeSat communication systems, including telemetry, telecommand, and payload data transmission [4], [5]. The proposed antenna operates at multiple resonant frequencies within the L- and S-band regions, enabling the simultaneous realization of low-data-rate control links and higher-data-rate downlink communication using a single radiating structure [6], [7].

To investigate the influence of substrate properties on antenna behavior, the proposed antenna geometry is evaluated using ten different dielectric substrate materials with varying relative permittivity and loss characteristics [8]. Parametric full-wave electromagnetic simulations are carried out using ANSYS HFSS to analyze key performance metrics such as reflection coefficient, impedance bandwidth, surface current distribution, radiation pattern, and realized gain [9]. The simulation results demonstrate stable multi-band operation with satisfactory impedance matching across all investigated substrates, while highlighting substrate-dependent frequency shifts and bandwidth variations [10], [11]. The results confirm that the proposed CPW-fed antenna structure offers a flexible and compact solution for multi-mission CubeSat communication systems, with potential applicability in L-band telemetry and navigation services as well as S-band payload data transmission [12].

Keywords

CubeSat Antenna, Tri-Band Microstrip Patch Antenna, Small Satellite Communication, S Band Communication, Compact Antenna Design, Impedance Bandwidth, Spaceborne Antennas.

A Developer-Centric Decay Index for Predicting Software Decay

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Abstract

Software decay results from complexity, changes to the codebase, and unmanaged contributions to the code. This results in technical debt and defect-prone software systems. Current tools, such as static analyzers, focus on the current state of the code and are unable to monitor changes in the behaviour of the code. This study introduces a new tool called SQA, which is a local-first tool that uses a predictive risk score (0-100), called the Developer Decaying Index (DDI), which is a combination of static and behavioural factors. It has a modular pipeline, can handle multiple languages, and can be integrated with CI/CD tools. SQA achieves 81.5% F1@Critical, outperforming ECM by 22% and tdebt by 25%.

Keywords

Software decay, technical debt, code entropy, churn prediction, DDI.

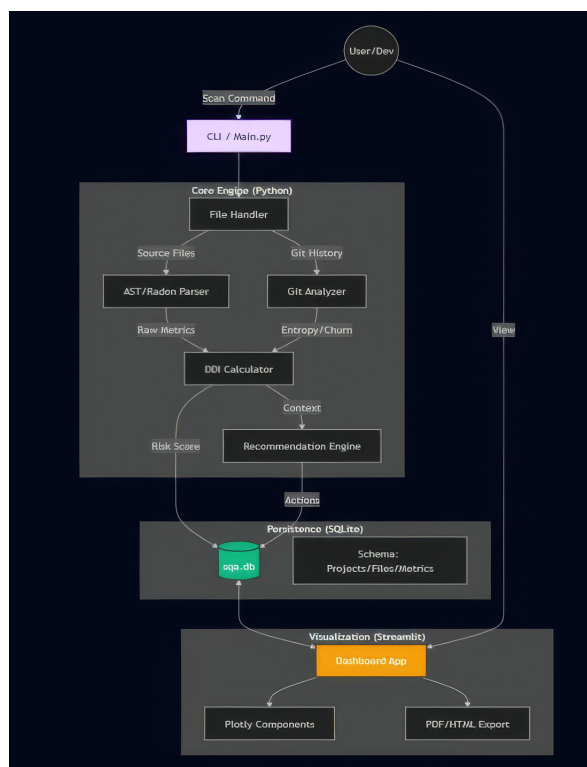


Figure 1. Architecture Diagram

Agentic Artificial Intelligence for Autonomous Financial Trading: A Framework for Adaptive Market Analysis and Strategy Execution

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Abstract

The evolution of financial markets has shifted away from simple automation on a rule basis to advanced forms of algorithms, however the more traditional forms of markets are not adaptable to newer market conditions. The paper proposes a new branch of autonomous trading: Agentic Artificial Intelligence, which is a paradigm shift where autonomous systems have the ability to set goals and reason and make independent decisions. Our comparison includes a detailed analysis of traditional algorithmic trading compared to the agentic AI-based models in terms of architectural design, learning mechanism, and operational autonomy. The study suggests a new five-module agentic model that combines a high level of machine learning and a market perception, reasoning, planning, and execution model. With a systematic comparison with our baseline strategies, we find that agentic AI systems are more adaptable in volatile environments and produce new trading strategies than the fixed rules do. The model is effective because it has the ability to combine multimodal information such as price fluctuations, volume, and sentiment indicators to make decisions based on context. The study is useful in autonomous intelligent systems and lays the groundwork for next-generation financial trading architecture that has the ability to improve itself continuously.

Keywords

Autonomous Trading Systems, Agentic Artificial Intelligence, Financial Market Analysis, Machine Learning, Reinforcement Learning, Algorithmic Trading, Multi-Agent Systems, Deep Learning, Autonomous Decision-Making.

A Structural Modelling Approach to Technology Adoption Among Mompreneurs in Kerala: Evidence from TISM–MICMAC Analysis

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Abstract

The rise of digital technologies that develop quickly around the world has created massive business opportunities for women entrepreneurs, or "mompreneurs," who are running businesses and raising families at the same time. With such a high level of literacy and many new digital forms of communication being produced within the region, the way in which women use technology has not been quantitatively assessed in this area and what drives women to use technology is still not clearly defined. This paper will help identify and classify key enablers of technology adoption within the mama (mompreneur) population in Kerala by utilizing the Total Interpretive Structural Modelling (TISM) method combined with Multidimensional (MICMAC) analysis. The primary data for this study were collected from 150 mompreneurs located in urban, semi-rural, and rural communities through a structured survey instrument. Using a thorough review of the literature as a guiding principle, ten key enablers of technology adoption were identified, further confirmed through expert consultation. The TISM process consists of four phases: creating a Structural Self-Interaction Matrix, building Binary Reachability Matrices, Level Partitioning, and building Hierarchical Digraphs that represent directional relationships between the variables. The MICMAC analysis also identified the levels of influence of each enabler, grouping them into four categories: Driving Factors (highest) and Dependent Factors (lowest); Linkage Factors (more than one link to an enabler), and Autonomous Factors (no links to other variables). The results illustrate that both Digital Infrastructure Access and Institutional Support are the two main enablers of technology use by mompreneurs, while Empowerment Outcomes are the highest rated enabler ranking/progressing in their learning curves for accomplishing their business goals. The research demonstrates that both Digital Literacy and Informal Networks act as strategic linkages. Policymakers, training organizations, and platform designers can use these findings as guides to develop inclusive digital environments to help women entrepreneurs efficiently integrate their domestic obligations with sustainable growth in their businesses.

Keywords

Mompreneurs, Technology Adoption, TISM, MICMAC, Digital Entrepreneurship, Female Entrepreneurs, Kerala.

Severity-Aware Automated Grading of Diabetic Retinopathy

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Abstract

The visual impairment which results from Diabetic Retinopathy (DR) affects millions of people across the globe making it essential to detect the condition at an early stage to achieve successful treatment outcomes. The research analyzes deep learning models which consist of MobileNet DenseNet Capsule Networks (CapsuleNet) UNet++ to identify and categorize five diabetic retinopathy stages which include Mild Moderate No_DR Proliferative_DR Severe. The models use retinal images to train their systems for accurate stage classification. The researchers implement Explainable Artificial Intelligence (XAI) techniques to make their models more understandable to users by applying the Grad-CAM (Gradient-weighted Class Activation Mapping) technique. The system achieves complete DR detection because its combination of CapsuleNet and UNet++ systems deliver superior performance through its dual functionalities which provide exact detection results. The results show that the three models which included DenseNet CapsuleNet and UNet++ achieved successful performance while the DenseNet model detected all DR stages with better accuracy because it had higher sensitivity and specificity. The system's operational details which Grad-CAM provides enable clinicians to understand how the model generates predictions. The application of Grad-CAM increases model interpretability which establishes trust with clinicians because it shows them how the model makes decisions. The article proposes explainable deep learning as a solution which will improve diabetic retinopathy diagnosis methods and treatment methods while it serves as a future tool which will benefit patient results.

Keywords

Diabetic Retinopathy, MobileNet, DenseNet, Explainable AI, Grad-CAM, Retinal Image Classification, Medical AI Transparency.

Design and Performance Analysis of a QCA-Based Cube Calculator Using Optimized Multiplier Architectures

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Abstract

Quantum-Dot Cellular Automata (QCA) has emerged as a promising nanoelectronic technology for designing ultra-low power and high-density digital circuits beyond CMOS limitations. In this paper, an energy-efficient design of QCA-based arithmetic circuits is proposed using majority logic minimization and optimized clock zone assignment. The proposed method integrates Half Adder-Subtractor, Full Adder-Subtractor, and 4-bit Adder-Subtractor architectures to reduce hardware redundancy and improve overall efficiency. The circuits are designed and analyzed using QCA Designer-E with both bistable and coherence simulation models for accurate energy evaluation. The simulation results demonstrate that the proposed designs achieve reduced energy dissipation and improved performance compared to existing circuits. The existing 4-bit adder exhibits a total energy dissipation of 3.02×10^{-2} eV, whereas the proposed 4-bit adder-subtractor reduces it to 2.70×10^{-2} eV, achieving an improvement of approximately 10–12%. Additionally, the proposed designs reduce switching activity, minimize cell count, and enhance scalability for multi-bit operations. These improvements make the proposed approach suitable for low-power nanoelectronic systems, including IoT devices, cryptographic hardware, and next-generation computing applications.

Keywords

Quantum-Dot Cellular Automata (QCA), Energy Dissipation Optimization, Majority Logic Minimization, QCA Designer-E, Adder-Subtractor Design etc.,

Quantum Secure E-Mail Client Application using Quantum Key Distribution and Post-Quantum Cryptography

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Abstract

Email communication plays an important role in personal, professional, and organizational information exchange. However, traditional email systems are increasingly exposed to security risks such as data tampering, interception and unauthorized access. The rapid development of quantum computing also threatens many classical cryptographic techniques used in current communication systems. To address these issues, this paper presents a Quantum Secure Email Client Application (QSECA) designed to improve email security using quantum-resist methods. The proposed system combines Quantum Key Distribution (QKD) with post-quantum cryptographic algorithms to enable secure key exchange and strong message encryption. The system uses the basic principles of quantum mechanics to identify any attempt to intercept the communication during the key exchange process. If an unauthorized user tries to access the channel, the disturbance in the quantum states helps in detecting the intrusion. Along with strong security features, the application is also designed with a simple and easy-to-use interface so that users can send and receive emails without difficulty. This approach helps in building a secure email environment that can protect sensitive information from both present-day cyber threats and possible future risks caused by quantum computing.

Keywords

Quantum key distribution, Quantum Cryptography, Post-quantum cryptography.

Detection of Diabetic Retinopathy in Indian Patients Using Deep Learning Models

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Abstract

Diabetic Retinopathy (DR) is a severe microvascular complication of diabetes that can lead to irreversible blindness if not detected early. According to your project report, early screening is critical due to the increasing global diabetic population and limited availability of ophthalmologists in rural regions. This study proposes an automated system using deep learning techniques, specifically Convolutional Neural Networks (CNNs), for detecting and classifying DR severity from retinal fundus images. As described in your PPT, preprocessing techniques such as grayscale conversion, Gaussian blur, normalization, and CLAHE are applied to enhance image quality and feature extraction. The system utilizes publicly available datasets such as APTOS and IDRID, and achieves an accuracy of approximately 90%, demonstrating its effectiveness. The model improves diagnostic speed, consistency, and scalability compared to traditional manual examination.

Diabetic Retinopathy (DR) is one of the leading causes of vision impairment and blindness among diabetic patients, particularly in India where the prevalence of diabetes is rapidly increasing. Early detection and timely treatment are crucial to prevent irreversible vision loss; however, manual screening by ophthalmologists is time-consuming, resourceintensive, and often inaccessible in rural areas. This study proposes an automated system for the detection of Diabetic Retinopathy in Indian patients using deep learning models applied to retinal fundus images.

A convolutional neural network (CNN)-based architecture is developed and trained on labeled retinal image datasets representing various stages of DR, including normal, mild, moderate, severe, and proliferative conditions. The model incorporates preprocessing techniques such as image normalization, contrast enhancement, and data augmentation to improve robustness and accuracy. Performance evaluation is conducted using metrics such as accuracy, precision, recall, F1-score, and AUC-ROC.

Experimental results demonstrate that the proposed model achieves high classification accuracy and effectively distinguishes between different stages of DR. The system shows potential as a reliable and scalable screening tool, particularly in resource-limited settings across India. This approach can assist ophthalmologists in early diagnosis, reduce workload, and enable large-scale screening programs, ultimately contributing to improved patient outcomes and prevention of vision loss.

Keywords

Diabetic Retinopathy, Deep Learning, CNN, Medical Imaging, Fundus Images, Image Processing.

An Automated Deep Learning Framework for Mammographic Microcalcification - ROI Detection and Classification

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Abstract

Mammographic micro calcifications are important in early disclosure of breast cancer and need suitable localization and categorization in order to enhance successful diagnosis. The proposed framework combines the preprocessing, segmentation, feature extraction, and the classification based on deep learning into one pipeline. Contrast Limited Adaptive Histogram Equalization (CLAHE) is added to enhance microcontours and bring out fine features of microcalcifications in the image. Image enhancement helps to minimize noise and enhance visual coverage of the regions that are suspected to be harmful. The U-Net composition allows obtaining accurate localization of pathological regions and extraction of Region of Interest (ROI). The segmented ROI does not lose significant anatomical and structural attributes that can be further analyzed. The Gray Level Co-occurrence Matrix (GLCM) is applied as a method to obtain the texture features based on the spatial and intensity-related patterns. These characteristics can be used to give useful detail in the differentiation of normal and abnormal tissue. To obtain a global contextual and local spatial feature, it uses a hybrid classification model that consists of Vision Transformer and EfficientNet. The given fusion model enhances the classification robustness and learning efficiency. The framework is set to deal with differences in mammographic image quality and tissue density. Accuracy, precision, recall, and ROC curve are used to evaluate performances. The experimental results prove to have a better detection limit than the traditional ones. The automated pipeline facilitates the use of consistent and objective interpretation of mammographic images. Such a strategy leads to quick screening of breast cancer and helps the radiologists in clinical decision-making.

Keywords

CLAHE, Image Analysis, Microcalcification, U-Net Segmentation, Vision Transformer and EfficientNet.

Developing an AI-Powered System for Early Detection and Prevention of Ransomware Attacks

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Abstract

Ransomware attacks represent one of the most destructive forms of cyber threats, characterized by rapid file encryption, system disruption, and financial extortion. Traditional signature-based antivirus mechanisms are increasingly ineffective against zero-day and polymorphic ransomware variants due to dynamic code obfuscation techniques. This paper proposes a real-time AI-driven behavioral ransomware detection and prevention framework that identifies malicious activity before irreversible file encryption occurs. The proposed system continuously monitors system-level behavioral indicators including file modification rates, process execution patterns, CPU utilization anomalies, network traffic bursts, and unauthorized access attempts. A supervised machine learning model using XGBoost is trained on datasets containing normal behavior and ransomware behavior to classify system activities as 'Normal' or 'Ransomware-like'. Upon detection of ransomware-like activity, an automated response engine immediately terminates the malicious process, isolates the affected device from the network, and logs forensic evidence for further investigation. Experimental evaluation demonstrates high detection accuracy with strong precision and recalls performance, while significantly reducing response latency compared to traditional signature-based approaches. The integration of continuous monitoring, behavioral learning, and automated containment provides a proactive and scalable defense mechanism against both known and zero-day ransomware threats.

Keywords

Ransomware, detection, machine learning, behavior, encryption, network, monitoring, prevention, cybersecurity, classification.

Integrating Salesforce with Legacy Systems like SAP: Patterns, Pitfalls, and Proven Solutions

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Abstract

These days, it is imperative for any firm turning to digital transformation to find a way to connect its cloud-based Customer Relationship Management (CRM) system, such as Salesforce, with the legacy Enterprise Resource Planning (ERP) system, like SAP. Salesforce is one of the platforms offering a flexible, scalable, and highly user-friendly environment for customer interaction, while on the other hand, it is often the case that the legacy ERP systems are the ones containing the main operational data which cannot be moved quite easily due to the complexity, the regulations, or even the price. Integration gives the chance to bring together customer data, to make their business processes more efficient, and to base their decisions on a better understanding of the data. However, it is not an easy task due to the fact the problems like data inconsistency, security compliance, real-time synchronization, and a very high cost of maintenance. The authors of this paper pinpoint the most popular integration patterns and, after that, they also describe some of the mistakes that can be made during the implementations of the integrations, most importantly, they show the way how these methods can be saved; the approach they used was a well-structured one. In a case study they practically present the application of these methods, at the same time, their analysis is focusing on the both technical and business results. By merging the knowledge of the literature, the best practices, and the real-life experience, this piece provides guidance to the companies that are looking for a Salesforce-SAP integration that is both effective and resilient.

Keywords

Salesforce Integration, SAP ERP, Legacy Systems, Data Synchronization, Middleware Solutions, Integration Patterns, Cloud-ERP Interoperability.

Deep Learning Based Eye Directive Wheelchair

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Abstract

For those who are suffering from severe paralysis and limited motor capabilities, it is impossible for them to use a normal wheelchair. This project is designed to provide a Deep Learning-Based Eye Directive Wheelchair System for those who want to use a wheelchair based on eye movement. This is a new and innovative way for people with limited motor capabilities to use a wheelchair without having to use their hands and without speaking. This is done by using a camera to focus on one of the eyes of the user, reducing any possible error based on eye movement and distractions. Based on eye movement, the following commands are defined for controlling a wheelchair: Left eye movement → Turn Left Right eye movement → Turn Right Eye opened and looking straight → Move Forward Eye closed → Stop To show the effectiveness of the proposed system, a 3D-printed miniature wheelchair model is designed and implemented using a motor. Based on the direction predicted by the proposed AI model, the wheelchair model is moved accordingly. Based on the proposed idea of using deep learning and computer vision, people with limited motor capabilities can improve their quality of life.

Sample Selection Bias in Machine Learning for Healthcare

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Abstract

Sample selection bias in healthcare machine learning occurs when training datasets do not accurately represent the full population to which a model will be applied. Models trained on such biased data perform reliably for over-represented groups while producing unreliable and potentially harmful predictions for under-represented populations, leading to inequitable clinical outcomes and unsafe AI-driven diagnoses.

This project investigates sample selection bias in machine learning for healthcare, proposing and implementing a T-Net (Twin Network) architecture that integrates Out-of-Distribution (OOD) detection directly into the clinical prediction pipeline. The system employs a dual-branch neural network: an Identification Network that determines whether a patient's profile belongs to the training distribution (bias detection), and a Prediction Network that performs multi-label disease classification across ten disease categories. When a patient is flagged as out-of-distribution (OOD score < 0.5), the system issues a safe referral recommendation rather than an unreliable AI-generated prediction.

The proposed system is deployed as a full-stack Streamlit web application at healthcarebias.streamlit.app, incorporating secure SHA-256 user authentication via SQLite3, interactive Plotly dataset analytics, configurable real-time T-Net training with animated loss curves, and a clinical dashboard with OOD scoring, disease probability visualisation, and symptom-based clinical alerts. The system uses a synthetic clinical dataset of 500 patients with 9 features and 10 disease labels, incorporating an explicit `Is_Training_Set` bias variable with 264 in-distribution (52.8%) and 236 out-of-distribution (47.2%) samples.

Results demonstrate that the T-Net's Identification Network successfully distinguishes in-distribution from out-of-distribution patients, and the Prediction Network produces clinically plausible disease probability distributions. Disease prevalence in the dataset ranges from 1.0% (Pneumonia) to 20.0% (Diabetes), reflecting realistic class imbalance. The OOD-gated prediction pipeline prevents potentially unsafe predictions for out-of-distribution patients, directly addressing the core patient safety risk posed by sample selection bias in clinical machine learning.

Cloud-Based Health Record System for Continuous Patient Monitoring

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Abstract

The routine examination of physiological indicators. enable the early detection of it. medical mal- functions and preventative care. This A cloud-based health combining record system, which, is offered in paper. IoT- based biomedical sensors with scalable cloud computing in-infrastructure. to gauge the vital signs of patients in real time. ECG, heart rate, oxygen saturation (SpO2). in blood and body temperature. ture indications are ever-present. compiled, digested and examined. The system provides secure offsite. access, identification of anomalies and. visualization of health trends. through a web-based dashboard, sup providing on time clinical. healing and improved healthcare. livery.

Keywords

IoT Healthcare, ECG Monitoring, SpO2, remote. Real Time Analytics, Monitoring, Cloud Computing. Keywords IoT Healthcare, ECG Monitoring, SpO2, Remote Monitoring, Cloud Computing, Real-Time Analytics.

An Accuracy-Aware Adaptive Framework for Automated Unit Test Generation Using Static Analysis and Execution-Guided Prompt Learning

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Abstract

Unit test case generation is a critical task that can be done in order to ensure the reliability of software and reduce the amount of human effort required as well as increase the scope of code that can be tested with the current software development. The existing approaches only allow a static analysis of the code that does not bring enough understanding of the code or they apply Large Language Models (LLMs) that may generate incorrect test cases or fail to run. This is the greatest challenge to the current automated testing systems, as they do not have an entire system that could test all three system components structural correctness and validity and system coverage optimization. The experiment proposes an Accuracy-Aware Adaptive Framework of Automated Unit Test Generation that resolves the above issues with the help of Static Analysis and Execution-Guided Prompt Learning. System implementation is by structural code analysis methods that involve Abstract Syntax Tree (AST) parsing and control flow analysis to generate structured prompt learning systems that are used by the LLMs to generate test cases. The system operates on the execution-guided validation, to test two various components that test case results by compilation testing and execution testing with an adaptive controller modifying the prompts against the error and coverage information. The framework sets its goal to reach the highest limits of the test execution ability and reasonable accuracy and branch coverage by reducing the demands to human intervention.

Keywords

Automated Unit Test Generation, Static Analysis, Execution-Guided Validation, Large Language Models, Accuracy-Aware Adaptation, Software Testing.

Performance, Cost, and Sustainability Evaluation of Recycled Plastic in Flexible Pavement Using Weighted Scoring Method

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Abstract

In this research, a critical analysis of recycled plastic as a modifier of flexible pavement has been provided in terms of multi-criteria decision-making approach. The combination of mechanical performance, economic feasibility, and environmental sustainability was determined using a structured framework, the Weighted Scoring Method (WSM). Four bituminous with different plastic tools (4%, 6% and 8%) were tested. The mechanical performance measures included the Marshall stability, flow, tensile strength(indirectly), rutting resistance, fatigue life. The initial, maintenance and lifecycle costs were covered in economic analysis, whereas plastic waste use, reduction of CO₂ emissions and saving of energy was considered in the sustainability analysis. Findings show that plastic-moderated mixes are known to substantially enhance the performance of structural performance, lifecycle costs, and environmental performance. The 6% plastic mix (M3) was the best mix with the highest total score (0.96), which shows the best combination between performance, cost efficiency, and sustainability. The sensitivity analysis also helped to ensure that the proposed model is sound. The research indicates that recycled plastic has the potential in being a sustainable substitute in the construction of pavements and offers a decision support model on how materials can be optimally utilized.

Keywords

Recycled Plastic, Flexible Pavement, Sustainable Materials, Weighted Scoring Method (WSM), Multi-Criteria Decision Making, Mechanical Performance, Lifecycle Cost Analysis.

Exploring Heart Disease Anomalies with a Novel Density-Based Unsupervised Framework

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Abstract

One of the main causes of death in the world is heart disease, and therefore, early diagnosis is the solution to a better patient survival rate and less expenditure on healthcare services. The traditional diagnostic practices and supervised machine learning models need to involve significant amounts of labeled health data, which are subject to privacy issues, annotation and labelling is expensive, and requires a level of domain knowledge. In this paper, we put forward a density-based unsupervised anomaly detector system to recognize possible cardiac abnormalities using unclassified clinical information. The method combines both Kernel Density Estimation (KDE) to estimate the normal cardiac trends and Local Outlier Factor (LOF) to identify anomalies in data density between patient records. The model takes the scores of anomalies in KDE and LOF and normalizes them by aggregating the scores using a weighted fusion mechanism to enhance diagnostic reliability. The experimental assessment based on the measures of Accuracy, Precision, Recall, F1-score and AUC-ROC proves that the suggested framework is more efficient than the existing methods. The framework offers a scalable and efficient framework to screen in-early cardiac risks and predictive healthcare analytics.

Keywords

Heart Disease, Cardiac Anomaly Detection, Unsupervised Learning, Density-Based Methods, Kernel Density Estimation (KDE), Local Outlier Factor (LOF).

Microscopic Image Analysis for Leukaemia Classification

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Abstract

In clinical haematology, the detection of leukaemia through microscopic blood smears is time-consuming and often dependent on expert advice. Although there are some recent advancements in the deep learning analysis for the automated classification of blood cell images, these systems work on black-box models that allow a very limited interpretation, lack clinically actionable insights beyond binary or multi-class predictions. In order to address this, this paper presents LeukoScope, an explainable AI framework that integrates classification, visualization, and quantitative disease assessment. EfficientNetB3-based CNN is used to classify cells into four categories: Benign, Early Pre-B, Pre-B, and Pro-B. Grad-CAM is used to generate heatmaps highlighting diagnostically relevant regions. A novel Activity Score (0–100) is developed to quantify disease aggressiveness using activation intensity, peak response, and hotspot distribution. In addition to this, a risk stratification module is developed to combine classification confidence with Activity Score to categorize cases into low, medium, and high risk. Results show that LeukoScope achieves strong performance and also provides meaningful visual and quantitative insights, enabling more interpretable and clinically relevant leukaemia diagnosis.

Keywords

Leukaemia Detection, EfficientNetB3, Explainable Artificial Intelligence (XAI), Grad-CAM, Blood Smear Analysis, Activity Scoring, Clinical Decision Support Systems.

A Secure Graph-Based Framework for Synthetic Identity Fraud Detection with Attribute-Based Access Control

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Synthetic identity fraud is hard to find because the signs of something being wrong are usually spread out across records that look fine on their own. In this project, we look at the relationships between clients and cards as a kind of graph so we can see if there are any suspicious connections between identities. If a card is connected to a lot of client names, that is a sign that we should take a closer look. We also keep an eye out for cards that have been used on the web because that makes them more likely to be involved in fraud.

Keywords

Synthetic identity fraud, graph analytics, fraud detection, access control, encrypted data access, financial security.

Seoulshade: AI-Powered Personal Color Analysis

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Abstract

Professional Personal Color Analysis (PCA) requires controlled studio lighting and expensive expert consultations. Automating this process with computer vision is difficult for two reasons: human experts only agree on results about 75% of the time, and standard CNNs are easily tricked by ambient light. Instead of trying to force an end-to-end deep learning model to solve this, we built SeoulShade. This pipeline deliberately trades perfect studio precision for something that actually works in uncalibrated, real-world conditions. It uses a segmentation network to isolate skin and hair, applies a mask-aware Gray World assumption to fix the lighting, and pulls basic statistical features in the CIE L*a*b* color space. Because color datasets are notoriously unbalanced—often heavily skewed toward "Winter"—we route the data through a Stacking Classifier (XGBoost, LightGBM, and ExtraTrees) with a balanced Logistic Regression meta-learner. The absolute accuracy of the system is low, stopping near 51%. But since human experts peak at 75% agreement, SeoulShade actually hits a Relative Accuracy Index (RAI) of 68% against the human ceiling. Ultimately, doing the hard work of geometric pre-filtering and color space correction proves far more effective and much easier to interpret than throwing a black-box deep learning model at subjective human attributes.

Deep Learning Based Diagnostic Model for Brain Tumor Detection Using MRI Images

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Abstract

Brain tumors are among the deadliest neurological conditions, particularly when detected at later stages. Magnetic Resonance Imaging (MRI) remains the primary imaging technique for diagnosis; however, accurately interpreting these scans requires extensive training, and even experienced radiologists may have differing opinions.

In this study, we introduce **NeuroScan AI**, an automated deep learning-based framework designed to classify MRI scans into four categories: *Glioma*, *Meningioma*, *Pituitary Tumor*, or *No Tumor*.

Our proposed method employs a dual-branch ensemble architecture that combines a pre-trained EfficientNetB0 model (initialized with ImageNet weights) and a custom-designed Convolutional Neural Network (CNN). Both branches process the same preprocessed MRI slice of size 150×150 pixels. The EfficientNetB0 branch generates a 1,280-dimensional feature vector, while the custom CNN produces a 256-dimensional feature vector. These feature vectors are concatenated and passed through a dense fusion layer, followed by a Softmax classification head to generate class probabilities.

The model was trained and evaluated using the Kaggle Brain Tumor MRI Dataset, consisting of 7,023 images. The proposed ensemble achieved a test accuracy of 94.7%, validation accuracy of 93.2%, and a macro-AUC score of 0.982. This performance surpasses that of baseline models, including VGG16 (88.3%) and ResNet50 (91.2%), trained under identical conditions.

To enhance interpretability, Grad-CAM heatmaps were incorporated, enabling visualization of regions in the MRI scans that influence the model's predictions. Additionally, the system estimates tumor size in physical units—area (cm^2), diameter (cm)—and assigns a severity label. It also provides a clinical knowledge card containing tumor descriptions, treatment options, and an adjusted curability score.

Hallucination-Aware Rag Chatbot for Pdf-Based Q & A (With Confidence Score + Citations)

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Abstract

Large Language Models (LLMs) are widely used for question answering but often suffer from hallucinations, lack of source grounding, and absence of reliability indicators, particularly in document-centric applications. This paper presents a Hallucination-Aware Retrieval-Augmented Generation (HA-RAG) chatbot for PDF-based question answering that generates evidence-grounded responses with explicit citations and confidence scores. The proposed system retrieves semantically relevant document segments using vector embeddings and restricts answer generation strictly to the retrieved content, ensuring alignment with the source document. A confidence estimation mechanism evaluates the semantic similarity between the generated response and supporting evidence, while automatic page-level citations provide transparency and traceability. To further reduce hallucinations, the system suppresses unsupported answers and explicitly reports insufficient evidence when relevant information is unavailable in the document. Experimental evaluation on a custom PDF-based benchmark demonstrates that the proposed approach significantly improves answer faithfulness and reduces hallucinated responses compared to LLM-only and keyword-based baselines, making it suitable for trustworthy academic and knowledge management applications.

Keywords

Retrieval-Augmented Generation, Document Question Answering, Hallucination Reduction, Evidence-Grounded Responses, Vector Databases, Large Language Models.

A Web-Based Intelligent Query Routing Framework for Heterogeneous Large Language Model Orchestration: Architecture, Optimization, and Empirical Evaluation

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Abstract

The widespread deployment of Large Language Models (LLMs) in production environments introduces three critical operational challenges: excessive inference costs, suboptimal latency, and computational resource misallocation. Contemporary architectures predominantly employ monolithic designs routing all user queries to a single high-capacity model regardless of task complexity resulting in significant economic inefficiency. This paper presents HeteroRoute, a web-based intelligent query routing framework that dynamically classifies user intent and dispatches requests to a heterogeneous pool of language models based on empirically derived task complexity features. The routing engine employs a hybrid classification approach combining keyword heuristics, token density analysis, and syntactic complexity scoring to achieve routing decisions within 18ms on average. The routing problem is formally modelled as a constrained multi-objective optimization that jointly minimizes monetary cost and time-to-first-token (TTFT) latency while maintaining a minimum quality utility threshold. Experimental evaluation over a manually curated benchmark of 300 diverse queries spanning code generation, mathematical reasoning, and conversational tasks demonstrates: (i) a 42% reduction in operational cost versus GPT-4-only deployment, (ii) a 39% improvement in TTFT latency, and (iii) a routing accuracy of 93.7% as validated through expert annotation and inter-annotator agreement (Cohen's $\kappa = 0.81$). The framework is implemented as a production-ready serverless application using Next.js 14 and the Vercel Edge runtime, supporting horizontal scaling to 10,000 concurrent requests. Ablation studies confirm that each component of the classification pipeline contributes meaningfully to end-to-end performance.

Keywords

Large Language Models, Query Routing, Cost Optimization, Intent Classification, Serverless Architecture, AI Orchestration, Heterogeneous Computing, Multi-Objective Optimization.

Design of Disaster Alert and Rescue via Mobile Application

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Abstract

As the number of cases of natural disasters increases, there is an emerging demand of intelligent tools that will help in quicker notification, rescuing operation, and efficient rescue process. The paper proposes a Mobile Application to Disaster Alert and Rescue that is aimed at sending real-time notifications, location concerns, and the general objective is to ensure that the communication between the affected parties, government, and rescue teams flows smoothly. It is a blend of GPS positioning, geofencing, cloud data analysis and artificial intelligence risk detection, to warrant a personal-based notification system depending on a specific distance to risk areas. The two-way communication aspect of the platform is one of the most important features as it enables people to request rescue, tell their location in real time and even share photos or messages even though the network connection could be of poor quality. The rescue teams can use the calls of help with the help of interactive dashboard where the calls are also ranked in order of urgency to distribute the aid efficiently. The goal is to fill in the asymmetries that persist in the conventional method of dealing with disasters and reducing the response time, increasing the awareness of the citizen and the government of the situation concerning the new system offered. The active intervention can significantly enhance the disaster resilience level within the vulnerable region because of its convenient nature and the capacity to interact with the governmental system.

Keywords

Disaster Alert System, Mobile Application, Early Warning, Rescue Operations, GIS-based Tracking.

HC²S-Boost: A Hierarchical Clustered Cost-Sensitive Stacked Boosting Framework for Clinically Optimized Alzheimer's Disease Prediction

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Abstract

Alzheimer's disease (AD) requires accurate early detection to reduce clinical risk and healthcare burden. Although existing predictive models achieve high accuracy, they often overlook false negative risk, probability reliability, and real-world deployment cost. To address these limitations, we propose HC²S-Boost (Hierarchical Clustered Cost-Sensitive Stacked Boosting), a novel ensemble framework for clinically optimized Alzheimer's prediction.

HC²S-Boost combines patient clustering with global and cluster-specific gradient boosting models (CatBoost [3], LightGBM [2], and XGBoost [1]), integrated through a cost-sensitive logistic regression stacking layer [4]. The framework further incorporates isotonic probability calibration [6] to ensure reliable risk estimation and applies cost-based threshold optimization [7] to minimize total clinical decision cost by balancing false negatives and false positives.

Experimental results demonstrate improved recall compared to traditional boosting models while maintaining competitive precision and ROC-AUC performance [8]. Calibration and cost analysis further confirm enhanced reliability and reduced screening burden. Overall, HC²S-Boost provides a clinically aware, economically optimized, and deployment-ready system for Alzheimer's disease detection.

Keywords

Alzheimer's Disease Prediction, Ensemble Learning, Gradient Boosting, CatBoost, LightGBM, XGBoost, Stacking, Cost-Sensitive Learning, Probability Calibration, Isotonic Regression, Clustering, Healthcare Machine Learning, Early Disease Detection.

Intelligent Crop Recommendation and Yield Prediction with Explainable AI

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Abstract

Selecting appropriate crops and forecasting harvest output are pivotal decisions in agricultural planning, yet smallholder farmers across developing regions continue to rely on outdated heuristics and regional averages rather than quantitative evidence. This paper addresses both challenges within a single, interpretable machine learning framework that integrates crop recommendation through multi-class classification and crop yield estimation through regression. For classification, eight algorithms – Logistic Regression, Decision Tree, Random Forest, Gradient Boosting, XGBoost, LightGBM, CatBoost, and a Stacking Ensemble – were evaluated on the Crop Recommendation Dataset comprising 2,200 samples across 22 crop categories, using seven soil nutrient and environmental features. Following Optuna-based hyperparameter optimisation with five-fold cross-validation, CatBoost achieved 99.77% accuracy with a macro F1-score of 0.9977. For yield prediction, seven regression models were benchmarked on 237,643 records from the Crop Production in India dataset (1997–2014). Feature engineering, including an area-year interaction term and log-scale target transformation, elevated Random Forest to $R^2 = 0.801$, MAE = 11,465 tonnes, and RMSE = 67,371 tonnes. SHAP-based interpretability analysis using TreeExplainer identifies humidity and rainfall as the dominant drivers of crop suitability, while cultivated area and its interaction with crop year govern yield outcomes. Permutation importance analysis independently validates these findings. The proposed framework demonstrates that high predictive accuracy and transparent model reasoning can coexist, offering a practical decision-support tool for farmers and agricultural policymakers.

Keywords

Crop Recommendation, Yield Prediction, CatBoost, Random Forest, XGBoost, SHAP, Explainable AI, Precision Agriculture, Optuna.

GNFSA: Towards a Novel Generic Framework for Sentiment Analysis of Twitter Posts

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Abstract

Online Social Networks (OSNs) have been around for helping people to have virtual communities and communications without time and geographical restrictions. The exponential growth of data in social networks has resulted in a goldmine in form of wealth of data which can be subjected to mining for extracting business intelligence. The data in OSN contains opinions, emotions and views of people from all corners of the globe. Opinion mining or sentiment analysis is one of the open research avenues that have high-utility to exploit social media for the growth of real world enterprises. For instance Twitter tweets, when carefully analyzed, can provide valuable insights that can pave way for contextual advertising. Thus OSN is the platform that has high potential for business growth of enterprises either directly or indirectly. Many researchers contributed towards sentiment analysis. However, a generic approach that can be used for any domain is still highly desired. In this paper we proposed a Generic Framework for Sentiment Analysis (GNFSA) which can be used for sentiment analysis and gain knowledge used for expert decision making. We built a prototype which demonstrates the proof of concept. The implementation of the framework in this paper has been tested with Tweets pertaining to Indian Railways. However, in future we intend to improve it to become a tool that can serve any domain. The empirical results are evaluated with performance measures like execution time and memory usage.

Keywords

Twitter posts, natural language processing, ontology, classification.

Development and Implementation of Multiplatform Application for the Management and Monitoring of Clinical Parameters in Pediatric Patients with Renal Transplantation in the Nephrology Area of a Pediatric Hospital

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Abstract

The present study aimed to develop and implement a multiplatform application for the administration and monitoring of clinical parameters in pediatric kidney transplant patients in the Nephrology Department of a pediatric hospital. The initiative arose from the limitations of conventional medical registration and follow-up systems, which hindered the constant and effective monitoring of these patients. A practical research methodology was applied, focused on a quantitative approach and with an experimental design, encompassing the stages of analysis, design, development, implementation, and evaluation of the system. The application was developed using technologies that allow its use on both mobile devices and laptops. Features such as vital sign recording, clinical alerts, automatic reports, and graphical representation of patient progress were included. After its implementation, the tool was evaluated in a real-life setting with the medical team, observing a notable improvement in the organization of clinical information, data accessibility, and effective decision-making. The findings indicated that the use of this digital tool optimized clinical follow-up and promoted more comprehensive and timely care, reducing transplant-related risks. It was concluded that the application represents an important advance in updating pediatric care processes and has the potential to be replicated in other hospital settings with similar needs.

Keywords

Medical Technology, Multiplatform Application, Clinical Follow-up, Digital Health.

Solar Assisted AQI Monitoring Multistage Air Purification System

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Abstract

The quality of indoor air has become an important concern due to its direct influence on human health and overall comfort. To address this issue, this work presents a solar-assisted system capable of monitoring air quality and performing efficient purification using an integrated approach. The proposed system combines real-time sensing, automated decision-making, and renewable energy support to enhance performance and sustainability.

Air quality is continuously evaluated using gas sensors that detect the concentration of harmful pollutants. The collected data is processed to estimate the Air Quality Index (AQI), enabling classification of pollution levels. Based on these values, a multi-stage purification unit is activated, which includes a pre-filtration stage for removing larger particles, an activated carbon layer for eliminating gaseous contaminants and odours, and a high-efficiency filter for capturing fine particulate matter.

To improve energy efficiency, solar power is incorporated as a supplementary energy source, reducing dependence on conventional electricity. The system is further enhanced with IoT connectivity, allowing real-time monitoring, remote access, and automated control actions based on environmental conditions. Experimental evaluation indicates a significant improvement in air quality, with pollutant levels reduced considerably within a short duration.

Overall, the developed system offers an energy-efficient, sustainable, and cost-effective solution for maintaining healthy indoor air environments, making it suitable for modern smart applications.

Keywords

Air Quality Index (AQI); Solar-Powered Air Purification; Multi-Stage Filtration System; IoT-Based Environmental Monitoring; Gas Sensor Technology; Indoor Air Quality Management.

Adaptive Threshold-Based IoT Water Leakage Detection System

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Abstract

Water leakage in pipeline distribution systems causes substantial loss of treated water, especially in the developing world, where there is little in terms of early detection mechanisms. This paper proposes an adaptive threshold based IoT water leakage detection and control system for real-time water leakage detection and efficient water management. The proposed system uses flow rate sensors to measure the inlet and outlet water flow, and the leakage is detected according to the variation of the two values. An adaptive threshold mechanism achieves dynamic adjustment of the sensitivity in accordance with the operating conditions, and improves detection accuracy over the traditional fixed threshold mechanism. The system is implemented with the ESP8266 microcontroller with inbuilt Wi-Fi to make the system seamlessly communicate with the Blynk IoT platform for real-time monitoring and user control. A DC solenoid valve is automatically activated to shut off water flow when leakage is detected to reduce the amount of water lost. Experimental results show reliable leakage detection based on fast response time and low operational cost of the system. The proposed solution is scalable and energy efficient and can be used for domestic, industrial and municipal water distribution applications.

Real-Time IoT Automated Water Control System

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Abstract

Based on ESP32 microcontroller with ultrasonic sensing technology, the current paper represents the design and implementation of an automated water pump controller system. The proposed system will offer a non-contact and high precision way of tracking how much water is in storage tanks to overcome the inefficiencies and the human factor errors that come with traditional manual operation of water level gauges. The real-time level measurement with a mean absolute error of less than 0.6% is obtained by taking advantage of the dual-core processing of the ESP32 and an HC-SR04 ultrasonic sensor. A 5V relay has a built-in control logic that continually drives a pump on or off as necessary, to achieve its goal of auto-turning off water overflow and saving a month of energy, which is about 24.5 times less than the monthly energy bills. Also, the system has an I2C LCD attached of local telemetry and Blynk IoT for remote monitoring and manual override using a mobile application. The experimental findings confirm the reliability of the system, its accuracy, and scalability to be applied in the management of domestic, agricultural, and industrial water.

Design and Development of a LiDAR-Based Autonomous Mobile Robot Using a Single-Board Microcomputer

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Abstract

Autonomous mobile robot navigation in indoor environments demands accurate real-time mapping, reliable obstacle detection, and efficient path planning. Existing high-performance navigation systems predominantly rely on expensive multi-beam LiDARs and high-end computing hardware, making them inaccessible for small-scale industrial, research, and educational applications. This paper presents the design and development of a cost-effective LiDAR-based autonomous mobile robot using an NVIDIA Jetson Nano as the central processing unit, an RPLiDAR A2 as the primary sensing module, and an Arduino Nano co-processor for low-level motor control via an L298N motor driver. The system architecture integrates ROS-based Simultaneous Localisation and Mapping (SLAM) with a differential-drive kinematic model incorporating wheel encoder feedback for closed-loop velocity correction. A 3D-printed chassis houses all electronics, keeping total hardware cost within the range accessible to student and research teams. Simulation validation was conducted in ROS Gazebo prior to physical testing. Experimental results confirm that the proposed system achieves reliable indoor mapping and autonomous goal-directed navigation at a significantly lower hardware cost compared to existing commercial platforms.

Keywords

Autonomous mobile robot, LiDAR, ROS, SLAM, Jetson Nano, Arduino Nano, differential drive, embedded navigation, low-cost robotics.

Smart Water Tank Monitoring and Quality Detection System

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Abstract

Such common issues include bacterial growth, dust, sedimentation, chemical contaminants and turbidity and can not be seen until they become health hazards, or otherwise disrupt operations. The Smart Water tank monitoring and quality detection system meets this expanding requirement by providing a combination of automated sensors, wireless connectivity, and intelligent purification module built into a single unit that purifies itself. An ultrasonic or a pressure sensor constantly controls water level and real time measurements of such quality parameters as pH, turbidity, conductivity, temperature, total dissolved solids are made. A dust-removal automatic purifier, consisting of microfiltration, sediment filters and activated carbon is turned on whenever the system senses that there is an abnormal concentration of the particulate matter or if there is a sudden increase in turbidity, to keep the stored water purified without the need to touch the purifier manually. The IoT is used to transfer the data via Wi-Fi or GSM and allows the users to monitor the tank with a mobile device and issue alerts regarding contamination, low level, overflow or malfunction of the pump. Its use extends to home, apartments, hostels, hospitals, industries, irrigation tanks and municipal water systems, where continuous and clean water is an important factor. The projected outcomes are a substantial decrease in water wastages, early realization of contamination, automatic elimination of dust and suspended solids, pump efficiency, and predictive maintenance according to the consumption pattern.

Hybrid Cross-Attention Sentiment Optimization for Enhancing Bilingual E-Commerce Customer Satisfaction Using Transformer Models

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Abstract

Analyzing Amazon product reviews is key to grasping what customers think, what they like, and how happy they are. By dissecting the text of their feedback, businesses can make informed choices. This, in turn, helps to refine e-commerce services and enhance the overall user experience. Current sentiment analysis systems based on transformers show strong performance. However, they struggle with differences between languages, unclear meanings, and a significant imbalance in the number of examples for each sentiment class. These systems often misclassify neutral sentiments, and they struggle to effectively combine features from different language representations. To overcome these limitations, we developed a Hybrid Cross-Attention Sentiment Optimization model. This model combines sentiment classification, using BERT, with representation learning, employing ELECTRA. It employs cross-attention mechanisms to integrate contextual embeddings, thus improving feature interaction and the understanding of minority classes. Experimental findings demonstrate that the proposed method attains an accuracy of 91.28%, surpassing the performance of both BERT and ELECTRA when used independently. Furthermore, it maintains a balanced precision, recall, and F1- score, thereby demonstrating enhanced robustness in the context of bilingual e-commerce sentiment analysis.

Keywords

Hybrid Sentiment Analysis, Cross-Attention Mechanism, BERT, ELECTRA, E-Commerce Analytics.

Predictive Maintenance for Dark Factories Using Machine Learning and Mathematical Modeling

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Abstract

Modern automated manufacturing systems, particularly dark factories, demand highly reliable and efficient operational frameworks. This study focuses on developing a predictive maintenance framework using machine learning and mathematical modeling to estimate the remaining useful life (RUL) of machine components. The methodology integrates data-driven models trained on historical operational data with analytical reliability models based on degradation behavior. Machine learning techniques are employed to identify hidden patterns in vibration, temperature, pressure, and operating hours, enabling accurate failure prediction. Simultaneously, mathematical models provide theoretical validation of component lifespan using reliability theory. The proposed hybrid approach enhances prediction accuracy and robustness. The results are expected to significantly reduce unexpected equipment failures, optimize maintenance schedules, and improve overall system efficiency. This research contributes to the advancement of autonomous manufacturing by enabling intelligent, self-sustaining maintenance systems in dark factories.

Keywords

Predictive maintenance, dark factories, machine learning, reliability, automation.

Sentiment Analysis of Student Feedback Using NLP

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Abstract

The digital literacy platform and on-line academic operation systems has backfired in the creation of a vast amount of untagged pupil feedback in the form of course reviews, checks, discussion forums, and institutional reviews. It is important to comprehend the pupil satisfaction and refine the tutoring quality by effectively assaying this feedback to ensure that the total academic decision-timber is improved. This exploration puts forward a full frame of Natural Language Processing (NLP) guided sentiment analysis of the pupil feedback in order to come up with a scenario of directly identifying pupil satisfaction. The methodology used in the proposed approach is based on sophisticated textbook preprocessing methods, such as tokenization, normalization, stop-word junking, and lemmatization, and then point birthing on both classic methods of vectorization and contextual word representations. Several machine literacy, and deep literacy models are explored, such as Support Vector Machines, Long Short- Term Memory networks, and motor-based- infrastructures, to categorize feedback as positive, negative, and neutral sentiment orders. analogously, the frame also integrates aspect- position sentiment analysis, to ascertain definite academic influences on the understanding of pupils, akin to tutoring methodology, course material, assessment techniques, and institutional support. It has been shown in experimental assessments on both standard and real world pupil feedback samples that deep contextual models are significantly better than traditional classifiers as far as delicacy, perfection, recall and F1-score are concerned.

Keywords

Sentiment Analysis, Natural Language Processing, Student Feedback Analysis, Machine Learning, Deep Learning, Educational Data Mining, Student Satisfaction.

Time-Aware Retail Sales Forecasting Using Explainable Machine Learning with Inventory and ERP Decision Support

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Abstract

Enterprise resource planning (ERP) systems have evolved into service delivery hubs for managing enterprises operational, financial, and sales activities. High-level Sales Forecasting has considerable implications for both strategic and operational planning. This research investigates how predictive analytics and machine learning can be employed to improve Sales Forecasting in retail using a public data source. Preprocessing was carried out rigorously on the data to ensure quality and reliability. Temporally coherent feature generation via sophisticated rolling and lag feature engineering was achieved using time-series walk-forward validation. A comparison of LightGBM, XGBoost, LSTM, and a novel dynamic Residual Hybrid Model was conducted based on RMSE, MAE, and R-squared values. The results show that LightGBM and the proposed Residual Hybrid Model were able to achieve better performance than the other models due to their ability to capture non-linear trend sequences and having R-squared values above 97.5. Additionally, the system transformed these forecasts into real-time operation decisions utilising automated ERP inventory parameter calculations, such as an optimal order quantity of 34,385 units and a dynamically calculated safety stock of 2,857 units. Future studies will focus on incorporating deep volatile emotion characterisation to further enhance algorithmic performance and add SHAP (Shapley Additive explanations) to provide explainable predictions that will aid in business decision-making and business strategies.

Keywords

Sales forecasting, ERP system, Residual Hybrid Model, Inventory Optimisation, Explainable AI.

IoT-Based Real-Time Water Quality Monitoring System for Agricultural Use with Python-Based Decision Analytics

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Abstract

In agriculture, a significant part of freshwater resources are used. Therefore, water quality is very important to maintain both high crop productivity and healthy soils. Poor water quality, which occurs as a result of urban pollution, industrial emissions, or another contamination source, affects negatively the development of plants and poses risks to the sustainability of farming activities. The conventional methods of assessing water quality are time-consuming, labor-intensive, and can hardly be used for continuous monitoring on the farm. In this research paper, an IoT water quality monitoring system designed specifically for farming is considered. It involves using a decision analytics system that operates based on Python technology. The proposed monitoring system relies on continuous collection of data about the level of pH, water temperature, and turbidity by sensors and transferring it to the cloud platform. Then, Python technology processes water quality indicators, compares them with the set values, and determines the risk level. As a result, this IoT-based system reduces human efforts, enables constant monitoring, and allows making informed irrigation decisions. In addition, using cloud technologies for this application is highly promising, and the concept of blockchain integration is proposed.

Keywords

Internet of Things (IoT), Smart Agriculture, Water Quality Monitoring, Irrigation, Python Analytics, Real-Time Monitoring.

SENTINEL – Intelligent Botnet Identification and Monitoring Using CNN

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Abstract

This study introduces a unique flow-based technique of botnet detection using a hybrid approach to deep learning, which integrates CNN and LSTM in order to improve on the weaknesses of the traditional techniques used in detecting botnets based on signatures and other limitations such as encrypted botnets. This project uses features extracted from traffic flows rather than inspecting the payload in the packets. In this process, traffic is reduced, and useful statistics obtained and further selected using the CART algorithm. Features thus selected are fed into the hybrid CNN-LSTM structure where the CNN extracts the spatial pattern and performs feature extraction, while the LSTM helps in identifying temporal dependency of the botnet. Evaluation of the algorithm is done using popular benchmark datasets including ISCX and ISOT, showing better accuracy, precision, recall, and F1-scores, as well as fewer false positives compared to existing algorithms. In addition, this method shows resistance against adversarial attacks such as FGSM, PGD, and BIM.

Keywords

Machine Learning, Network Security, Intrusion Detection System (IDS), Supervised Learning, DDoS, Cybersecurity.

ANFIS Based Power Quality Control in Renewable Energy Systems

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Abstract

This work presents a Unified Power Quality Conditioner (UPQC) controlled using an Adaptive Neuro-Fuzzy Inference System (ANFIS) to enhance power quality performance in distributed systems powered by green resources. A hybrid solar photovoltaic and wind energy source is interfaced with the utility grid through the UPQC to maintain dependable power supply under fluctuating generation and load conditions. The ANFIS-based controller maintains the DC-link voltage, ensuring synchronized control between the series and shunt converter units. Its adaptive nature allows effective handling of nonlinear loads, voltage disturbances, and current harmonics commonly observed in renewable-integrated systems. MATLAB/Simulink is used to develop and analyse the suggested system under various operating condition in order to assess voltage regulation, harmonic mitigation, and overall power quality performance. Simulation results demonstrate steady system behavior with lower harmonic content and improved voltage regulation, confirming that the ANFIS-driven UPQC offers an effective approach for improving electrical conditions in modern distribution networks integrated with hybrid renewable sources.

Keywords

ANFIS, UPQC, Renewable Energy: Based Distributed Generation, Power Quality Enhancement, Harmonic Reduction, MATLAB/Simulink.

Data-Driven Strategies for EV Demand Forecasting and Charging Infrastructure Requirement Estimation

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Abstract

Electric cars are increasingly becoming popular and revolutionising the field of transport. Therefore, there is a need for the construction of charging stations for electric vehicles that can efficiently meet their requirements. Proper forecasts and data-driven decisions should be employed in the planning of such stations. This paper presents a method that will enable the prediction of demand for electric cars and the determination of infrastructure requirements by region. First, previous records regarding the number of electric cars sold in each region will be used to analyse the trends and patterns of the demand in the market. Second, machine learning techniques will be applied to classify and group the demand. In this research, the k-means clustering technique is used to categorise the regions according to their levels of demand for electric cars – low, medium, and high. Third, the number of charging stations required to satisfy the forecasted demand will be calculated considering the frequency of charging and the capacity of the stations. The presented approach will help to pinpoint the regions that require urgent development of charging infrastructure. The results indicate that there are significant differences in the demand for electric cars among regions, thus emphasising the importance of planning infrastructure at the regional level.

Keywords

Electric Vehicles, EV Demand Prediction, Charging Station Planning, K-Means Clustering, Machine Learning.

A Robust Framework for Online Payment Fraud Detection Using Balanced Machine Learning

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Abstract

The growing use of online payment systems has resulted in both the ease of online payments and the risk of fraudulent transactions. The detection of fraud in such systems is difficult because of the dynamic nature of fraudsters and the class imbalance problem in real-world transaction datasets, where the number of fraudulent transactions is significantly less compared to legitimate ones. Traditional rule-based systems and traditional machine learning models have difficulty in detecting fraudulent transactions in such scenarios. This paper proposes a balanced machine learning approach for accurate online payment fraud detection. The proposed method combines data preprocessing and sophisticated resampling methods such as Synthetic Minority Over-sampling Technique (SMOTE) and Adaptive Synthetic Sampling (ADASYN) to handle the class imbalance problem in transaction data. Several supervised machine learning models—Logistic Regression, Decision Tree, Random Forest, and XGBoost—are trained and tested on both imbalanced and balanced datasets. The performance of the models is evaluated using appropriate evaluation metrics for class imbalance problems, including precision, recall, F1-score, and the Area Under the Receiver Operating Characteristic Curve (ROC-AUC). The experimental results show that the application of data balancing methods can greatly improve the performance of fraud detection. Ensemble-based models, such as Random Forest and XGBoost, perform better than single classifiers. The results show that the proposed framework provides an efficient and scalable solution for real-time online payment fraud detection.

Keywords

Online Payment Fraud, Class Imbalance, SMOTE, ADASYN, Machine Learning, Fraud Detection.

AI-Powered Anomaly Detection Using Adaptive Machine Learning with Dynamic Threshold Optimization

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Abstract

The growing complexity of anomaly detection in dynamic data environments exposes limitations in traditional static machine learning models, particularly under evolving distributions and concept drift. While conventional approaches achieve initial performance, their inability to adapt leads to increased false positives and reduced accuracy. This paper presents an AI-driven anomaly detection framework integrating adaptive learning with dynamic threshold optimization. The system employs a hybrid ensemble of Isolation Forest, One-Class SVM, XGBoost, Gradient Boosting, and a dense Autoencoder. A batch-wise incremental learning strategy enables continuous updates through an evaluate-then-update protocol, while dynamic thresholding based on F-beta score maximization refines decision boundaries. A leak-free evaluation pipeline ensures unbiased assessment by preventing overlap between training and testing data. Experiments across credit card fraud, IoT anomalies, manufacturing defects, and network intrusion datasets show F1-scores ranging from 0.66 to 0.98, with adaptive learning improving performance across batches. The framework is deployed via a Streamlit dashboard for real-time monitoring and visualization.

Keywords

Anomaly Detection, Adoptive Learning, Concept Drift, Ensemble Models, Dynmaic Thresholding, Machine Learning.

Design and Implementation of a Microcontroller-Based 4–20 mA Calibration System Using PIC18F46K22

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Abstract

This paper presents the development of a low-cost and reliable calibration system designed for industrial sensors that operate on the standard 4–20 mA current loop. The system is implemented using the PIC18F46K22 microcontroller, leveraging its integrated 10-bit ADC, flexible port configuration, and stable clock architecture. The proposed design converts current-loop inputs into proportional voltage signals, processes these signals through the ADC, and maps them to a 0–100% calibrated output. A multiplexed three-digit seven-segment display is employed for real-time visualization of the calibrated value. The system demonstrates stable operation, accurate measurement performance, and suitability for industrial environments requiring precise monitoring and calibration of analog process variables.

Keywords

PIC18F46K22, 4–20 mA loop, ADC calibration, embedded system, seven-segment display, signal conditioning, industrial automation.

EWIN: An AI-Based Intelligent Framework for Automated E-Waste Detection and Management

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Abstract

The fast growth in technology has seen an increased demand for electronics, hence leading to more electronic waste. The frequent upgrading of products coupled with shorter product lifespans has seen the rise of discarded electronic gadgets. The improper disposal of this waste poses several health and environmental threats. Most electronic devices have harmful elements like lead, mercury, and cadmium. Inefficient handling of this waste can see it leaching into the environment, thus contaminating the ground, water bodies, and air. The existing waste management models lack automation in waste handling and segregation techniques. Furthermore, there is a poor understanding of how waste should be disposed of among consumers. This necessitates the introduction of an intelligent solution that will facilitate proper disposal of this waste. The suggested project will solve the problem using the application of artificial intelligence. The solution incorporates automatic detection and categorization of electronic waste. The system uses images of the electronic devices to detect different objects. YOLO-based object detection model is implemented to classify the electronic waste. The solution further involves cloud processing to facilitate scalability. The user is directed to the nearest authorized facility using location technology. There is also an electronic marketplace that facilitates recycling. Such an approach fosters a circular economy and minimizes waste generation. The solution increases efficiency, visibility, and accessibility in waste management. In addition, it fosters proper disposal habits among the users. In summary, the presented approach represents a viable and scalable solution.

Keywords

E-waste, Object Detection, YOLO, Smart Waste Management, Disposal Locator, Recycling Marketplace.

A Deep Learning Framework for Reliable Malaria Diagnosis from Blood Smears

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Abstract

Despite the global effort, malaria is still endemic in several developing countries, partially because of late diagnoses, few lab technicians, and a lack of PoC diagnostic tools. This research paper will present a new hybrid deep learning framework that can be used to diagnose whether a smear image taken by microscope contains a malaria-infected RBC. The proposed architecture involves a CNN for high-level feature extraction as well as an RNN-based framework of classifiers including GRU, LSTM, and BiLSTM. The performances of the classifiers are assessed according to the accuracy of predictions, type-I and type-II errors as well as training and inference time. According to our experiments, CNN-LSTM-BiLSTM is the most accurate classifier (with accuracy of 96%, type-I error of 5.10%, total error of 2.67%). Moreover, in the field of IoT, CNN-LSTM-BiLSTM classifier would work great in new distribution points and PoC devices due to its performance and limited computational consumption. Therefore, a cascading deep learning classifier could be a great innovation for effective and scalable malaria diagnoses.

Keywords

Deep learning, Convolutional neural networks, Recurrent neural networks, Long Short term memory, Gated Recurrent Unit, Bidirectional LSTM.

TriageBench-IN: Benchmarking Large Language Models for Disease Triage in the Indian Clinical Context

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Abstract

Large Language Models (LLMs) are increasingly proposed as clinical decision-support tools, yet their safety-critical behavior under region-specific epidemiology is under-evaluated. India bears high burden of pulmonary tuberculosis, malaria, dengue, ischemic heart disease/hypertensive crises, and waterborne diarrheal disease—conditions with overlapping symptomatology and severity gradients that can challenge generic prompting. We introduce TriageBench-IN, a physician-validated benchmark of 25 synthetic Indian-context clinical vignettes (five diseases × five severity/variant patterns). We evaluate five models spanning frontier general-purpose and regional/domain-specific families (GPT-4o, Claude Sonnet 4, Gemini 1.5 Pro, Sarvam-M, BioMistral-7B) on two axes: (i) Diagnostic Direction Score (DDS) measuring whether the response lands in the correct diagnostic lane, and (ii) Triage Accuracy Score (TAS) measuring urgency classification (Emergency/Urgent/Non-Urgent). We specify a standardized zero-shot prompting protocol, structured output schema, automatic parsing, and error taxonomy for downstream safety analysis. This paper contributes an India-focused evaluation framework and a reproducible methodology for comparing LLM triage reliability prior to deployment. Empirical results are planned as an immediate follow-up and will populate the reported tables and confusion matrices in the camera-ready version.

Keywords

Large language models, clinical triage, benchmarking, India, medical AI, Sarvam.

Balancing Decentralization and Security: Optimal Consensus Parameterization to Resist 51% Control

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Abstract

Blockchain networks face a fundamental trade-off between decentralization and security. While decentralization enhances openness and censorship resistance, it also increases coordination overhead and may expose the network to concentration of power in mining pools or validator cartels. Security, on the other hand, depends on ensuring that no adversary can control the majority of consensus power, yet rigidly favoring security often comes at the cost of reduced participation and higher centralization. Among the most critical threats is the 51% attack, in which a malicious entity gains majority control of the consensus mechanism, enabling double spending, transaction censorship, or chain reorganization. This paper investigates the problem of optimal consensus parameterization as a means of resisting 51% control. We model the interaction between system parameters—such as block generation interval, committee size, staking distribution, and validator rotation frequency—and their impact on both decentralization and security. Using game-theoretic analysis and simulation, we evaluate the economic cost of attack across Proof-of-Work, Proof-of-Stake, and hybrid consensus mechanisms, and measure decentralization via the Nakamoto coefficient and stake concentration indices.

The results indicate that adaptive consensus tuning can significantly increase the effective cost of a 51% attack while maintaining a balanced level of decentralization. We propose a dynamic framework that allows blockchain networks to adjust parameters in real time, guided by network conditions and participation levels, to maximize both security and inclusiveness. This research provides a pathway toward self-optimizing blockchains that are resilient against majority control while preserving the democratic ethos of decentralization.

Keywords

Electronic voting, E-voting, blockchain, consensus mechanisms, hybrid blockchain, mobile app.

A Boundary-Aware Deep Learning Framework for Precise Liver Tumor Delineation in Clinical CT Scans

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Abstract

Accurate delineation of liver tumors from computed tomography (CT) scans plays a crucial role in diagnosis, treatment planning, and disease monitoring. However, challenges such as low contrast between tumor and surrounding tissues, irregular tumor boundaries, and variability in imaging conditions often limit the performance of conventional segmentation methods. To address these issues, this study proposes a boundary-aware deep learning framework designed to enhance the precision of liver tumor segmentation in clinical CT data.

The proposed approach builds upon a U-Net-based architecture integrated with a boundary-sensitive attention mechanism that emphasizes edge information and improves feature representation around tumor margins. By incorporating boundary-focused learning, the model effectively captures fine-grained structural details that are often missed by standard convolutional networks. Additionally, the framework leverages multi-scale contextual features to improve robustness across varying tumor sizes and shapes. Experimental evaluation on publicly available CT datasets demonstrates that the proposed method achieves improved segmentation accuracy, particularly in terms of boundary delineation and overlap-based metrics such as Dice Similarity Coefficient (DSC). Comparative analysis indicates that the model outperforms baseline U-Net variants in capturing precise tumor contours, thereby reducing segmentation errors in clinically challenging regions.

The results highlight the potential of boundary-aware attention mechanisms in enhancing medical image segmentation performance. This framework can serve as a reliable assistive tool for radiologists, contributing to more accurate tumor localization and improved clinical decision-making in liver cancer management.

Keywords

Liver Tumor Segmentation, CT Imaging, U-Net, Boundary-Aware Learning, Attention Mechanism, Medical Image Segmentation, Deep Learning.

Adaptive Artificial Intelligence Models for Real-Time Cyber Attack Detection in Distributed Networks

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Abstract

The rapid evolution of cyber threats demands intelligent, scalable intrusion detection systems capable of operating across diverse distributed environments. This paper presents a comprehensive intrusion detection framework integrating classical machine learning, federated learning, adaptive aggregation, and ensemble techniques. Structured network traffic data from CICIDS2017 is processed via a memory-efficient chunk-based pipeline, while feature alignment addresses dimensional disparities with UNSW-NB15. Baseline classifiers establish performance benchmarks; an optimised Random Forest model with systematic feature selection significantly improves results. A federated learning framework deployed under IID and Non-IID conditions enables privacy-preserving distributed training. Adaptive aggregation dynamically weights client models by validation metrics, accelerating convergence and reducing aggregation bias. A final ensemble strategy consolidates multiple learning paradigms, achieving up to 98% accuracy with robust cross-dataset generalisation, outperforming recent state-of-the-art methods in accuracy, robustness, and adaptability.

Keywords

Intrusion detection, federated learning, adaptive aggregation, ensemble learning, network security.

Deep Learning-Based Smart Contract Vulnerability Identification in Decentralized Applications

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Abstract

Smart contracts make it possible for transactions to be executed independently and without the involvement of a trusted third party in blockchain ecosystems; nevertheless, because their code cannot be changed after deployment, any security vulnerabilities become very critical and often result in the loss of money that cannot be reversed. Traditional rule, based auditing tools depend on predefined patterns and are not capable of generalizing to unknown or obscured attack strategies such as a reentrancy, integer overflow, access, control issue, timestamp dependence, and denial, of, service conditions. This research introduces an AI, based smart contract vulnerability detection framework that combines static code analysis, semantic embedding, and deep learning classification to automatically detect security threats before deployment. The framework transforms smart contract source code and bytecode into structured representations using abstract syntax trees and control flow graphs, then it performs feature extraction by means of graph, aware neural embeddings. A hybrid model consisting of Bidirectional Long Short, Term Memory and Graph Neural Networks identifies the contextual and structural aspects of the contract logic in order to recognize both familiar and zero, day vulnerabilities. The solution also uses XAI to locate the unsafe code sections and to offer remediation suggestions at the developer level. Experiments on public Ethereum contract datasets indicate that accuracy, precision, and recall of the detection were all improved relative to traditional static analyzers and machine learning baselines.

Keywords

Smart Contracts, Blockchain Security, Vulnerability Detection, Deep Learning, Graph Neural Network, Static Analysis, Ethereum, Explainable AI, Reentrancy Attack, Automated Security Auditing.

Auralink - A Secure, Offline Voice-Controlled Smart Home Ecosystem Using Agentic AI

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Abstract

Smart home automation has become an important application of the Internet of Things (IoT) and Artificial Intelligence (AI), enabling users to control and monitor household devices efficiently. However, most existing systems rely on cloud-based voice assistants, which introduce challenges such as latency, privacy concerns, and dependency on continuous internet connectivity. To address these limitations, this project proposes an AI-powered offline smart home automation system that integrates voice interaction, intelligent command processing, and device control within a unified platform. The system utilizes speech recognition models for converting voice input into text and applies natural language processing techniques to interpret user commands. A hybrid approach combining rule-based logic and intelligent processing is used to ensure accurate and reliable command execution. The system also incorporates scheduling functionality to automate device operations and an energy monitoring module to track device usage and optimize power consumption. A user-friendly dashboard provides real-time device status, system feedback, and usage insights. By processing data locally, the proposed system enhances privacy, reduces latency, and ensures reliable operation even without internet connectivity. Overall, the system provides an efficient, scalable, and user-centric solution for modern smart home environments.

Keywords

Smart Home Automation, Internet of Things (IoT), Voice Assistant, Speech Recognition, Natural Language Processing (NLP), Offline Processing, Arduino, Scheduling System, Energy Monitoring, Streamlit Dashboard.

Web App for Smart Parking System Based on IoT

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Abstract

In Today's cities, the number of vehicles is increasing very fast. Because of this, traffic and parking problems are very common. Many drivers waste their important time and fuel searching for finding free parking spaces. Current parking systems are expensive, complex to use, or do not show free spaces in real time. They also do not provide Online booking feature and did not accept online payments. This project will provide the solution for these issues by making a Smart Parking Web App. That app will allow users to see free spaces, book them Online, and pay digitally. The system will use real-time data (from sensors or manual updates) to show which slots are available and free to use. It will also guide the user to the nearest parking space. For managers, the app will provide tools to add or remove slots, check usage, and make reports. This project is important because it saves time, reduces fuel use, and lower pollution. It will also help reduce traffic problems and support smart city growth. The system will be low-cost, simple, and easy to expand. It will directly help people by solving one of the biggest problems in cities finding a free parking space.

Keywords

Car park system, intelligent transportation system, parking technology, smart parking system.

SoulWhisper: A Voice-Driven Intelligent Web Navigation and Accessibility Assistant

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Abstract

The current websites have complicated user interfaces with multifaceted menus, buttons, forms and dynamically generated content. Such interfaces can be user friendly only under the condition that they are used by users who are guided with assistive technologies or possess limited experience with the structure of the websites. Handicapped users with impaired eyesight as well as the aged users and novices are usually not able to find certain elements or carry out some task on the complex webpage. This paper summarizes SoulWhisper, which is an intelligent web navigation assistant powered by voice, and allows the interaction between websites in a hands free manner. It is a speech recognition system with fuzzy text matching and Document Object Model (DOM) real time analytics that seeks and finds interactive elements of a webpage, i.e., links, buttons and input fields. Voice commands are simple and allow users to do different activities such as navigation, scrolling, and form interaction. SoulWhisper is devised as a lightweight web browser extension whereby commands are processed in a local manner to enhance responsiveness and privacy to users. The usability is further enhanced by additional accessibility options such as multilingual commands, gesture interaction or visual viewing modes. The proposed system is geared towards offering more convenient and user-friendly windows browsing behavior to the consumers of the contemporary web platforms.

Keywords

Voice navigation, web accessibility, speech recognition, DOM analysis, fuzzy matching, browser extension, assistive technology.

DeFiVault: Redefining Security in Digital Finance

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Abstract

Nowadays, most people are moving towards decentralized finance because everyone wants to make transactions or transfer money without banks getting in the way. The major problem is that no one is really verifying users' identities one after another, which acts as a major loophole and gives an opportunity for those who are trying to engage in malpractice. Regular banks have entire departments dedicated to preventing this, but these new practices might lead to the exposure of some users' details. In our project, we developed a system that analyzes what users are doing before their money moves. We have set up an automatic checker that assigns every transaction a risk score based on the user's past actions and how quickly the funds are being moved. If a transaction looks suspicious, we can predict the risk score before the transaction is executed by analyzing the account's previous transactions. If the risk score is high, the transaction will be prevented before it occurs. The system also sends an AML alert to the admin dashboard.

Keywords

Blockchain, Decentralized Finance (DeFi), Digital Financial Transactions, Anti-Money Laundering, Digital Banking.

EXE – Thick Client Malware Scanner

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Abstract

This application represents the Static Thick Client malware scanner that is majorly designed to perform the analysis of the Windows Portable Executable (.exe) before dynamically pushing or executing or installing those applications and giving access to the internal environment of the system. This is a light-weight modular level approach which has a multiple-layered architecture, including UI, analysis engine, ML prediction model and 6 different and major parts that help in analyzing and prediction of malware based on the signature and the patterns existing inside it. Multiple detection techniques are layered for matching the Malware rules and easy to identify the suspicious categories across the application. Additionally, a machine learning model – “Random Forest” is included to combinedly classify the extracted features. This application computes a risk score and divides the elements into 6 major categories and allows the user to view and download the reports and scan findings for the betterment of the application security. A user-friendly GUI helps in Scanning, Visualization. For the Logs and the new scanning data is stored in the PostgreSQL. This provides a safe, efficient and scalable solution for the pre-execution and malware detection.

Keywords

EXE Malware Scanner, Static Analysis, Portable Executable (PE), YARA Rules, Heuristic Detection, Random Forest, Risk Scoring, Thick Client Application, Malware Detection.

Effectiveness and Impact of Agile Supervised Learning to Protect Energy Resources during War in the Middle East

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Abstract

Energy infrastructure in the Middle East has become a primary target in modern hybrid warfare, particularly through cyber-physical attacks. This paper evaluates the effectiveness of integrating **agile methodologies with supervised machine learning (ML)** to enhance protection of energy systems during wartime. Using case studies from Saudi Arabia, the UAE, and Israel, the research demonstrates that Agile-supervised learning frameworks significantly improve resilience, threat detection, and adaptive response in smart energy infrastructures. Energy infrastructure in the Middle East is highly vulnerable during modern hybrid warfare involving cyber-physical attacks. This paper proposes an **Agile-supervised learning framework** for protecting energy systems such as smart grids, oil pipelines, and gas networks. The study integrates **iterative Agile methodologies with supervised machine learning models** to provide adaptive, real-time defense mechanisms. Mathematical modeling, algorithmic design, and case studies from Saudi Arabia, UAE, and Israel demonstrate improved detection accuracy, system resilience, and response time.

Keywords

Agile methodology, Supervised learning, Smart grid, Cybersecurity, Energy security, Middle East, War systems.

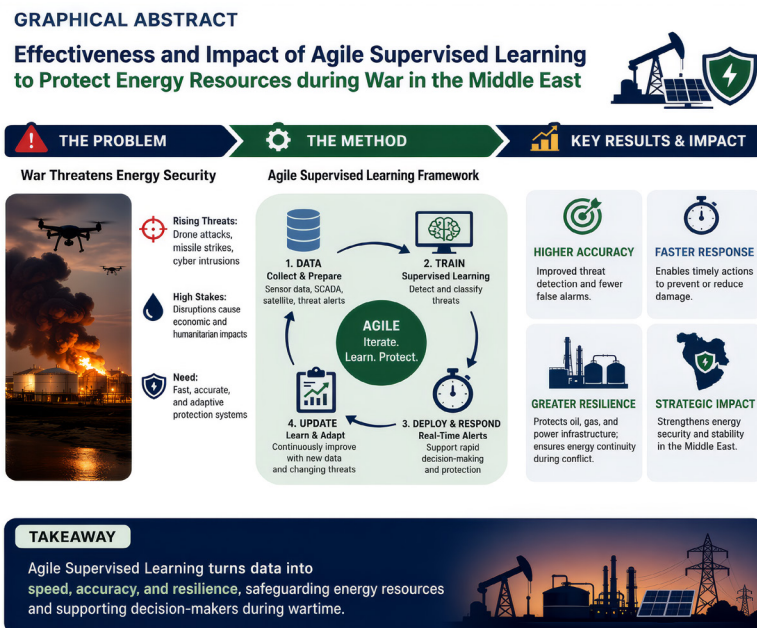


Figure 1. Graphical Abstract

AI That Predicts Online Shopping Price Drops and Best Buy Time

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Abstract

This research introduces an intelligent system named SmartPrice AI, designed to help users deal with the challenges of changing prices on online shopping sites like Amazon and Flipkart. The system collects real-time information on product prices, discounts, and customer ratings through web scraping, making it easier for shoppers to decide when to buy. The study compares two methods: a traditional ARIMA model and a Long Short-Term Memory (LSTM) deep learning model. The results show that the LSTM model is more effective at predicting prices, achieving 92.7% accuracy and a very low Mean Absolute Error (MAE) of 0.019, which is better than traditional statistical approaches. Once developed, the system is made available as an API using Flask and also as a browser extension. This allows users to get real-time suggestions like “Buy Now” or “Wait” when making purchases. The research shows that using AI to assist consumers can help them get the best deals despite fluctuating prices in the market.

Keywords

Artificial Intelligence, Time-Series Forecasting, Price Prediction, Web Scraping, E-Commerce Analytics, Dynamic Pricing, Browser Extension, Machine Learning, LSTM, Consumer Decision Support.

Six Sigma Application to Precision Instrument Manufacturing Facility for Defect Reduction: A Case Study

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Abstract

Manufacturing efficiency remains a critical challenge in the small-scale industry, where quality defects directly impact product reliability and customer satisfaction. This paper presents a diagnostic case study applying Six Sigma DMAIC methodology and 7QC tools to the small scale voltmeter manufacturing facility in India. Defect data were collected passively from production quality logs of 30 days, capturing 869 defects across 22 component types from a total production volume of 6,340 units. Pareto Analysis identified seven Critical-to-Quality (CTQ) components namely Glass, Joule, Bobbins, Resistance 15–20 W, Coil, Dial, and Zero Adjuster. Root cause analysis using an Ishikawa diagram, developed through structured brainstorming sessions with facility management who enlisted the defects commonly occurring in these components. The primary contribution of this study is a structured framework and a targeted improvement action plan for each CTQ component. It is important to note that this study is concerned only with recommendations, and implementation and measurement of resultant outcomes are beyond the present scope.

Keywords

Six Sigma, DMAIC, Data Collection, Quality Control Plan, Pareto Analysis, Ishikawa Diagram, MSME Industry.

Life Cycle Cost Assessment and Financial Feasibility of Sustainable Energy Integration in Automotive Manufacturing Industries

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Abstract

The study in this report details a comprehensive techno-economic assessment of sustainable energy integration in automotive manufacturing industries, using Life Cycle Cost Assessment (LCCA) and financial feasibility analysis as the primary evaluation tools. Focusing on a representative automotive assembly plant with significant electrical and thermal loads (body-in-white, paint shop, utilities, and final assembly), the work compares the conventional, grid and fossil fuel based energy supply with a portfolio of sustainable measures: rooftop solar photovoltaic (PV) systems, compressed air system optimisation, and high-efficiency motors with variable frequency drives (VFDs). Conventional energy planning in such plants is often based on simple payback and short-term capital constraints, which tends to undervalue options with higher upfront cost but superior performance over their full life cycle. This study addresses that gap by explicitly modelling capital, operating, maintenance, replacement and residual costs over a 20-year horizon under realistic Indian industrial conditions, including tariffs, discount rates and energy price escalation.

In contrast to single-year cost comparisons, the LCCA framework developed here quantifies the long-term economic impact of each measure as well as combined scenarios. Annual energy balances are constructed from the mechanical equipment side, compressors, pumps, fans, HVAC units and process heating systems, and are then translated into cash flows using projected electricity and fuel prices. Net Present Value (NPV), Internal Rate of Return (IRR), discounted payback period and Levelized Cost of Energy (LCOE) are computed for each alternative, while sensitivity analyses on discount rate, energy tariffs, capital cost and savings fractions capture the effect of key uncertainties.

The results indicate that integrated sustainable energy strategies can achieve substantial reductions in grid electricity consumption and life cycle energy costs, with combined PV and efficiency measures yielding markedly higher NPVs and shorter payback periods than either option alone, even under conservative assumptions.

The study concludes that life-cycle-based decision making offers clear advantages over traditional, short-term economic assessment for energy investments in automotive manufacturing. By linking detailed mechanical system modelling with LCCA and financial metrics, the proposed framework demonstrates that sustainable energy integration can be both technically feasible and financially attractive, particularly for plants operating under rising energy prices and stringent competitiveness pressures. The methodology and findings make the topic highly relevant for modern manufacturing, and provide a practical decision-support tool for plant engineers, managers and policy makers aiming to reduce operating costs, enhance energy security and support wider decarbonisation goals in the automotive sector.

Smart IoT-Based Automated Conference Hall System Using Distributed Sensor Network Architecture

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Abstract

To enhance efficiency in terms of energy, comfort, and reliability of work, this paper describes a Smart IoT-Based Automated Conference Hall System that will be used in large-scale settings. The architecture of this system is a distributed sensor network, with several embedded nodes controlling local sensing and control activities. Occupancy, environmental, lighting, and energy sensors are built into each node, which allow obtaining real-time data. A hierarchical model of communication via a wireless structure guarantees a flawless data flow to a central platform to be processed and visualized. Dynamic control measures can be used to adaptively control lighting and air conditioning to occupancy and environmental conditions using adaptive control strategies. The system also has energy analytics and fault detection capabilities to improve the performance and maintenance. Scalability, isolation of faults and efficient use of resources are also guaranteed by the distributed design, which is why it is applicable to the intelligent infrastructure applications of the modern world.

Keywords

Smart automation, IoT monitoring, distributed architecture, energy efficiency, occupancy detection, environmental control, fault detection.

Path Optimization Using Deep Reinforcement Learning in Wireless Sensor Network

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Abstract

Wireless Sensor Networks (WSNs) are widely used in today's modern world like in smart cities, health sector, defence, forest alarm monitoring and many more. However, the limited capacity of these sensors creates a problem and maintaining a network for long aspect. Insufficient and unoptimized path and static technique add more problem to the effectiveness of these sensors. These ineffective technique results in dead sensors and reduce network lifetime. To solve these issues effective technique of Deep Reinforcement Learning (DRL) is proposed.

This method based on dynamic environment where a routing decision based on effective interactive real time learning rather than pre-defined rules. An Agent continuously observes energy level of nodes and charger, effective connectivity between nodes, shortest distance and find optimized path for charger that reduce energy consumption, interaction time and number of dead nodes. Simulation results shows that this DRL based method approach significantly improve energy efficiency and overall enhance the network environment lifeline than previous static routing algorithms.

Keywords

Wireless Sensor Networks, Deep Reinforcement Learning, Path Optimization, Energy Efficiency, Intelligent Routing.

Challenges in Identification of Medicinal Plants

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Abstract

Medicinal plants are commonly used in both traditional and modern healthcare, but identifying them accurately is still difficult. Similar leaf structures and differences in local names add to the challenge. Traditional methods, which rely on visual inspection and local expertise, can often be subjective and prone to mistakes. In this work, we present a low-cost, automated system designed to identify medicinal plants based on their leaf features, using a Raspberry Pi. We use image processing and machine learning techniques to evaluate leaf shape, texture, and color for accurate classification. This approach decreases reliance on human input and reduces errors in recognizing plants. The system is compact, efficient, and easy to access for use in rural or field settings. By integrating technology with botanical knowledge, the project supports accurate plant authentication and encourages sustainable use. This paper discusses the design, methodology, and potential applications of the system in medicinal plant conservation and healthcare practices.

Keywords

Medicinal plants, Raspberry Pi, Image Processing, Handheld.

A Deep Learning Framework for Breast Cancer Detection from RF Microwave Data

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Abstract

Lately, as AI quickly becomes a bigger part of medicine, it's really shown us how much we need diagnostic tools. We need tools that don't just crunch numbers, but truly grasp the complex physical signs of human sickness. Even though deep learning has really changed how we do image recognition and make decisions, a lot of the diagnostic tools we have now still aren't smart enough to really understand unusual imaging data. They don't have that subtle "perceptual intelligence" needed for it. So it's still tough to make screening systems that are really good at finding problems and also easy for patients to use. This paper describes a deep learning system we built to find breast cancer using RF microwave data. This approach uses the different electrical properties of healthy and cancerous tissues. It picks up on small differences in how light scatters, which other methods generally can't see. It uses methods based on something called convolutional neural networks to pick out important details from complicated electromagnetic signals. Then, we combine these features using a specific method to create a very accurate diagnostic map. This system does more than just find problems; it also has a smart part that helps doctors make better choices. This part of the system helps it keep track over time. It does this by changing how sensitive it is, depending on how dense the tissue is and what its past RF signals looked like. We found that putting together different types of radio frequency information—like the phase, magnitude, and how different antennas relate in space—really helped improve how accurately our system could classify things. It worked much better than just using one type of microwave data alone. Also, the way this system works has really helped make non-invasive screenings faster and more dependable. We think this deep learning method could be really useful for things like cheap portable scanners, regular check-ups, and as a way to check dense tissues without using radiation.

Keywords

Breast Cancer Detection, RF Microwave Imaging, Deep Learning, Dielectric Properties, Signal Processing, Diagnostic Intelligence, Feature Fusion.

An Ensemble Learning Approach for Real-Time DDoS Attack Detection Using Network Traffic Flow Features

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Abstract

One of the most significant threats to the contemporary network infrastructure is the Distributed Denial-of-Service (DDoS), which can saturate servers with extremely large amounts of bad traffic and produce disastrous service interruptions. The conventional intrusion detection systems primarily use signature-based approaches which fail to identify new and changing patterns of attacks. In this paper, a machine learning based framework of identifying network traffic flow based DDoS attacks will be provided. The system identifies the features of the network flow captured in a statistical format at the flow level i.e. Packet rate, byte rate, packet length statistics and protocol content. CIC-DDoS2019 dataset is utilized as a training dataset and evaluation dataset and preprocessing methods tend to enhance model performance such as data cleaning, class balancing, and feature scaling. Several trained machine learning models recorded, based on Logistic Regression, Random Forest, Decision Tree, Gradient Boosting, Support Vector Machine (SVM), Multilayer perceptron (MLP), and XGBoost models are tested in attack identification. The findings of the experiments indicate that tree-based models in the form of ensembles obtain a detection accuracy of over 99 % and have a high precision and recall with a low rate of false positive. The suggested framework has offered a useful method of detecting malicious traffic patterns and may be used to facilitate real-time network security surveillance systems.

Keywords

DDoS detection, intrusion detection system, machine learning, network security, ensemble learning, network traffic analysis.

Design and Real-Time Evaluation of Load Distribution Strategies in Distributed Web Server Systems

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Abstract

Load balancing is a required method employed in the distributed systems in an attempt to efficiently allocate the network traffic across servers. This is also the design and implementation of real-time load balancing system of the web servers as well as the monitoring of the traffic and performance analysis. This system will have several servers that are backends, a load balancer (that will be centralized) and a real-time monitoring dashboard. The incoming client requests are distributed by the load balancer system with such algorithms as Round Robin, Random Selection, and Least Connections to provide equal distribution of the working load. Traffic can be generated on the network through a traffic generator module, which is used to identify the performance of the system given different load on the network. Important performance measures like the number of requests and the mean response latency are continuously monitored in the system. The visualization of this metrics is provided in form of a live dashboard. Through experimental findings, the proposed system is effective in distributing traffic between the servers, alleviating server overload as well as enhancing the overall system performance and reliability in distributed web environments.

Keywords

Load Balancing, Distributed Systems, Web Servers, Round Robin Algorithm, Network Traffic Analysis, Latency Monitoring, Performance Evaluation, Real-Time Monitoring.

Real-Time Motor Fault Detection Using ML and IoT

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Abstract

Permanent Magnet Synchronous Motors (PMSMs) are extensively employed in modern industrial drive systems owing to their high efficiency and superior torque characteristics. Nevertheless, prolonged operation under variable loading conditions may lead to progressive electrical and thermal irregularities that compromise reliability. Conventional protection mechanisms primarily respond to threshold violations, which limits their capability to detect incipient fault development. This work presents an integrated hardware–software diagnostic framework for realtime condition assessment of PMSMs. Operational parameters are continuously acquired through embedded sensing and processed within a centralized computational environment. Temporal dependencies in the measured signals are modelled using a Long Short-Term Memory (LSTM) network to distinguish among healthy, pre-fault, and fault states. A web-based monitoring interface enables continuous visualization and decision support. The architecture incorporates hybrid retraining governed by performance evaluation and scheduled updates, while model deployment remains administratively supervised to ensure operational stability. Experimental validation demonstrates reliable classification behaviour and improved responsiveness to emerging anomalies. The proposed framework offers a scalable and intelligent solution for predictive condition monitoring in industrial environments.

Keywords

Permanent Magnet Synchronous Motor (PMSM), Fault Diagnosis, Condition Monitoring, Time-Series Analysis, Long Short-Term Memory (LSTM), Cyber-Physical Systems, Predictive Maintenance, Real-Time Monitoring.

Risk Identification, Assessment, and Mitigation in Construction Projects: An Empirical Study from a Management Perspective

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Abstract

Construction projects are inherently exposed to multiple uncertainties that adversely affect cost, time, quality, and safety, making effective risk management essential for successful project delivery. This study aims to analyze risk identification, assessment, and mitigation in construction projects from a management perspective using secondary data sourced from published research, journals, and industry reports. A qualitative and descriptive research design is adopted, utilizing probability-impact analysis to evaluate risk severity and classify risks into financial, technical, managerial, environmental, and safety categories. The results reveal that managerial risks—such as poor planning, ineffective communication, and inadequate scheduling—have the most significant impact on project performance, followed by financial risks including cost overruns and payment delays. Technical and environmental risks demonstrate moderate influence, while safety risks remain critical under specific project conditions. Existing mitigation strategies, including systematic planning, stakeholder coordination, financial monitoring, and safety management practices, are found to be effective but require further strengthening through proactive managerial involvement and structured risk management frameworks. The study concludes that improved management practices, early-stage risk identification, and continuous monitoring significantly enhance project outcomes. This research contributes to the field of construction management by highlighting the pivotal role of management in minimizing risks and ensuring efficient and successful project execution.

Keywords

Risk management, Risk assessment, Risk mitigation, Project performance, Construction management.

Confidence-Calibrated Medical Lab Report Analysis via Parameter-Efficient Fine-Tuning of MedGemma

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Abstract

We present a parameter-efficient fine-tuning approach for calibrated confidence estimation in medical laboratory report interpretation. Using Low-Rank Adaptation (LoRA), we fine-tuned MedGemma-4B (only 0.23% of parameters, 78.9M trainable) to generate clinically-calibrated confidence scores (50–95%) alongside diagnostic interpretations for diabetes-related lab reports. Our model learns to map case complexity to appropriate confidence: severe/clear abnormalities yield high confidence (90–95%), borderline cases yield moderate confidence (70–79%), and discordant or incomplete data yield lower confidence (50–65%). Across 48 diverse clinical test cases spanning seven categories (severe, moderate, borderline, prediabetes, discordant markers, incomplete data, and edge cases), our approach achieved 85.4% calibration accuracy with relaxed clinical ranges. Notably, the model demonstrates 100% calibration accuracy on severe/clear cases and 88% on discordant markers—a novel capability rarely addressed in medical AI systems. Our work demonstrates that training-time confidence learning via parameter-efficient fine-tuning can embed clinically-appropriate uncertainty quantification directly into medical language models, offering a scalable alternative to post-hoc calibration.

Keywords

Medical AI, confidence calibration, parameter-efficient fine-tuning, LoRA, MedGemma, laboratory report interpretation, uncertainty quantification, diabetes monitoring.

Structural Performance of Reinforced Concrete Beams with Different Reinforcement Ratios

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Abstract

The reinforcement ratio in reinforced concrete (RC) beams plays a vital role in determining their structural performance and ensuring safe, economical design. This study examines how varying percentages of reinforcement influence key parameters such as load-carrying capacity, deflection response, and crack development. The analysis is based on secondary data collected from previously published research studies. Data from multiple sources were compiled, organized, and analyzed using Microsoft Excel to generate graphical representations and identify behavioral patterns. The findings indicate a clear positive relationship between the reinforcement ratio and the ultimate strength of RC beams. Beams with higher reinforcement percentages exhibit greater load resistance and reduced deflection under service loads. However, an excessive increase in reinforcement leads to a reduction in ductility, making the beam more susceptible to sudden and brittle failure. Additionally, it was observed that with higher reinforcement ratios, cracks become more closely spaced and finer in nature. These results highlight the importance of selecting an optimum reinforcement ratio that achieves a balance between strength, serviceability, and ductility requirements. The study also demonstrates that secondary data analysis is an effective and reliable approach for evaluating structural behavior, offering valuable insights without the need for extensive experimental work. The noval work will be useful for the future research work.

Keywords

Reinforced Concrete Beam, Reinforcement Ratio, Flexural Behaviour, Deflection, Crack Pattern, Ultimate Load.

Inter-Drone Communication System: Comparing Synchronization and Control Accuracy

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Abstract

This paper presents the design, construction, and testing of a modular two-drone automation system for surveillance and delivering lightweight cargo. Each drone is controlled using ESP32 microcontrollers, and communication for each is facilitated using the ESP-NOW protocol to ensure speed and low latency.

The system performance was gauged in two phases: stability of individual flights with respect to roll, pitch, and yaw, and the formation flight where the path taken by both flying drones is evaluated. During flights, we have developed a ground control web panel for sending commands and downloading telemetry data.

The system realized reliable communication among drones and achieved very good attitude control for each drone, hence smooth coordination during flights by multiple drones. It also points towards the capability of automatic flight in a larger scale.

Keywords

Drones, ESP-NOW protocol, flight controller, websocket.

AI-Driven Multimodal Thermal–RGB Surveillance Framework for Real-Time Anti-Poaching Detection in Wildlife Reserves

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Abstract

Poaching continues to endanger wildlife populations in protected reserves, particularly in regions where vast terrain, irregular visibility, and limited on-ground manpower constrain effective monitoring. Conventional surveillance tools, including visible-light cameras and manual patrolling, provide restricted operational capability during nighttime or adverse weather. Thermal imaging offers a viable alternative by detecting heat signatures independent of illumination; however, thermal data alone often lacks the discriminative detail required to reliably distinguish between humans, animals, and environmental thermal artifacts. This work proposes a real-time anti-poaching surveillance framework that integrates thermal and RGB visual streams through a multimodal deep learning architecture. The system incorporates thermal-stream analysis, RGB-based semantic recognition, and a late-fusion module combining YOLO-based detectors optimized for both sensing modalities. In addition, a spatio-temporal anomaly recognition component evaluates movement patterns, proximity interactions, and restricted-zone violations to identify high-risk behavior indicative of poaching. The framework is designed for deployment on edge hardware, enabling continuous monitoring in remote or low-connectivity environments while maintaining low inference latency. Experimental evaluations using field-recorded RGB footage and simulated thermal datasets demonstrate improved human–animal classification accuracy, reduced false-alarm rates, and enhanced robustness under nocturnal and low-visibility conditions. The results highlight the effectiveness of multimodal fusion in strengthening autonomous surveillance systems for wildlife conservation and timely poaching intervention.

Keywords

Thermal imaging, multimodal fusion, wildlife protection, anti-poaching surveillance, YOLO, deep learning, anomaly detection, UAV monitoring, real-time edge inference.

A Web-Based Real-Time Driver Drowsiness Detection and Alert System Using Vision Transformer (ViT) and Facial Landmark Features

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Abstract

Driver drowsiness is one of the major reasons for road accidents across the world, causing a significant number of fatalities and injuries annually. In this paper, we propose a real-time web-based driver drowsiness detection and alert system called DriverGuard AI, which uses facial landmark detection along with deep learning techniques. In our system, we use Google's MediaPipe FaceMesh to obtain 468 facial landmarks and calculate critical physiological signals such as Eye Aspect Ratio (EAR), Mouth Aspect Ratio (MAR), Percentage of Eye Closure (PERCLOS), blink rates, and head pose. Moreover, we integrate a Vision Transformer (ViT)-based model pre-trained on publicly accessible databases such as the Driver Drowsiness Dataset (DDD), NTHU Driver Drowsiness Dataset, MRL Eye Dataset, and so on, to improve the detection system's performance under various environmental conditions. A hybrid decision-making system is designed by incorporating geometric features and deep learning outputs to categorize driver states into three classes: ALERT, WARNING, and DROWSY. system is implemented as a FastAPI-based web application, and it includes a dashboard that is accessible from a browser and offers video monitoring, feedback, and audio alerts for sustained drowsiness. The experimental results show that eye closure, yawning, and patterns of fatigue can be reliably detected using real-time performance on standard CPU hardware, eliminating the need for GPU acceleration. system is cost-effective, non-intrusive, and scalable, and it can be used for consumer vehicles, fleet monitoring, and safety-critical applications.

Keywords

Driver drowsiness detection, Vision Transformer (ViT), facial landmarks, Eye Aspect Ratio (EAR), Mouth Aspect Ratio (MAR), PERCLOS, MediaPipe FaceMesh.

Automated Health Risk Analysis Using Machine Learning Techniques

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Abstract

Global healthcare systems grapple with the significant challenge of detecting diseases at advanced stages, leading to elevated treatment costs and suboptimal patient outcomes. This paper introduces HealthSense AI, an automated health risk analysis system that employs machine learning to facilitate the early identification of potential health conditions. The system integrates patient vital signs, medical history, and lifestyle indicators, drawing data from cardiovascular and diabetes datasets. A Decision Tree Classifier serves as the core prediction model, enhanced by an Extra Trees Classifier ensemble for improved accuracy and analysis of feature importance. Patient records are categorized into three risk levels: High, Medium, and Low Risk. Tested on 1,025 cardiovascular records and 768 diabetes records, the system achieved classification accuracies of 99.1% and 78.6%, respectively. A web-based interface allows healthcare professionals to upload patient data, access an interactive risk dashboard, and generate detailed reports for individual patients. Experimental findings confirm that this proposed method effectively reduces reliance on manual health risk assessments, thereby supporting proactive and preventive healthcare management.

To address current limitations, the system incorporates data preprocessing, including imputation of missing values and min-max normalization, followed by feature selection using Extra Trees importance ranking. The trained Decision Tree model predicts risk levels based on clinical input data, while the HealthSense AI web interface offers a user-friendly dashboard for visualizing risk distribution, patient categorization, and downloadable CSV reports for clinical application.

Keywords

Machine Learning, Health Risk Analysis, Decision Tree Classifier, Extra Trees, Feature Importance, Cardiovascular Disease, Diabetes Prediction, Risk Stratification, HealthSense AI, Preventive Healthcare.

Vision-Guided Autonomous Assistive Robot for Indoor Domestic Care Using ROS 2

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Abstract

This work describes the development of an indoor assistive robotic system designed to support daily activities within residential environments. The platform combines a differential-drive mobility base with a mechanically stable structure for reliable movement in confined spaces. Autonomous operation is achieved through a ROS 2-enabled control architecture incorporating LiDAR-based mapping, real-time trajectory generation, and obstacle avoidance. A deep learning-driven vision module enables human detection and object identification to support interactive task execution. Additionally, a microcontroller-controlled dispensing mechanism allows controlled release of items when triggered through a graphical interface. Experimental evaluation demonstrated reliable system performance, achieving 91.4% human detection accuracy with an average processing latency of 0.42 seconds per frame, confirming stable real time operation in indoor environments.

Keywords

Assistive Robotic Systems, Indoor Mobile Platform, ROS 2 Architecture, LiDAR Mapping, Deep Learning Vision, Embedded Control, Human-Robot Interaction, Domestic Support Robotics.

Performance Evaluation and Analysis of Energy-Efficient Dynamic Comparator Circuits for High-Speed VLSI Applications

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Abstract

The increasing demand for efficient and high-performance components in modern digital systems and growing complexity of contemporary digital applications necessitates circuit architectures that offer high speed, reduced power consumption, and simplified design. This work is focused on the performance evaluation and analysis of the various topologies of dynamic comparator circuit to demonstrate improvements in key performance parameters such as delay, power and delay-power product (PDP). The different topologies of the dynamic comparator circuit which are analyzed and evaluated are classified on the basis of NMOS and PMOS at the input of preamplifier. Here two topologies of dynamic comparator circuit are based on the NMOS at the input of preamplifier while the other topologies are based on the PMOS at the input of preamplifier. The simulation analysis of this research is carried out using Cadence Virtuoso simulation software at 90nm CMOS technology node, beginning with architectural specification and extending through circuit-level implementation and performance evaluation and their comparison. This work thoroughly documents the architectural choices and comparative performance analysis of various topologies of energy-efficient dynamic comparator circuit for high-speed VLSI applications.

Keywords

Delay, Dynamic Comparator, Energy-Efficient, Modified, Monte Carlo, Optimized, Power.

Digital Coding Metasurfaces for Adaptive Beamforming

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Abstract

With the evolution of wireless communication and radar technologies, there has been an increasing demand for intelligent and adaptive antenna systems in recent years. Beamforming, which involves shaping the radiation pattern of an antenna array toward a specified direction, is crucial to enhance signal quality, range, and interference rejection. In this paper, we focus on the software based design and simulation of adaptive beamforming using Digital Coding Metasurfaces (DCMs). The so-called digital coding metasurfaces are artificially engineered surfaces composed of subwavelength unit cells that can be configured with discrete phase states usually from a binary set such as 0° and 180° to arbitrarily modulate electromagnetic wavefronts. Unlike traditional analog methods, DCMs offer a low complexity yet highly reconfigurable means of beam control by simple digital sequences. In this paper, we design, implement, and simulate various binary coding schemes for beam steering and beamwidth reconfiguration. By using Ansys HFSS, we investigate the effects of different coding patterns on the direction and morphology of the radiated beam. From these simulations, it follows that the dynamic control of the main-lobe direction and beamwidth with high precision and reduced computational overhead can be realized by changing the digital codes allocated to the elements of metasurface.

This study emphasizes flexibility and efficiency in the radiation pattern control without physical prototyping, which makes the methodology particularly suitable for researchers and engineers working in software-defined antennas, reconfigurable communication systems, and radar signal processing. The simulation-driven approach also facilitates rapid testing and optimization of metasurface designs for a wide range of application requirements. In the wake of leveraging the concept of digital coding and beamforming, this work contributes to offering a scalable and adaptable solution that goes hand in hand with the trajectories of 5G/6G networks, smart sensing, and intelligent wireless systems.

Keywords

Adaptive Beamforming, Digital Coding, Metasurfaces, Reconfigurable Antennas, Beam Steering, Ansys HFSS and 5G/6G.s

Balancing Decentralization and Security: Optimal Consensus Parameterization to Resist 51% Control

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Abstract

Blockchain networks face a fundamental trade-off between decentralization and security. While decentralization enhances openness and censorship resistance, it also increases coordination overhead and may expose the network to concentration of power in mining pools or validator cartels. Security, on the other hand, depends on ensuring that no adversary can control the majority of consensus power, yet rigidly favoring security often comes at the cost of reduced participation and higher centralization. Among the most critical threats is the 51% attack, in which a malicious entity gains majority control of the consensus mechanism, enabling double spending, transaction censorship, or chain reorganization. This paper investigates the problem of optimal consensus parameterization as a means of resisting 51% control. We model the interaction between system parameters—such as block generation interval, committee size, staking distribution, and validator rotation frequency—and their impact on both decentralization and security. Using game-theoretic analysis and simulation, we evaluate the economic cost of attack across Proof-of-Work, Proof-of-Stake, and hybrid consensus mechanisms, and measure decentralization via the Nakamoto coefficient and stake concentration indices.

The results indicate that adaptive consensus tuning can significantly increase the effective cost of a 51% attack while maintaining a balanced level of decentralization. We propose a dynamic framework that allows blockchain networks to adjust parameters in real time, guided by network conditions and participation levels, to maximize both security and inclusiveness. This research provides a pathway toward self-optimizing blockchains that are resilient against majority control while preserving the democratic ethos of decentralization.

Keywords

Electronic voting, E-voting, blockchain, consensus mechanisms, hybrid blockchain, mobile app.

