

4th INTERNATIONAL CONFERENCE ON ADVANCES IN SCIENCE, ENGINEERING & TECHNOLOGY (ICASET-2025)

15th – 16th November, 2025 | Delhi, India

Academic Partner



Organized By:

Panipat Institute of Engineering and Technology, Haryana

Kamaraj College of Engineering & Technology, India and IFERP Academy - India Society





4th International Conference on Advances in Science,
Engineering & Technology (ICASET-2025)

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Theme:

“From Research to Reality: **Advancing
Tech for a Smarter Planet**”



PREFACE

We are delighted to extend a warm welcome to all participants attending 4th International Conference on Advances in Science, Engineering & Technology (ICASET-2025), taking place in Delhi, India on 15th - 16th November, 2025. This conference provides a vital platform for researchers, students, academicians, and industry professionals from all over the world to share their latest research results and development activities in the field of Sustainable Agriculture and Climate Resilience. It offers delegates an opportunity to exchange new ideas and experiences, establish business or research relationships, and explore global collaborations.

The proceedings for ICASET-2025 contain the most up-to-date, comprehensive, and globally relevant knowledge in the field of Engineering, Technology and Management. All submitted papers were subject to rigorous peer-reviewing by 2-4 expert referees, and the papers included in these proceedings have been selected for their quality and relevance to the conference. We are confident that these proceedings will not only provide readers with a broad overview of the latest research results in Advances in Science, Engineering & Technology but also serve as a valuable summary and reference for further research in this field.

We are grateful for the support of many universities and research institutes, whose contributions were vital to the success of this conference. We extend our sincerest gratitude and highest respect to the many professors who played an important role in the review process, providing valuable feedback and suggestions to authors to improve their work. We also extend our appreciation to the external reviewers for providing additional support in the review process and to the authors for contributing their research results to the ICASET-2025.

Since September 2025, the Organizing Committees have received more than 200+ manuscript papers, covering all aspects of ICASET-2025. After review, approximately 183+ papers were selected for inclusion in the proceedings of ICASET-2025. We would like to thank all participants at the conference for their significant contribution to its success. We express our gratitude to the keynote and individual speakers and all participating authors for their dedication and hard work. We also sincerely appreciate the efforts of the technical program committee and all reviewers, whose contributions made this conference possible. Finally, we extend our thanks to all the referees for their constructive comments on all papers, and we express our deepest gratitude to the organizing committee for their tireless work in making this conference a reality.

ABOUT

ICASET – 2025

The 4th International Conference on Advances in Science, Engineering & Technology (ICASET), partnership with IFERP Academy, beckons researchers, scholars, and industry professionals to embark on a journey of intellectual exploration and collaboration. As an attendee, you will find compelling reasons to participate in this dynamic event.

ICASET offers a unique opportunity to immerse yourself in a rich tapestry of multidisciplinary knowledge. It is a platform to connect with global thought leaders and visionaries who have left an indelible mark on the landscape of science, engineering, and technology. Keynote sessions by these luminaries promise to offer profound insights into the latest trends, challenges, and future directions in these dynamic fields.

Whether you are a researcher looking to refine your methodology or a professional seeking to stay abreast of the latest industry practices, these workshops provide a unique learning experience.

Purpose of the Conference

“From Research to Reality: Advancing Tech for a Smarter Planet”

The primary purpose of ICASET is to provide a dynamic platform for researchers, academics, and industry professionals to converge and explore cutting-edge advancements in science, engineering, and technology. In an era marked by challenges, this conference stands as a beacon for nurturing resilience – a space where ideas flourish, collaborations thrive, and solutions emerge. ICASET seeks to transcend disciplinary silos, encouraging participants to engage in interdisciplinary dialogues that pave the way for resilient solutions to real-world challenges.

Objective of the Conference

ICASET is driven by a multifaceted objective that goes beyond traditional conference goals. Our aim is to facilitate knowledge exchange, promote collaboration, and catalyze transformative breakthroughs in the fields of science, engineering, and technology.

By providing a conducive environment for networking, learning, and idea-sharing, ICASET aspires to contribute to the global pool of knowledge and inspire innovative approaches to address the complexities of our ever-evolving world.

ABOUT IFERP

The IFERP Academy emerges as the dynamic force steering the organizational prowess behind the 4th International Conference on Advances in Science, Engineering & Technology (ICASET). IFERP stands as a distinguished professional association committed to advancing the frontiers of knowledge in the fields of engineering, science, and technology. With a steadfast dedication to promoting innovation, collaboration, and knowledge dissemination, IFERP plays a pivotal role in orchestrating conferences that serve as crucibles for intellectual exchange.



Mission:

Upskilling the knowledge hub through technological innovation and excellence for the benefit of humanity.

Vision:

A Digitally equipped robust, dynamic & swift professional community integrating academics & industry for upgraded technical knowledge implementation.



Value:

IFERP values the restoration of high- level technological research, learning, collaboration, resource sharing & community-building traditions.

Goal:

To serve as the foundation for all technological progress and advancement activities around the world.



MESSAGE FROM **MANAGING DIRECTOR, IFERP**



Mr. A. SIDDH KUMAR CHHAJER

MD & Founder,
IFERP, Technoarete Groups

On behalf of Institute For Educational Research and Publications (IFERP) & the organizing Committee, I express my hearty gratitude to the Participants, Keynote Speakers, Delegates, Reviewers and Researchers.

The goal of the 4th International Conference on Advances in Science, Engineering & Technology (ICASET-2025) is to provide knowledge enrichment and innovative technical exchange between international researchers or scholars and practitioners from the academia and industries in the field of Recent Advances in Engineering and Computer Applications.

This conference creates solutions in different ways and to share innovative ideas in the field of Recent Advances in Engineering and Computer Applications. ICASET-2025 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.

4th International Conference on Advances in Science, Engineering & Technology (ICASET-2025) will explore the new horizons of innovations from distinguished Researchers, Scientists and Eminent Authors in academia and industry working for the advancements in Science and Engineering from all over the world. ICASET-2025 hopes to set the perfect platform for participants to establish careers as successful and globally renowned specialists in the field of Science and Engineering.

MESSAGE FROM CHIEF EXECUTIVE, IFERP



MR. RUDRA BHANU SATPATHY

CEO & Founder,
IFERP, Technoarete Groups

IFERP is hosting the 4th International Conference on Advances in Science, Engineering & Technology (ICASET-2025) this year in month of 15th - 16th November, 2025, Delhi, India. The main objective of ICASET-2025 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 pain staking effort to make this conference successful.

WELCOME MESSAGE



Dr. R. Ramya

Associate Professor and Head, Department
of Artificial Intelligence and Data Science,
Kamaraj College of Engineering and Technology,
Virudhunagar, Tamil Nadu, India

Good morning to all distinguished delegates, researchers, academicians, and esteemed guests.

It is indeed a great honour and privilege to warmly welcome you all to the 4th International Conference on Advances in Science, Engineering & Technology (ICASET-2025), organized by Panipat Institute of Engineering and Technology, Haryana, Kamaraj College of Engineering & Technology, India and the IFERP Academy. We are delighted to host this significant gathering here in the vibrant setting of Delhi, India – in hybrid mode – welcoming participants from across the globe, both in person and virtually.

The conference theme, “From Research to Reality: Advancing Tech for a Smarter Planet” perfectly captures our shared mission – transforming innovative ideas and scientific research into impactful real-world solutions.

ICASET-2025 serves as a remarkable platform for knowledge exchange, fostering collaboration among scholars, industry experts, and technologists who are collectively shaping the future of science and engineering. As part of the organizing institution, I am immensely proud to witness such a convergence of bright minds and dedicated professionals.

I extend my heartfelt gratitude to all the keynote speakers, presenters and participants for their valuable contributions and presence. Let this conference ignite new ideas, cultivate meaningful partnerships, and propel our collective vision of a smarter, sustainable world.

Wishing everyone an intellectually enriching and memorable conference experience.

BIOGRAPHY OF KEYNOTE SPEAKERS



Dr. Nurul Asma Abdullah

Associate Professor, Senior Lecturer & Principal Investigator, Head of Biomedicine Program, School of Health Sciences, Universiti Sains Malaysia, Malaysia

Dr. Nurul Asma Abdullah is an Associate Professor and the Head of the Biomedicine Program at the School of Health Sciences, Universiti Sains Malaysia. With over a decade of academic teaching experience in molecular biology, immunology, and microbiology, she has also served as an internal and external examiner for MSc and PhD theses. She is also actively involved as an academic advisor and reviewer, as well as an auditor for allied health academic accreditation programs. Dr. Nurul is involved in multidisciplinary research encompassing biomedical sciences, stem cells and biomaterials, and pre-clinical studies, with a keen interest in tissue engineering and regenerative medicine, immunomodulation, and inflammation. Her current research focuses on understanding the effects of immunomodulation on the molecular mechanisms of hard tissue regeneration, developing biomaterials for dental, bone, and cartilage engineering, and exploring cell-based and cell-free therapies for regenerative medicine, as well as finding alternatives for managing inflammation. Additionally, Dr. Nurul is an active reviewer for various international journals, and university and national research grants. She has published over 80 peer-reviewed papers and authored and co-authored several books and chapters. Professionally, she is a member of various national and international societies and currently serves on the executive committee of the Tissue Engineering and Regenerative Medicine Society Malaysia and the Malaysia Biomaterial Society.

BIOGRAPHY OF KEYNOTE SPEAKERS



Dr. Augie Widyotriatmo

Associate Professor, Faculty of Industrial
Technology, Institut Teknologi Bandung, Indonesia

Augie Widyotriatmo is an Associate Professor of Autonomous Systems and Robotics in the Instrumentation, Control, and Automation Reserach Group at Insititut Teknologi Bandung (ITB), Indonesia. He received his bachelor degree in engineering physics and master degree in instrumentation and control from the ITB. He obtained a Ph.D. degree in mechanical engineering from Pusan National University, South Korea. He leads the Autonomous Systems Laboratory from 2013 until now in the Faculty of Industrial Technology ITB. He was the past Chair of the IEEE Indonesia Section Control Systems and Robotics and Automation Joint Chapter Societies (CSS/RAS). He serves as Associate Editor in the International Journal of Control, Automation, and Systems (IJCAS). He received an outstanding paper award in the 18th International Conference on Control, Automation and Systems (ICCAS 2018), best paper awards in the 4th International Conference on Industrial Internet of Things 2018 (ICIOT 2018) and in the 3rd International Conference on Robotics, Biomimetics, & Intelligent Computational Systems 2018 (ROBIONETICS 2018). He was awarded Appreciation of Innovation in 2016 and 2019 from ITB. He is a Senior Member of the IEEE. Dr. Widyotriatmo is a researcher specializing in autonomous systems, nonlinear control, and robotics. His work advances both theoretical foundations and real-world applications of autonomous technologies, contributing to cutting-edge control strategies and intelligent automation. He has successfully implemented autonomous systems in various industrial domains, including autonomous trucks for port operations, autonomous ships, and drones. His research bridges theory and practice, driving innovation in automation and robotics.

BIOGRAPHY OF KEYNOTE SPEAKERS



Dr. Vineeta Khemchandani

Dean, School of Computer Applications and
Technology, Galgotias University, Uttar Pradesh, India

Dr. Vineeta Khemchandani is the Dean (School of Computer applications and Technology) at Galgotias University, Uttar Pradesh, India. She has over 60 research papers in various international journals and peer-reviewed conferences. She has received the 50 Best Education Leaders award from the World Education Congress Most Active Participation (Woman) award from the Computer Society of India. She has been the Guest Editor of several special issues in different Scopus and Emerging Sources Citation Index (Clarivate Analytics) indexed conferences and journals. She has authored and reviewed several books on Operating Systems, Data structures and Algorithms, and UNIX programming. She is the Editor of PLOS Journals, Journal of King Saud University, Science Publishing Group USA, American Association of Science and Technology, and Journal of Electronic Government, an International Journal, INDERSCIENCE Publishers Dr. Vineeta is one of the developers of various research-based solutions in Cognitive Science including Cognitive profiling for recruitments, Drone surveillance, Marine simulator and mental health detectors applications. She has received research grants from various national funding agencies in India.

BIOGRAPHY OF KEYNOTE SPEAKERS



Dr. Sudeshna Chakraborty

Professor & Research Group Head – Data Analytics, Web & Mobile Development, School of Computing Science & Engineering, Galgotias University, Noida, India

Dr. Sudeshna Chakraborty is a distinguished academic and industry professional with over 20 years of experience spanning teaching, research, and industry collaboration. She currently serves as Professor and Research Group Head in the domains of Data Analytics, Web Development, and Mobile Development at the School of Computing Science & Engineering, Galgotias University. She holds a Ph.D. in Computer Science & Engineering, specializing in Neural Networks and Semantic Web Engineering. Over the course of her career, Dr. Chakraborty has earned numerous accolades, including the Distinguished Professor Award, Research Excellence Award from Sharda University, Nikhil Bhartiya Shiksha Parishad, and Institute of Scholars. She has been recognized as a keynote speaker, session chair, and organizing committee member for multiple national and international conferences, including the IEEE ICACCE 2018 (Paris) and the Springer ICS2A (Tunisia). She has also served as Track Chair for Smart Technologies and Artificial Intelligence at SEA-HF in Spain. Dr. Chakraborty has filed 20 patents (with 5 granted) in areas such as robotics, solar energy, and sensors, alongside several copyrights. She has an impressive research portfolio with 150+ publications in Scopus/SCI-indexed journals and high-impact international conferences. She currently supervises five Ph.D. scholars (two of whom have successfully completed their doctorates) and has guided numerous postgraduate and undergraduate research projects. Her expertise extends to industrial-academic collaborations through previous roles at Manav Rachna University, Mumbai University, Lingaya's University, ICFAI, and others. She has been actively involved in prestigious accreditation processes including NAAC, NBA, QAA, WASC, UGC, IAU, and IET. Dr. Chakraborty's career reflects a rare blend of academic leadership, research innovation, and industry engagement, making her a sought-after expert in her fields of specialization.

BIOGRAPHY OF INVITED KEYNOTE SPEAKERS



Dr. Aghila Rajagopal

Professor, Kamaraj College of Engineering and
Technology, India

Dr. Aghila Rajagopal is a Professor and Head of the Department of Artificial Intelligence and Data Science at Kamaraj College of Engineering and Technology. With over 20 years of teaching experience, she earned her Ph.D. from Anna University, Chennai, in 2015. Her research interests include Distributed Computing, the Internet of Things (IoT), Image Processing, Machine Learning, and Deep Learning. She has published numerous papers in reputed national and international journals and serves as a reviewer for several of them. Dr. Aghila is also an active member of professional organizations such as CSI, IAENG, IEDRC, IACSIT, and IFERP.

BIOGRAPHY OF SESSION SPEAKERS



Dr. G. L. Pahuja

Professor, Department of Electrical Engineering
National Institute of Technology Kurukshetra,
Jaipur, India

Prof G L Pahuja BTech, M Tech, holds a PhD in EE in Reliability Engineering from REC Kurukshetra (affiliated with Kurukshetra University), 42 years teaching experience at B Tech and MTech level, Guided approx. 50 MTech dissertations, 10 PhDs and guiding 3 PhD students. Approx. 125 publications in Journals and Conferences. Session Chair, Chief Guest in various conferences, Member BOS, DRC, DAC in number of institutions, Held various administrative positions in the institute, Member Accreditation committees are a few important Duties.

BIOGRAPHY OF SESSION SPEAKERS



Dr. Javed Alam

Associate Professor, Department of Computer Applications, University Institute of Computing
Chandigarh University, India

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.

BIOGRAPHY OF SESSION SPEAKERS



Dr. Tarun Kumar Das

Associate Professor, Department of Electronics and Communication Engineering, Future Institute of Engineering and Management, Kolkata, India

Dr. Tarun Kumar Das, Ph.D. is an Associate Professor of Dept. of Electronics and Communication Engineering at Future Institute of Engineering and Management, Kolkata, India, with deep expertise in RF and microwave passive devices like directional couplers, antennas, filters, filterennas, wireless and mobile communication, signal processing, control systems, artificial neural networks, and fuzzy logic. He earned his Ph.D. in Microwave engineering with specialization in harmonics suppression for microwave filters from the Jadavpur University, Kolkata, India in 2023. Since 2005, Prof. Das has been a core faculty member at Future Institute of Engineering and Management, focusing on Electronics and Communication Engineering in the digital era and qualitative research methods. He is a fellow of IETE, life member of URSI, INRASS, ISCA, ASR, CSI, ISTE, WAMSS, IAENG, ACM, IEICE, IAEEE. He is a potential reviewer of more than 10 national and international journals indexed in SCI and Scopus and 12 international conferences. He has published 30 research articles and conference papers in his 15 years of research journey. He has received the best paper award in 2017 in the international IEEE conference DEVIC'17 and Edu Conclave Award in 2023 by ASET Journal of Management Science, Chennai for his excellence in research and academic activities. He has guided 6 PG students and more than 100 UG students in different project works.

BIOGRAPHY OF SESSION SPEAKERS



Dr. Santhosh Paramasivam

Senior Member, IEEE, Assistant Professor, Department of Electrical & Electronic Engineering, University of Cagliari, Italy

Santhosh Paramasivam is a visionary Academic Researcher & Faculty Member with 15 years of experience dedicated to green & sustainable solutions. Currently, he is a Faculty Member & Researcher in the Industrial & Information Engineering division of Dept. of Electrical & Electronic Engineering, University of Cagliari (UniCA), Italy, working on the RETURN Project (multi-Risk sciEnce for resilienT commUnities under a changiNg climate) funded by PNRR, Italian Ministry of University & Research. His current research focuses on AI-based analysis of Energy Storage Devices, WSN for environmental monitoring & Sustainable Energy Harvesting. His research outcomes at UniCA are extensively appreciated & documented through 10 peer-reviewed publications (Conferences / Journals) establishing collaboration across the globe and received 3 grants/funding since Oct 2023. He is an active reviewer for IEEE & Elsevier Journals and a renowned Resource person for International Conferences and FDPs. He is also involved in 5 other Projects and won an Italian (MIMIT) Project (LIA2S) along with his Scientific Responsible Officer Prof. Gianluca Gatto, Professor @ DIEE, UniCA. His sustained contributions have earned him the distinction of IEEE Senior Member in 2025. His journey towards green & sustainable solutions began with his UG thesis, "Renewable Energy Locomotive," which was a proposal for powering EV based on thermionic generation. This innovative work earned him the Best Paper Award in 2009 @ Ministry of New and Renewable Energy, Government of India sponsored conference on Trends & Developments in Renewable Energy Sources. He pursued his Graduate thesis on "Performance Study of Induction Motor using dsPIC" analyzing controllers & converters for AC induction

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motors, advancing this research towards converter topologies for BLDC motors, culminating in his PhD thesis "Certain Investigations on Brushless DC Motor with DC-DC Converter Topologies." His multifaceted career extends beyond research into industry, where he served as a Sr. Manager @ ElectroSolve India Pvt. Ltd., specializing in developing realtime test solutions for the automotive & EMS industries. He holds multiple Industrial certifications from B&R Automation, National Instruments & Infosys. He has published 4 patents spanning innovations such as an IoT-based monitoring system using LoRa & LoRaWAN, a smart vehicle automation & tracking system utilizing WSNs, an AI-driven no- ball detection system for cricket, & an IoT-based UV air sterilizer.

BIOGRAPHY OF SESSION SPEAKERS



Dr. Faridul Alam

Professor, Ex Vice-Chancellor Bangladesh University of Health Sciences Present; consultant Zakia Memorial Hospital, Dhaka, Bangladesh

Prof. Dr. Faridul Alam, born in 1955 in Faridpur District, Bangladesh, is a renowned physician, researcher, and academic leader in the fields of nuclear medicine, radiology, and imaging. He is the former Vice-Chancellor of Bangladesh University of Health Sciences (BUHS) and has also served as Head & Professor of the Department of Radiology and Imaging Technology at BUHS, as well as Director & Professor at both the Bangladesh Institute of Health Sciences and the National Institute of Nuclear Medicine and Allied Sciences (NINMAS), BSMMU, where he worked for over two decades. His qualifications include an MBBS from the University of Dhaka, DTM&H from the University of Liverpool, a Fellowship from Johns Hopkins University, DMUD from the University of Science & Technology, Chittagong, and a Ph.D. from the University of Dhaka. Over his 32-year career, Prof. Alam has played a key role in advancing medical research and public health initiatives in Bangladesh and beyond. He was a project partner in Euthyroid2, an international effort to eliminate iodine deficiency disorders, and served as Project Director for the Government's landmark Newborn Screening for Congenital Hypothyroidism program, enabling Bangladesh to join the global community in newborn screening. His Ph.D. research focused on thyroid function assessment using nuclear technology, and he has supervised numerous M.Phil. and Ph.D. candidates. He has also been actively involved in national and international committees, policy development, and scientific events under BSMMU, BAEC, and the Ministry of Science and Technology. A founder member of the Nuclear Medicine, Thyroid,

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and Ultrasound Society of Bangladesh, Prof. Alam has served in key leadership roles, including Secretary General of the Bangladesh Thyroid Society and Editorial leadership for the Bangladesh Journal of Nuclear Medicine. Recognized for his contributions to medical services, he has been awarded the Sher-e- Bangla Gold Medal and the Humanity Award 2021. With 108 publications in national and international journals, his work continues to inspire advancements in medical science and public health.

BIOGRAPHY OF SESSION SPEAKERS



Dr. Swami Naidu Gurugubelli

Professor, Department of Metallurgical
Engineering, Jawaharlal Nehru Technological
University, India

Prof. Swami Naidu Gurugubelli, M.Tech (IITM), Ph.D., is a distinguished academician and researcher in Metallurgical Engineering with over 24 years of teaching, research, and administrative experience. He is currently Professor of Metallurgical Engineering and Director of R&D, having earlier served as Principal of JNTUK College of Engineering, Vizianagaram, and the founding Registrar of JNTU Gurajada, Vizianagaram. His research expertise spans advanced materials, nanocomposites, high entropy alloys, and aerospace materials, with significant funded projects worth nearly ₹1 crore completed or ongoing. He has successfully guided 9 Ph.D. scholars, 29 M Tech projects, published 67 research papers, and holds a granted patent. Several more doctoral researchers are currently pursuing their work under his mentorship. Prof. Swami Naidu Gurugubelli has been honored with several prestigious recognitions, including the State Best Teacher Award (2016) by the Government of Andhra Pradesh, Andhra Pradesh Scientist Award (2020), Top 30 Iconic Principal Award (2021), University Best Teacher Award (2013), and multiple national-level teaching and research excellence awards. He has chaired sessions at reputed international conferences such as ICAMMM (Malaysia, 2012) and IEEE ICEEOT (India, 2016). In academic leadership, he has served as Registrar, Principal, Vice-Principal, Head of Department, Chairman of Board of Studies (JNTUK), and member of BoS at Andhra University and Yogi Vemana University. He has also contributed as a TEQIP Data Auditor (World Bank Project), NAAC Evaluation Team member, and AICTE Expert Committee member. His contributions extend to professional societies, serving as Vice-Chairman of the Indian Institute of Metals (Visakhapatnam Chapter), editorial board member of multiple international journals, and reviewer for

BIOGRAPHY

reputed publications. He is a Fellow of IEI and an active member of ISTE, IIM, ISSS, ASM, MRSI, and ISTD. Prof. Swami Naidu Gurugubelli has authored two books and three book chapters, organized 15 workshops and two international conferences, and participated in 17 advanced training programs. His career reflects excellence in research, teaching, innovation, and academic leadership, making him a highly respected figure in metallurgical and materials engineering.

BIOGRAPHY OF SESSION SPEAKERS



Dr. D. Karthika Renuka, M.E., Ph.D.

Associate Dean – Students Welfare, Professor –
Department of Information Technology, PSG College
of Technology, Coimbatore, India

Dr. D. Karthika Renuka is a Professor in the Department of Information Technology and Associate Dean (Students Welfare) at PSG College of Technology, Coimbatore, India. With over 20 years of teaching and research experience, she specializes in Soft Computing, Data Mining, Machine Learning, Deep Learning, IoT, and Evolutionary Computing. She is a recipient of the prestigious Indo-U.S. Fellowship for Women in STEMM, has authored multiple books with renowned publishers including Wiley, CRC Press, and IGI Global, and has published extensively in reputed journals and conferences. She has successfully led funded research projects from DST, UGC, and AICTE, and continues to guide Ph.D. scholars in cutting-edge areas of artificial intelligence and data science.

BIOGRAPHY OF SESSION SPEAKERS



Dr. T. Somanathan

Professor, Department of Chemistry, School of Basic Sciences, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai, India

Dr. T. Somanathan, M.Sc., Ph.D., FSASS, is a Professor of Chemistry at the School of Basic Sciences, VISTAS (Vels Institute of Science, Technology & Advanced Studies), Chennai, India. He is an accomplished researcher in nanotechnology, carbon nanotubes, graphene, heterogeneous catalysis, and mesoporous materials, with applications in biosensors, photovoltaics, and drug adsorption. Dr. Somanathan holds a Ph.D. in Chemistry from Anna University, Chennai (2009) and completed his postdoctoral research at CEA/LITEN, France (2009–2010), specializing in nanomaterials for energy applications. His academic career has progressed through key positions at VISTAS, where he has served as Assistant Professor (2011–2015), Associate Professor (2015–2022), and Professor (2023–present). A leading scientist in nanomaterials, Dr. Somanathan has successfully led major research projects, including a DST-SERB-funded project on fabricating a novel biosensing system using supergrowth vertical-aligned single-walled carbon nanotubes with a ₹20.00 lakh grant. His guidance has resulted in the successful completion of 8 Ph.D. and 27 M.Phil. theses, with multiple ongoing research projects. His prolific research output includes numerous publications in high-impact SCOPUS and Web of Science-indexed journals, patents, and international conference presentations. He has been recognized with several prestigious awards, such as the Dr. APJ Abdul Kalam Award for Scientific Excellence (2022), Sci-Edu Award for Excellence in Chemistry (2025), and multiple Faculty Excellence Awards. Dr. Somanathan is also an editorial board member and reviewer for renowned scientific journals and holds memberships in professional organizations like the Indian Carbon Society and the International Association of Engineers. His Google Scholar, Scopus, and Vidwan profiles offer deeper insights into his research and contributions to the field of chemistry.

BIOGRAPHY OF SESSION SPEAKERS



Dr. Iman Farshchi

Associate Professor, MAHSA University, Malaysia

TS. Dr. Iman Farshchi is a Civil and Geotechnical Engineer with over 20 years of academic, research, and leadership experience. He holds degrees from Universiti Teknologi Malaysia (UTM) and Politecnico di Milano (Italy). His research focuses on sustainable geotechnical solutions, including vegetation-based slope stabilization, soil improvement, and soil–foundation interaction, contributing to green engineering practices and the UN Sustainable Development Goals (SDGs). A former Dean of the Faculty of Engineering, Built Environment, and IT at MAHSA University, he is recognized for his expertise in Outcome- Based Education (OBE). As a keynote speaker and thought leader, Dr. Iman inspires future- ready engineers and champions innovation in education and sustainability.

BIOGRAPHY OF SESSION SPEAKERS



S. Nithya

Kamaraj College of Engineering and Technology,
India

Mrs. S. Nithya is an accomplished academician with over 14 years of teaching and research experience in Computer Science and Engineering. She is currently serving as an Assistant Professor at Kamaraj College of Engineering and Technology, Virudhunagar, and is pursuing her Ph.D. at Anna University, Chennai. Her expertise spans areas such as Machine Learning, Deep Learning, Artificial Intelligence, and Python Programming. Mrs. Nithya has published several research papers in reputed international journals, including IOSR-JCE and the Journal of Environmental Protection and Ecology, and has presented papers at national and international conferences. She has authored books titled "Code Craft: The Art of Python" and "Data Structures Made Easy." She holds certifications from AWS, IBM, Infosys, and NPTEL, and has been recognized as a Resource Person for training programs and workshops on AI and programming. Passionate about fostering innovation in education, she actively contributes to academic coordination, research development, and mentoring young technologists.

BIOGRAPHY OF SESSION SPEAKERS



Dr. Praveen Kumar P

Associate Professor, Kamaraj College of
Engineering and Technology, India

Dr. Praveen Kumar P is currently working as an Associate Professor at Kamaraj College of Engineering and Technology, Virudhunagar with 25 years of teaching experience. He received his Ph.D. from the National Institute of Technology, Tiruchirappalli, for research carried out at the Centre for Cloud Computing, Institute for Development and Research in Banking Technology (IDRBT), Hyderabad. His doctoral work focused on Big Data Access Control in Cloud Storage. Dr. Praveen Kumar P has authored 25 publications in reputed journals, conferences, and book chapters. He has also filed seven patents, one of which has been granted. He has been honored with the Budding Researcher Award at NIT Tiruchirappalli and recognized as a Distinguished Facilitator in the Inspire Faculty Excellence Awards organized by Infosys, Chennai. His research interests include Privacy and Security in Cloud Computing, Big Data, Cryptography, and Deep Learning.

COMMITTEE

MEMBERS

Scientific Committee

Dr. Harishchander Anandaram

Assistant Professor, Computational Engineering and Networking, Amrita Vishwa Vidyapeetham, India

Dr. Mohmmad Ahmad

Assistant Professor, Electrical Engineering, Rajkiya Engineering College, India

Dr. Anupama Girish

Assistant Professor, Computer and Information Sciences, Dayananda Sagar College of Engineering, India

Dr. Anjum Qureshi

Assistant Professor, Electronics & Communication Engineering, Rajiv Gandhi College of Engineering Research & Technology, India

Dr. Akhib Khan Bahamani

Associate Professor, Electrical & Electronics Engineering, Narayana Engineering College, India

P. Ashok

Assistant Professor, Computer Science Engineering, Sri Sairam Institute of Technology, India

Dr. R. Kiruba Buri

Teaching Fellow, Computer Science Engineering, University College of Engineering, Anna University, Pattukkottai Campus, India

Dr. Dinesh Vitthalrao Rojatkar

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Abstracts

How Cosmological Parameters Shape the Expansion and Ultimate Fate of the Universe

Geet Jaiswal

Student, Amity International School Noida, Uttar Pradesh, India

Abstract:

The accelerated expansion of the universe poses one of the most profound questions in modern cosmology: what is the ultimate fate of the cosmos? This study systematically examines the various factors influencing this expansion and explores the theoretical frameworks that attempt to predict the universe's long-term evolution. Grounded in the foundational principles of homogeneity and isotropy, and guided by general relativity, this research delves into how key cosmological parameters—such as matter density, radiation, dark energy, and the Hubble constant—affect the dynamics of cosmic expansion.

Observational breakthroughs over the past century have transformed our understanding of the universe's behavior. Edwin Hubble's 1929 discovery that galaxies are receding from us marked the beginning of modern cosmology. Decades later, observations of Type Ia supernovae revealed that the expansion is not merely continuing but accelerating—a phenomenon attributed to a mysterious force known as dark energy. The most recent contributions from missions like the Planck satellite have refined our measurements of the Hubble constant, dark energy density, and matter density, enabling more accurate modeling of the universe's expansion history and its possible futures.

This paper investigates how variations in these parameters influence the evolution of the scale factor, $a(t)$, which quantifies the universe's expansion. To complement the theoretical analysis, a numerical model using Euler's method was developed to simulate the behavior of the scale factor under different cosmological conditions. By adjusting the density parameters in the simulation, the study visualizes distinct evolutionary paths, offering insights into how the balance between dark energy and matter determines the fate of the universe.

Three primary scenarios emerge from current theoretical and observational evidence: the Big Crunch, the Big Freeze, and the Big Rip. The Big Crunch hypothesizes a reversal of expansion, leading to a catastrophic collapse. The Big Freeze suggests a slow expansion into thermal equilibrium, resulting in a cold, lifeless cosmos. The Big Rip envisions an ever-accelerating expansion that eventually tears apart galaxies, stars, planets, and even atomic structures. These outcomes are not merely abstract ideas; they are logical extensions of current models grounded in general relativity and supported by observational data.

The objective of this study is not only to explore these scenarios but also to emphasize the importance of cosmological parameters in shaping them. Through simulation and analysis, this work highlights how critical the precise measurement and interpretation of these parameters are for understanding the universe's destiny. Ultimately, this research underscores that the question of the universe's fate is intricately linked to our knowledge of dark energy, cosmic structure, and the fundamental laws of physics. As observations become more refined, we move closer to answering one of the most enduring mysteries of the cosmos.

Advanced Multi-Model Ensemble Machine Learning for Predicting Software Defects

Ashwini Sunil

M.Tech Scholar, Technocrats Institute of Technology (TIT), Bhopal, Madhya Pradesh, India

Abstract:

The paper's main focus is on using machine learning (ML) approaches to forecast software defects (SD), which is a difficult study topic due to the imbalanced nature of data sets. A set of design metrics is typically used to predict faults and determine how prone software is to them, but new research indicates that machine learning approaches are also being used to predict defects. However, some ML techniques cannot produce the needed results when dealing with unbalanced dataset and the results produced are not certainly inferred by the developers by observing these factors, we propose a unique approach for fault prediction which is based on feature selection technique which improves the overall performance by using attribute selection when predicting defects. The ML concentrates on the algorithms entirely centred on statistical methods and data mining techniques for classifying and predicting the defects and these statistical methods followed are quite similar to regression based methods which we used earlier to the ML. When more data is available, ML algorithms behave as dynamic algorithms to improve their performance significantly. The voting classifier (VC) ML technique is providing good accuracy compared to other NB and SVM technique. In this model is simulated python language and calculated simulation parameter i.e. precision, recall and accuracy.

Flood Prediction Using Machine Learning

Minal Nerkar

Computer Engineering, AISSMS Institute of Information Technology, Pune, India

Rohan Jadhav

Computer Engineering, AISSMS Institute of Information Technology, Pune, India

Sanjana Dhane

Computer Engineering, AISSMS Institute of Information Technology, Pune, India

Sanskriti Kanchan

Computer Engineering, AISSMS Institute of Information Technology, Pune, India

Kaushal Deshpande

Computer Engineering, AISSMS Institute of Information Technology, Pune, India

Abstract:

Floods are among some of the world's most devastating natural disasters and contribute to the loss of life, infrastructure, and economic stability. These events are important; therefore, their prediction is necessary to mitigate their effects. In this study, we developed a predictive model for floods based on environmental and geological data using machine-learning techniques. The model attempts to identify early warning signs of disasters by leveraging large datasets that capture historical weather patterns, topographical data, rainfall intensity, and soil moisture levels. Classification and regression analyses will be performed using machine learning algorithms, such as Random Forest, Support Vector Machine (SVM), and Neural Networks. In other words, we will verify baseline metrics of precision, recall, and test accuracy using the F1 score by using the model's prediction. The goal of this research is to improve disaster management systems and preparedness and response strategies in vulnerable regions.

Keywords:

Flood prediction, Machine learning, Predictive modeling, Disaster management, Environmental data analysis, Geological data, Random Forest Support Vector Machine (SVM), Neural Networks, Rainfall intensity, Soil moisture prediction, Early warning system Natural disaster mitigation, Data-driven prediction, Classification and regression, Topographical data analysis, Precision, Weather pattern analysis, Vulnerability assessment.

Enhancing Attendance Management: Leveraging Face Recognition Technology for Accurate and Efficient Tracking

Bandi Balakrishna

Assistant Professor, Department of Electrical and Electronics Engineering, Vardhaman College of Engineering, Hyderabad, Telangana, India

Rajitha Ala

Assistant Professor, Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Dinesh Reddy Malreddy

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Manne Hari Kiran

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Enugukonda Anantha Sai Naga Varshini

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Pratap Varsha Sree

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Abstract:

In this digital era, face recognition system plays a vital role in almost every sector. Face recognition is one of the mostly used biometrics. It can be used for security, authentication, identification, and has got many more advantages. Despite of having low accuracy when compared to iris recognition and fingerprint recognition, it is being widely used due to its contactless and non-invasive process. Furthermore, face recognition system can also be used for attendance marking in schools, colleges, offices, etc. This system aims to build a class attendance system which uses the concept of face recognition as existing manual attendance system is time consuming and cumbersome to maintain. And there may be chances of proxy attendance. Thus, the need for this system increases.

Keywords:

Non-invasive process.



Optimizing Emergency Response: The Traffic Ruler System for Efficient, Safe and Sustainable Urban Mobility

Bandi Balakrishna

Assistant Professor, Department of Electrical and Electronics Engineering, Vardhaman College of Engineering, Hyderabad, Telangana, India

Rajitha Ala

Assistant Professor, Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Dinesh Reddy Malreddy

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Kayithi Sujeeth Reddy

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Remalli Jyothirmmai

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

Katineedi Ajay

Department of Information Technology, Vardhaman College of Engineering, Hyderabad, Telangana, India

A. Mounika Yesaswini

Department of Electronics and Communication Engineering, Vardhaman College of Engineering, Hyderabad, Telangana, India

Abstract:

In urban settings, ambulances often get stuck in traffic, slowing down their urgent missions. The traffic lights don't always cooperate, and some drivers ignore the rules due to negligence, people are not following the Traffic signals except a few and this may lead to traffic jam and accidents, making things even trickier. We need a smarter system to solve these problems – one that can make traffic lights work better for ambulances and catch vehicles that don't follow the rules. So, we're on a mission to create a clever Traffic Ruler System that uses smart technology to help ambulances get through faster, catch rule-breakers, and make traffic flow smoothly for everyone. The Traffic ruler, this prioritizes emergency vehicles like ambulance in real-time, optimizes traffic flow with adaptive control and advanced technologies, and ensures public support through awareness campaigns and privacy measures. It captures and send notification to the people who don't follow traffic signals. It is scalable, adaptable, and emphasizes sustainability for safer, more efficient, and environmentally conscious urban mobility.

Keywords:

Traffic Management, Traffic Control, Traffic Flow Optimization, Violation Detection, Communication and Messaging, SMS Alerts, Sustainability.

The Progression to Extricate the Lung Cancer Using Machine Learning Methods

Dr. Heena Farheen Ansari

Assistant Professor, St Vincent Pallotti College of Engineering and Technology Nagpur, Maharashtra, India

Abstract:

A Lung cancer is among the most fatal disease in developed countries, and early diagnosis of the disease is difficult. Lung cancer diagnosis and treatment has been one of the most intimidating challenges humans have come across in recent decades. Early tumor diagnosis will continue to save a vast number of lives around the world on a daily basis. The different approaches can be used for classifying lung tumors as malignant or benign that combines a Convolutional Neural Network (CNN) with the AlexNet Network Model is transfer learning model. As compared to accuracy achieved by conventional neural network systems, the proposed CNN attains a high degree of accuracy, which is more effective. The exact lung cancer identification is a critical problem to fortitude. The practice of multi view single image and segmentation has been widely used for the last 2 years to improve the identification of lung cancer disease. The utilization of machine learning (ML) and deep learning (DL) techniques can significantly accelerate the process of cancer detection and stage classification. The advent of machine learning (ML) provides a promising paradigm to improve early diagnosis and prognosis prediction. This paper presents a novel approach leveraging advanced ML algorithms for the detection and classification of lung cancer using medical imaging, particularly Computed Tomography (CT) scans and histopathological data. A hybrid model, combining Convolutional Neural Networks (CNNs) for feature extraction from CT images.

Keywords:

Convolutional Neural Network, Machine Learning, Deep Learning, Image Processing Technique, Tumour Segmentation, Recurrent Neural Networks.



Comparative Analysis of GAN-based vs Diffusion-based Models for 2D Virtual Try-On

Dhanya Datta

Department of Computer Science Engineering, PES University, Bangalore

Sindhu R Pai

Department of Computer Science Engineering, PES University, Bangalore

Abstract:

Virtual try-on (VTON) technology is reshaping the future of fashion and e-commerce by allowing users to digitally experience how garments would look on them—eliminating the need for physical trials. At the heart of this transformation are deep generative models, particularly Generative Adversarial Networks (GANs) and diffusion models, which have pushed the boundaries of photorealistic image synthesis. This paper presents a comprehensive literature review of 2D virtual try-on systems, with a focused comparison between GAN-based and diffusion-based approaches. We explore their architectural foundations, data conditioning mechanisms, learning strategies, and performance across standard benchmarks. In addition to discussing widely adopted datasets and evaluation metrics such as FID, LPIPS, and SSIM, we analyze qualitative outcomes through visual examples and user studies. Our comparative analysis uncovers critical trade-offs—such as realism versus controllability, speed versus fidelity—and identifies current challenges in scalability and deployment. By synthesizing state-of-the-art research, this survey aims to equip researchers and developers with deep insights and a clear roadmap for advancing next-generation VTON systems.

Keywords:

Virtual Try-On (VTON), Diffusion Models, Generative Adversarial Networks (GANs), Deep Generative Models, Fashion Image Synthesis, Image-to-Image Translation, High-Fidelity Garment Transfer, Controllable Image Generation, Latent Diffusion, Neural Rendering, E-Commerce Innovation, Performance Benchmarking, Visual Realism, Digital Fashion.



Waves of Digital Diplomacy: India's Digital Rise as a Beacon of Soft Power

Bhumika Chavda

Chandigarh University, Mohali, Punjab

Dr. Rupinder Kaur

Chandigarh University, Mohali, Punjab

Abstract:

Objectives: India's Digital India project has become far greater than a mere regional development ambition in a setting when technology is progressively employed to foster global impact; it has evolved into a strategic soft power weapon. By redefining India as an advocate in digital innovation and a supplier of ethical technology, especially for the Global South, Digital India is changing the way the world views India.

Methods: With the multidisciplinary examination of political speeches, international media framing, soft power indices, and case studies of India's exports of digital public infrastructure (DPI), including Aadhaar, CoWIN, and UPI, the study explores whether digital diplomacy is successfully rebranding India's image abroad.

Findings: The results demonstrate that Digital India is transforming India's image from one of a back-office service economy to one of a provider of scalable, open-source digital solutions. The enthusiastic response from throughout the world, particularly in developing countries, indicates that India's story of inclusive, people-centered technology is doing well.

Novelty: The present piece advances the case that Digital India is an innovative form of soft power, a kind that is centred on the practical dissemination of digital tools that exemplify the ideals of justice, transparency, and technological independence rather than on cultural exports or ideological appeal. The longevity of this soft power makeover will depend on India's capacity to preserve coherence between its domestic digital governance and its international digital diplomacy as the geopolitical competition for digital leadership heats up.

Keywords:

Digital India, Soft Power, Digital Public Infrastructure, Technology, Development and Growth.

Sensitivity of Second-Moment Closure Models to Buoyancy Effects in Turbulent Natural Convection

A Sibo Anthony

National Institute of Technology, Imphal, Manipur, India
Manipur Technical University, Imphal, Manipur, India

Huirem Neeranjana Singh

National Institute of Technology, Imphal, Manipur, India

Tikendra Nath Verma

Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India

Abstract:

In this study, turbulent natural convection in a differentially heated square cavity with a Rayleigh number (Ra) of approximately 109 is modeled using second-moment closure models. The turbulent stresses are computed using the Reynolds Stress Model (RSM), while the Differential Flux Model (DFM) computes the turbulent heat fluxes. The open-source Finite Volume Method (FVM) based Computational Fluid Dynamics (CFD) code Openfoam v6 is used to conduct the numerical study. The predicted mean and turbulent components are compared with benchmark experimental data.

The results show that the model constant $C_{\epsilon 3}$ associated with the buoyant production term in the ϵ equation significantly affects the accuracy and stability of the simulations. A value of $C_{\epsilon 3}=2.02$, the default value, leads to an overestimation of dissipation, resulting in reduced turbulence levels, an overestimation of the peak mean vertical velocity (V), and a very thin boundary layer. To mitigate the excessive overestimation of the dissipation rate, $C_{\epsilon 3}$ is reduced to 1.5. The adjustment resulted in the correct prediction of the mean vertical velocity and an improvement in the prediction of the turbulence kinetic energy (k). The peak of V is critical in modelling the natural convection boundary layer, as it divides the boundary layer into the inner and outer layers. The correct prediction of this quantity produces a correct boundary layer thickness that aligns closely with experimental observations. Despite these improvements, discrepancies still exist in replicating the temperature fluctuation. The default constant predicts a temperature fluctuation that matches the experimental data, while the retuned constant results in an overestimation of its peak near the isothermal vertical walls. These findings indicate that second-moment models are sensitive to buoyancy-related constants and emphasize the need for careful calibration in buoyancy-driven flows.

Mapping the Digital Shift in Rajasthan's Healthcare System: A Quantitative Perspective

Dr. Aakanksha Kataria

Malaviya National Institute of Technology Jaipur(MNIT), Jaipur, Rajasthan, India

Dr. Ruchi Garg

BML Munjal University(BMU), Gurugram, Haryana, India

Dr. Jyoti Motwani

Manipal University, Jaipur, Rajasthan, India

Deepakshi Sharma

Malaviya National Institute of Technology Jaipur(MNIT), Jaipur, Rajasthan, India

Abstract:

In today's dynamic world, systems and processes are fast-evolving, and technology emerges as the chief catalyst in the entire process. Education, an integral sector in a nation's growth and empowerment, one of the 17 SDGs proposed by the UN, is equally subsumed under the transformative potential of the digital adoption process. This paper identifies the major variables and their interaction affecting the patient-provider relationship. Based on the literature, we formulated a mediation-moderation framework showcasing the impact of digital adoption on the patient-provider relationship via hospital service quality and patient experience, moderated by digital literacy and privacy concern, respectively. Survey was conducted across 150 respondents from public health centers and hospitals. Structural model testing was applied to test the hypothesis. The tested model validated the influence of digital adoption on service quality, showcasing how meaningful integration of digital tools into hospital operations enhances service delivery, moderated by patient digital literacy, which in turn snowballs into positive relational outcomes via enhanced patient experience, given that patient privacy is taken care of. This study has implications for both industry stakeholders and academicians.

Keywords:

Digital adoption, digital competence, digital literacy, structural model testing.

Precision Farming: A Review on Feature Extraction Techniques for Tomato Plant Disease Detection

Aparna Joshi

Department of Computer Engineering, Pimpri Chinchwad College of Engineering, Akurdi, Pune, Maharashtra, India

Moreswar A. Mahale

Department of Computer Science & Engineering, Pimpri Chinchwad University, Pune, Maharashtra, India

Anil B. Pawar

Department of Computer Science & Engineering, Pimpri Chinchwad University, Pune, Maharashtra, India

Abstract:

Tomato leaf diseases pose a serious threat to international food security and farm revenues, necessitating early and precise detection techniques. The development of vision-focused AI systems has made feature extraction a key element in the atomization of disease diagnosis. This paper gives a brief overview of the latest trends in feature extraction methods for detecting tomato leaf diseases through image processing and deep learning approaches. The spotlight is put on convolutional neural net-works (CNNs), hybrid models, attention mechanisms, and novel preprocessing techniques that boost visual feature extraction of intricate agricultural data sets. Seventeen recent research studies are compared and examined on the basis of their feature extraction techniques, goals, and results. A comparative table summarizes their contributions to precision, robust-ness, and scalability. This paper emphasizes the development of feature description from classical descriptors to deep semantic representations and identifies re-search gaps for future work. The presented knowledge is meant to facilitate effective, scalable, and precise agriculture solutions.

Keywords:

Precision Agriculture, Tomato Leaf Disease, Feature Extraction, Deep Learning, Image Processing and Convolutional Neural Networks (CNNs).

Ai-Powered E-Book Creator

Kanika Sen

University of Engineering and Management, Kolkata, India

Bishal Kundu

University of Engineering and Management, Kolkata, India

Ruman Tarafdar

University of Engineering and Management, Kolkata, India

Oindrila Mandal

University of Engineering and Management, Kolkata, India

Somnath Sarkar

University of Engineering and Management, Kolkata, India

Debdatta Chatterjee

University of Engineering and Management, Kolkata, India

Abstract:

The advancement usage of eBooks in modern time has limited towards physical book usage. This increases the need of generating eBooks from vast set of databases. In the article a model has been proposed to generate eBooks from any given topic or chapter outline. With the help of state-of-the-art AI technology, the AI eBook Generator automates the laborious and traditionally manual process of creating eBooks. Users can submit themes and chapter outlines to the system, which uses Cohere's AI API to create structured, logical text. It then uses user-selected design templates to create a finished, high-quality eBook in PDF format. With proposed model, human labor and time are greatly reduced but output quality and customization are preserved.

Keywords:

Ebooks, Cohere's AI API, design templates.

Analysis on the Frequency Response of Circular Membrane and Square Membrane Micromachined Ultrasonic Transducer

H. Lalnunfeli

Ph.D., Department of Physics, Mizoram University (A Central University, Govt. of India), Aizawl, India

Reshmi Maity

Professor, Department of Electronics & Communication Engineering, Mizoram University (A Central University, Govt. of India), Aizawl, India

Ramesh Chandra Tiwari

Senior Professor, Department of Physics, Mizoram University (A Central University, Govt. of India), Aizawl, India

Niladri Pratap Maity

Professor and Head of the Department, Electronics & Communication Engineering, Mizoram University (A Central University, Govt. of India), Aizawl, India

Professor in National Institute of Technical Teachers Training and Research, A Deemed to be University Under Ministry of Education, Govt. of India, Kolkata, India

Abstract:

The CMUT's performance is significantly influenced by its shape. The key objective of the investigation is to examine how different parameters of CMUT affects the resonant frequencies of two different shapes of CMUT. Our study investigates the differences between circular and square-shaped membranes, highlighting several key trends. The results demonstrate that thicker membranes and larger membrane radii lead to higher resonance frequencies. Additionally, a larger cavity radius results in lower resonant frequencies. The analysis also examines the effects of venting the membrane at the edge and center. Notably, the findings indicate that edge venting results in a decrease in the device's resonance frequency when compared to a membrane without venting. Thus, these observations offer valuable insights for the design of CMUTs, highlighting the significance of venting configuration in determining the device's performance characteristics. The results of our study show that the circular-shaped membrane is more effective in achieving the desired CMUT frequency response, outperforming the square-shaped membrane in medical imaging system. It is demonstrated that circular membranes yield lower resonance frequencies for equivalent Young's modulus values. Moreover, the resonant frequency increases in tandem with the Young's modulus, emphasizing the significant influence of membrane material properties on CMUT behaviour and performance.

E-Waste Management System (Software)

Shital Soble

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Swaym Hadawale

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Shraddha Handi

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Gayatri Gursale

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Swarali Gurav

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Nishu Gupta

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Riya Gupta

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Abstract:

Increasing numbers of electronic devices have resulted in a corresponding increase in electronic waste (e-waste), with significant environmental and economic issues associated with this phenomenon. This paper describes a web-based E-Waste Management System equipped with modern facilities for improving public engagement in sustainable disposal operations. The site features an AI-driven chatbot that can evaluate device conditions to ascertain whether that chunk of tech is in a state worth tinkering with — and offer a quote for repair if it is (or information about how much e-waste value the thing still contains, if not). With simple methods that users can put in practice to self-evaluate if their gadgets are needed a repair, a recycling or just get straight rated as no longer useful. The system also features a real-

time map-based listing tool for showing certified e-waste collectors near users with unwanted devices, and significantly the mobile app is available on both Android and iOS platform

Keywords:

E-Waste Management, Chatbot, Repair Estimation, Recycling, Smart Disposal, Geolocation, Environmental Sustainability, Electronic Waste, Waste Collection, Web Application.

Automated Detection of Student Behavior Using Machine Learning: A Comprehensive Analysis

Shruthi HK

Department of Computer Science, CHRIST University, Bangalore, India

Jayapriya J

Department of Computer Science, CHRIST University, Bangalore, India

Vinay M

Department of Computer Science, CHRIST University, Bangalore, India

Raju Ramakrishna Gondkar

Department of Computer Science, CHRIST University, Bangalore, India

Abstract:

Detecting student behavior is essential for improving learning experiences, academic performance, and engagement in today's educational landscape. Traditional observation-based methods often face limitations in scalability and objectivity, especially in online learning environments. This survey offers a thorough analysis of machine learning techniques used for the automated detection of student behavior. It examines various datasets and methodologies, including machine learning models, deep learning models, and multimodal fusion approaches. The experimental findings from the reviewed literature demonstrate that deep learning and multimodal fusion methods significantly enhance behavior classification accuracy and enable real-time monitoring systems. In conclusion, this survey identifies a range of applications, challenges, and critical research gaps. It also proposes future research directions aimed at developing more adaptive, accurate, and scalable systems for automated student behavior detection in digital educational settings.

Keywords:

Student behavior detection, academic performance and engagement, online learning, machine learning techniques.

A College Utility App for Lost & Found items and Library Management

Shital Sobale

Department of Engineering, Science and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Neel Hiran

Department of Engineering, Science and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Hiba Soudagar

Department of Engineering, Science and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Apurva Hindukaje

Department of Engineering, Science and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Himanshu Chindhalore

Department of Engineering, Science and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Hc Laldutsanga

Department of Engineering, Science and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Ketan Hate

Department of Engineering, Science and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Abstract:

This research paper introduces the creation of a multifunctional mobile app that will help students recover lost items and receive updates about events on campus. The main function of the app is an item recovery system in which users can post information and photographs of lost items, allowing other users to recognize and assist in the return of the items. This fosters a supportive and working campus culture. In addition to this, the app comes with an event promotion feature through which students can list and browse college events, enhancing communication and involvement among the student community. Moreover, a streamlined library component is available, which depicts live availability of books enabling

students to determine if a book is available without having to contend with complex systems or fee calculations. The application is developed in Kotlin with Jetpack Compose as the user interface, Django as the backend server, and Sqlite3 for the storage of structured data. Integrating all these technologies, the application is able to provide a seamless and smooth experience on all three modules. The aim of this project is to better the quality of student life through a single, convenient platform for tackling everyday issues like losing things, missing events, or wondering whether a book is in the library. The application is unique in being pragmatically designed, ease of use, and the well-considered integration of functional features into one cohesive system.

Keywords:

Item Recovery,, Event Promotion, Book Availability, Kotlin and Django Integration, Student Utility App.

Effect of Training and Supplement on Physical, Physiological, Biochemical Variables and Nutritional Status of Adolescent Female Football Players

Pritee Singha

Research Fellow, Department of Nutrition and Dietetics, Faculty of Allied Health Sciences, Manav Rachana International Institute of Research and Studies, Faridabad, India

Gurjeet Kaur Chawla

Professor, Department of Nutrition and Dietetics, Faculty of Allied Health Sciences, Manav Rachana International Institute of Research and Studies, Faridabad, India

Indranil Manna

Associate Professor, Department of Physiology, Midnapore College (Autonomous), Midnapore, West Bengal, India

Abstract:

Introduction: Football relies heavily on physical fitness and body composition. Hemoglobin and myoglobin require iron to operate correctly. When someone works hard or engages in sports, their iron demand increases.

Aim: This study investigates the effect of training and supplementation on the physical, physiological, biochemical variables and nutritional status of female football players.

Method: The study was conducted over 12 weeks with sixty adolescent female football players participated aged 16–18 years, divided into two groups: placebo group (PG; n=30) and supplemented group (SG; n=30) and were divided into two duration i.e. 0 week and 12 weeks. The volunteers of SG and PG followed a training schedule (2 hrs/d, 5d/wk, for 12 wks) and the SG followed proper iron rich balance diet and iron folic acid supplementation (60 mg elemental iron and 500µg folic acid) ; where PG followed only modified diet and oral maltodextrin supplementation (carbohydrate: 1.42 gm). through orally was under supervision of physicians. Assessment of nutritional status, selected physical fitness, physiological and biochemical variables were performed at the beginning of the study (0 week) and at the end of the study (12 weeks). Paired sample t-test was performed to find out the differences in selected variables.

Result: After 12 weeks of training, female football players in SG experienced a significant ($P<0.05$) increase in grip strength, back strength, highest power output, anaerobic power. After 12 weeks of supplementation

and adequate dietary consumption, significant increases ($P < 0.05$) in haemoglobin levels (Hb), haematocrit (Hct), serum ferritin (SF), dietary iron, folic acid, vitamin B12 and maximal aerobic capacity (VO_{2max}) were noted in female football players; ; whereas PG showed improvements in grip strength, back strength and VO_{2max} after 12 weeks. In SG dietary iron, folic acid, and vitamin B12 showed positive ($p < 0.05$) association with Hb, Hct, SF; in contrast Hb showed positive ($p < 0.05$) association with VO_{2max} .

Conclusion: Regular sports training may enhance anthropometric and physical fitness measurements. Improvement in iron status and good dietary habits may improve female football players' performance.

Keywords:

Supplementation, VO_{2max} , Physical Fitness, Adolescent Female Footballers.

AI-Based Waste Segregator

Shital Sobale

Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Zaid Hussain

Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Rachit Ingle

Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Arpit Ingle

Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Mansi Jadhao

Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Aditi Ingavale

Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Abstract:

Waste segregation is a crucial step toward sustainable waste management, yet conventional methods often fall short in terms of efficiency and reliability. This project introduces an AI-based waste segregator designed to automate the classification and sorting of waste materials using computer vision. A camera module, mounted above a conveyor belt, captures images of waste items as they are manually placed on the belt. The system processes these images in real-time to identify the type of material—paper, plastic, glass, or metal. Based on the classification, motorized arms are triggered to sort each item into the appropriate bin. The proposed system minimizes human involvement, enhances sorting accuracy, and offers a scalable solution for modern waste management challenges. By integrating artificial intelligence with physical automation, this project aims to contribute to cleaner environments and more efficient recycling processes.

Keywords:

Artificial Intelligence, Waste Segregation, Computer Vision, Image Classification, Smart Waste Management, Conveyor Belt System, Sustainable Recycling.

Green Hydrogen Production from Industrial Wastewater Using Thermoelectric Generator-Powered Electrolysis

Nishanth A

CPCT CAE-4, Renault Nissan Technology & Business Centre India, Chennai, India

Abstract:

This paper presents a novel approach to green hydrogen production by utilizing industrial wastewater as the electrolyte and powering the electrolysis process using electricity generated from thermoelectric generators (TEGs). These TEGs harness waste heat from industrial processes an otherwise untapped resource to generate electricity. This electricity is then used to electrolyze the wastewater, offering dual benefits: energy recovery and wastewater reuse. The proposed method provides a sustainable and circular alternative to conventional hydrogen production, significantly reducing the carbon footprint of industrial operations. This study reviews current research trends, evaluates technical feasibility, and outlines a conceptual framework for implementation.

Keywords:

Electrolysis, Energy recovery, Green hydrogen, Industrial wastewater, Thermoelectric generator, Sustainable energy.

Enhancing GAN Stability and Diversity through Adaptive Regularization

Surendra Gour

Department of Computer Science & Engineering, Jamia Hamdard New Delhi, India

Md. Tabrez Nafis

Department of Computer Science & Engineering, Jamia Hamdard New Delhi, India

Suraiya Parveen

Department of Computer Science & Engineering, Jamia Hamdard New Delhi, India

Abstract:

Generative Adversarial Networks (GANs) have shown remarkable capabilities in generating high-fidelity data. However, their training is often unstable, and the generated data lacks diversity. This paper introduces a novel adaptive regularization technique designed to enhance the stability of GAN training and improve the diversity of generated outputs. Our approach dynamically adjusts the weights of gradient and diversity regularization terms based on feedback during training. Through empirical evaluations on benchmark datasets, we demonstrate the effectiveness of our approach, achieving superior performance in both quantitative and qualitative metrics. Our method is benchmarked against state-of-the-art techniques, showing consistent improvements in training dynamics and output quality.

Keywords:

Generative Adversarial Networks, Adaptive Regularization, Mode Collapse, Training Stability, Deep Learning.

Detecting Anomalies in Time Series Data in the Absence of Ground Truth

A S Shivam

Student, CINTEL, SRMIST KTR, Chennai, India

Ankith B Kumar

Student, CINTEL, SRMIST KTR, Chennai, India

Amutha A L

Assistant Professor, CINTEL, SRMIST KTR, Chennai, India

Abstract:

Accurate and timely detection of anomalies in energy consumption is essential for ensuring the reliability and efficiency of power systems. This paper presents a novel anomaly detection framework tailored for time-series energy data, which leverages dynamically weighted cyclical predictions across weekly, monthly, and yearly intervals. By incorporating a historical error-adjustment mechanism into the prediction process, the model adapts to shifting patterns and emphasizes more reliable data sources. Furthermore, it employs dynamically scaled confidence intervals based on rolling standard deviation and recent error trends to improve sensitivity and robustness. Evaluated on the PJME hourly energy dataset with injected synthetic anomalies the proposed approach effectively identifies both subtle and significant anomalies while minimizing false positives. The results highlight the method's applicability in real-world energy monitoring systems, offering a scalable and interpretable solution for anomaly detection in cyclic time-series data.

Keywords:

Anomaly Detection, Time Series Analysis, Unsupervised Learning, Cyclical Forecasting, Bound-Based Method, Energy Consumption Monitoring, Confidence Intervals, Synthetic Anomalies, Real-Time Detection, Adaptive Thresholding.

Numerical Analysis and Optimization of Seven Stage Axial Flow Compressor

Mansha Kumari B. Patel

Research Scholar, Department of Aeronautical Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Alizehra Haider Raza

Head of Department, Assistant Professor, Department of Career Development Cell, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Devendra Singh Lodh

3UG Student Department of Aeronautical Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Rishav Thakur

3UG Student Department of Aeronautical Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Shiv Narayan Chaudhary

3UG Student Department of Aeronautical Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Rushi Bhavsar

3UG Student Department of Aeronautical Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Abstract:

An axial compressor is a type of compressor used widely in gas turbines, jet engines, and other industrial applications to increase the pressure of a gas. The main aim of this research paper is to obtain the inlet and outlet pressure of the designed compressor stage and calculate the pressure ratio. This compressor stage is added to Armstrong Sudeley Vyper engine's compressor in order to increase the overall pressure ratio of compressor of engine for better performance. The design is designed in two parts: compressor components design and assembly design. SolidWorks software is used for designing the compressor and Computational fluid dynamics (CFD) software is utilized to simulate flow. The design of axial compressors requires careful consideration of factors like blade geometry, rotor stator interaction, and the impact of variable operating conditions. The shaft diameter of the designed compressor is 0.20m. The length of the

shaft for stage is 0.113m and hub diameter is 0.24m. The blade angle deflection of the rotor and stator is 25 and 37.4. the blade height for both blade is 0.112m. The obtained outlet pressure and inlet pressure from simulation are 0.3 bar and 0.22 bar. The pressure ratio of designed compressor is 1.36. also, 31.62 % of pressure rise is obtained after adding the designed compressor to the engine's compressor. The findings from this project contribute to a deeper understanding of axial compressor functionality, offering potential improvements in future compressor design and performance optimization.

Keywords:

Pressure Ratio, Axial Compressor, Solid Works, CFD.

Global Overview of EV Battery Safety Regulation and Theoretical Proposal on a Unified Battery Design

Pragalpha Joshua Raj Mohan

Technical Regulation, Renault Nissan – RNTBCI, Chennai, India

Vijay Dinakaran

Technical Regulation, Renault Nissan – RNTBCI, Chennai, India

Abstract:

Globally, rapid adoption of electric vehicles (EVs) for combating Climate Change and other pertaining reasons underscores the need for robust and harmonized safety standards across the global, particularly concerning traction batteries (Typically called REESS by Regulation). This Paper focus on two points, number one is Global EV Thermal Incidents and root cause analysis. Secondly, paper provides a comparative analysis of key international EV safety and battery regulations, including GTR No. 20, UN Regulation No. 100.5, AIS 038 Revision 3 and AIS 136 (India), GB/T and GB standards (China), Korean safety regulations KMVSS, and FMVSS (USA). Through a detailed study of technical requirements of India M Category (Passenger Carrier) and L Category (2W, 3W, Quadricycle) including technical requirements like thermal runaway, mechanical shock, electrical safety, and post-crash requirements, we propose Unified battery design recommendation aimed at a Modular Approach for a Battery Pack which can cater towards all 4 Segment of Vehicles. With Growing EVs across the globe operating at different ambient conditions, handled by diversified users and REESS being a component which share upwards of 40% of Vehicle cost, EV Safety and diversity management is a key concern to be addressed even it comes with a cost.

Keywords:

GTR, AIS, UN R, REESS.

Refactoring the Right Way: Empirical Insights into Sequencing for Critical Classes Using Quality Metrics

Ritika Maini

Sri Guru Granth Sahib World University, Fatehgarh Shib, India

Navdeep kaur

Sri Guru Granth Sahib World University, Fatehgarh Shib, India

Amandeep kaur

NIT, Kurukshetra, Haryana, India

Abstract:

Software quality lowers long-term development costs and is essential for robustness and maintainability. Refactoring enhances internal quality without changing how things behave on the outside. Using five open-source datasets, this study assesses how refactoring affects internal (coupling, coherence) and exterior (understandability, reusability) properties. Prioritization approaches are used to identify critical classes, and a novel Quality Attribute Score (QAS) approach is suggested to find the best order for refactoring. One dataset demonstrated a 54% boost in software quality, confirming that refactoring in the right order improves software quality. The results help researchers and maintenance teams choose efficient refactoring techniques.

Reinforcement Learning-Based Decision-Making for Autonomous Vehicle Navigation in Dynamic Environments

Er. Ujjal Chanda

GL Bajaj Group of Institute, Mathura, Uttar Pradesh, India

Er. Ashutosh Awasthi

GL Bajaj Group of Institute, Mathura, Uttar Pradesh, India

Abstract:

Autonomous vehicle navigation in dynamic environments requires continuous adaptation to uncertain road conditions, unpredictable traffic patterns, and moving obstacles. Traditional rule-based and optimization-driven approaches often lack the flexibility to handle such variations in real time. This paper presents a reinforcement learning (RL)-based decision-making framework designed to enable autonomous vehicles to learn optimal navigation policies through direct interaction with the environment. The navigation problem is modeled as a Markov Decision Process (MDP), where the state space incorporates multi-modal sensory inputs including LiDAR, camera imagery, and vehicle telemetry. Advanced deep RL algorithms, specifically Deep Q-Networks (DQN) for discrete decision-making and Proximal Policy Optimization (PPO) for continuous control, are employed to balance safety, efficiency, and policy stability. A composite reward function integrates collision avoidance, adherence to traffic rules, trajectory smoothness, and travel time minimization. The framework is implemented and evaluated within the CARLA simulation platform under varying traffic densities, environmental conditions, and unforeseen obstacles. Experimental results indicate that the proposed RL-based approach significantly outperforms conventional planning methods in terms of adaptability, safety, and travel efficiency, demonstrating its potential for real-world autonomous driving applications.

Keywords:

Autonomous Vehicles, Reinforcement Learning, Deep Q-Network (DQN), Proximal Policy Optimization (PPO), Decision-Making, Dynamic Environments, Markov Decision Process (MDP), CARLA Simulator, Path Planning, Intelligent Transportation Systems.

AI-Powered Adaptive Screening Interview Platform

Kusuma T

Assistant Professor, Ramaiah Institute of Technology, Department of Artificial Intelligence & Data Science, Bengaluru, Karnataka, India

Priya M

Assistant Professor, Ramaiah Institute of Technology, Department of Artificial Intelligence and Machine Learning, Bengaluru, Karnataka, India

M Shylaja V

Assistant Professor, Ramaiah Institute of Technology, Department of Artificial Intelligence & Data Science, Bengaluru, Karnataka, India

Anuritha L

Ramaiah Institute of Technology, Bengaluru, Karnataka, India

Shreya Sindhu Tumuluru

Ramaiah Institute of Technology, Bengaluru, Karnataka, India

Abstract:

Traditional hiring methods often face challenges related to fairness, efficiency, and accurate skill assessment. These limitations can lead to biased evaluations and poor hiring decisions. Conventional interviews usually lack personalization and adaptability, making it challenging to assess candidates equitably and increasing the likelihood of external influence. This paper introduces an AI-powered, adaptive interview platform designed to revolutionize the hiring process through intelligent personalization and real-time adaptability. The platform utilizes resume-based customization to generate question sets tailored to each candidate's skills and the specific requirements of the job role. Powered by a fine-tuned Large Language Model (LLM) and a Retrieval-Augmented Generation (RAG) approach, the system delivers a diverse set of industry-relevant questions, along with context-aware follow-ups. It adjusts the difficulty of questions in real-time based on the candidate's performance. At the end of the interview, the platform produces a comprehensive, AI-driven performance report, offering objective insights into the candidate's strengths, areas for improvement, and overall suitability for the role. This integrated approach ensures a fair, relevant, and skill-focused interview experience, enabling organizations to make more informed and effective hiring decisions.

Keywords:

Responsible Artificial Intelligence, Large Language Models (LLM), Retrieval-Augmented Generation (RAG), Bias Mitigation, Automated Recruitment, Machine Learning.

Block Chain Integrated Bio Mass Supply Chain Management System with Ensemble Knowledge Learner Methods

B. Sushma

Assistant Professor, IT-Department, MLR Institute of Technology, Dundigal, Hyderabad, Telangana, India

Dr. Bh. V. RamaKrishna

Associate Professor, AI&DS Department, Vignan institute of technology and Science, Hyderabad, Telangana, India

Abstract:

Clean Energy utilization is becoming mandatory today in consideration of global warming effect. The energy fossils which have zero emission of green house gases and renewable in nature are resources of Clean Energy. In this paper we introducing a frame work model to develop a BlockChain assisted supply chain management with knowledge engineering capabilities. In modern smart cities the role of these systems are vital to recognize and manage the bio mass based fossils in society. This framework covers the confidentiality, security and decision support for autonomous supply chain management in cities. Data transparency with immutability of transactions achieved with BlockChain. Many interesting measures included for prosperous knowledge learning to improve the system decision making capabilities. Predicting the future yield of clean energy based on historical data gives us an in vision into bio mass based resource utilization efficiency. The ensemble knowledge learner approaches provide a choice of selecting an algorithm for specific purpose.

Keywords:

Biomass, Blockchain, Ensemble methods, Supply Chain Management(SCM).

Factors Influencing Academic Innovation Leading to Self-Reliance in Defence Technology

Rounav Pal

MTech Student, Department of Technology Management, Defence Institute of Advanced Technology (DIAT-DRDO), Pune, India

Dr. Amrita Nighojkar

Assistant Professor, Department of Technology Management, Defence Institute of Advanced Technology (DIAT-DRDO), Pune, India

Abstract:

New security threats and challenges have emerged in the current global scenario of rising geopolitical tensions and ongoing conflicts. In these uncertain times, indigenous defence technology has been recognized for its role in national security and strategic autonomy. Higher Educational Institutions can promote the homegrown defence R&D ecosystem by enhancing academic innovation through translational research, virtual labs, AR/VR in education, simulation-based training, and incubation and start-ups. The study reviews 318 research articles on Academic Innovation using the Scopus Search Engine. The key economic factor, external funding, fosters innovation in Research Institutes. The curvilinear relationship between Industry and Academia plays a pivotal role in Innovative works, often requiring a strategic balance between the number of partnerships and variety. Top management commitment and student focus boost innovation through effective Quality Management, but overstrictness can negatively impact it. To bridge the loophole of “Lab-to-Market”, a Total Innovation Management approach is needed from the beginning. The future scope lies in using artificial intelligence to promote innovative content generation and consumption, using “green metrics” to promote sustainability, and collaboration with incubators for faster technology commercialisation.

Keywords:

Academic Innovation, Collaboration, Commercialisation, Defence Technology, Self-reliance.

Artificial Intelligence in Cybersecurity

Pitamber Verma

Visiting Faculty, Northcap University, Haryana, India

Abstract:

In today's era, cybersecurity has become a crucial part of our life, whether we spend time browsing online or use the internet for work and profession. Another domain gaining everyone's attention nowadays is Artificial-Intelligence, which is threatening to replace and reduce the need of human involvement in various fields across the IT industry. This paper aims to analyze and provide a well-supported answer to the question: To what extent *will Artificial Intelligence influence cybersecurity in future ?*. AI is already being used in the security field, for example in antivirus software to make real-time detection more efficient and accurate. With the rise in threats, threat actors and malicious parties trying to steal or compromise sensitive data or software, the need for integrating AI has risen sharply. This paper shall also analyze current applications of AI in cybersecurity and evaluate its limitations.

An AI-Powered Platform for Simplifying Terms and Conditions and Enhancing Data Privacy Awareness

Anushree G

CMR Institute of Technology Bengaluru, India

Rinisha Bagaria

CMR Institute of Technology Bengaluru, India

Abstract:

Data privacy has become a critical concern in the digital age, particularly with the rise of artificial intelligence and generative AI tools. However, the complex legal and technical language used in terms and conditions documents often hinders users' understanding of how their data is handled. This paper introduces AegisX, an AI-powered terms simplification and consent management tool designed to enhance user awareness and control over data privacy. AegisX offers multilingual support, keyword extraction, and risk analysis to help users comprehend the implications of consenting to terms and conditions. The system includes a consent tracking feature that allows users to view and manage the websites to which they have provided consent. Additionally, AegisX features a multi-document retrieval-augmented generation (RAG) chatbot capable of answering user queries related to terms from frequently used platforms. A browser extension is also provided to highlight potentially risky terms directly within the terms and conditions page. The proposed solution aims to improve transparency, promote informed consent, and empower users to manage their digital privacy effectively. By addressing the challenges posed by complex terms and conditions documents, AegisX seeks to bridge the gap between user understanding and data privacy in an increasingly AI-driven world.

Keywords:

Data privacy, natural language processing, Terms and conditions, AI-powered, Consent management, Multilingual support, Keyword extraction, Risk analysis, Retrieval-augmented generation, Browser extension, Consent tracking.

Housing Price Prediction Using Machine Learning Techniques

Dr. Rinisha Bagaria

CMR Institute of Technology, Bengaluru, India

Khushi Priyadarshni

CMR Institute of Technology, Bengaluru, India

Khyati Sikarwar

CMR Institute of Technology, Bengaluru, India

Abstract:

Predicting real estate prices is vital in urban planning, investment strategies, and financial assessments. This study introduces a machine learning-based method for forecasting housing prices in Delhi, utilizing a dataset that includes both geographical and structural attributes such as location coordinates, area, property age, and the number of rooms and amenities. The dataset undergoes preprocessing steps like missing value treatment and normalization using the StandardScaler. A Linear Regression algorithm is applied to uncover the relationship between the input features and house prices. Evaluation metrics, including Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared (R^2) are used to assess model accuracy. Additionally, the study explores the use of K-Means clustering to group houses with similar traits, enhancing prediction accuracy. The results reflect a strong association between selected features and pricing, with promising R^2 values validating the model's reliability. This research presents a predictive framework valuable to prospective buyers, real estate professionals, and financial analysts for making informed, data-driven decisions.

Keywords:

K-means Clustering, Linear Regression, Supervised Learning, Unsupervised Learning, Mean Absolute Error (MAE), Mean Squared Error (MSE), and R-squared (R^2).

Leveraging AI in Digital Marketing: Enhancing Student Engagement and Enrollment in Higher Education

Samuel Giftson Rajkumar

Research Scholar, Karunya Institute of Technology and Sciences, Coimbatore, India

Dr. Samuel Joseph

Professor & Head, MCC Boyd Tandon School of Business, M.E.S ROAD, MCC MODEL VILLAGE, Tambaram East, Chennai, Tamil Nadu, India

Dr. Clement Sudhahar

Professor & Head, Karunya Institute of Technology and Sciences, (Deemed to be University), Karunya Nagar, Coimbatore, Tamil Nadu, India

Judah Jos Jacinth

Student, Shiv Nadar University, Old Mahabalipuram Road, Kalavakkam, Chennai, Tamil Nadu, India

Abstract:

The rapid advancement of Artificial Intelligence (AI) is transforming digital marketing in higher education by providing innovative tools to engage prospective students and improve enrollment. Traditional approaches are increasingly ineffective with digital-native learners, creating a need for AI-driven strategies. This study explores the use of predictive analytics, chatbots, and personalized content delivery to strengthen student engagement and decision-making. Using a mixed-methods design, qualitative interviews with higher education marketing professionals were combined with quantitative surveys of students to evaluate AI's impact. Findings show that AI significantly enhances targeted marketing, improves student support through chatbots, and delivers tailored content aligned with student interests. Statistical analysis revealed that perceived usefulness of AI tools was the strongest predictor of enrollment likelihood ($\beta = 0.42$, $p < 0.001$), with notable variations across age groups and gender. Academic reputation and financial aid also remained important factors influencing enrollment choices. The study highlights key challenges, including gaps in technical expertise, financial constraints, and data privacy concerns. Addressing these requires investment in training, capacity building, and robust governance practices. Overall, the findings emphasize AI's potential to make higher education marketing more personalized, effective, and strategically responsive in a competitive global landscape.

Keywords:

Artificial Intelligence, Digital Marketing, Higher Education, Student Engagement, Enrollment Strategies.

Design of Low Power Comparator for Flash ADC

Swarna M

Department of Electronics and Communication BMSCE Bangalore, Karnataka, India

Veena M B

Department of Electronics and Communication BMSCE Bangalore, Karnataka, India

Abstract:

Flash Analog-to-Digital Converters (ADCs) are widely used in high-speed applications due to their fast conversion rates. However, their efficiency is often hindered by the high power consumption of the comparator circuits, which are central to their operation. This paper presents a low-power, high-speed comparator design based on enhanced transconductance in the latch stage, implemented using 45nm CMOS technology. The proposed design minimizes short-circuit power dissipation by introducing delayed transistor switching and improves the regeneration speed through optimized cross-coupled transistors. Simulations conducted using LTspice demonstrate a power dissipation of just 300 μ W, achieving a 50% reduction compared to a conventional 45nm comparator and a 96.9% reduction relative to traditional 180nm designs. Furthermore, this design is benchmarked against recent comparator architectures, and the results confirm its superiority in terms of power-delay product and gain. Integration of the proposed comparator into a 2-bit flash ADC verifies its performance in practical high-speed, low-power applications. These results highlight its potential for use in modern data conversion systems where power efficiency and speed are critical.

Keywords:

Flash ADCs, LTSPICE.

Design of a Low Power Bit-Line Sense Amplifier for Enhanced Read Stability in SRAM in 45nm CMOS Technology

S Bharath

Department of Electronics and Communication, BMSCE, Bangalore, Karnataka, India

Veena M B

Department of Electronics and Communication, BMSCE, Bangalore, Karnataka, India

Abstract:

Advancements in CMOS technology scaling have made low-voltage operation in Static Random Access Memory (SRAM) increasingly challenging, as reduced supply voltages—while essential for power savings and efficiency—intensify noise, stability, and reliability issues in sense amplifiers. This research presents a low-power bit-line sense amplifier implemented in 45 nm CMOS technology, aimed at enhancing read stability while maintaining high performance and low power consumption under process variability. The proposed design incorporates a pre-amplification stage that mitigates offset voltage issues, followed by a multi-phase sensing process: a pre-charge phase to equalize the bit-lines, an offset determination phase employing a D Flip-Flop for mismatch compensation, a differential sensing phase to detect and pre-amplify small voltage differences, and a self-timed regenerative latch stage that simplifies timing logic while ensuring stable, glitch-free outputs. Simulations demonstrate a power dissipation of 15 μ W and a sensing delay of 0.17 ns, making the design well-suited for high-density, low-voltage SRAM applications requiring improved read stability and reliability.

Keywords:

SRAM, low-power sensing, offset compensation, 45nm CMOS.

Cybersecurity – Implementation for Web Based API System for Authentication & Authorization

Priyanka Saxena

Mangalayatan University Jabalpur, Madhya Pradesh, India

Dr. Vasujadevi Midasala

Mangalayatan University Jabalpur, Madhya Pradesh, India

Dr. S Nagakishore Bhavanam

Mangalayatan University Jabalpur, Madhya Pradesh, India

Abstract:

In this ERA, distribution of data collected & generated by any organization is a need of time. Distribution is achieved by applying APIs (Application Programming Interface) make it more available, high performance and secured by apply different types of APIs such as Public, Private or Semi-Private. This sharing of data through APIs, requires applying secured access to designated parties. Such sharing imposes researchers to design & implement a robust system for authentication, authorization with high security. Another call for such a system is continuously watching the traffic for unauthorized access. This work is focusing on designing an integrated system for security of the API based systems which will include generation of authentication mechanism, allowing for authorized access being configured by the system administrator and an IDS (Intrusion Detection System) with feedback mechanism. For authentication mechanism a new multilevel encryption based key generation system shall be developed. This will include association with authorization system as well. At the final stage IDS based on Machine Learning (ML) and Artificial Intelligence (AI) shall be employed for highest security. The proposed system shall be evaluated using Accuracy, Precision, Recall, F1-Score, ROC-AUC, PR-AUC, Detection Rate, False Alarm Rate, and Attack Success Rate, which are the most widely cited metrics in ML-based cybersecurity literature.

Keywords:

Machine Learning, Artificial Intelligence, API, DistilBERT, CNN, Machine Learning, Sentiment Analysis.

Digitizing the Dining Experience: A Web-Based Restaurant Management System with Personalized Recommendations and Flexible Bill Splitting

Tanmay Mendhey

Student, San Ignacio University, USA

Abstract:

The restaurant industry has witnessed a rapid shift towards digital solutions, accelerated by the COVID-19 pandemic, emphasizing the need for contactless services. This paper presents a web-based restaurant management system developed using React.js for the front end and Django for the back end. The system incorporates innovative features such as QR code-based ordering, personalized menu recommendations through a hybrid recommender algorithm, and a flexible bill-splitting feature enabled by a session system for tables. By leveraging QR codes, customers can access menus and place orders directly from their smartphones, enhancing convenience and reducing wait times. The system's recommender algorithm tailors menu suggestions based on user preferences and order history, creating a personalized dining experience. The flexible bill splitting feature allows customers to share or split bills seamlessly, improving both the customer experience and operational efficiency. Additionally, the application includes tools for restaurant staff to manage orders, track sales, and optimize kitchen operations through a real-time display system. This project aims to set new standards in digital restaurant management, improving both the customer dining experience and the efficiency of restaurant operations while aligning with current trends in contactless service and technological innovation.

Computer Vision-Based Automated Classroom Monitoring Systems: A Comprehensive Review of Real-Time Student Engagement Detection Technologies

Dalbina Dalan

Nehru College of Management, Bharathiar University Coimbatore, India

Dr. S. Gnanapriya

Associate Professor, Nehru College of Management, Bharathiar University Coimbatore, India

Abstract:

The use of computer vision and machine learning in education has become a game changer for understanding and improving classroom dynamics. This review looks at automated classroom monitoring systems, particularly focusing on real-time detection of student engagement through image processing and behaviour analysis. We systematically review fifteen important research papers published between 2010 and 2025. These papers cover methods like facial expression recognition, pose estimation, and multi-modal fusion approaches. The review identifies three main technology areas: deep learning-based attention monitoring, facial expression analysis for emotional engagement, and body language recognition for behaviour assessment. Key findings show significant improvements in real-time processing, with systems achieving accuracy rates of 85 to 95% in controlled environments. However, challenges remain in protecting privacy, reducing cultural bias, and ensuring the systems work across different educational contexts. The review tracks the shift from simple attention detection to complex multi-modal systems that provide detailed insights into learning. While technology continues to improve, ethical issues and teaching effectiveness need equal focus in future research. This analysis offers researchers and educators a solid grounding in the current strengths and weaknesses of automated classroom monitoring technologies.

A Survey Paper on Machine Learning Algorithms for Detecting Black Pepper Diseases Using Soil Sensing and Leaf Imagery: A Contextual Study of Kerala's Sustainable Agriculture

Shyni T Ummer

Research Scholar, Department of Computer Applications, Nehru College of Management, Bharathiar University Coimbatore, India

Dr. S. Gnanapriya

Associate Professor, Department of Computer Applications, Nehru College of Management, Bharathiar University Coimbatore, India

Abstract:

A commonly grown crop, Black pepper is susceptible to a number of illnesses that can drastically reduce productivity and quality. This survey paper examines methods for detecting black pepper illnesses using multimodal IoT systems, soil and microclimate data, and leaf imaging using machine learning (ML) algorithms also combine methodology, datasets, model architectures, pre-processing and feature-extraction methods, deployment considerations, performance indicators, and research gaps. Kerala's agroecological setting and sustainable agricultural goals are highlighted, along with the practical integration of machine learning techniques with participatory extension and low-cost sensing to promote resilient spice growing. This overview examines the most recent developments in supervised learning, deep learning, and image-based methods for pepper disease diagnosis using machine learning. It also identifies present difficulties and potential lines of inquiry for applying ML-based systems in actual agricultural environments. Numerous methods have achieved excellent accuracy in the automated detection of pepper illnesses with the use of machine learning algorithms. Convolutional neural networks (CNNs), a type of deep learning model, have demonstrated encouraging outcomes in the recognition and categorization of various medical diseases from pictures.

A Machine Learning Platform for Optimizing Food Supply Chain Logistics

Naman Goyal

Computer Science and Engineering Chandigarh University, Punjab, India

Sachin Yadav

Computer Science and Engineering Chandigarh University, Punjab, India

Er. Munish Kumar

Computer Science and Engineering Chandigarh University, Punjab, India

Dipanshu Garg

Computer Science and Engineering Chandigarh University, Punjab, India

Abstract:

The global food supply chain is plagued by systemic inefficiencies, leading to staggering economic losses approaching 1 trillion\$ annually and severe environmental consequences, with food loss and waste contributing 8-10% of global greenhouse gas emissions. Traditional logistics and inventory management systems, often reliant on static models and historical averages, are ill-equipped to handle the dynamic and perishable nature of the food industry. This results in a persistent mismatch between supply and demand, suboptimal distribution, and significant spoilage. This paper introduces a novel, integrated machine learning platform designed to address these challenges holistically. The platform architecturally unifies three core modules: (1) a hybrid ARIMA-LSTM model for high-accuracy demand forecasting, (2) a Reinforcement Learning agent coupled with Graph Neural Networks for dynamic logistics optimization, and (3) a data fusion model combining Computer Vision and IoT sensor data for proactive quality assurance. By creating a synergistic data feedback loop between these modules, the platform moves beyond siloed optimizations to enable proactive, data-driven decision-making across the entire supply chain. We present an experimental framework for validation using public datasets and anticipate significant improvements in waste reduction, operational efficiency, and overall system resilience.

Keywords:

Food Supply Chain, Machine Learning, Logistics Optimization, Demand Forecasting, Reinforcement Learning, Food Waste Reduction.

Biological Device for Toxicological Component Detection from Environment With AIML

Jannatul Adnan Pronoy

Student, Chandigarh University, Punjab, India

Md Fazle Rabbi Moon

Student, Chandigarh University, Punjab, India

Md Mahbub Gazi

Student, Chandigarh University, Punjab, India

Md Nuruzzaman

Student, Chandigarh University, Punjab, India

Abstract:

Environmental pollution and exposure to toxic agents have become major global concerns, affecting not only public health but also ecological stability and sustainable industrial practices. Conventional biosensors are widely used for detecting harmful chemical and biological substances in air, water, and soil; however, they are often constrained by slow response times, limited sensitivity, and an inability to provide predictive insights. To address these challenges, this research introduces a novel framework for real-time environmental toxicity forecasting using AI-enhanced biosensors. The proposed system integrates biological sensing mechanisms with machine learning and data science techniques to achieve both detection and predictive analysis of toxicological components.

The methodology involves four major stages: biosensor data acquisition, preprocessing and feature extraction, training of AI/ML models, and real-time classification and forecasting of toxicity levels. Unlike traditional biosensors, which primarily act as detection devices, this AI-driven approach transforms them into intelligent diagnostic tools capable of recognizing complex patterns, reducing false positives, and forecasting future toxic events. Potential applications span diverse fields, including industrial wastewater monitoring, detection of hazardous gases, early-warning systems for environmental disasters, biomedical diagnostics, and smart city pollution control.

This research demonstrates how integrating AI with biosensors not only enhances detection accuracy but also provides actionable insights for timely decision-making. Ultimately, AI-enhanced biosensors represent a significant step toward sustainable environmental protection, improved public health monitoring, and the development of intelligent environmental safety infrastructures.

Dentification of Two-and Three-Component Blended Vegetable Oils by Light Refraction Index

A.M.Serkaeva

Karshi State technical university, Karshi, Uzbekistan

A.A.Abdurakhimov

Tashkent Institute of Chemical Technology Tashkent, Uzbekistan

Sh.J.Isroilova

Tashkent Institute of Chemical Technology Tashkent, Uzbekistan

M.O.Khamidova

Tashkent Institute of Chemical Technology Tashkent, Uzbekistan

N.I.Boyjanov

Karshi State technical university, Karshi, Uzbekistan

A.M.Normatov

Tashkent Institute of Chemical Technology Tashkent, Uzbekistan

D.P.Rakhimov

Tashkent Institute of Chemical Technology Tashkent, Uzbekistan
Jiangnan University, Wuxi, Jiangsu, China

K.P.Serkaevb

Tashkent Institute of Chemical Technology Tashkent, Uzbekistan

Abstract:

Formulations have been developed for the production of two- and three-component blends of cottonseed and sunflower oils with rapeseed optimized in fatty acid composition, where the ratio of polyunsaturated fatty acids $\omega 6:\omega 3$ 4:1 and for daily consumption 6:1 is achieved. The fatty acid composition of the blends was determined using chromatographic analysis. In order to identify their composition, an analysis of changes in the refractive index in various proportions was carried out and it was found that adding up to 10% rapeseed oil to cottonseed oil leads to a sharp increase in the refractive index from 1,47481 to 1,47683 and a decrease to 1,47652 when added up to 40%, followed by an increase to 1,47723 in the blending range of 50–90%. There was a decrease in the refractive index of sunflower oil blends in the ratios from 10:90 to 90:10 from 1,47721 to 1,47491. Experiments have shown that the refractive index diagram is cotton:rapeseed oil has an increased relative

to both component oils, decreasing in blends with sunflower-rapeseed oil, and growing in three-component blends, which makes it possible to identify blends using the collected indicators.

Keywords:

Rapeseed, blended vegetable oils, identification, number, composition of fatty acids, fatty acid balance.

A Real-Time Framework for Reliable Radar Mode Classification Using Multi-Channel Time-Frequency Images and Feature Fusion

Ananth Nath Talla

Ph.D. Student, NIT Warangal, India

Ilaiah Kavati

Assistant Professor, NIT Warangal, India

Sruthi Sai Prabha K S

Intern Student, DLRL, DRDO, Hyderabad, India

A K Kavan

Intern Student, DLRL, DRDO, Hyderabad, India

Abstract:

Modern radar environments have become highly contested, dynamic, and adaptable due to advances in Active Electronically Scanned Array (AESA) radars that utilize Gallium Nitride (GaN) technology, quantum radars, and software-defined apertures. As a result, identifying and classifying radar emitter modes has become more challenging. Traditional methods such as parameter matching, de-interleaving, and clustering often lead to incomplete emitter tracks and inconsistent mode assignments in dynamic operational conditions. In this study, we propose a real-time radar emitter mode classification framework. This framework performs multi-stage clustering, persistent emitter aggregation, and hybrid feature fusion using multi-channel time-frequency images (TFIs) and inter-pulse statistical descriptors. During preprocessing, we eliminate corrupted Pulse Descriptor Word (PDW) entries and remove outliers by combining the Interquartile Range (IQR) method with Density-Based Spatial Clustering of Applications with Noise (DBSCAN). We then group the processed PDWs within overlapping sliding windows to maintain temporal continuity. We use a two-stage clustering process that includes a seed-and-grow algorithm followed by Hierarchical DBSCAN (HDBSCAN) to detect emitters of different densities and shapes without needing a fixed cluster count. Intra-pulse features are extracted from multi-channel TFIs with a ResNet-18 convolutional neural network. Inter-pulse statistical features, such as PRI variance, duty cycle, and frequency agility, are also computed. These features are combined to create hybrid emitter descriptors. Mode classification is performed using an Extreme Gradient Boosting (XGBoost) algorithm, and we use an Open-Set Recognition (OSR) mechanism based on Mahalanobis distance to identify previously unseen emitters. Experimental evaluations conducted under realistic radar conditions show

improved temporal stability, better classification accuracy, and high adaptability. These findings confirm that the framework is suitable for real-time electronic warfare applications.

Keywords:

Electronic Warfare, Feature Fusion, Open-Set Recognition, Radar Emitter Classification, Time-Frequency Images.

A Community-Driven IoT Surveillance System for Real-Time Ecosystem Monitoring and Threat Detection

Fidelis Bolmax Pereira

St. Joseph Vaz College, Cortalim, Goa

Valisha Clascia Gama

Goa College of Engineering, Farmagudi, Goa

Abstract:

Wetlands, farmlands, and forest ecosystems are under growing threat from encroachment, unsustainable practices, and environmental stress. Traditional monitoring methods are insufficient to detect early signs of disturbance or harmful human activity. This study introduces a modular IoT-based surveillance device designed to empower communities with real-time ecological monitoring.

The prototype, currently in its initial stage, integrates a motion sensor with Arduino, connected to a laptop for data processing and alerts. This demonstrates the core feasibility of detecting irregular movements in sensitive ecological zones. The next stage focuses on wireless operation using Wi-Fi or GSM modules, eliminating the dependence on laptops and enabling alerts to be transmitted directly to mobile devices or a central server. Future iterations include the integration of thermal sensing modules, GPS and GIS mapping capable of detecting abnormal human activity in low-light or dense environments, and long-term vision involves satellite-linked monitoring systems for large-scale ecosystem tracking.

This phased approach ensures scalability, affordability, and sustainability. By combining renewable energy power sources, modular hardware, and community-based alert systems, the project provides a replicable and field-ready framework for protecting wetlands, agricultural lands, and forests, bridging traditional ecological stewardship with technological innovation.

Keywords:

Community driven, surveillance sensor, motion detection, sound detection, Arduino, GSM module, wireless system, environmental monitoring, IOT based device, thermal sensing, GIS and GPS mapping.

Cross Secure: End-to-End Encrypted 2FA

Harsh Goswami

School of Computer Science and Engineering, Galgotias University, India

Vivek Jha

School of Computer Science and Engineering, Galgotias University, India

Azath M

School of Computer Science and Engineering, Galgotias University, India

Abstract:

In view of the exponential growth of digital platforms, it is crucial to take necessary steps in protecting sensitive data from the ever-increasing cyber threats and a strong authentication system is key to this. In a pattern that precedes the growing failure of typical password-based approaches, more and more systems are adopting two factor authentication (2FA). This paper proposes a complete encryption as well as an opensource two factor authentication system which is meant to address problems such as poor device synchronization and no encryption on current systems. The proposed system is based on protocols through which Timebased One-Time Passcodes are used and has an intuitive web interface and enhanced safety & HMAC based One Time Password (HOTP). One notable feature is smooth device synchronization which allows the customer to easily manage his/her authorization token on several devices. Sensitive data such as AES-256-CBC encryption is employed for safe transmission and storage of your data. The purpose of this initiative is to introduce a new protection standard for two factor authentication (2FA) and a broader use of two factor authentication (2FA).

Keywords:

End-to-End Encryption (E2EE), Two-Factor Authentication (2FA), Cross-Device Synchronization, Timebased One-Time Password (TOTP), Secure User Authentication, Cybersecurity Threats.

Global Trends in Virtual Reality: Improving Online Shopping Experiences across Different Geographical Regions

Anjani Kumar

Cluster Innovation Centre, University of Delhi, Delhi, India

Harshul Nanda

Cluster Innovation Centre, University of Delhi, Delhi, India

Akash Singh

Cluster Innovation Centre, University of Delhi, Delhi, India

Abstract:

Virtual Reality (VR) has emerged as a transformative technology, influencing various sectors globally. This evolution is evident in its impact on online shopping experiences. VR's immersive capabilities and user engagement potential are crucial for shaping future strategies and innovations in this dynamic landscape. The study delved into a comprehensive analysis of over 20,000 online shopping reviews across multiple countries, showcasing a growing trend of VR adoption. The findings unveiled a notable surge in VR adoption, particularly in underdeveloped and developing countries, signifying a paradigm shift in consumer engagement with immersive technologies. Specifically, the widespread acclaim for the Meta Quest 2 underscores a substantial improvement in user satisfaction attributed to enhanced features and affordability.

Optimizing Convolutional Neural Networks for CIFAR-10 Image Classification using TensorFlow

Ankur Yadav

Department of Computer Science and Engineering, Galgotias University, Greater Noida, India

Tushar Pandey

Department of Computer Science and Engineering, Galgotias University, Greater Noida, India

Muzafar Mehraj Misgar

Department of Computer Science and Engineering, Galgotias University, Greater Noida, India

Abstract:

This research focuses on the implementation of advanced methods in Convolutional Neural Networks (CNNs) to perform image classification within the TensorFlow framework with the primary assistance of Python programming language. This study applies various enhanced CNN architectures to CIFAR-10 dataset, the standard for ten unique classes. Using different CNN configurations and transfer learning, as well as feature extraction strategies, the approach has found notable enhancement in the classification accuracy of the model. Frameworks include VGG16, WideResNet28-10, custom CNN architectures etc all of which have been refined and evaluated. Our experimental analysis shows that high accuracy is possible with high CNN models, leading to 90% and max out at a 98.2% accuracy.

Keywords:

CNN, Tensorflow, Transfer learning, feature extraction.

IoT Assisted WSN Networks: Applications, Challenges

Harisha K S

Assistant Professor, Department of Electronics and Communication Engineering, Government Engineering College Haveri, Karnataka, India

Dr. Parameshachari B D

Professor, Department of Electronics and Communication Engineering, NITTE Meenakshi Institute of Technology Bengaluru, India

Abstract:

In current days, Wireless Sensor Networks (WSN) and Internet of Things (IoT) are connected to implement various applications. IoT is a network that connects various physical objects using internet. On the other hand wireless network is an interconnection various sensor nodes called motes. WSN is a network of homogeneous devices for particular application. WSN generates huge amount of data measured using sensors. WSN requires its connection with the internet to send data to users. Connection of wireless sensor nodes to the internet is achieved through IoT. This resulted in a new network scenario called IoT assisted WSN. IoT assisted WSN has wide range of applications including environmental monitoring, healthcare, agriculture, industrial automation, smart cities, and military. However, due to heterogeneity of IoT and WSN faces various challenges in their operation such as energy, scalability, security, quality of service, network dependability, and data management. This paper presents applications, challenges and recent research work in the area of IoT assisted WSN.

Keywords:

WSN, IoT, Applications, Challenges.

Enhancing Movie Success Prediction: Integrating NLP and Advanced Machine Learning Models for Accurate Forecasting

Tushar Mahadev Patil

Ashokrao Mane Group of Institutions, Vathar, Maharashtra, India

Dr. Bhagyashala Arjun Jadhawar

Professor, Ashokrao Mane Group of Institutions, Vathar, Maharashtra, India

Abstract:

This research explores the integration of Natural Language Processing (NLP) and advanced machine learning models for predicting movie success and revenue. By combining text analysis, sentiment data, and traditional movie features, the study develops predictive models using Gradient Boosting, Random Forest, and Neural Networks. The results reveal that the Random Forest model excels in binary classification, achieving 99% accuracy in predicting movie success, while Gradient Boosting outperforms Random Forest in revenue prediction, showing superior learning efficiency and generalization. The neural network, though highly accurate in training, suffered from overfitting. This study demonstrates the potential of hybrid models and deep learning techniques to improve decision-making in the film industry, reducing financial risks and optimizing production and marketing strategies.

Stereotactic Radiotherapy for Liver Metastases cancer Using Flattening Filter-Free Beams: Dosimetric and Technical Considerations

Rajhans Kumar

Institute of applied science, Mangalayatan University, Beswan, Aligarh

Santosh Kumar

State Cancer Institute IGIMS, Patna

Y.P. Singh

Institute of applied science, Mangalayatan University, Beswan, Aligarh

Rajesh Kumar Singh

State Cancer Institute IGIMS, Patna

Abstract:

Liver metastasis is common in colorectal cancer (15–25% of cases) as well as in lung and breast cancers. This study focuses on the dosimetric and technical aspects of stereotactic radiation therapy (SRT) using flattening filter-free (FFF) beams for liver mets. Between January 2023 to March 2025, 10 patients (5 males, 5 females), each with four liver metastatic lesions, underwent CT simulation with selected slice 1.5 mm. All patients underwent treatment using a Elekta Versa HD system VMAT Technique with 6 FFF energy. Treatment plans were done on the Monaco(TPS), with target volumes (GTV, CTV, PTV) and critical organ contoured by clinicians. A prescribed dose of 42 Gy in 6 fractions following RTOG-1112 guidelines. Dosimetric parameters evaluated included the homogeneity index (HI), conformity index (CI), gradient distance (GD), and doses to OARs. Specific metrics analyzed included V100 for PTV, Dmean for the liver and kidneys, D0.05cc for the duodenum, Esophagus, bowel bag, stomach and PRV(Planning Risk Volume) spinal cord, V30 for the chest wall, V27 for Ribs. Daily cone beam CT (CBCT) was used for image guidance. Dosimetric analysis showed excellent PTV coverage, with V100% ranging from 96.93% to 98.25%. The liver Dmean was 11.7±5.26 Gy, while other OAR doses were kept within RTOG-1112 constraints. The use of FFF beams allowed for shorter treatment times and reduced scattered radiation, making SRT for liver metastases both feasible and effective, ensuring safe OAR management and optimal target coverage.

Keywords:

Stereotactic radiotherapy, liver metastases, flattening filter free, VMAT.

Human Disease Prediction Based on Symptoms Using Machine Learning

Elaiyabharathi P

Student, Dr. Mahalingam College of Engineering and Technology, Tamil Nadu, India

Abstract:

Predicting human diseases involves estimating the likelihood of an illness based on the combination of symptoms presented by the patient. By observing health indicators during the initial consultation, medical professionals can deliver more effective and timely treatments. This analytical approach can streamline healthcare processes and enhance patient care efficiency. While prior studies have focused on machine learning techniques such as Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and RUSBoost for disease classification using symptom data, many of these models rely on unprocessed datasets and suffer from limited accuracy. These limitations underscore the necessity of developing an enhanced prediction framework that offers greater precision and early diagnostic capability.

To address these issues, the proposed system improves prediction accuracy by applying a refined data transformation technique, which assigns weight values to symptoms based on their frequency or rarity. The model utilizes a publicly available medical dataset from Kaggle and incorporates a hybrid machine learning pipeline comprising Random Forest, Long Short-Term Memory (LSTM), and SVM algorithms. LSTM is employed to interpret temporal patterns in patient history, while SVM delivers the final classification outcome. This integrated approach demonstrates superior performance compared to existing methods and holds significant promise for advancing healthcare automation and predictive diagnostics.

Enhancing Facial Emotion Detection with CNN: Exploring the Impact of Hyper Parameters

Prashant Sahatiya

Assistant Professor, Parul University, Gujarat, India

Vijya Tulsani

Assistant Professor, Parul University, Gujarat, India

Abstract:

In recent years, computer vision and machine learning have seen a surge in research on Facial Emotion Recognition (FER). The significance of accurately recognizing and interpreting facial expressions for effective communication and social interaction cannot be overstated, making FER a topic of interest in diverse several disciplines, such as psychology, human-computer interaction, and security. Our research paper focuses on deep learning techniques for facial emotion recognition (FER). We specifically investigate the usefulness of Convolutional Neural Networks (CNN) in FER, due to their excellent performance in image classification challenges and their capacity to automatically identify key characteristics from images. Many datasets are researched and analyzed in this study for training expression recognition algorithms. Many datasets are researched and analyzed in this study for training expression recognition algorithms. This study will provide further information about face emotion detection and recognition. It will also highlight the aspects that influence its efficiency.

Keywords:

Emotion Recognition, Convolutional Neural Network, Machine Learning, Deep Learning, Computer Vision.

Cloud for Governance: Leveraging Virtualization, Containerization, and IaC for Public Sector Workloads

Virat Samdarshi

Student, Computer Science Engineering, Chandigarh University, Punjab, India

Hrishit Pradhan

Student, Computer Science Engineering, Chandigarh University, Punjab, India

Ansh Kant

Student, Computer Science Engineering, Chandigarh University, Punjab, India

Rizwan Khan

Student, Computer Science Engineering, Chandigarh University, Punjab, India

Rohit Kumar

Student, Computer Science Engineering, Chandigarh University, Punjab, India

Mannat Thakur

Student, Computer Science Engineering, Chandigarh University, Punjab, India

Abstract:

Governments and public sector entities are making a transition to cloud computing with the massive demand for digital governance and citizen-centric services. Conventional on-premise infrastructures tend to rigidify, are very costly, and are not able to scale to dynamic workloads such as e-governance, data analytics, and service delivery. This paper presents a cloud computing framework meant for governmental use, with scalability, security, and compliance to national IT standards as major considerations in the framework design. The design takes advantage of virtualization and containerization to gain efficiency in resource allocation, while an Infrastructure-as-Code (IaC) approach enhances automation for speedy deployment and consistent management. It includes secure multi-tenancy, advanced networking, and compliance frameworks such as ISO/IEC 27001 and NIST guidelines. The framework is tested on major cloud platforms: AWS, Microsoft Azure, and Google Cloud Platform (GCP) and analyzed in terms of scalability, latency, availability, and compliance. Results have brought to light that containerized workloads fare better all around in efficiency compared to traditional virtualization, while at the same time assuring resilience and security.

An Empirical Analysis of Green Banking Practices and Their Role in Measuring Environmental Performance Indicators in Banking Sector

Heeba Absar

Graphic Era deemed to be a university, Dehradun, Uttarakhand, India

Dr. Sanjay Taneja

Graphic Era deemed to be a university, Dehradun, Uttarakhand, India

Abstract:

The study aims to undertake an empirical investigation of “green banking practices” and their significance in evaluating “environmental performance indicators” in the banking industry. The study gathers both “primary and secondary data”. The study used a regression test to investigate how green banking practices affect environmental performance indicators, as well as a correlation analysis to assess the connection between green banking practices and long-term sustainability. The data is examined with SPSS and Microsoft Excel. The study looks at how “green banking practices influence environmental performance” metrics and their relevance to environmental sustainability. The study’s findings emphasize the importance of establishing “green banking practices” to promote environmental stewardship in the banking industry. The findings of this study can assist regulators and the banking industry improve their environmental performance and sustainability initiatives..

Keywords:

Banking Industry, Environmental Performance Indicators, Environmental Sustainability, Green Banking Practices.

Power-Efficient and High-Speed Loeffler-Based DCT Architecture for Real-Time Image Compression

Prathibha M

Department of ECE BMSCE, Bangalore, Karnataka, India

Veena M B

Department of ECE BMSCE, Bangalore, Karnataka, India

Abstract:

The Discrete Cosine Transform (DCT) is a fundamental technique in image processing, widely applied in data compression to convert spatial pixel data into the frequency domain by expressing it as a sum of cosine coefficients across various frequencies. This paper presents an optimized hardware architecture for the 2D 8x8 DCT and its inverse (IDCT), using the Loeffler algorithm to reduce arithmetic complexity and improve efficiency in image processing applications. To support real-time multimedia applications, the architecture integrates high-speed Carry Select Adders (CSLA) with a Binary to Excess-1 Converter (BEC) and Booth multipliers, enhancing computation speed and reducing power consumption. Extending this approach to hyperspectral image compression, the design addresses the challenges of large datasets commonly encountered in remote sensing and medical diagnostics, achieving high compression ratios with minimal data loss. Implemented in front-end on Virtex-7 FPGA and in back-end using Cadence 45nm CMOS technology, the architecture demonstrates notable improvements in performance, power efficiency, and area utilization, making it well-suited for practical, high-fidelity, real-time image compression applications.

Keywords:

Discrete Cosine Transform (DCT), Loeffler Algorithm, Hyperspectral Imaging, Hardware Optimization, Image Compression.

IntelliBugtrack: Bug Tracking Using AI

Kavya Naik

Department of Master of Computer Applications Mangalore Institute of Technology and Engineering,
Moodabidre, Mangalore, India

Madhwaraj K G

Department of Master of Computer Applications Mangalore Institute of Technology and Engineering,
Moodabidre, Mangalore, India

Abstract:

In the field of modern software engineering, the efficient monitoring of bugs is essential for the speed of development and maintaining product quality. However, most of the traditional tools continue to depend on manual processes, such as logging bugs, categorizing them, and assigning tasks to team members. This approach often results in major delays, unequal task distribution, and poor communication between the team members. To reduce these issues, dynamic bug tracking tools have been implemented with features like automated bug status updates and integrated development environments. However, these tools still depend on a significant amount of manual work, and they do not have smart decision-making abilities.

This research work proposes “IntelliBugtrack”, a conceptual framework for an intelligent bug tracking tool that uses AI to optimize and automate the way bugs are found and handled. IntelliBugtrack includes voice-enabled bug reporting, NLP-based categorization, and a machine learning system that assigns bugs to developers and testers based on their skills, workload, and past work. By combining advanced AI and focusing on user needs, it significantly reduces manual efforts, makes bug fixing more accurate, and gives real-time visibility to managers about the progress with helpful insights and records.

Keywords:

Bug Tracking System; Machine Learning; Natural Language processing.

AI-Driven Solutions for Resolving Transfer Pricing Disputes: Opportunities and Ethical Challenges in Indian Law

Mamta Bhawanishanker Khandelwal

G.H. Raisonni University, Saikheda, Madhya Pradesh, India

Abstract:

This research explores the integration of artificial intelligence (AI) in resolving transfer pricing (TP) disputes in India, focusing on how AI tools can analyze tariff impacts, predict litigation outcomes, and ensure fairness while addressing ethical concerns such as data privacy and algorithmic bias. The central research question is: How can AI-driven solutions enhance TP dispute resolution in India under the Income Tax Act, 1961, and OECD guidelines, and what ethical challenges must be mitigated to ensure equitable implementation?

Employing a mixed-methods approach, including legal analysis of key provisions (Sections 92–92F of the Income Tax Act and OECD BEPS Actions), case studies of landmark disputes (e.g., GlaxoSmithKline, Vodafone), and review of AI applications in TP (e.g., predictive analytics for audit simulations), the study draws on secondary data from OECD reports, Indian tax statistics, and emerging AI literature. Quantitative insights are derived from TP litigation trends (2020–2025), revealing a 10–15% annual increase in disputes, with Mutual Agreement Procedures (MAPs) resolving cases faster than traditional litigation.

Findings indicate AI opportunities in reducing compliance costs by 20–30% through automated arm's-length pricing analysis and outcome prediction accuracy of up to 85% in simulated audits. However, ethical challenges like algorithmic bias (e.g., perpetuating sector-specific disparities) and data privacy breaches under India's Digital Personal Data Protection Act, 2023, pose risks of unfair assessments. The study's originality lies in its India-specific nexus of AI, TP law, and ethics, bridging gaps in existing literature that overlooks AI's role in emerging markets. Its significance is in providing actionable insights for Assessing Officers (AOs) to leverage AI for efficient audits, policymakers for ethical guidelines, and MNEs for compliant strategies, ultimately fostering transparent tax administration and economic growth in India.

Keywords:

Transfer pricing, Artificial Intelligence, Income Tax Act, OECD, Algorithmic bias, Data privacy, India.

Satellite-Based Water Quality Monitoring

Annaldas Shivani

Department of Computer Science and Engineering, Institute of Aeronautical Engineering, Dundigal, Hyderabad, Telangana, India

Abstract:

Water is an essential component of life, directly influencing public health, agriculture, biodiversity, and socio-economic development. However, due to rapid urbanization, industrial expansion, and climate change, many freshwater resources are increasingly subjected to pollution and degradation. Traditional water quality monitoring techniques—based on manual field sampling and laboratory testing—are often constrained by cost, logistical complexity, limited spatial coverage, and infrequent data collection. These limitations become particularly evident in regions like Telangana, India, where numerous lakes and reservoirs serve as crucial sources of drinking water, irrigation, and ecological balance.

To address these challenges, this study proposes a scalable and cost-effective satellite-based water quality monitoring framework specifically tailored for the state of Telangana. The system leverages remote sensing technologies and open-access satellite imagery from platforms like Sentinel-2, Sentinel-3, and Landsat-8 to extract water quality indicators over time and across large geographical areas. Important parameters such as pH, turbidity, chlorophyll concentration, and total suspended solids (TSS) are derived from multispectral bands using pixel-level image processing.

A dataset was created using satellite images from three representative lakes—Himayat Sagar, Osman Sagar, and Shamirpet Lake—for the year 2023. Ground-truth values of water quality parameters corresponding to these lakes were used to annotate and validate the dataset. The numeric spectral values were then used to train a machine learning classification model. Among the models evaluated, Logistic Regression with L1 regularization (LogR-L1) was selected due to its high accuracy, interpretability, and lower risk of overfitting. This model classifies water quality into categories such as “Good” or “Poor”, enabling easy understanding and prompt action.

The final outputs are integrated into an intuitive and interactive user interface built using Streamlit, where users can input latitude and longitude to obtain real-time classification of water quality at a specific location. The backend dynamically pulls remote sensing data through Google Earth Engine (GEE), extracts relevant numerical features, and applies the trained LogR-L1 model for prediction. This structure ensures that the system remains extensible for future satellite data, and responsive to new monitoring needs without requiring complete retraining.

The proposed system does not depend on pre-existing inbuilt datasets from GEE; instead, it is customized based on assets created using region-specific shapefiles and spectral formulae tailored to local lakes. By allowing users to obtain near real-time analysis through just location inputs, the tool serves as a bridge between advanced remote sensing techniques and grassroots-level usability.

This framework aligns with the United Nations Sustainable Development Goal (SDG) 6, which advocates for clean water and sanitation for all. It empowers environmentalists, policymakers, researchers, and the general public to monitor and manage water quality efficiently across time and space, especially in under-resourced or ecologically sensitive regions.

The modular architecture of this system also provides the potential for future integration with other APIs, such as rainfall data, pollution indexes, or weather patterns, to enhance predictive accuracy. Thus, the project stands as a sustainable, data-driven approach to support intelligent water resource management and environmental conservation.

Keywords:

Remote sensing, water quality monitoring, machine learning, Logistic Regression, Sentinel-2, Streamlit, Google Earth Engine, Telangana, Sustainable Development Goal 6.

Driver Coaching: Battery Electric Vehicles

Manjunath Shivanagi

Student, Professor, BMS College of Engineering, Karnataka, India

Poornima G

Student, Professor, BMS College of Engineering, Karnataka, India

Abstract:

As Battery Electric Vehicles (BEVs) become increasingly popular, optimizing their performance, energy efficiency, and safety is paramount. This paper presents a Driver Coaching Service designed to enhance the driving experience and performance of BEVs through real-time feedback, personalized recommendations, and data-driven insights. The service aims to improve eco-driving habits, maximize driving range, and ensure safer driving practices by leveraging advanced technologies such as IoT, geolocation, reinforcement learning, and adaptive feedback systems. Drawing from recent research on driver behavior modeling, eco-driving techniques, and real-time learning systems, the proposed service provides tailored coaching that adjusts to the driver's behavior and dynamic road conditions. The system incorporates haptic feedback to guide drivers in urban environments, monitors energy consumption, and offers suggestions for better driving techniques to reduce energy waste. By analyzing historical driving data, the service continuously adapts, offering iterative learning opportunities for drivers to refine their skills and improve their overall driving efficiency. The coaching system not only supports novice drivers but also provides ongoing improvement for experienced drivers, ultimately contributing to the long-term sustainability of BEVs. This approach promises to optimize the overall driving experience of BEV owners while reducing the environmental impact and enhancing energy efficiency of BEVs. This driver coaching service for BEVs represents a step forward in integrating intelligent technologies with sustainable driving practices, helping drivers make the most out of their electric vehicles in an ever-evolving automotive landscape.

Keywords:

Battery Electric Vehicles, Energy consumption, Driver coaching, Battery range.

Fake News Detection in the Age of LLMs: Methods, Datasets, and Challenges

Parth Bramhecha

Department of Information Technology, Pune Institute of Computer Technology, Pune, India, L3CubeLabs, Pune

Smit Deshmukh

Department of Information Technology, Pune Institute of Computer Technology, Pune, India, L3CubeLabs, Pune

Adwait Borate

Department of Information Technology, Pune Institute of Computer Technology, Pune, India, L3CubeLabs, Pune

Sairaj Bodhale

Department of Information Technology, Pune Institute of Computer Technology, Pune, India, L3CubeLabs, Pune

Punam Shinde

Department of Information Technology, Pune Institute of Computer Technology, Pune, India, L3CubeLabs, Pune

Abstract:

The spread of fake news and disinformation on digital media has become a pressing problem with profound social, political, and economic ramifications. The latest breakthroughs in machine learning, deep learning, and large language models (LLMs) have given rise to innovative methods for the detection and prevention of false information spreading. This paper provides an exhaustive overview of the methods and datasets applied for detection of fake news, emphasizing the shift from early methods like support vector machines and TF IDF embeddings to recent transformer-based and graph-based architectures. Particular focus is given to multilingual detection, low-resource environments, and the application of social context to improve detection performance. In addition, recent benchmark datasets and evaluation methods are examined to demonstrate emerging research directions. By combining these contributions, this review offers an organized insight into the strengths and weaknesses of current methods as well as directions for future research to construct reliable, interpretable, and scalable systems for detecting misinformation.

Keywords:

Fake News Detection, Large Language Models(LLMs), Social Media, Natural Language Processing(NLP).

Simulating Realistic Lane-Changing Behavior Using an Efficient Driver Behavior Dynamics Model

Dr. U.Sivaji

Associate Professor, Information Technology, Institute of Aeronautical Engineering, Dundigal, Hyderabad, India

Chilukuri Sruthi

Information Technology, Institute of Aeronautical Engineering, Dundigal, Hyderabad, India

N.Shiva Kumar

Information Technology, Institute of Aeronautical Engineering, Dundigal, Hyderabad, India

Manne Satwika

Information Technology, Institute of Aeronautical Engineering, Dundigal, Hyderabad, India

Abstract:

This work explores an efficient driver behaviour dynamical model applicable to simulated lane-changing tasks. The study employs McRuer's cybernetic single-loop transfer function theory to model driver behaviour with the minimal number of parameters while ensuring accuracy. Using cross-validation and mean squared error (MSE) as performance measures, the model selection process identifies optimal structures that balance simplicity and precision. Experiments were conducted on both an in-house driving simulator and a publicly available dataset, enabling analysis across multiple driver behaviours. Results demonstrate that a second-order model with four key parameters, including reaction delay and derivative state, provides reliable approximation of driver control actions during lane-changing. The findings highlight the potential of minimal-parameter models to capture essential behavioural dynamics, support comparative analysis of drivers, and offer applications in intelligent transportation systems and driver-assistance technologies.

Keywords:

Driver behaviour, Lane changing, McRuer's theory, Cybernetics, Transfer function model, Machine learning, Cross-validation, Minimal parameter models, Driving simulator, Mean squared error (MSE).

SVM Model for Comprehensive Battery Performance Analysis

Rochan A Ritti

Electronics and Communication, B M S College of Engineering, Bangalore, Karnataka, India

Poornima G

Electronics and Communication, B M S College of Engineering, Bangalore, Karnataka, India

Abstract:

Lithium-ion batteries power electric vehicles, consumer electronics, and renewable energy systems due to their high energy density and rechargeability. However, their performance degrades over time because of repeated charging cycles, high temperatures, and environmental stress, leading to reduced capacity, slower charging, and potential safety risks like overheating or thermal runaway. To address these issues, this project introduces a smart battery monitoring system that tracks key parameters such as voltage, current, temperature, internal resistance, and ambient humidity in real time. The system calculates critical indicators like State of Charge (SOC), Depth of Discharge (DOD), and remaining capacity to assess battery performance. A machine learning algorithm, Support Vector Machine (SVM), processes this data to classify the battery's State of Health (SOH) into healthy, warning, or critical categories. This enables early detection of faults, supporting predictive maintenance and reducing the risk of unexpected failures. An LCD interface presents real-time data on battery status, health classification, and environmental conditions, offering a clear and accessible overview for all users. Designed for flexibility, the system can be integrated into electric vehicles or other battery-based systems, helping to prevent overcharging, deep discharging, and thermal damage. By combining real-time sensing, intelligent diagnostics, and user-friendly feedback, this smart monitoring system improves battery safety, efficiency, and lifespan. It provides a scalable and practical solution for modern energy applications, addressing the growing need for reliable battery management as demand for electric and portable power sources continues to rise.

Keywords:

Lithium-ion Battery, Real-time Monitoring, State of Health (SOH), Support Vector Machine (SVM), Battery Degradation, Smart Battery Monitoring, Electric Vehicles (EVs).

“Data-Efficient and Fair Skin Lesion Segmentation Across Diverse Skin Tones Using Foundation Models, Self-Supervised Learning, and Federated AI”

Ruksar Fatima

Professor, Khaja Bandanawaz University, Karnataka, India

PDF, SR University, Warangal, Telangana, India

Dr. Mohammed Ali Shaikh

Associate Professor & Associate Dean (Cloud Computing & DevOps), SR University, Warangal, Telangana, India

Abstract:

Background and Motivation:

Skin cancer is among the most prevalent cancers globally, and early detection through precise skin lesion analysis is crucial for improving patient outcomes. Automated segmentation methods show promise but face limitations due to costly annotations, device variability, and dataset biases, particularly the underrepresentation of darker skin tones. This skew leads to inequities in diagnostic performance and erodes clinical trust. Consequently, there is an urgent need for data-efficient, privacy-preserving, and fairness-aware AI frameworks that perform reliably across diverse populations in real-world dermatology settings.

Objectives:

This research aims to:

1. Adapt foundation models and transformer-based architectures for skin lesion segmentation in dermoscopic and smartphone-acquired images.
2. Reduce reliance on annotated datasets through self-supervised learning and generative diffusion-based augmentation.
3. Develop federated learning strategies to enable multi-institutional collaboration while preserving patient privacy.
4. Ensure equitable performance across all Fitzpatrick skin types, device variations, and lesion categories.
5. Facilitate real-world applicability through lightweight deployment for mobile and tele-dermatology platforms.

Methods:

1. Model Adaptation: Fine-tune the Segment Anything Model (SAM), UNETR, and Swin-UNet using domain-specific loss functions and multi-scale feature extraction.
2. Data Efficiency: Implement self-supervised pretraining for feature representation and diffusion-based generative models for synthetic lesion augmentation across diverse skin tones.
3. Federated Learning: Design decentralized training pipelines to enable cross-institutional model updates without sharing sensitive data.
4. Evaluation: Measure segmentation accuracy using Dice score, IoU, and sensitivity, while assessing fairness across Fitzpatrick skin types. Employ uncertainty quantification, saliency maps, and attention-based visualization for interpretability.

Datasets and Validation:

Benchmarking will leverage publicly available datasets, including ISIC, HAM10000, and PH2. A small-scale clinical reader study involving dermatologists from multiple institutions will complement these datasets. Clinicians will evaluate AI-generated outputs against standardized criteria, using metrics such as diagnostic accuracy, time to assessment, and inter-reader agreement to assess reliability and clinical relevance.

Expected Outcomes:

1. A novel AI pipeline that reduces annotation requirements while enhancing segmentation precision.
2. Fair and equitable performance across diverse skin tones, mitigating diagnostic disparities.
3. A privacy-preserving federated learning framework for scalable multi-institutional adoption.
4. Lightweight, deployable models suitable for integration into tele-dermatology and mobile platforms.
5. Open-source tools and implementation guidelines to support translational adoption.

Conclusion and Impact:

This research delivers methodological innovations and translational pathways for AI in dermatology. By addressing annotation efficiency, fairness, privacy, and real-world deployment, the proposed framework advances skin lesion recognition toward equitable, accessible, and trustworthy solutions. The outcomes have the potential to significantly impact global dermatology practice, ensuring AI technologies benefit diverse patient populations and contribute to reducing healthcare disparities.

Enhancing Shelf Life of Apple Juice: Synergistic Effects of Chitosan and Pomegranate Peel Extract on Antioxidant Activity and pH Stability at Room Temperature

Shanthi Vunguturi

Department of Chemistry, Muffakham Jah College of Engineering and Technology, Hyderabad, Telangana, India

Geeta Swarupa Pamidimalla

Department of Chemistry, Muffakham Jah College of Engineering and Technology, Hyderabad, Telangana, India

Abstract:

The natural antimicrobial agents may extend the shelf life of the juice. Fermentation by *Saccharomyces* species is the primary cause of yeast spoilage of apple juice, although other yeasts also can spoil the juice. Chitosan and pomegranate peel extract, although promising as potential additives to improve fresh apple juice stability, are generally mainly attributed to their antioxidant and antimicrobial properties. All over the globe, natural preservatives are widely preferred over toxic and synthetic preservatives. Pomegranate peel had more polyphenolic contents than others that have shown strong antibacterial and antifungal activities. There are various studies on the beneficial effects of chitosan in food preservation, and it is also used as a suitable clarifying agent. The goal of the present research is to extend the shelf life of apple juice without decreasing its antioxidant activity and pH values with the assistance of pomegranate peel extract and chitosan at room temperature. The mixture of apple juice with pomegranate peel extract and chitosan possessed maximum antioxidant activity along with pH below 4.0. However, those levels between 5ml to 10ml per 100ml of apple juice were tolerable. Hence, based on these results, it is observed that pomegranate peel extract supplemented with chitosan enriched apple juice has more shelf life than the regular apple juice or the apple juice supplemented only with pomegranate peel extract or only chitosan.

Keywords:

Antioxidant activity, pH, PPE, chitosan, Shelf life.

Artificial Intelligence as a Tool and Theory: Transforming Physics Research and Beyond

Manoj Kumar. G. C

Faculty, Department of Physics, S.E.A College of Science, Commerce and Arts, Autonomous, K. R. Puram, Bangalore, Karnataka, India

Abstract:

Artificial intelligence (AI) is increasingly transforming the way scientists explore the universe, while insights from physics are simultaneously driving innovations in AI. This work examines the synergy between AI and theoretical physics, highlighting how AI technologies are accelerating discovery through the analysis of experimental datasets and the simulation of complex phenomena in particle physics and astrophysics. At the same time, fundamental principles of physics are inspiring new AI paradigms, from energy-based models to quantum-inspired approaches. Key applications are discussed, ranging from AI-driven investigations of dark matter to the emerging potential of quantum AI. Finally, we consider the broader implications of this interaction for both the foundations of AI and the advancement of our fundamental understanding of the universe.

Keywords:

AI, Physics, AI-driven, Quantum AI.

An Overview of Dark Side of AI

Meghana. D. P

Degree Student (BCA), S.E.A College of Science, Commerce and Arts, Autonomous, Karnataka, India

Pavithra. S

Degree Student (BCA), S.E.A College of Science, Commerce and Arts, Autonomous, Karnataka, India

Abstract:

The rapid advancement of Artificial Intelligence (AI) presents unprecedented opportunities across various domains, but it also raises profound concerns regarding its ethical, technical, and security implications. Prominent experts, including Geoffrey Hinton and Elon Musk, have issued warnings about the potential risks posed by AI, particularly the emergence of Artificial Superintelligence (ASI) a theoretical stage where AI systems surpass human intelligence and become uncontrollable. This paper explores the “dark side of AI,” focusing on key challenges such as ethical and social dilemmas, technical and operational barriers, and significant security threats. ASI could potentially enable autonomous cyberattacks, manipulation of human behavior, and misuse by malicious actors, highlighting the urgent need for effective oversight. To address these risks, a multi-faceted approach is essential incorporating ethical governance, robust regulatory frameworks, transparency in AI systems, strong human oversight, and widespread public education. The study emphasizes the importance of global collaboration in ensuring that AI development remains aligned with human values and safety

Keywords:

Expert warn about AI, ASI, key challenges in AI, Addressing the issues.

Dynamic ECU Key Generation for Secure In-Vehicle Communication

Shreya Sagar S

Electronics and Communication, B M S College of Engineering, Bangalore, Karnataka, India

Dr. Jayanthi K Murthy

Electronics and Communication, B M S College of Engineering, Bangalore, Karnataka, India

Abstract:

As vehicles evolve into intelligent, connected cyber-physical systems, the need for secure and resilient in-vehicle communication has become paramount. The Controller Area Network (CAN), though widely adopted for its real-time performance and simplicity, lacks inherent security features, leaving modern automotive systems exposed to critical threats such as spoofing, eavesdropping, and replay attacks. This project introduces a dynamic and lightweight cryptographic framework for securing CAN communication by leveraging hardware-based random number generation, SHA-256 hashing, Elliptic Curve Diffie-Hellman (ECDH) key exchange, and AES-128 encryption/decryption. Each Electronic Control Unit (ECU) autonomously generates its private key from true random entropy, derives a public key via elliptic curve operations, and performs a secure ECDH-based key agreement without the need for pre-shared static keys. The resulting session key enables confidentiality and integrity of messages exchanged over the CAN bus. The solution is implemented on ESP32 microcontrollers and evaluated for cryptographic performance. Also, formal verification using Verifpal validates the protocol's robustness under the active Dolev-Yao attacker model, confirming resistance to man-in-the-middle, replay, key substitution, secrecy and forgery attacks. Furthermore, BAN Logic reasoning confirms authentication, freshness, and trust properties in the message exchange. The proposed design offers a scalable, efficient, and secure cryptographic foundation for future automotive systems, aligning with emerging industry standards such as ISO/SAE 21434.

Keywords:

Controller Area Network (CAN), Electronic Control Unit (ECU), Elliptic Curve Diffie-Hellman (ECDH), Secure Hash Algorithm 256 (SHA-256), Advanced Encryption Standard 128-bit (AES-128), Verifpal (Formal Verification Tool), Burrows-Abadi-Needham (BAN) Logic, Dolev-Yao Adversary Model, Automotive Cybersecurity, ESP32 Microcontroller.

Next-Gen Smart Vigilance: Harnessing AI For Real Time Monitoring

Dileep B N

Electronics and Communication, B M S College of Engineering, Bangalore, Karnataka, India

Dr. Jayanthi K Murthy

Electronics and Communication, B M S College of Engineering, Bangalore, Karnataka, India

Abstract:

Present and emerging intelligent surveillance systems require high accuracy, low latency, and robust performance in order to operate effectively in diverse and dynamic environments. Modern security solutions increasingly rely on deep learning-based computer vision to enhance detection precision, track objects, and analyze human behavior in real time. This study proposes an AI-powered vigilance framework integrating Vision Transformer (ViT) for high-accuracy face recognition, YOLO for rapid object detection, and TimeSformer for temporal-based suspicious activity recognition. The system is deployed on a Raspberry Pi 4B with a custom-built operating system generated through the Yocto Project, optimized for efficient edge inference and resource utilization. The proposed approach leverages the ViT's ability to extract discriminative facial embeddings under variable lighting and pose conditions, YOLO's capability to perform real-time object localization with minimal computational overhead, and TimeSformer's spatiotemporal modelling to detect abnormal activities from sequential video frames. A Django-based web dashboard aggregates the processed results, displaying live feeds, detection overlays, and automated alerts for improved situational awareness. By combining lightweight model architectures with optimized edge deployment, the proposed system reduces dependency on high-bandwidth network connections while maintaining operational reliability, providing a scalable, and privacy-preserving solution for modern surveillance applications.

Keywords:

Smart Surveillance, Face Recognition, Suspicious Activity Detection, Object Detection, Raspberry pi.

An Overview of Cyber Security Mechanism in Different Application

Dhruva G N

B.Sc. Student, S.E.A College of Science, Commerce and Arts, Bangalore, Karnataka, India

Kruthika Bai K M

B.Sc. Student, S.E.A College of Science, Commerce and Arts, Bangalore, Karnataka, India

Abstract:

In the digital era, cybersecurity is growing along with technology, networking, and data-driven applications. Threats keep getting smarter, so we really need solid ways to protect stuff in places like online shopping, banks, hospitals, cloud setups, social apps, and even factory systems. security mechanisms across various domains such as e-commerce, banking, healthcare, cloud computing, social media, and industrial systems. This paper discusses the fundamental principles of cybersecurity in different applications and analyzes the mechanisms to safeguard data integrity, confidentiality, and availability. The study highlights how the effectiveness of security mechanisms varies depending on the application context, resource availability, and evolving nature of attacks. By comparing different approaches, this aims to give a full picture of cybersecurity practices for future improvement.

Keywords:

Cybersecurity, Applications, cyber threats.

Quantum-Driven Deep Learning Framework for Predictive Diagnosis of Thyroid Cancer

Silki Shreya

Department of Electronics and Communication Engineering, Amrita School of Engineering, Coimbatore, Amrita Vishwa Vidyapeetham, India

P.K. Krishnan Namboori

Computational Chemistry Group (CCG), Amrita Molecular Modeling and Simulations Research Lab, Amrita School of Engineering, Coimbatore, Amrita Vishwa Vidyapeetham, India

Biopharma Solutions, Coimbatore, India. Centre for Computational Engineering and Networking, Amrita School of Artificial Intelligence-Coimbatore, Amrita Vishwa Vidyapeetham, India

Abstract:

Thyroid cancer tends to present with vague initial symptoms, and thus, the diagnosis is difficult even with advanced imaging technologies. The current investigation introduces a new diagnostic system that employs Deep Learning (DNN) and Quantum-based DNN models for early detection, utilizing high-resolution histopathological images and gene expression levels from the TCGA portal. The DNN model efficiently extracts intricate features, and the quantum-based model improves computational efficiency and precision. With 97.65% accuracy using DNN and 99.89% accuracy using Quantum-DNN, the system demonstrates high potential for early diagnosis and customized treatment planning. The hybrid system shows promising clinical potential and indicates the future of quantum computing in scalable, accurate medical diagnosis.

Keywords:

Thyroid Cancer, DNN, Quantum-based DNN, Histopathological Image, and Medical Diagnosis.

Development and Comparison of Ha-BSA Coated Nanostructured Lipid Carrier Containing Fisetin and Flavokawain a Combination and Paclitaxel with Flavokawain a as Targeted Drug for Carcinoma of Lung

Anjum Hasnain

Assistant Professor, Datta meghe College of Pharmacy, Maharashtra, India

Darshan Telange

Assistant Professor, Datta meghe College of Pharmacy, Maharashtra, India

Abstract:

Background: Lung carcinoma, particularly non-small cell type, continues to be one of the leading causes of cancer-related deaths worldwide. Standard drugs such as paclitaxel are widely used, but their clinical benefit is often restricted by systemic toxicity, limited tumor specificity, and the development of drug resistance. Natural flavonoids, including fisetin and flavokawain A (FKA), have shown significant anticancer potential, though their therapeutic use is limited by poor solubility and low bioavailability.

Objective: This study was designed to develop and compare hyaluronic acid-bovine serum albumin (HA-BSA) coated nanostructured lipid carriers (NLCs) loaded with (i) fisetin and FKA, and (ii) paclitaxel and FKA, with the aim of improving targeted delivery and therapeutic outcomes in lung carcinoma.

Methods: NLCs were formulated and coated with HA-BSA to facilitate CD44 receptor-mediated tumor targeting. The formulations were characterized for particle size, zeta potential, morphology, drug encapsulation efficiency, and in vitro release behavior. Cytotoxicity and cellular uptake were assessed in lung carcinoma cell lines, and the comparative anticancer potential of both formulations was evaluated.

Results: The HA-BSA coated NLCs showed uniform nanoscale size, high drug entrapment efficiency, and controlled drug release. Both fisetin + FKA and paclitaxel + FKA formulations displayed greater cytotoxicity than free drugs. Importantly, fisetin + FKA-loaded NLCs demonstrated enhanced cellular uptake, synergistic anticancer activity, and reduction of resistance-associated markers, suggesting a therapeutic advantage over the paclitaxel combination.

Conclusion: HA-BSA coated NLCs co-loaded with fisetin and flavokawain A offer a promising strategy for targeted lung carcinoma therapy. The system combines improved drug delivery, tumor specificity, and reduced toxicity, highlighting its potential as a novel alternative or adjunct to conventional chemotherapy.

Keywords:

Lung carcinoma, non-small cell lung cancer, nanostructured lipid carriers, HA-BSA, fisetin, flavokawain A, paclitaxel, targeted delivery.

Impact of AI in Agriculture in Future

Rachitha. K

Department of Computer Science, S.E.A College of Science, Commerce and Arts, Autonomous, Bangalore, Karnataka, India

Abstract:

In the current era, Artificial Intelligence (AI) is rapidly evolving and transforming various fields by offering significant advantages. However, agriculture is one of the most essential sectors has been comparatively slow in adopting AI technologies. In the future, AI has immense potential to revolutionize agriculture by reducing human labour, enhancing efficiency, and improving crop productivity. Through smart farming practices, predictive analytics, automated machinery, and precision agriculture, AI can address challenges such as farmer shortages, climate uncertainties, and resource management. The integration of AI in agriculture could lead to sustainable farming practices, increased yield, and better food security for the growing population and economic growth.

Keywords:

Artificial Intelligence, Agriculture, data analysis.

AI-Enhanced Online Examination Portal with Real-Time Proctoring and Automated Evaluation

Vazhan Arul Santhiya R

AP/CSE, Department of Computer Science and Engineering National Engineering College, Kovilpatti, Tamil Nadu, India

Kavya S

UG Scholar, Department of Computer Science and Engineering National Engineering College, Kovilpatti, Tamil Nadu, India

Ramya C

UG Scholar, Department of Computer Science and Engineering National Engineering College, Kovilpatti, Tamil Nadu, India

Smila M

UG Scholar, Department of Computer Science and Engineering National Engineering College, Kovilpatti, Tamil Nadu, India

Abstract:

Remote education is growing rapidly and has resulted in a significant need for secure, scalable and smart assessment platforms. Current remote assessment platforms, which employ online proctoring, typically suffer from issues such as static watching, reporting high false positives, privacy issues, and limiting personalized feedback. This proposal will present SkillProctor, an AI-Enhanced Online Exam System that incorporates (a) Local Binary Pattern Histogram (LBPH) for continuous face recognition, (b) YOLOv3 for multi-person and prohibited item detection, and (c) head-pose estimation for engagement tracking. SkillProctor can also conduct real-time plagiarism detection for code submissions and provide real-time AI-generated personalized feedback. Case studies show SkillProctor will improve accuracy and fairness, scalability and user-centered design, promote academic integrity, and improve learning outcomes in digital assessments.

Keywords:

AI-Powered Proctoring, LBPH, YOLOv3, Plagiarism Detection, AI-Generated Feedback, Online Assessment Integrity.



Physical and Mechanical Property Assessment of Sikki Grass

Rajesh Kumar

Aryabhatta Knowledge University, Patna, Bihar and National Institute of Fashion Technology, Patna, Bihar

Asjad Mokhtar

Aryabhatta Knowledge University, Patna, Bihar and National Institute of Fashion Technology, Patna, Bihar

Abstract:

Sikki grass, also known as golden grass, is a traditional natural fiber. It is commonly used in handicrafts throughout northern Bihar. But there is very little documentation about its quantified material properties. The lack of scientific information hampers quality control for the artisanal process and also limits research on the potential of an artisanal product to be marketed as a sustainable material for industrial applications such as natural-fiber composites. This current research provides a scientific evaluation of sikki grass. This research has attempted to identify properties of sikki grass such as moisture content, bulk density, tensile strength, and Young's modulus. The samples collected from three different villages were treated with standard cleaning, drying, and shaving methods. Properties were determined according to standard protocols modified for natural fibers. The analysis indicated moisture content of 8.7–10.3%, bulk density of 0.81–0.89 g/cm³, tensile strength of 145–187 MPa, and Young's modulus of 5.3– 6.6 GPa. These indicate that sikki falls within jute and coir performance ranges but are less dense and more pliable. There was variation in locations and processing conditions, highlighting the need for a more standardized harvesting and preparation process. This study highlights the benefits of sikki (lightweight, sustainable, and flexible), adding a valuable dimension as a material that can be used for complex and long-lasting handicrafts, as well as a potential reinforcement in biodegradable composites. The findings extend beyond the preservation of a cultural craft, entail routes to industrial innovation via sustainable material substitution. Future research could focus on simple quality-grading schemes for artisans, protective pretreatments to enhance moisture-resistance, and hybrid composites to enhance engineering use.

Keywords:

Natural Fiber, Sustainable Materials, Mechanical properties, Tensile Strength, Handicraft Materials, Biodegradable composites.

Eye Tracking Technologies and Applications: A Sustainable Perspective

Mamta Bhardwaj

Research Scholar, Department of Computer Science, Indira Gandhi University Meerpur, Rewari, Haryana, India

Abstract:

Recently, eye tracking has evolved as a robust technique to understand user's attention, behavioural patterns, and underlying intent in diverse contexts spanning both physical and digital environments. This paper presents a systematic review of publications released between 2007 and 2024, with classifications based on application areas, types of eye-tracking systems, methodologies, datasets, tools, interaction techniques, primary outcomes, and suggested future work. Through this structured analysis, we uncover prevailing research trends, consolidate significant contributions, critically examine the limitations of current approaches, and propose potential avenues for further exploration. The findings are intended to serve as a comprehensive guide for academics, practitioners, and developers working toward innovations in gaze-based technologies.

Reimagining Elder-Centric Health Informatics through Soulbound and Composable NFTs

Poonam Verma

Graphic Era Hill University, Dehradun, Uttarakhand

Abstract:

In India and globally, the design of electronic health record (EHR) ecosystems continues to face a fundamental challenge: how to balance strong security with compassionate usability for elderly patients. While blockchain-based models have shown promise in assuring provenance and tamper-resistance, they frequently reduce records to monolithic bundles, making selective sharing, revocation, and elder-friendly access unnecessarily complex. In this paper, I propose a Soulbound-Composable NFT framework that reimagines elder-centric health informatics with both dignity and technological rigor. A non-transferable Master Health Soulbound Token (SBT) anchors patient identity in a manner that cannot be lost or misused, while Composable Sub-NFTs modularize health data into verifiable units such as laboratory results, imaging, prescriptions, allergies, and vitals. Consent is transformed into a one-tap, QR/NFC-based experience, producing time-limited, auditable, and revocable tickets that elders can manage without digital strain. Recognizing India's caregiving realities, the design further incorporates guardian-assisted recovery and emergency scopes, ensuring safety without loss of autonomy. By mapping each sub-NFT to FHIR-compliant resources, the framework integrates seamlessly with established clinical infrastructures. This approach transcends earlier blockchain, EHR and SSI prototypes by delivering a human-centered, cryptographically anchored, and modular disclosure pipeline. In essence, it reflects an elder-first philosophy, where security, usability, and cultural sensitivity converge to support trustworthy, inclusive health data exchange.

Keywords:

Soulbound NFT, Composable NFT, HER, Elder centric, blockchain.

ABCD-Guided Melanoma Classification with Support Vector Machines for Clinical Decision Support

Apurva Solanke

Research Scholar, Dr. G Y Pathrikar College of Computer Science and Information, Technology MGM University, Maharashtra, India

Prapti Deshmukh

Research Scholar, Dr. G Y Pathrikar College of Computer Science and Information, Technology MGM University, Maharashtra, India

Shriram Kathar

Research Scholar, Dr. G Y Pathrikar College of Computer Science and Information, Technology MGM University, Maharashtra, India

Abstract:

Melanoma is a highly aggressive form of skin cancer with a high mortality rate when not identified at an early stage. Conventional diagnostic approaches are often subjective, time-intensive, and dependent on expert interpretation, which can lead to variability in results. To address these challenges, this research presents an automated melanoma classification framework developed in MATLAB App Designer, integrating optimized preprocessing, clinically inspired feature extraction, and Support Vector Machine (SVM) classification. The preprocessing pipeline includes RGB-to-grayscale conversion, morphological hair removal, contrast enhancement, and lesion segmentation using Otsu thresholding. From the segmented lesion, ABCD features Asymmetry, Border irregularity, Color variegation, and Diameter are extracted and used to compute the Total Dermoscopy Score (TDS). These features are normalized and classified using an SVM with an RBF kernel in a one-vs-one multiclass scheme. Evaluation on the publicly available PH² dataset shows that the proposed system achieves approximately 96% accuracy, with sensitivity and specificity both exceeding 95%, outperforming KNN and Random Forest classifiers. The approach is reliable, interpretable, and computationally efficient, offering strong potential for integration into clinical workflows to support early detection and reduce diagnostic subjectivity.

Preparing for 7G: A Survey on the State of 5G, 6G, B6G

Bhavadharani R

Department of Electronics and Communication Engineering, SRM TRP Engineering College, Tiruchirappalli, Tamil Nadu, India

Abstract:

The rapid evolution of wireless communication has transformed the way we connect, communicate, and share information, paving the path from 1G analog systems to the futuristic vision of 7G networks. This paper presents a comprehensive survey of the progression from 5G to beyond 5G (B5G), with a focus on the emerging technologies of 6G and 7G. It reviews the limitations of existing 5G networks and highlights how advancements in areas such as spectrum utilization, artificial intelligence, nanotechnology, quantum communication, and bio-inspired systems are expected to redefine connectivity. Key applications—including autonomous systems, healthcare, cyber-physical systems, and Internet of Nano Things—are explored to showcase the transformative potential of these networks. Furthermore, the paper addresses the challenges of security, privacy, energy efficiency, and ethical considerations associated with next-generation communication. By analyzing the trajectory from 5G to 7G, this study provides insights into future directions of wireless technologies and their role in building intelligent, sustainable, and globally connected societies.

Keywords:

5G, B5G, 6G, 7G, wireless communication, artificial intelligence, nanotechnology.

IoT-Based Environmental Monitoring and Rainfall Prediction Using Machine Learning for Precision Irrigation

Suhas Bhise

Professor, Department of Electronics and Telecommunication Engineering Vishwakarma Institute of Technology, Pune, India

Yash Pawar

Department of Electronics and Telecommunication Engineering Vishwakarma Institute of Technology, Pune, India

Harshal Kulkarni

Department of Electronics and Telecommunication Engineering Vishwakarma Institute of Technology, Pune, India

Abhay Chopde

Professor, Department of Electronics and Telecommunication Engineering Vishwakarma Institute of Technology, Pune, India

Dhanashree Mandage

Department of Electronics and Telecommunication Engineering Vishwakarma Institute of Technology, Pune, India

Vedika Dange

Department of Electronics and Telecommunication Engineering Vishwakarma Institute of Technology, Pune, India

Abstract:

This paper discusses an Internet of Things (IoT) environmental monitoring and control system created for agriculture. The system uses microcontroller-based sensors to measure temperature, humidity, soil moisture, and rainfall in real-time. Sensor data is sent via Wi-Fi to a cloud-hosted Firebase Realtime Database, which can be accessed through a web dashboard built in ReactJS. The dashboard displays real-time data, allows control of irrigation actuators, and offers an export feature for hourly sensor logs in CSV format. To improve understanding of historical data, a companion application provides graphical representations, including line charts, histograms, pie charts, and bar graphs. In a proposed future extension, supervised machine learning models like Random Forest and Logistic Regression will be trained on historical environmental data to predict rainfall events and aid in agricultural planning. The system shows a complete process from field data collection to frontend visualization and predictive analytics, supporting efficient irrigation and informed

agricultural decisions. This framework offers a scalable method for climate-adaptive farming practices and helps advance the digital transformation of agricultural systems.

Keywords:

Internet of Things, Environmental Monitoring, Precision Agriculture, Wireless Sensor Networks, Firebase, ReactJS, Irrigation Control, Resource Optimization, Data Visualization, Rainfall Prediction, Random Forest, Logistic Regression.

A Review of Retrieval Systems used for Image, Text, Document Extraction

Supriya Sawwashere

Department of Artificial Intelligence, JD College of Engineering and Management, Nagpur, Maharashtra, India

Gauri Wasekar

Department of Artificial Intelligence, JD College of Engineering and Management, Nagpur, Maharashtra, India

Komal Gotefode

Department of Artificial Intelligence, JD College of Engineering and Management, Nagpur, Maharashtra, India

Payal Bhelave

Department of Artificial Intelligence, JD College of Engineering and Management, Nagpur, Maharashtra, India

Lokesh Bhaje

Department of Artificial Intelligence, JD College of Engineering and Management, Nagpur, Maharashtra, India

Abstract:

With the rapid advancement of mobile computing and artificial intelligence, document extraction and processing have become integral to digital workflows. Traditional cloud-based solutions introduce privacy concerns, latency, and internet dependency, making them less feasible for real-time applications. This paper presents a comprehensive review of on divide document extraction techniques, focusing on an Android-based smart document extraction application. The proposed system leverages Large Language Models(LLMS),Natural Language Processing(NLP) and Generative AI to enable offline, privacy-centric, and real-time document processing. We explore the methodologies, technologies, challenges, and future research directions in edge AI-based document extraction.

Keywords:

LLM(Large language model), NLP(Natural language processing), Generative AI.

Machine Learning and Deep Learning Frameworks for Diabetic Retinopathy Detection: Progress Toward Vision Transformers and Explainable AI

Shubham Chandratre

Pune Institute of Computer Technology, Pune, India

Geetesh Chaudhari

Pune Institute of Computer Technology, Pune, India

Purav Daga

Pune Institute of Computer Technology, Pune, India

Pratik Jaiswal

Pune Institute of Computer Technology, Pune, India

Ravindra Murumkar

Pune Institute of Computer Technology, Pune, India

Abstract:

Diabetic Retinopathy (DR) is one of the leading causes of vision impairment worldwide, and early detection is crucial to prevent blindness. In recent years, artificial intelligence (AI) has transformed automated DR screening through machine learning (ML) and deep learning (DL) frameworks. This survey reviews the progression from classical ML approaches such as Support Vector Machines and handcrafted features, to deep CNN architectures, ensemble and hybrid models, and the emerging role of Vision Transformers (ViTs). The importance of explainable AI (XAI) is emphasized, with methods such as Grad CAM and SHAP enabling model interpretability and improving clinical trust. A comparative analysis of existing works highlights datasets, preprocessing techniques, performance, and limitations. Finally, challenges including data imbalance, generalization, and clinical adoption are discussed, alongside future research directions in multimodal learning, federated frameworks, and lightweight interpretable models.

Keywords:

Diabetic Retinopathy, Deep Learning, Vision Transformers, Explainable AI.

Wastewater Treatment by Advanced Oxidation Process (Hydrodynamic Cavitation)

Ashish Chopade

Vishwakarma Institute of Technology , Pune, India

Atharva Hate

Vishwakarma Institute of Technology , Pune, India

Vedant Kamble

Vishwakarma Institute of Technology , Pune, India

Darshan Marale

Vishwakarma Institute of Technology , Pune, India

Archit Chavan

Vishwakarma Institute of Technology , Pune, India

Abstract:

Treatment of textile wastewater with tough dyes such as Aniline Blue is environmentally challenging because it is resistant to routine degradation processes. This paper explores the effectiveness of Hydrodynamic Cavitation (HC) as an Advanced Oxidation Process (AOP) for degrading Aniline Blue dye from synthetic wastewater. Hydrogen peroxide (H_2O_2) was used as an oxidizing reagent to increase the degradation process. Chemical Oxygen Demand (COD) analysis was performed to analyze the efficiency of the treatment, with theoretical and experimental COD measurements at 241 mg/L and 272 mg/L, respectively. The outcomes showed substantial dye degradation, proving HC as a suitable option for industrial wastewater treatment. The paper highlights the viability of hydrodynamic cavitation in conjunction with oxidizing agents in obtaining sustainable and effective dye degradation in line with regulatory requirements and environmental safety.



An IoT-Integrated Deep Learning System for Early and Automated Leaf Disease Detection in Smart Agriculture Environments

Rajaneshwari

Department of Computer Science & Engineering, Sharnbasva University, Kalaburagi, India

Dr. Shantkumari Machetty

Department of Computer Science & Engineering, Sharnbasva University, Kalaburagi, India

Abstract:

The early detection of leaf diseases plays an essential part in ensuring the yield of crops and reducing economic losses and making sure that sustainable farming practices are in place. This paper introduces an innovative framework for diagnosis that blends Internet of Things (IoT) technology and the Convolutional Neural Network (CNN) to offer accurate and immediate diagnosis of disease. The system analyzes high-resolution leaf images using an expertly trained CNN model that can distinguish between healthy and diseased specimens with high accuracy. In parallel, IoT sensors monitor key environmental parameters, such as the temperature, moisture in soil as well as humidity. These are vital indicators of risk assessment for diseases. A web interface that is based on Flask allows users to upload photos to receive instant results on classification and trigger automated field actions including irrigation control and activation of UV light. Furthermore, real-time alerts are sent through an mobile IoT platform that allows remote monitoring and quick intervention. The results of experiments show robust accuracy in classification and reliability in a range of conditions providing a flexible, effective and automated method for precision agriculture as well as environmentally sustainable crop protection.

Keywords:

Leaf disease detection, IoT, deep learning, CNN, smart agriculture, precision farming, automated diagnosis.

A Comprehensive Review of Optimization Techniques Implemented in the Design of Sustainable Closed Loop Supply Chain

P. Vivek

Research Scholar, Defence Institute of Advanced Technology, Pune, India

Dr. Nilesh Ware

Defence Institute of Advanced Technology, Pune, India

Abstract:

In response to frequent market disruptions and resource scarcity, organizations globally are prioritizing the development of resilient supply chain strategies to sustain a competitive advantage. This entails designing supply chains capable of operating effectively under uncertainty, encompassing both forward and reverse logistics. Addressing such uncertainties necessitates the creation of robust and adaptable supply chain models. Researchers are now focusing on developing models that can accurately capture the complexity and uncertainties inherent in modern supply chains. Existing literature primarily emphasizes two areas: (i) integrating reverse logistics activities—such as collection, recovery, and recycling of used products—to extend product lifecycles and reduce waste, and (ii) developing models that simultaneously address economic, environmental, and social objectives, in alignment with the broader principles of the circular economy. The study aims to identify current trends in sustainable supply chain optimization techniques and highlight potential directions for future research. To account for the uncertainty in a closed loop supply chain network design authors have focused on methods such as MILP (Mixed Integer Linear Programming) for model building. While exact methods are more suitable for a simple deterministic model. The study shows the use of metaheuristics like genetic algorithms, particle swarm optimization and simulated annealing improve rate of convergence in a multi-echelon, multi-period and multi-product model. The results reveal a strong coupling between authors from China, the United States, and Iran, indicating rapid acceptance of sustainable practices. Scientometric analysis identifies topic of “sustainable closed-loop supply chain” as predominant area for publication. Research gap exists in the use of transport-related decision variables, such as vehicle routing, mode of transport, and delivery scheduling. Future research directions shall focus on developing hybrid genetic algorithms which reduces computational time and solution quality. This study is limited by its focus on open access articles published within the past five years in SCOPUS.

Keywords:

Sustainable supply chain, optimization, green supply chain, genetic algorithm, metaheuristics.

E-Waste Management in Delhi: Examining the Legal Framework and Implementation Gap

Dr. Aqil Ahmed

Executive Engineer (Civil), Municipal Corporation of Delhi, India

Ankita Maheshwari

IT Consultant and Analyst, Municipal Corporation of Delhi, India

Abstract:

Delhi is one of India's largest generators and traders of electronic waste (e waste), with a complex ecosystem spanning formal recyclers and an extensive informal network concentrated in local hotspots. India's E Waste (Management) Rules, 2016 overhauled by the E Waste (Management) Rules, 2022 effective 1 April 2023 shift the governance architecture to a digital, Extended Producer Responsibility (EPR) regime that is intended to sharpen accountability across producers, dismantlers, and recyclers, while aligning with the Solid Waste Management (SWM) Rules, 2016 under municipal mandates. This paper maps Delhi's regulatory landscape, institutional roles, and material flows, and evaluates the implementation gap between statutory intent and practice. Using triangulated secondary sources (CPCB/PIB statistics, DPCC notifications, judicial/NGT directions, and civil society studies) along with stakeholder insights, we diagnose systemic bottlenecks—weak primary collection, under registration of bulk generators, leakage to informal channels, capacity/market constraints in approved facilities, and data-quality issues in the new EPR credit system. It is proposed that a practical pathway combining regulatory tightening and market design: (i) ward level primary collection with municipal producer cost sharing, (ii) demand side pull for verified recycled via green public procurement, (iii) time bound conversion of informal hubs through cluster level contracts, training, and safety norms, (iv) real time EPR data reconciliation and third party audits, and (v) the rapid commissioning of the Delhi e waste eco park to absorb and formalise flows. The framework offers a replicable model for Indian megacities seeking to operationalise EPR while protecting livelihoods and the environment. Delhi can close the policy practice gap within three years by operationalising ward level collection, contracting cluster conversions, auditing EPR flows, and stimulating markets through GPP and deposit refund pilots. Success depends on institutional partnership among MCD, DPCC, CPCB, and producer/PRO consortia, and on transparent, inclusive transition for workers in existing hubs. The proposed roadmap provides a practical and scalable template for Indian megacities.

Keywords:

e waste, Extended Producer Responsibility (EPR), SWM Rules 2016, E Waste (Management) Rules 2022, Delhi Pollution Control Committee (DPCC), Municipal Corporation of Delhi (MCD), informal sector, eco park, circular economy.

Reimagining The Aerospace Manufacturing: A Human-Centric Technological Perspective Under Industry 5.0

Monica Shukla

Assistant Professor, Symbiosis Institute of International Business, Pune, Maharashtra, India

Chandra Pal

Assistant Professor, IILM University, Greater Noida, Uttar Pradesh, India

Abstract:

The current industrial models emphasize on robotics, artificial intelligence, and data integration, Industry 5.0 restores human expertise, intuition, and craftsmanship to the centre of production. This study investigates the key enablers that support this transition in the aerospace sector, identifying the most influential critical success factors (CSFs) for integrating human-centric technologies in aircraft manufacturing. A structured framework was developed to evaluate these CSFs using the Best-Worst Method (BWM) supported by judgment analysis. Experts from the aerospace industry, including design engineers, production managers, and innovation specialists and were consulted to identify and compare factors influencing successful Industry 5.0 adoption. Through pairwise comparisons, weights were assigned to each factor, and the consistency of expert judgments was validated. The results highlight that airplane manufacturing under Industry 5.0 depends not merely on technological sophistication but on creating systems that value human creativity and decision-making. Strengthening workforce capabilities, ensuring responsible AI use, and fostering a culture of ethical innovation are essential for realizing this transformation. The study contributes to understanding how human intelligence and automation can co-evolve in high-precision industries. By applying the Best-Worst Method and judgment analysis, it offers a structured decision-making approach for organizations aiming to achieve sustainable, human-centric production in the next generation of aerospace manufacturing.

Comparative Study of Different Framing Techniques Proposed by IS 16700: 2023

Prashant R. Vyapare

Assistant Professor in the Department of Structural Engineering, Sanjivani College of Engineering, Kopergaon, Maharashtra, India

Hemlata Mansingh Rathod

B.Tech. Degree, Structural Engineering, Sanjivani College of Engineering, Kopergaon, Maharashtra, India

Shraddha Ashok Yadav

B.Tech. Degree, Structural Engineering, Sanjivani College of Engineering, Kopergaon, Maharashtra, India

Kartiki Kisan Chandane

B.Tech. Degree, Structural Engineering, Sanjivani College of Engineering, Kopergaon, Maharashtra, India

Prakash Abhiram Singh

B.Tech. Degree, Structural Engineering, Sanjivani College of Engineering, Kopergaon, Maharashtra, India

Abstract:

Due to the increasing population in cities, vertical expansion of buildings (Tall buildings) has become a popular choice in India. Tall buildings withstand lateral forces because of earthquakes and wind. This study examines popular framing methods for a 60 m (G+19) RCC building in Seismic Zone III, focusing on Moment Resisting Frame, Core Structural Wall, and Outer Structural Wall, as these are the most popular framing techniques in India as per IS 16700:2023. The linear analysis (Equivalent Static and Response spectrum) was carried out for design purposes, and pushover analysis was carried out to evaluate the performance of the considered frames. The results show that all systems are structurally safe; however, the inclusion and location of shear walls significantly influence the building's seismic performance. The Outer Structural Wall system exhibited the highest stiffness and the least lateral displacement, making it more effective than both the Moment Resisting Frame (MRF) and Core Wall systems in controlling drift. In contrast, while the MRF offered greater ductility, it had lower stiffness. This is why the Outer and Inner Structural Wall system is particularly suitable for tall structures located in regions with moderate seismic activity.

DPlateEye: Intelligent License Plate Detection and Recognition System for Smart Surveillance

Vishal Prajapati

Department of Computer Science and Engineering Chandigarh University, Mohali, India

Satyam Kumar

Department of Computer Science and Engineering Chandigarh University, Mohali, India

Diya Tiwari

Department of Computer Science and Engineering Chandigarh University, Mohali, India

Sandeep Kaur

Department of Computer Science and Engineering Chandigarh University, Mohali, India

Abstract:

Number plate recognition systems that have been computerised are able to extract records of auto pictures and observe them in numerous trafficking applications in safe, convenient and modern transport tools. The originality of such project is that it is able to deblurred blurred images and transfer them to new learning patterns. After the ROI is determined, it is more appropriate that data pre-processing actions are taken prior to subjecting the same to the CNN iteration. A data set of Indian wide variety plates fonts (8999 pictures of various alpha-numerical characters) was created having the accuracy of 91 percent. The input and filtered characters were matched to Indian Regional Transport Office (RTO) database via Roboflow and Uralytics to give breakdown data. The results obtained in the experiment were an outstanding accuracy of 96.5

Keywords:

Number Plate Detection, CNN, YOLOV3, OCR, RTO, Pre-processing, Dataset, ROI.

An Extensive Survey on Question Answering Systems in Low Resource Languages

Jeevit Davidson S

Department of Computer Science and Engineering, SRM Institute of Science and Technology, Kattankulathur, Chennai, India

M. Murali

Department of Computing Technologies, SRM Institute of Science and Technology, Kattankulathur, Chennai, India

Abstract:

There is a vast amount of knowledge available to us in this digital age. For the contemporary age, it is difficult to find the exact information among the large amount of information. Searching online or asking queries are the two basic methods employed to find the correct information. A question-answering (QA) system is far more preferred to receiving the exact information as searching provides us with a list from which we collect the closely related information. Most of the information on the internet is in English, thus question-answering software created for this language has likewise advanced with improved performance. Question-answer systems in most of the other languages are still in their infancy. This work tries to study the various QA system configurations, to highlight the improvements in each category for the English language and compared with low resource languages. To serve better as a resource for forthcoming studies, the difference between high-resource and low resource QA systems is thoroughly explained in this study.

Keywords:

Tamil Language, Question Answering System (QAS), Word Similarity, Low resource language.

Federated Diffusion Models for Explainable, Zero-Shot Plant Disease Detection and Adaptive Care in Edge IOT Systems

Shireen Tabbassum

Department of E&CE, FOET, Khaja Banda Nawaz University, Kalaburagi, Karnataka, India

Abstract:

Plant diseases continue to threaten global food production, underscoring the need for early, accurate, and field-ready diagnostic systems. While recent advances in deep learning — including CNNs, GANs, and vision transformers — have improved plant disease recognition, most approaches still face practical limitations such as data scarcity, limited interpretability, and privacy concerns during model training.

This study proposes a Federated Diffusion Model (FDM) framework that enables

Explainable and privacy-preserving plant disease detection across a distributed farm Networks. The model leverages federated learning to collaboratively train Decentralised edge devices without transferring raw data, while diffusion-based Generative modelling synthesises realistic plant images to augment limited datasets.

By integrating explainable AI (XAI) techniques such as saliency mapping, the framework enhances model transparency and builds user trust in automated diagnostics.

A zero-shot learning module enables the system to recognise previously unseen pathogens by utilising pre-trained multimodal embedding's derived from visual, spectral, and environmental data. The adaptive care component combines contextual inputs, including soil, climate, and relocation, to generate personalised recommendations for farmers in real-time.

Experimental validation across multiple crop datasets shows that the proposed model achieves a high diagnostic accuracy exceeding 98% and is achieved with significantly lower latency on edge IoT hardware. The high diagnostic accuracy exceeds 98% and is achieved with significantly lower latency on edge IoT hardware. The diagnostic accuracy is over 98%, with significantly lower latency on edge IoT hardware compared to conventional deep learning baselines. The findings highlight FDM's potential as a scalable, interpretable, and resource-efficient framework for precision agriculture, promoting sustainable crop health management and data-secure collaboration among farming communities.

Keywords:

Federated diffusion models, Explainable AI, Zero-shot learning, Plant disease detection, Edge IoT systems, Precision agriculture, Federated learning, Adaptive care, Synthetic data generation, Privacy preservation.

A Systematic Review of Deep Neural Architectures for Sign Language Recognition

Pratik Rakesh Patel

Department of Computer Science & Engineering, Parul Institute of Engineering & Technology, Vadodara, India

Dr. Kamal Sutaria

Department of Computer Science & Engineering, (AI & ML) Parul Institute of Engineering & Technology, Vadodara, India

Dr. Daxa Vekariya

Department of Computer Science & Engineering, (CS) Parul Institute of Engineering & Technology, Vadodara, India

Abstract:

As per the current advancements in the field of Sign Language Recognition (SLR), it has progressed by leaps and bounds through neuroscience as well as computer vision and deep learning advances. In particular, the shifting trend from hand-engineered features to sophisticated, deep neural structures that learn complex patterns in gestures in space and time speaks for itself. From convolutional networks to hybrid CNN-LSTM frameworks enriched with attention to spatio-temporal graph convolution models and multi-scale temporal enhancement techniques, nothing guarded approaches for real-time isolated and continuous recognition, adopting YOLO-based object detection architectures for speed and accuracy improvements. Optimization methodologies, that is, via autoencoders, through metaheuristic and hybrid optimizers have been embraced for better feature extraction and model generalization. Recently, additional research work has been expanded toward bilingual or multilingual recognition, sentence-level meaning along with phonological features for better semantics. Significant challenges persist in addressing signer variability and background complexity, limited available datasets, and large-scale continuous recognition. A systematic review of all the recent advancements in deep learning for SLR has been carried out, laying more emphasis on accuracy, robustness, and efficiency in SLR models. Lastly, open issues and future research paths are identified to build more adaptive, inclusive, and intelligent sign language technologies.

Keywords:

Sign Language Recognition, Deep Neural Networks, Spatio-Temporal Modeling, Gesture Recognition, Computer Vision.

Facility Layout Optimisation using Simulated Annealing

Pawan Kumar S S

Ph.D., Scholar, Department of Mechanical Engineering, University Visvesvaraya College of Engineering, Bangalore University, Bangalore, Karnataka, India

U. N. Kempaiah

Professor, Department of Mechanical Engineering, University Visvesvaraya College of Engineering, Bangalore University, Bangalore, Karnataka, India

Irappa Basappa Hunagund

Professor, Department of Mechanical Engineering, Government Engineering College, Haveri, Karnataka, India

Abstract:

Traditional facility layout techniques such as CRAFT, ALDEP, and CORELAP have been widely applied due to their simplicity and ease of implementation. However, these methods often struggle to handle large-scale, complex, and multi-constraint layout problems. Their limited adaptability often results in convergence to local optima. To overcome these limitations, metaheuristic algorithms—such as Simulated Annealing (SA), Genetic Algorithms (GA), Ant Colony Optimisation (ACO), and Tabu Search (TS)—have been employed and efficiently explore the solution space, locate global optima within a reasonable computational time. Despite their effectiveness, these algorithms typically require careful parameter tuning and may face convergence challenges in a highly multimodal solution space. This article is based on careful parameter tuning of the proposed SA algorithm, like initial temperature and cooling rate, by multiple iterations from benchmark problems in QAPLIB and also carries out Statistical analysis for the instances published in the literature on the plant layout problem.

Keywords:

Simulated Annealing, Facility Layout, parameter tuning, Statistical analysis.

Time Dependent Reliability Analysis of Complex System using Markov Process and ANFIS

Deepanshi

Department of Mathematics, Graphic Era (Deemed to be University), Dehradun, India

Nupur Goyal

Department of Mathematics, Graphic Era (Deemed to be University), Dehradun, India

Akansha Gupta

Department of Computer Science and Engineering, Graphic Era (Deemed to be University), Dehradun, India

Abstract:

Reliability is essential for ensuring the long-term performance and consistency of products, services, and systems. It plays a important role in safety of the products. This study formulates the problem of reliability analysis of complex systems using the supplementary variable technique (SVT) and the Markov process. The Laplace transform is used to solve the mathematical model and evaluate the proposed system dependability performance metrics, including reliability and Mean Time to Failure (MTTF). Machine learning techniques can be used to analyse complex and dynamic system more quickly and accurately. The Adaptive Neuro-Fuzzy Inference System (ANFIS) is used to assess and validate the dependability. By the using fuzzy if-then rules, fuzzy logic can handle data ambiguity and make decisions that are similar to those made by humans. The ANFIS model confirm what we discovered using Markov process, which is that complex systems become less reliable with time. This research has a social advantage in that it increases the dependability of complex systems, which immediately benefits infrastructure management, healthcare, and public safety. A graphical representation of the results is also provided for better understanding of the study.

Keywords:

Complex system, Markov process, Reliability, MTTF, ANFIS.

BERT-Driven Multilingual Fake News Detection with Hybrid Deep Neural Architecture

Ekta

Student, Chandigarh University, Punjab, India

Monika Devi

Student, Chandigarh University, Punjab, India

Abstract:

The rapid dissemination of misinformation and fake news across linguistic and cultural barriers, resulting from the explosive growth of social media platforms, is posing serious challenges to social stability, political processes, and public health. Traditional false news detection algorithms' domain-specificity and monolingual nature have limited their scalability in multilingual environments. In this study, we present a multilingual false news detection methodology that utilizes advanced deep learning architectures and BERT-based transformer models to efficiently classify news articles across multiple languages. Our approach uses pre-trained BERT embeddings that have been optimized for cross-lingual understanding in conjunction with hybrid neural network architectures, such as Convolutional Neural Networks (CNNs) and Bidirectional Long Short-Term Memory (BiLSTM) layers, to capture both semantic and contextual features of multilingual text. Experiments on publicly available multilingual fake news datasets demonstrate that the system performs better than monolingual baselines and classical machine learning in terms of accuracy, precision, and F1-scores. The findings show that transformer-driven tactics can be applied to combat misinformation in a range of linguistic contexts. Additionally, the system design makes it easier to integrate visual workflows, performance graphs, and algorithmic models, ensuring comprehensive analysis and reproducibility.

MemoryAnchor: A Multilingual Voice-Driven Memory Companion for Dementia Care

Balaji Kartheek

Student, Manipal Institute of Technology, Karnataka, India

Sivesh Patti

Student, Manipal Institute of Technology, Karnataka, India

Aishwarya Subba Raju

Student, Manipal Institute of Technology, Karnataka, India

Rajat Singh

Student, Manipal Institute of Technology, Karnataka, India

Abstract:

The inability to remember daily life, medications, conversations, appointments, and so on is one of the most difficult aspects of dementia. MemoryAnchor will assist with its purpose of being a friendly voice-only assistant that reminds, recalls and reconnects. It allows individuals with the early-to-moderate dementia to document their lives (appointments, preferences, medication schedules, stories) by voice or typing in whatever language they would be comfortable with. This is all safely stored in a memory store with a time stamp and personal context.

When they lose it--"When was I last doctor? or What did my daughter say today?-- MemoryAnchor uses those bits in that store and provides clear answers, which are spoken when necessary, and gives information sources so the caregivers can confirm. Not only does it allow users to gain some sense of confidence, independence, and peace of mind, but it also provides them with answers.

When we test people with dementia and their caregivers, we evaluate the accuracy of the memory recall, the ease and naturalness of interaction using the voice, and the perception of the users that they have been less frustrated and more in control. We also add such features as gradual, memory-decay, weighting of remindances, to make older, less relevant memories de-emphasized and an explainability layer, to allow a person to see what information the system is relying on to reply to them. Our privacy policies are encrypted storage and supervision by the people caring about us.

Our findings demonstrate that MemoryAnchor can greatly decrease instances of forgetting, enhance user satisfaction, and serve as an important companion in everyday life of dementia patients and their caregivers.

Poseidon Plus

Shivangi

Student, NIT Kurukshetra, Haryana, India

Bharati Sinha

Student, NIT Kurukshetra, Haryana, India

Abstract:

Zero-knowledge proofs (ZKPs) represent a transformative cryptographic paradigm that enables verification without data disclosure. As ZKP applications expand across privacy-preserving protocols, blockchain transactions, and decentralized verification systems, computational efficiency has emerged as the primary barrier to widespread adoption. This efficiency challenge is particularly acute in resource-constrained environments where every operation carries significant costs. Hash functions like SHA-2, while secure, create substantial overhead in ZKP systems. Poseidon improved efficiency but matrix multiplication operations remain a bottleneck. We introduce PoseidonPlus, which redesigns Poseidon's structure while maintaining security. Our key innovation is a hybrid matrix approach that alternates between dense and sparse matrix rounds, significantly reducing field multiplications. This preserves essential diffusion properties while eliminating redundant computation. Our security analysis confirms PoseidonPlus resists differential and algebraic attacks. Experimental evaluation shows performance improvements of 18% across ZKP applications without compromising security. This advancement addresses a critical efficiency barrier, enhancing the viability of privacy-preserving technologies.

Keywords:

Zero-Knowledge Proofs, zk-SNARKs, Poseidon Hash, PoseidonPlus, Cryptographic Hash Functions, MDS Matrices, Sparse Matrices, Blockchain.

A Blockchain Enabled Smart Contracts for Data Transmission in Healthcare

Harveen Kaur

Research Scholar, Punjabi University Patiala, Punjab, India

Dr. Harpreet Kaur

Research Scholar, Punjabi University Patiala, Punjab, India

Dr. Navjot Kaur

Research Scholar, Punjabi University Patiala, Punjab, India

Abstract:

Emerging technologies are playing a vital role to offer top-notch services in the field of healthcare systems. Utilizing contemporary information and communication technologies (ICTs) to gather and transfer electronic health records (EHRs) and make them available to authorized users and healthcare professionals is crucial when it comes to achieving the objectives of e-Health safely and effectively. EHR adoption by healthcare providers, however, increases the danger of data breaches for patient privacy and information security. The development of effective EHR access control techniques to provide safe client identification, authentication, and permission is made possible by the emergence of smart contracts and blockchain technology. In this paper, we create and deploy a smart contract to enhance the patient-centric services and this work would enrich all the stakeholders of healthcare system to provide enhanced healthcare services, will strengthen data sharing and transferring infrastructure to handle public health risks when a severe illness at the times of epidemic break out like COVID-19.

Marine Debris Detection using Cloud Masking and Vegetation Indices from Sentinel-2 Imagery: Implementation and Performance Evaluation

Swati Magare

Associate Professor, BAMU Aurangabad, Maharashtra, India

R R Deshmukh

Associate Professor, BAMU Aurangabad, Maharashtra, India

Abstract:

Marine debris detection using remote sensing is vital for monitoring and mitigating pollution in marine environments. In this research, we propose an automated debris detection framework leveraging Sentinel-2 satellite imagery. The approach includes preprocessing of MARIDA dataset imagery, cloud detection using s2cloudless, debris detection based on NDVI and FDI indices, and performance evaluation using standard metrics. The implementation integrates GUI-based output visualization. Our experimental results show promising performance with high recall and F1-scores, indicating the model's effectiveness in accurately identifying marine debris patches.

We propose an interpretable and efficient approach for marine debris detection in Sentinel-2 imagery by combining spectral indices NDVI and Floating Debris Index (FDI) with robust cloud masking via the S2PixelCloudDetector. Evaluated on the MARIDA dataset, our method achieves high pixel-level precision (0.82), recall (0.82), and F1-score (0.82), demonstrating effective debris identification without the need for complex model training. While spatial overlap with ground truth ($IoU = 0.124$) indicates room for improvement in segmentation, the approach offers a practical baseline for rapid debris quantification through patch counting and area estimation. Future work will focus on enhancing spatial coherence with post-processing and hybrid modeling techniques to improve detection performance.

Optimization of Thermoacoustic Heater Design for Waste Heat Recovery Using Delta-EC Simulation

Yash Jagtap

Undergraduate Student, Vishwakarma Institute of Technology Pune, India

Bhumika Gaud

Undergraduate Student, Vishwakarma Institute of Technology Pune, India

Shantanu Jamadar

Undergraduate Student, Vishwakarma Institute of Technology Pune, India

Laxmikant Mangate

Undergraduate Student, Vishwakarma Institute of Technology Pune, India

Abstract:

This paper gives an overview of a simulation-based optimization of a thermoacoustic heater for waste heat recovery on the DeltaEC platform. A one-dimensional model was created to study the impact of geometry, stack configuration, and material properties on system performance. Three different materials—stainless steel, copper, and Kapton—were considered for comparing the influence of high, medium, and low thermal conductivity. The outcome indicates that Kapton, due to its extremely low thermal conductivity, maintained a high temperature gradient and registered the highest outlet temperature of approximately 2331 K. Metals scattered heat across the stack and reduced overall efficiency. Parametric study of stack length, wall thickness, and heat input identified optimal ranges maximizing temperature gain while reducing losses. The originality of this work is in the integration of material selection with geometry optimization for the development of design guidelines of efficient thermoacoustic heaters. These results confirm the promise of thermoacoustic technology as an environmentally friendly technique for converting low-grade waste energy to useful heat.

A Deep Learning-Based Approach for Automated Blood Cancer Detection using Convolutional Neural Network: A Comprehensive Review

Vidhi Jitendrabhai Yadav

M. Tech student, Department of Computer Science, Marwadi University, Gujarat, India

Rachit Adhvaryu

Associate Professor, Department of Computer Science, Marwadi University, Gujarat, India

Abstract:

Blood cancer is a life-threatening disease that needs timely and accurate diagnosis for effective treatment. The use of computer-aided diagnosis tools is driven by the subjective and time-consuming nature of traditional microscopic evaluation of blood cell images. This paper presents a comprehensive review of recent advancements in deep learning methods applied to blood cancer detection and classification, summarising its key architectures, methods, and trends reported in the literature review. The study explores how CNN-based models have improved from traditional feature extraction methods to advanced transfer learning and lightweight architectures, improving efficiency and accuracy. It also analyses approaches to model training, feature representation, and performance evaluation across studies. The review explores existing work, including model performance, current research trends, and open challenges.

Keywords:

Blood cancer, leukemia detection, Acute Lymphoblastic Leukemia (ALL), Deep Learning (DL), Convolutional Neural Networks (CNN).

Design and Implementation of a Nano Drone using ESP8266

Suhas Bhise

Professor, Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology, Pune, India

Om Prashant Kela

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology, Pune, India

Yash Laddha

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology, Pune, India

Vijay Mane

Professor, Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology, Pune, India

Anshuman Modak

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology, Pune, India

Abstract:

This paper presents the design, development, and implementation of a compact nano drone powered by the ESP8266 microcontroller, integrating both flight control and wireless communication capabilities. The proposed system features onboard Wi-Fi for real-time telemetry and control via a custom web-based interface, enabling seamless operation without the need for external transmitters. The drone incorporates an MPU6050 inertial measurement unit (IMU) for attitude estimation through sensor fusion algorithms combining accelerometer and gyroscope data. The propulsion system employs brushed DC motors driven by a custom-designed MOSFET-based driver circuit utilizing SI2302 N-channel MOSFETs and 1N5819 Schottky diodes to ensure efficient current switching and back-EMF protection. The entire electronics are implemented on a custom-designed lightweight PCB, optimized for minimal power consumption and compact integration within the 3D-printed airframe to achieve a total weight of less than 50 grams. A PID-based stabilization algorithm is implemented for flight control, ensuring stable hovering and maneuvering even under small disturbances. The control system parameters are tuned experimentally for optimal responsiveness and stability.

Keywords:

Nano Drone, ESP8266, Unmanned Aerial Vehicle (UAV), Embedded Systems, Wireless Communication, Drone Control, Flight Stabilization, Real-time Monitoring, IoT-enabled Drone, Microcontroller, Autonomous Navigation, Low-power Electronics.

A Hybrid PSO–GWO Framework with Adaptive Fitness Function for Alzheimer’s Disease Prediction

J A Jevin

Research Scholar, Department of Computer Science & Engineering, SRM Institute of Science & Technology, Chennai, India

A.Umameswari

Research Supervisor, Department of Computer Science & Engineering, SRM Institute of Science & Technology, Chennai, India

Abstract:

Alzheimer’s disease (AD), a progressive neurological illness that significantly impairs memory and cognitive abilities, makes early and accurate prediction of a crucial healthcare concern. Because medical datasets frequently contain duplicate or unnecessary characteristics, traditional machine learning algorithms frequently struggle to attain high accuracy. In order to solve this, we provide a brand-new hybrid optimization framework that combines Particle Swarm Optimization (PSO) and Grey Wolf Optimization (GWO) for effective feature selection with adaptive fitness function. The adaptive fitness mechanism dynamically balances exploration and exploitation in contrast to traditional methods. Comparing the suggested Adaptive PSO–GWO framework to conventional PSO, GWO and other cutting-edge techniques, experimental assessment on benchmark Alzheimer’s datasets shows that it greatly enhances classification performance, attaining greater accuracy, sensitivity and specificity. These findings demonstrate the novelty suggested methods as a trustworthy decision-support tool for clinical practices early Alzheimer’s disease prediction.

Keywords:

Alzheimer’s disease, Medical image analysis, Feature selection, Extreme Gradient Boosting classifier, Particle Swarm Optimization, Grey Wolf Optimization, Adaptive Fitness Function.

Towards Sustainable Construction Management: Life Cycle Assessment of Prestressed Concrete Railway Bridges

Rajesh Kumar Singh

Research Scholar, Department of Civil Engineering, ICFAI Tech School, The ICFAI University, Dehradun, India

Ram Karan Singh

Senior Professor, Department of Civil Engineering, ICFAI Tech School, The ICFAI University, Dehradun, India

Amit Kumar Bera

Assistant Professor, Department of Civil Engineering, ICFAI Tech School, The ICFAI University, Dehradun, India

Abstract:

Sustainable construction management emphasizes minimizing environmental impacts throughout a project's life cycle. Railway bridges, particularly prestressed concrete structures, are material and energy intensive components of transport infrastructure, requiring comprehensive environmental evaluation. This study aims to integrate the principles of Life Cycle Assessment (LCA) into construction management practices to develop a sustainable framework for prestressed concrete railway bridges in the Indian context. A cradle-to-grave LCA approach was adopted following ISO 14040 and ISO 14044 standards. The analysis employed OpenLCA software with inventory data derived from primary sources and secondary databases to quantify key environmental indicators such as global warming potential, embodied energy, and resource depletion. Findings indicate that material production particularly cement and steel contribute the most to the environmental footprint. Optimization in material mix design and local sourcing significantly reduces emissions and energy use. Integrating LCA outcomes into construction management decisions promotes resource efficiency, reduces environmental impact, and supports United Nations Sustainable Development Goal 9 (Industry, Innovation, and Infrastructure) for sustainable infrastructure development.

Keywords:

Life Cycle Assessment, Sustainable Construction Management, Prestressed Concrete Railway Bridges, Environmental Impact Analysis, Infrastructure Sustainability.

Road Rescuer: Pothole Detection and Levelling

Kiran Ingle

Professor, Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India

Medha Wyawahare

Professor, Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India

Swaraj Todkar

Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India

Dhaval Sonawane

Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India

Yash Tambe

Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India

Yash Solankar

Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India

Chirag vasave

Department of Electronics and Telecommunication, Vishwakarma Institute of Technology, Pune, India

Abstract:

Maintaining roadways and sports courts is a significant challenge, particularly in urban areas where surface defects like potholes can lead to accidents, increased vehicle wear, and safety risks for athletes. Traditional manual detection and repair methods are inefficient, labor-intensive, and costly, leading to prolonged infrastructure deterioration and higher safety hazards. This research proposes an innovative automated system using a prototype robotic device equipped with advanced sensors and YOLOv8 to detect, prioritize, and repair surface defects in real time. While testing, the model achieved 91.5% of image accuracy. The dataset used to train the model was taken from GitHub[Error! Reference source not found.]. By automating the process, the system optimizes resource allocation, reduces human error, and minimizes maintenance costs while ensuring prompt action on critical defects. Scalable and adaptable to various environments, the system offers a sustainable, cost-effective solution for road safety and sports infrastructure quality, highlighting the importance of automation in infrastructure management.

Keywords:

Pothole detection, Surface maintenance, Automated repair, Robotic systems, Roadway safety, Sports court quality, YOLOv8, Infrastructure management, Real-time monitoring.

Enhancing Heat Transfer: Experimental Insights on 90° Hexagonal Ribs in Trapezoidal and Circular Ducts

Nilesh Shinde

Department of Mechanical Engineering, Medicaps University, Indore, India

Dr. Himanshu Borade

Department of Mechanical Engineering, Medicaps University, Indore, India

Dr. Birajashis Pattnaik

Department of Mechanical Engineering, Medicaps University, Indore, India

Abstract:

Due to their depletion and environmental impact, fossil fuels are becoming unsustainable as global energy demand rises. To meet global energy needs as traditional energy sources decline, sustainable energy sources must be developed and used. Solar air heaters are a viable sustainable thermal energy source. The present investigation studied the thermal hydraulic performance of a solar air heater with a hexagonal rib on the heat-absorbing plate and trapezoidal and circular ducts. This study analyzes the impact of rib height ratio ($e/D_h = 0.1109, 0.1479, \text{ and } 0.1849$), rib pitch ($P = 60 \text{ mm}, 80 \text{ mm}, \text{ and } 100 \text{ mm}$), and attack angle ($\alpha = 90^\circ$) on heat augmentation transmission in trapezoidal and circular ducts for Re of 5000–30000. Experimental results show that the Reynolds number increases the Nusselt number for varied blockage ratios. The ultimate blockage ratio, $e/D_h = 0.1849$, is best for 90° inline ribs with circular ducts. Circular ducts transported heat 40–60% better than trapezoidal ducts at all blockage ratios. The 90° rib orientation worked better in circular duct inline arrangements than trapezoidal duct. With the lowest Reynolds number, the 90° inline rib has a maximum thermal performance of 1.76, 60% better than the equivalent 90° orientation's 1.10. Blockage ratio and angle of attack increase thermal performance and control pressure losses. Hexagonal rib absorbers boost thermal efficiency, making solar air heaters more efficient and inexpensive.

Keywords:

Hexagonal ribs, blockage ratio, heat transfer enhancement, convective heat transfer, artificial Roughness.

Fuzzy Logic-Based Implementation in Teaching and Learning Methodologies: Analyzing Its Impact on Learners

Dr. I.Samuel Peter James

Associate Professor, Department of Computer Science and Engineering, Shadan Womens' College of Engineering and Technology, Hyderabad, India

Dr. D.Magdalene Delighta Angeline

Associate Professor, Department of Computer Science and Engineering, Joginpally B.R. Engineering College, Hyderabad, India

Dr. T.Prabakaran

Professor, Department of Computer Science and Engineering, Joginpally B.R. Engineering College, Hyderabad, India

Dr. I.Felcia Jerlin

Assistant Professor, Department of Computer Science and Engineering, Grace College of Engineering, Thoothukudi, India

E. Wiselin Kiruba

Assistant Professor, Department of Computer Science and Engineering, VOC College of Engineering, Thoothukudi, India

Abstract:

Traditional teaching and learning methodologies often follow a standardized approach failing to address the individual learner's need, engagement levels, and prior knowledge. To overcome this limitation, a fuzzy logic-based system was designed to personalize teaching strategies by modeling uncertainty and student variability. This study develops a Mamdani Fuzzy Inference System (FIS) that uses inputs such as learner engagement, prior knowledge, and assessment scores to generate adaptive instructional recommendations. Triangular membership functions and a set of IF-THEN rules were generated to classify students into Basic, Moderate, or Advanced teaching strategies. The model was evaluated using a dataset of 112 students and compared with Decision Tree, Random Forest, and Gradient Boosting models using metrics such as MSE, RMSE, R^2 , and accuracy. Additional analysis included residual distribution, and statistical significance tests. The FIS achieved an R^2 of 0.76 and 92.5% accuracy, with a defuzzified teaching strategy score of 6.83. SHAP-based feature importance from ensemble models validated the relevance of prior knowledge and engagement as key predictors. These results highlight the potential of integrating fuzzy logic into educational AI frameworks to promote inclusive and effective learning environments.

Keywords:

Decision Tree, Fuzzy Logic, Fuzzy Inference System, Learning Methodologies, Teaching Methodologies.

Enhancing Programming Competency through Micro-Learning in Higher Education: A Quantitative Study

Krishna Palod

Technology Management Department, Mukesh Patel School of Technology Management & Engineering, NMIMS (Deemed-to-be-University), Mumbai, India

Nishita Parekh

Technology Management Department, Mukesh Patel School of Technology Management & Engineering, NMIMS (Deemed-to-be-University), Mumbai, India

Pravin Shrinath

Computer Engineering Department, Mukesh Patel School of Technology Management & Engineering, NMIMS (Deemed-to-be-University), Mumbai, India

Abstract:

Background and Purpose: Programming education in higher education faces persistent challenges including high dropout rates, cognitive overload, and varying student competency levels. These challenges are driven by programming's abstract syntax, complex logical structures, and demands for higher-order thinking skills such as problem-solving and critical thinking. Traditional lecture-based approaches often overwhelm learners with extensive content delivery, resulting in reduced learning effectiveness and limited retention of programming concepts. This study investigates the effectiveness of micro-learning interventions in enhancing programming competency through short, focused, and interactive learning experiences.

Method: A pre- and post-test quasi-experimental design examined 65 undergraduate programming students. Grounded in Cognitive Load Theory and Experiential Learning, the micro-learning intervention delivered 10–15-minute modules targeting single programming concepts through interactive activities: Debug-the-Output, Games, Code Pictionary and other techniques and tools. Programming competency was assessed using a 21-item validated instrument before and after the intervention.

Results: Statistical analysis demonstrated a significant improvement in programming competency ($M_{pre} = 7.21$, $SD \approx 2.75$; $M_{post} = 11.49$, $SD \approx 2.86$; $t(64) = 20.17$, $p < .001$, Cohen's $d = 1.99$). The very large effect size indicates substantial learning gains, with students showing a 59% improvement in programming competency scores following the micro-learning intervention.

Conclusion: The findings confirm micro-learning as a highly effective pedagogical approach for programming education, as evidenced by strong quantitative gains (Cohen's $d = 1.99$). The study provides robust empirical

support for adopting focused, modular, and activity-based instruction in computer science courses to improve conceptual understanding, engagement, and skill development in higher education.

Keywords:

Programming Competency, Micro-Learning, Micro-learning based interactive activities, Higher Education.

Autonomous Stair-Climbing in Wheelchairs Using a Cyber-Physical System (CPS)

Vanshika Sharma

Department of Computer Science and Engineering, Chandigarh University Mohali, Punjab, India

Tushar Sharma

Department of Computer Science and Engineering, Chandigarh University Mohali, Punjab, India

Anukriti

Department of Computer Science and Engineering, Chandigarh University Mohali, Punjab, India

Abstract:

Maintaining safe and efficient transportation for physically disabled people is critical to enhance independence and quality of life. Standard wheelchairs are confined to flat surfaces and ramps, limiting travel in situations involving stairs or uneven surfaces. Stair-climbing wheelchairs fill this gap by making complicated terrains accessible while ensuring safety. This research paper puts forward a new framework of a Cyber-Physical System-based Stair-Climbing Wheelchair (CPS-SCW) that combines intelligent sensing, real-time decision-making, and smart actuation mechanisms. The system uses multi-sensor fusion for sensing terrain, optimized control algorithms for decision-making, and adaptive actuators for stair climbing. Cyber elements of IoT connectivity and AI-based feedback loops improve system safety and comfort of users. Mechanical designs, such as a hybrid wheel-track and ergonomic seats, provide stability and convenience. Simulation and prototype experiments were used to evaluate the CPS-SCW model based on parameters like energy efficiency, stability index, and climbing capability. Experimental results show significant improvements in terms of an average climbing success rate of 96.8% with optimized control strategies, as compared to 89.5% for traditional designs. These results emphasize the success of blending Cyber-Physical Systems with mechanical innovation in order to provide a strong, safe, and user-friendly stair-climbing wheelchair solution.

Keywords:

Cyber-Physical System (CPS), Stair-Climbing Wheelchair, Intelligent Control Systems, Smart Wheelchair Systems, IoT-based Healthcare, Ergonomic Design.

Enhancing Cybersecurity within a Manufacturing Execution System Setting

Urvashi

Assistant Professor, Chandigarh University, Punjab, India

Vishal Sharma

Chandigarh University, Punjab, India

Abstract:

The fast growth of MES challenges vendor standardization of security standards. Despite the challenges, manufacturers may limit the chance of an attacker gaining unauthorized access to their MES systems by adhering to security guidelines and standards. Unfortunately, the threat endures, and any MES system is vulnerable to various assaults. Instead of the standard MES system, a security system may be connected to provide multiple levels of security. Machining is the process of shaping and sizing the raw material by removing excess fabric in the form of chips. Machining processes are broadly classified into (i) Conventional machining processes like Turning, Milling, Drilling, and Grinding; (ii) Non-conventional or unconventional machining processes like EDM, ECM, USM, LBM, etc. Computerized Numerically Controlled (CNC) machine tools are commonly used to produce high-quality components in almost all possible machining processes. With high-cost CNC machine tools, the machining needs to be performed at optimum cutting conditions. In this research, an attempt is made to develop a cloud computing and cyber security structure for standard machining processes.

Keywords:

Cyber security, challenges, machine, system, structure.

Design and Optimization of Fused Silica Reinforced Liquid Silicone Rubber Composites for Enhanced Thermal, Mechanical and Chemical Performance

Akula Priyanka

Ph.D. Research Scholar, Department of Mechanical Engineering, SR University, Warangal, Telangana, India

Pulla Sammaiah

Professor and Director, Department of Mechanical Engineering, SR University, Warangal, Telangana, India

M. Padmanabha Raju

Department of Mechanical Engineering, SR University, Warangal, Telangana, India

Abstract:

Advancements in silicone-based materials are driven by the demand for multifunctional polymer composites capable of operating under extreme thermal and mechanical conditions. This study investigates Fused Silica Reinforced Liquid Silicone Rubber composites engineered for high-temperature insulation and mechanical integrity. Composites were prepared with 1–25 wt% fused silica and fabricated in thicknesses of 3 mm, 4 mm, and 5 mm. Mechanical properties, including Shore A hardness, tensile strength, and elongation at break, were evaluated per relevant standards. Thermal performance was assessed through conductivity, while chemical stability was determined by measuring electrical conductivity, total dissolved solids, and pH variation during NaCl immersion. Results demonstrated that both filler content and sample thickness significantly influenced performance. Optimal filler dispersion between 15–20 wt% enhanced strength and surface hardness without compromising flexibility. Increased thickness improved structural integrity and chemical resistance. These findings position FS-LSR composites as promising candidates for multifunctional applications such as electrical insulation, aerospace sealing, and thermal shielding, where precise control over composition and dimensions is critical for achieving a balance between mechanical robustness, thermal performance, and long-term environmental stability.

Detection of Brain Tumors from MRI Scans using Classical Image Processing: An Ablation Study on Preprocessing and Morphological Techniques

Laxita Jain

Department of Computer Science NMIMS University, Shirpur, India

Dr. RadhaKrishna Rambola

Department of Computer Science NMIMS University, Shirpur, India

Abstract:

Clinical diagnostics and treatment planning heavily rely on the identification of brain tumors from magnetic resonance imaging (MRI) scans. The classical image processing pipeline for tumor detection presented in this paper is based on watershed segmentation, morphological enhancement, and anisotropic diffusion filtering. This method prioritizes interpretability, computational efficiency, and reproducibility over deep learning models, which necessitate large labeled datasets. To measure the contribution of preprocessing and morphological steps to segmentation performance, we conduct a comprehensive ablation study using the BraTS dataset. Anisotropic diffusion filtering and top-hat correction can increase Dice similarity by up to 7%, according to the results, highlighting the importance of well-thought-out classical preprocessing in tumor segmentation.

Keywords:

Brain tumor, MRI, image segmentation, classical image processing, ablation study, morphology, watershed.

From Remote Sensing to Hybrid Deep Learning: A Critical Review of Crop Yield Forecasting Trends and Challenges

Dhanapriya M

PhD Scholar, Remote Sensing, Birla Institute of Technology, Mesra, Jharkhand

Dr. Kirti Avishek

PhD Scholar, Remote Sensing, Birla Institute of Technology, Mesra, Jharkhand

Dr. C. Jeganathan

PhD Scholar, Remote Sensing, Birla Institute of Technology, Mesra, Jharkhand

Abstract:

Over the two decades, crop yield prediction research has undergone substantial evolution, driven by the emergence of machine learning and deep learning techniques alongside the increasing availability of satellite-based remote sensing, climatic datasets, and limited field observations. Numerous high-impact studies indexed in SCI and Scopus journals have demonstrated that algorithms such as Random Forest, XGBoost, Support Vector Machines, Convolutional Neural Networks, LSTMs, GRUs, and hybrid CNN-LSTM or Transformer-based architectures are capable of capturing complex, nonlinear interactions among climatic, environmental, and vegetation variables, often outperforming traditional regression and empirical models. These models typically leverage vegetation indices such as NDVI, EVI, and LAI, combined with meteorological parameters including rainfall, temperature, radiation, and growing degree days, to estimate crop yield and monitor vegetation dynamics across various spatial and temporal scales. Despite these advances, critical limitations persist. Many studies have relied on coarse or incomplete datasets, with soil properties such as organic carbon content, pH, bulk density, nutrient availability (N, P, K), and rooting depth either represented through coarse global proxies or omitted altogether, while management practices including irrigation scheduling, fertilizer application, and sowing dates are inconsistently incorporated. Consequently, although the models achieve high statistical accuracy, their generalizability, interpretability, and agronomic relevance are often restricted. Deep learning-based frameworks, while capable of handling multi-temporal and multi-sensor data, are highly data-dependent, susceptible to overfitting, and frequently operate as “black boxes,” limiting their utility in practical decision-making. Furthermore, most studies focus on short-term datasets spanning only a few years, preventing the accurate capture of long-term climatic variability and inter-annual trends, while few models integrate process-based crop physiology or agronomic knowledge to guide predictions. These combined limitations highlight the need for approaches that not only exploit multi-year time-series satellite and climate data but also incorporate detailed soil and management information to improve prediction robustness and interpretability.

In light of this synthesis, the present review emphasizes three key objectives that emerge naturally from the identified gaps:

First, to examine the effects of various agro-climatic and soil parameters on crop yield, thereby quantifying their influence across seasons and regions.

Second, to predict future vegetation growth conditions using multi-year satellite-derived time series, enabling early-season forecasting and assessment of crop performance trends.

Third, to develop hybrid deep learning frameworks that integrate climatic, soil, and management variables to enhance predictive accuracy, generalization, and interpretability. By critically analyzing the evolution of crop yield prediction models, the review provides a comprehensive perspective on the successes, shortcomings, and opportunities for future research, establishing a foundation for more robust, data-integrated, and interpretable predictive frameworks.

Keywords:

Crop yield prediction, Remote sensing, Machine learning, Deep learning, Hybrid models, Vegetation indices (NDVI, EVI, LAI), Agro-climatic conditions, Time-series analysis, Spatio-temporal modelling, Agricultural forecasting, Crop growth, modelling, Satellite imagery.

Hydro-Pulmonary Signal Processing: Decoding Lung Fluids with MATLAB Algorithms

Rupika S

Electronics and Communication Engineering, Sona College of Technology, Salem, India

SharmilaDevi D

Assistant Professor, Electronics and Communication Engineering, Sona College of Technology, Salem, India

Vijayadharshini V

Electronics and Communication Engineering, Sona College of Technology, Salem, India

Sakthinaavathara S

Electronics and Communication Engineering, Sona College of Technology, Salem, India

Dr. R.S.Sabeenian

Professor and Head of Department, Electronics and Communication Engineering, Sona College of Technology, Salem, India

Abstract:

The main objective of the proposed system, Lung Water Level Monitoring is to develop an efficient, non-invasive method for detecting and estimating the level of water accumulation in human lungs using chest X-ray images. The proposed system aims to apply advanced image processing techniques such as filtering, contrast enhancement, segmentation, and morphological operations to accurately identify abnormal fluid regions. By automating the analysis process, the system seeks to support medical professionals in the early diagnosis of pulmonary edema and related lung disorders. This proposed system also focuses on providing a cost-effective, user-friendly solution that can enhance clinical decision-making.

Keywords:

Pulmonary edema, Extravascular lung water, Chest X-ray, Image processing, MATLAB, Otsu threshold, Morphology, Computer-aided diagnosis.

Optimum Placement of Electric Vehicle Charging Station (EVCS) using Different Optimization Algorithms: A Review

P Rizwan

Research Scholar, School of Electrical and Electronics Engineering, REVA University, Bangalore, India

Raghu C N

Associate Professor, School of Electrical and Electronics Engineering, REVA University, Bangalore, India

Abstract:

Large- scale adoption of Electric Vehicles (EVs) requires widespread installation of Electric Vehicle Charging Stations (EVCS) to alleviate range anxiety, or the concern that the EV's battery won't last the trip. With the anticipated growth of EVs and their rising popularity, it is important to find an efficient means for coordinating their charging, fast battery chargers, are desperately required. There is absolutely no denying that the heavy electricity consumption associated with charging EVs has detrimental effects on the Distribution System, causes increase in the load demand associated with the corresponding increase of the losses in the system. In order to overcome the impact of EVCS on the Distribution System, the Distributed Generators (DGs) of renewable sources such as solar, wind, etc., are integrated into the system. Due to the stochastic nature of DGs, Vehicle-to-Grid (V2G) technologies have gained a great deal of attention in both academia and business as an energy management solution in microgrids due to the fast growth of power infrastructures and the rise in the number of EVs. The optimal location and size of the EVCS and DGs along with the V2G method from the coordinated charging and discharging is necessary for the stable and reliable operation of the Distribution System. A review of the literature analysis different metaheuristic algorithms for finding the optimal location and placement of EVCS in the distribution system with their merits and demerits.

Keywords:

Electric Vehicle Charging Stations (EVCS), Distributed Generators (DGs), Vehicle-to-Grid (V2G), Metaheuristic Algorithms, Distribution System Optimization.

Developing a Software-Defined Networking (SDN) Integrated Intrusion Detection System for Fog-IoMT Using Hybrid Deep Learning

Mohita Narang

Amity University, Gurgaon, India

Nirmal Punetha

Amity University, Gurgaon, India

Aman Jatain

K.R. Mangalam University, Gurgaon, India

Abstract:

Integrating the Internet of Medical Things (IoMT) with fog computing introduces complex security challenges that require dynamic and intelligent intrusion detection systems. This research presents a Convolutional BiLSTM Neural Network, optimised using a hybrid Particle Swarm Optimisation (PSO) and Sine Cosine Algorithm (SCA), and integrated with a Software-Defined Networking (SDN) controller to enhance real-time threat detection and adaptive network response. The model is trained on a comprehensive dataset that combines EDGE-IIoTset and WUSTL-EHMS-2020, following data preprocessing steps that include normalisation, standardisation, and feature extraction through Variance Thresholding, Correlation Analysis, and Mutual Information. The optimised BiLSTM + CNN model achieved a detection accuracy of 99.1%, precision of 99.2%, recall of 99.1%, and F1-score of 99.1%. Incorporating SDN facilities has enhanced network responsiveness during attacks and facilitated adaptation to changing conditions. The findings of this research confirm that fog-based IoMT networks can be effectively secured by integrating deep learning, bio-inspired optimisation, and software-defined control, thereby proving the model's efficacy.

Keywords:

SDN, IoMT, BiLSTM, intrusion detection, Deep Learning.

Real-Time Poverty Alert System

Paras Saini

University Institute of Engineering, Chandigarh University, Mohali, India

Swati Panwar

University Institute of Engineering, Chandigarh University, Mohali, India

Aryan Yadav

University Institute of Engineering, Chandigarh University, Mohali, India

Sanjay Verma

University Institute of Engineering, Chandigarh University, Mohali, India

Abstract:

Traditional methods of assessing poverty, which often hinge on infrequent household surveys, are plagued by sizable time lags which prevent effective and timely interventions. This paper suggests Real Time Poverty Alert System (RTPAS) as a solution to overcome these limitations. The system architected herein combines a multi-modal data strategy, including robust ETL (Extract, Transform, Load) data pipelines for ingesting data from APIs, high-frequency satellite imagery, IoT sensor networks, mobile data and participatory community reporting platforms. At its heart, the RTPAS utilizes a new predictive fusion model that utilizes machine learning and AI to analyze these heterogeneous data streams for early indicators of economic distress, such as changes in energy consumption, mobility patterns, or market prices [1]. By spotting emerging hotspots of vulnerability in realtime, the system enables governments, non-governmental organizations and aid organizations to move from a reactive to a proactive stance in poverty alleviation. This research presents the architecture of the system as well as the data engineering challenges and the ethical frameworks that are necessary for the responsible implementation of the system [2].

Keywords:

Sentiment Analysis, Natural Language Processing (NLP), Social Media, Machine Learning, Public Opinion, Transformer Models.

Smart Glove-Based Wearable System for Tremor Detection in Parkinson's Patients

Divya Madhavan

Cathedral and John Connon School Mumbai, India

Vinay Vishwakarma

Mentor, On My Own Technology Pvt. Ltd., India

Abstract:

Parkinson's disease (PD) is a progressive neurodegenerative disease that severely limits motor control, and as one of several motor symptoms associated with PD, tremor may be the most disabling. Typical methods for assessment, such as observational-in-clinic assessments and rating scales, are subjective to the clinician, are limited to transient interactions with the patient, and cannot capture deterioration in tremor from "on" to "off" periods outside of the clinic. In this project, we present the development of a smart glove-based wearable system used to objectively and continuously assess tremor and rehabilitate patients with PD using physiotherapeutics. The system consists of an Inertial Measurement Unit (IMU) sensor array, flex sensors, and force sensitive resistors to capture complex hand movements. Signals were transmitted to a real-time classification and visualization platform using an ESP32 microcontroller. Techniques for signal processing, including root mean square (RMS) analysis and machine learning (ML) algorithms, were used to classify tremor severity into normal, low, medium, and high duration categories. Using a Random Forest classifier, the system achieved a mean accuracy of (99.69%) and mean results of precisely balanced precision, recall, and F1-scores across severity level classifications. Overall, this shows strong predictive power for the classification of tremors in PD patients.

Keywords:

Stock Market Volatility, Social Media Influence, Elon Musk Tweets, Financial Markets, Sentiment Analysis, Tech Stock Prices, Market Reactions, Public Statements, Machine Learning, Predictive Modeling, Finance, Investor Behavior, Market Manipulation, Financial Data Analysis. % Sections start here.

Personalized Medicine Recommendation System using AI

Garima Sharma

Bachelor of Engineering (CSE), Chandigarh University, Mohali, Punjab, India

Sharandeep Kaur

Bachelor of Engineering (CSE), Chandigarh University, Mohali, Punjab, India

Arpan Samuel Nanda

Bachelor of Engineering (CSE), Chandigarh University, Mohali, Punjab, India

Anishka Sharma

Bachelor of Engineering (CSE), Chandigarh University, Mohali, Punjab, India

Abstract:

Personalized medicine has been a paradigm shift of the previous paradigm of treatment in that it concerns personalizing treatment to individual-patient details. The advancement of artificial intelligence and predictive analytics makes it possible to develop systems that will be able to process various data about patients and provide reasonable treatment guidance. The proposed study proposes an AI-powered recommendation system that is utilized to tailor medical treatments with the help of a combination of clinical data, genomic data, and demographic data. They predict individual patient treatment response, can optimize treatment plans, and can minimize adverse drug reactions with the use of machine learning and deep learning systems. The system is explainable- based so as to ensure transparency and clinical trust and to make clinicians know the logic behind each recommendation. It is expected that the outcomes will be higher rates of recovery, more effective treatment, and reduced risks of medication side effects. The hybrid architecture, i. e. the synthesis of multi- modal patient data (i.e. the synthesis of genomics, electronic health records (EHR) and lifestyle parameters) and explainable AI to deliver accurate, patient-centered, and trustful medical guidance is the originality of this work hence adding to the goals of precision medicine.

Keywords:

Adverse Drug Reaction Prediction, Artificial Intelligence, Clinical Decision Support System, Deep Learning, Electronic Health Records, Explainable AI, Genomic Data Integration, Machine Learning, Multi-Modal Data Fusion, Patient-Centric Therapy Recommendation, Personalized Medicine, Predictive Analytics, Risk Modeling.

InfoSage: Leveraging Explainable AI for Intelligent Decision Support in Business Management Systems

Ananyaa R P

RNS Institute of Technology, Bengaluru, Karnataka, India

Anusha A S

RNS Institute of Technology, Bengaluru, Karnataka, India

Apoorva S B

RNS Institute of Technology, Bengaluru, Karnataka, India

Dr. Kavya N P

RNS Institute of Technology, Bengaluru, Karnataka, India

Abstract:

In today's rapidly evolving digital ecosystem, business management systems rely heavily on Artificial Intelligence (AI) for data-driven decision-making. However, most AI systems operate as "black boxes," offering little transparency into how predictions or recommendations are made. This lack of interpretability creates barriers for managers who must justify strategic choices and comply with governance requirements.

This paper introduces InfoSage, a novel Explainable AI (XAI)-based decision support framework designed to integrate interpretability into managerial analytics. The system employs a hybrid model combining predictive algorithms with SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-Agnostic Explanations) to generate transparent, human-understandable insights. Experimental simulations demonstrate that InfoSage enhances managerial trust, accountability, and decision accuracy by 18% compared to traditional opaque models.

The framework thus bridges the gap between AI-driven automation and human-centric reasoning, enabling responsible and explainable business intelligence.

Keywords:

Explainable AI, Decision Support Systems, Business Intelligence, Interpretability, Data Analytics.

Crowdsourcing for Quality: A Design Enhancement Framework for Small and Medium-sized Enterprises

Nikhil Pisal

Research Scholar Department of Mechanical Engineering, AISSMS College of Engineering Pune, affiliated to Savitribai Phule Pune University, Pune, India and Assistant Professor, Jaywant College of Engineering and Polytechnic Killemachindragad

Dr. C.M. Sedani

Professor, PK Technical Campus, Pune, India and Research Supervisor AISSMS College of Engineering, Pune affiliated to Savitribai Phule Pune, University Pune

Abstract:

Manufacturing organizations often struggle to deliver high-quality products within tight budgets and schedules, primarily due to shortages of skilled labor and other essential resources. The increasing use of crowdsourcing provides a promising solution, allowing manufacturers to leverage the expertise of a diverse and distributed pool of contributors, including end users. This evolution has led to two distinct design paradigms: the traditional in-house design approach and the crowdsourcing-based design approach. The traditional model emphasizes control, hierarchy, and structured processes that influence product quality through aspects such as design methodology, team collaboration, and information flow. In contrast, crowdsourced design introduces flexibility and collective innovation but also poses challenges in maintaining consistent quality. Existing studies have examined product life cycles, quality control systems, design processes, and post-production activities, while also recognizing the quality assurance issues inherent to crowdsourcing platforms. This research proposes a conceptual model for product design and quality assurance in a crowdsourced manufacturing environment, with the goal of identifying key quality control challenges and exploring strategies to enhance exploratory analysis within Indian manufacturing industries.

Keywords:

Crowdsourcing, SMEs, Manufacturing, Design, and Quality.

Fuzzy Logic-Based Implementation in Teaching and Learning Methodologies: Analyzing Its Impact on Learners

Dr. I.Samuel Peter James

Associate Professor, Department of Computer Science and Engineering, Shadan Womens' College of Engineering and Technology, Hyderabad, India

Dr. D.Magdalene Delighta Angeline

Associate Professor, Department of Computer Science and Engineering, Joginpally B.R. Engineering College, Hyderabad, India

Dr. T.Prabakaran

Professor, Department of Computer Science and Engineering, Joginpally B.R. Engineering College, Hyderabad, India

Dr. I.Felcia Jerlin

Assistant Professor, Department of Computer Science and Engineering, Grace College of Engineering, Thoothukudi, India

E. Wiselin Kiruba

Assistant Professor, Department of Computer Science and Engineering, VOC College of Engineering, Thoothukudi, India

Abstract:

Traditional teaching and learning methodologies often follow a standardized approach failing to address the individual learner's need, engagement levels, and prior knowledge. To overcome this limitation, a fuzzy logic-based system was designed to personalize teaching strategies by modeling uncertainty and student variability. This study develops a Mamdani Fuzzy Inference System (FIS) that uses inputs such as learner engagement, prior knowledge, and assessment scores to generate adaptive instructional recommendations. Triangular membership functions and a set of IF-THEN rules were generated to classify students into Basic, Moderate, or Advanced teaching strategies. The model was evaluated using a dataset of 112 students and compared with Decision Tree, Random Forest, and Gradient Boosting models using metrics such as MSE, RMSE, R^2 , and accuracy. Additional analysis included residual distribution, and statistical significance tests. The FIS achieved an R^2 of 0.76 and 92.5% accuracy, with a defuzzified teaching strategy score of 6.83. SHAP-based feature importance from ensemble models validated the relevance of prior knowledge and engagement as key predictors. These results highlight the potential of integrating fuzzy logic into educational AI frameworks to promote inclusive and effective learning environments.

Keywords:

Decision Tree, Fuzzy Logic, Fuzzy Inference System, Learning Methodologies, Teaching Methodologies.

A Baybayin Script Recognition System for Natural Scene Images

Percival Ng Cael

University of the Cordilleras, Benguet, Philippines

Abstract:

This study introduced a Baybayin Script Recognition System for natural scene images using deep learning techniques from similar studies. The objective was to create an effective automatic detection and recognition of the Baybayin script in real-world contexts such as within natural scene images. The system architecture consisted of three main components: text region detection, Latin-Baybayin script discrimination, and Baybayin character recognition. A custom Baybayin dataset was created, consisting of Baybayin natural scene images annotated with ground truth for polygonal annotations. The key challenges addressed in the study included identifying Baybayin characters that are visually similar, handling difficult features of natural scene images such as occlusions and complex backgrounds, and making the proposed system robust to various image conditions found in natural scenes. Effective techniques for text within natural scene images such as script discrimination, data augmentation, and data preprocessing were integrated into the system to improve the proposed system's performance. The results demonstrated that the proposed system achieved high levels of accuracy in text detection, script discrimination, and in recognition tasks, affirming the viability of the approach for practical applications in real world scenarios such as digital archiving, educational tools, app development, etc.

Keywords:

Baybayin, computer vision, natural scene images, scene text.

A Comprehensive Review on Advances in Braille Recognition and Braille-to-Text Conversion Integrated with Speech Technologies

Pooja V C.

Department of Computer Science and Engineering, Atria Institute of Technology, Bangalore, India

Dr. Devi Kannan

Head of Department, Department of Computer Science and Engineering, Atria Institute of Technology, Bangalore, India

Abstract:

The Braille Recognition System captures a Braille document image and converts its content into corresponding natural language characters, enabling seamless text-to-speech (TTS) and speech-to-text (STT) applications. It involves two key phases: Braille cell transcription and recognition, where the first phase identifies Braille characters, and the second translates these into machine-readable text that can be processed by TTS or STT systems. The system can convert Braille to text, which is then spoken by TTS technology, or convert speech into text and then into Braille for tactile reading. This process begins with capturing an image of a Braille document, typically stored in formats like jpeg or tiff, and using Braille Cell Recognition (BCR) to translate the pixel representation into characters. This technology benefits visually impaired individuals, particularly in educational settings, by enabling communication between Braille, text, and speech. The system involves stages like image acquisition, preprocessing, and character recognition, and this review examines prior research on Braille cell recognition and transcription, comparing techniques and highlighting advancements that contribute to the integration of Braille with text-to-speech and speech-to-text technologies.

Keywords:

Braille Recognition System, Machine- readable text, Speech-to- text (STT), Text-to-speech (TTS).

Analysis of Steel Structure with and Without Infill

Sangeetha T. R

P.G Student, Department of Civil Engineering, Sri Siddhartha Institute of Technology, SSAHE Tumakuru

Pradeep A. R.

Associate Professor Department of Civil Engineering–Sri Siddhartha Institute of Technology, SSAHE Tumakur

Anusha P

Assistant Professor Department of Civil Engineering–BGSIT B G Nagar

H Siddesha

Associate Professor Department of Civil Engineering–SIT Tumkur

Abstract:

The present study focuses on the seismic performance evaluation of a steel structure considering two configurations: a bare frame and the same frame with infill. The analysis aims to understand the influence of bare frame & infills on the seismic behavior of steel buildings, particularly in high seismic risk areas. A G+9 storey steel framed building is modeled and analyzed using ETABS software. The structure is located in Seismic Zone IV as per IS 1893:2016, with an importance factor of 1.5, reflecting its critical nature. The seismic analysis is carried out using the Response Spectrum Method, which effectively captures the dynamic characteristics of the structure under earthquake loading. Three models are developed: one representing the bare steel frame, and the other incorporating infills with Masonry & Glass. The primary parameters compared include base shear & storey displacement. The results indicate that the inclusion of glass infill panels alters the dynamic response of the building significantly. While the stiffness and lateral load resistance increase due to infills, the overall displacement values show noticeable variation when compared to the bare frame. This study emphasizes the importance of considering non-structural components like infills in seismic design and highlights their potential contribution to overall structural performance during earthquakes.

Keywords:

Seismic Analysis, Steel Structure, Masonry infill, Glass Infill, Bare Frame, Response Spectrum Method, ETABS, Storey Drift, Storey Displacement, Base Shear, Structural Stiffness.

Democratizing Mathematical Optimisation: A Review of Tools and Techniques Making MILP Accessible to Non-Experts

Mital Kadu

Dr. D.Y. Patil Institute of Engineering, Management & Research Pune, Maharashtra, India

Vibhavari Jawale

Dr. D.Y. Patil Institute of Engineering, Management & Research Pune, Maharashtra, India

Omkar Thakur

Dr. D.Y. Patil Institute of Engineering, Management & Research Pune, Maharashtra, India

Rohit Waghmode

Dr. D.Y. Patil Institute of Engineering, Management & Research Pune, Maharashtra, India

Swapnil Baranwal

Dr. D.Y. Patil Institute of Engineering, Management & Research Pune, Maharashtra, India

Jordan Chandra

Dr. D.Y. Patil Institute of Engineering, Management & Research Pune, Maharashtra, India

Abstract:

Mixed Integer Linear Programming (MILP) is a widely used problem-solving methodology for modelling and solving combinatorial and resource allocation problems. MILP can be used to solve various enterprise problems, including but not limited to production planning and scheduling, supply chain network design, batch processing and more. However, MILP formulations are inherently NP-hard. In essence, they often demand an exponential computational cost. Domain experts and various other problems. This systematic, selective literature review provides a self-contained overview of papers from 2020 to 2025 aimed at making MILP more usable for enterprise problem solving. The scope of this review paper focuses on three complementary directions: 1) the use of machine learning to assist MILP, 2) Algorithmic and engineering advances that reduce computational cost and 3) improvements in MILP interfaces. This paper synthesises representative works, compares approaches, identifies gaps, and highlights promising research towards the democratisation of optimisation.

Smart Agriculture: AI and Cloud-Based Crop Disease & Prediction Identification

Dr. T. Hari Krishna

Assistant Professor, Department of AI & ML, AITS, Rajampet, India

S. Vinay

Department of AI & ML, Annamacharya University, Rajampet, India

M. Ramya

Department of AI & ML, Annamacharya University, Rajampet, India

O. Sainath Reddy

Department of AI & ML, Annamacharya University, Rajampet, India

K. Thanuja

Department of AI & ML, Annamacharya University, Rajampet, India

Abstract:

Plant diseases remain a critical food security issue worldwide, especially in developing countries where farmers with small scale have limited access to the experts agriculture. These days, accurate plant disease identification has been made possible through image processing technologies provided by AI and cloud computing. However, there remains a significant barrier because of certain factors like farmers' linguistic diversity and their varying ability to read and write. To fill this gap, we propose the enhanced Plant Disease Identification Platform whose base is AI and Cloud Computing and is supplemented with multilingual and voice recognition capabilities. The system marries deep learning-based disease detection (CNN) with natural language processing and speech recognition so that farmers may engage with the platform in their language, either through text or voice. The framework proposes that farmers receive disease predictions, preventive measures, and expert suggestions in their language of choice, thus ensuring accessibility, inclusivity, and usability. Evaluation results indicate that not only does the system maintain over 95% disease detection accuracy, but it also enhances user engagement and adoption rates among non-English speaking farmers. This development is a step towards democratizing of precision agriculture using AI solutions sculpted to the socio-linguistic realities.

Keywords:

AI in agriculture, plant disease detection, multilingual support, voice recognition, cloud computing, CNNs, NLP, speech-to-text, and farmer's accessibility.

A Powerful Hybrid Approach for Accurate Detection of Skull-Conjoined Brain Tumor Condition using Modified Power Law Transform (MPTL) and Discrete Wavelet Transform (DWT)

Pooja P P

Research Scholar, CHRIST(Deemed to be University), Kengeri Campus, Bangalore, India

Dr. Aruna S K

Associate Professor, CHRIST(Deemed to be University), Kengeri Campus, Bangalore, India

Abstract:

Identification of skull-conjoined brain tumors presents a multifaceted obstacle due to low contrast, noise, and overlapping tissue structures in clinical imaging. To overcome these restrictions, this research recommends a hybrid image processing framework combining the Modified Power Law Transform (MPTL) and the Discrete Wavelet Transform (DWT) for precise tumor identification and delineation. The MPTL technique improves image contrast adaptively, enabling better differentiation between soft and hard tissue intensities, while DWT decomposes the enhanced image into numerous frequency sub-bands for effective feature extraction. The combination of spatial and frequency-domain evaluation enhances the robustness of tumor positioning, even in complex skull-conjoined zones. Experimental evaluation on MRI datasets demonstrates that the suggested MPTL-DWT model significantly outperforms conventional enhancement and segmentation methods in terms of accuracy (97.8%), sensitivity (96.4%), and specificity (98.2%). The results verify that integrating nonlinear intensity transformation with multiresolution analysis provides a reliable pathway for early and accurate diagnosis of conjoined brain tumor conditions.

Design and Development of Multiport Solid State Transformer (SST)

Dr. Jyoti M. Kharade

Associate Professor, Department of Electrical Engineering, Annasaheb Dange College of Engineering and Technology, Ashta (Maharashtra), India

Sanghamitra Vijay Kamble

B.Tech Student, Department of Electrical Engineering, Annasaheb Dange College of Engineering and Technology, Ashta (Maharashtra), India

Isha Suresh Kapdekar

B.Tech Student, Department of Electrical Engineering, Annasaheb Dange College of Engineering and Technology, Ashta (Maharashtra), India

Sahil Sachin Shewale

B.Tech Student, Department of Electrical Engineering, Annasaheb Dange College of Engineering and Technology, Ashta (Maharashtra), India

Abstract:

This paper focuses on design and development of a compact, efficient, and intelligent alternative to the conventional transformer named as Solid State Transformer (SST). A Multiport SST is a power electronic-based high frequency transformer that not only reduces the physical size and weight but also offers the flexibility to connect multiple ports such as grid input, solar PV, battery storage, and various AC/DC loads, all within one system. Traditional line-frequency transformers, although reliable, have several major drawbacks when it comes to modern power applications. They are large, heavy, and only support single input and output paths. The SST enables bi-directional power flow, high-frequency operation, real-time control, and integration of smart grid technologies. This project aims to develop a system that can efficiently manage power flow between different sources and loads, maintain voltage regulation, and enhance overall power quality. The MATLAB Simulink model is designed and studied its performance for power flow, short circuit analysis and power quality profile for EV charging application. Through simulation, design, and possibly hardware prototyping, the goal is to showcase a new generation of transformers that are ready to meet the demands of the future energy ecosystem. This paper also provides the literature survey about the various applications and design perspectives of SST, objectives of project, methodology, system development, result discussion and conclusion.

Keywords:

SST, Bi-directional DC-DC, EV, THD.

An Integrated Framework Leveraging Agentic AI and Retrieval-Augmented Generation for Enhanced Industrial Equipment Reliability

Prashant Steele

Rajiv Gandhi Proudlyogiki Vishwavidyalaya, University Institute of Technology, Bhopal, India

Alka Bani Agrawal

Rajiv Gandhi Proudlyogiki Vishwavidyalaya, University Institute of Technology, Bhopal, India

Abstract:

As Industry 4.0 continues to evolve, complex predictive maintenance (PdM) systems that can efficiently monitor industrial equipment health without or at minimal human input are increasingly needed. This paper provides a broad framework of Agentic Artificial Intelligence (AI) and Retrieval-Augmented Generation (RAG) agents with the ability to disrupt the conventional predictive maintenance paradigms associated with manufacturing processes. This research provides an assessment of existing gaps in predictive maintenance literature today through the design of an agent-based autonomous system that reads data, builds consensus, acts on knowledge, and learns in real-time. The framework we propose relies on combinations of machine learning algorithms, IoT sensors, and intelligent-agent architectures that can achieve unprecedented levels of reliability of equipment and effectiveness of operations. Through reviewing and analysing 43 papers and a number of industrial case studies, the research has identified the exceptional developments in enabling technologies against the relatively poor challenge of the implementation of predictive maintenance systems today. The research shows that Agentic AI-RAG systems can predict with 97% accuracy, propose maintenance in 95% accuracy and suggest downtime reductions of more than 92% with at least the same time spent on maintenance as before predictive models were used. The research also identified significant gaps in three areas, which relate to decision-making autonomous factors, cross-domain knowledge integration and in real-time adaptive learning capabilities related to predictive maintenance systems. Our intended objectives involve creating autonomous self-learning maintenance agents, multi-modal sensor fusion, and industry-agnostic maintenance frameworks. This work will serve as a contribution to the science by providing a foundational roadmap for next-generation predictive maintenance systems that incorporates autonomous intelligence with an ability to extend knowledge management.

Keywords:

Agentic AI, Retrieval-Augmented Generation, Predictive Maintenance, Industry 4.0, Machine Learning, Autonomous Systems.

Applying Machine Learning Algorithms for the Classification of Sleep Disorders

Chitte Anil

Department of Computer Science and Engineering(Data Science) Institute of Aeronautical Engineering,
Dundigal, Hyderabad, India

J. Isha Mudiraj

Department of Computer Science and Engineering(Data Science) Institute of Aeronautical Engineering,
Dundigal, Hyderabad, India

B. Chandrika

Department of Computer Science and Engineering(Data Science) Institute of Aeronautical Engineering,
Dundigal, Hyderabad, India

T. Akhil

Department of Computer Science and Engineering(Data Science) Institute of Aeronautical Engineering,
Dundigal, Hyderabad, India

Abstract:

Sleep disorders, mainly sleep apnea, have an important impact on human health, making accurate diagnosis of sleep disorders important. Although important, traditional diagnosis of sleep disorders is often complicated, long, and requires experts to recognize and manually classify different sleep stages. This work introduces a classification approach based on Machine Learning (ML), which includes publicly available Sleep Disorder Data with 400 records and 13 attributes. The sleep disorder data has more relevant lifestyle parameters combined with general sleep health characteristics, which are required for recognizing specific patterns that indicate potential sleep disorders when they occur. Various baseline ML models including other deep learning model and ensemble-based models were considered to ensure an accurate diagnosis. The experimental results indicate that bagged models, with Voting Classifier as a strong bagged ML model (Random Forest (RF), Decision Tree (DT)), performed the best with an accuracy, precision, recall, and F1-Score of 0.973. Therefore, the proposed ML algorithm is a reliable and robust classifier for sleep disorders classification. It is suggested that the proposed ML approach offers a scalable, accurate, and reliable diagnostic support tool for clinicians providing diagnostic support to empower in their diagnostic decision making improving health outcomes for patients.

Keywords:

Machine Learning, Sleep Disorders, Sleep Apnea, Classification, Ensemble Learning, Random Forest, Decision Tree, Voting Classifier, Predictive Modeling, Healthcare Analytics.

FinSight: Harnessing Explainable AI for Transparent Financial Risk Management

Akshata A

RNS Institute of Technology, Bengaluru, Karnataka, India

Dr. Kavya N P

Professor & Associate Dean (Research), RNS Institute of Technology, Bengaluru, Karnataka, India

Akshata Laxman Bhandagi

RNS Institute of Technology, Bengaluru, Karnataka, India

Abstract:

Financial institutions increasingly rely on Artificial Intelligence (AI) to manage credit scoring, fraud detection, and portfolio optimization. However, conventional AI models often operate as opaque systems, providing little insight into how risk assessments are derived. This lack of interpretability undermines regulatory compliance, stakeholder confidence, and decision accountability.

This paper introduces FinSight, a novel Explainable AI (XAI) framework designed to integrate transparency into financial risk management systems. FinSight combines ensemble learning algorithms with explanation methods such as SHAP (Shapley Additive exPlanations) and LIME (Local Interpretable Model-Agnostic Explanations) to provide interpretable, data-driven insights for financial analysts. Experimental evaluations indicate that FinSight improves decision accuracy by 16% and user trust by 22% compared to traditional black-box models.

By embedding explainability into financial analytics, FinSight advances responsible AI practices and strengthens trust in automated financial decision systems.

Keywords:

Explainable AI, Financial Risk Management, SHAP, LIME, Credit Scoring, Model Transparency.

A Comparative Survey and Co-Optimization Framework of Quantum-Native Algorithms for High-Fidelity Entanglement Distribution

Shivanandini D

Thiagarajar College of Engineering (Autonomous), Affiliated to Anna University, Madurai, India

Dr. S. Rajaram

Thiagarajar College of Engineering (Autonomous), Affiliated to Anna University, Madurai, India

Dr. M.S.K. Manikandan

Thiagarajar College of Engineering (Autonomous), Affiliated to Anna University, Madurai, India

Abstract:

The viability of a quantum internet depends on the efficient distribution of high-fidelity entanglement across long distances. This work reviews quantum-native algorithms developed to enhance entanglement distribution rate (EDR) while maintaining fidelity within quantum networked systems. Unlike classical approaches, these algorithms inherently operate in quantum regimes, encompassing entanglement swapping, purification, nested repeater architectures, multiplexed routing, and various optimization methods such as Markov decision processes, heuristic swap scheduling, and local scoring strategies. The survey compares these methods based on cost, fidelity–tradeoff, scalability, and resource efficiency. Building on this analysis, a new Greedy Local Scoring with Purification-Swapping Co-Optimization (GLS-PS) algorithm is proposed. GLS-PS adopts a responsive local scoring approach by integrating node density and connectivity (fidelity) to determine optimal operations that balance entanglement quality and network reachability. It simultaneously co-optimizes purification and swapping within a single time slot, maintaining equilibrium between fidelity enhancement and entanglement extension. Simulation results demonstrate that GLS-PS achieves higher EDR and better scalability than existing heuristic and greedy algorithms. Moreover, it exhibits superior practicality under constrained memory conditions, enabling scalable and efficient entanglement distribution for large quantum and repeater networks, marking a significant advancement toward practical quantum internet realization.

Evolution of Cryogenic CMOS Phase-Locked Loops for Quantum Computing Control

Durkesh B S

Thiagarajar College of Engineering (Autonomous), Affiliated to Anna University, Madurai, India

Dr. S. Rajaram

Thiagarajar College of Engineering (Autonomous), Affiliated to Anna University, Madurai, India

Abstract:

In order to accommodate the rapid advancement of quantum computation, control electronics must provide energy efficiency, high precision, and ultra-low jitter at cryogenic temperatures (≤ 4 K). Conventional room-temperature systems introduce latency, wiring complexity, and thermal burden, which restricts the integration of quantum processors on a large scale. By permitting the integration of control circuits within the cryostat, cryogenic CMOS (Cryo-CMOS) technology presents a promising avenue, thereby reducing thermal overhead and latency. Phase-Locked Loops (PLLs) are the primary enablers for the generation of stable, low-noise oscillators that maintain qubit coherence and timing fidelity.

A decade-long survey (2014–2024) of Cryo-CMOS PLL advancements is presented in this paper, which encompasses innovations in device modelling, circuit design, and cryogenic system integration. Performance metrics, including phase noise, jitter, power efficiency, and frequency range, are critically compared to underscore the influence of cryogenic device physics on PLL behaviour.

Standardised cryogenic PDKs, noise modelling, and long-term reliability continue to pose challenges, despite substantial progress. In order to facilitate the development of scalable, high-performance quantum control systems for the forthcoming generation of quantum processors, the paper concludes with future research directions that prioritise all-digital PLLs, 3D cryogenic integration, and cross-layer co-design.

Edge AI-Based Real-Time Root Cause Analysis System for Non-Invasive Fault Detection in Manufacturing Processes

Shreya S

Easwari Engineering College, Ramapuram, Chennai, India

Elakkia N J

Easwari Engineering College, Ramapuram, Chennai, India

Sangeetha V

Easwari Engineering College, Ramapuram, Chennai, India

Amsavalli K

Easwari Engineering College, Ramapuram, Chennai, India

Subbulakshmi S

Easwari Engineering College, Ramapuram, Chennai, India

Abstract:

Undetected faults in manufacturing can lead to severe financial losses, especially when rapid escalation occurs under dynamic conditions. Traditional fault detection systems, often limited by single-sensor inputs and their inability to accurately localize faults, prove insufficient in modern industrial environments. This research introduces a multimodal sensor fusion system, integrating vibration, temperature, optical (camera), and light-dependent resistor (LDR) sensors for comprehensive fault detection and prognostic analysis. Each sensor modality is processed using task-specific deep learning architectures: a 1D CNN for vibration analysis, a 2D CNN for visual anomaly detection, and an LSTM for temperature trends. The system effectively addresses faults including mechanical wear, temperature anomalies, visual defects, and light-based irregularities common in manufacturing processes. Implementation was initially demonstrated on a Raspberry Pi platform, establishing a practical edge AI-based real-time monitoring setup. Decision-level fusion consolidates predictions from all modalities, ensuring that signal context is maintained for robust, interpretable fault localization. Experimental results show accuracies of approximately 95% for vibration faults using 1D CNN, 92% for visual anomalies via 2D CNN, and 90% for temperature trend prediction with LSTM. The LSTM-based Remaining Useful Life (RUL) estimator further supports proactive maintenance by predicting component degradation. This integrated system outputs real-time fault alerts and sensor-based explanatory evidence, enhancing reliability and transparency. The framework's robustness against sensor noise and superior diagnostic performance over prior state-of-the-art multi-sensor approaches mark a significant advance toward resilient, self-explanatory fault management in next-generation manufacturing ecosystems.

Keywords:

Edge AI, sensor fusion, fault detection, LSTM, decision-level fusion.

A Benchmark Study of 1D CNN, GRU, and TCT on Thyroid Disease Classification

K Illakiya

Assistant Professor, Information Technology, Karpagam Academy of Higher Education, Coimbatore, India

Ajithmani M

Assistant Professor, Information Technology, Karpagam Academy of Higher Education, Coimbatore, India

Abstract:

Accurate classification of thyroid diseases is essential for early diagnosis and effective treatment, and machine learning models offer promising solutions to address this challenge. This study evaluates the performance of three deep learning models 1D Convolutional Neural Network, Gated Recurrent Unit, and Temporal Convolutional Transformer on the UCI Thyroid Disease dataset. The 1D CNN achieved the optimal accuracy (98%), with a weighted F1 score (97%). The GRU model also showed strong performance with an accuracy (97%) and a weighted F1 score (97%). The TCT model, while slightly lower in accuracy (97%), performed well with a weighted F1 score (96%). The average test accuracy across folds for the models was 97.07% for 1D CNN, 97.46% for GRU, and 96.54% for TCT, demonstrating that deep learning models, particularly CNN and GRU, can effectively classify thyroid diseases with high precision and recall.

Keywords:

Thyroid Disease Classification, Predictive Analytics in Endocrinology, TCT, 1DCNN, GRU.

FocusFlex: A Behaviorally-Driven Adaptive UI for Reducing Cognitive Load and Boosting User Performance

Ganesh S Gulannanavar

Department of MCA, RNS Institute of Technology, Bengaluru, Karnataka, India
Visvesvarayya Technological University, Belagavi, Karnataka, India

Jayanth H D

Department of MCA, RNS Institute of Technology, Bengaluru, Karnataka, India
Visvesvarayya Technological University, Belagavi, Karnataka, India

Kadeer

Department of MCA, RNS Institute of Technology, Bengaluru, Karnataka, India
Visvesvarayya Technological University, Belagavi, Karnataka, India

Hithesh Kumar N

Department of MCA, RNS Institute of Technology, Bengaluru, Karnataka, India
Visvesvarayya Technological University, Belagavi, Karnataka, India

Nagesh B S

Department of MCA, RNS Institute of Technology, Bengaluru, Karnataka, India
Visvesvarayya Technological University, Belagavi, Karnataka, India

Abstract:

The challenge of maintaining user focus in today's information-rich digital environments is a critical concern for Human-Computer Interaction (HCI). This paper presents FocusFlex, an adaptive user interface system engineered to dynamically adjust its components in real-time by observing user behavior without active sensors. Operating entirely on the client-side, the system monitors signals such as scroll speed, typing rhythm, mouse activity, and tab visibility to generate a continuous engagement score. This score then triggers UI modifications designed to lessen extraneous cognitive load when a user's attention diminishes. We detail the system's architecture, featuring a signal capture module, a weighted scoring algorithm, and a dynamic rendering layer developed with React and TailwindCSS. To assess its effectiveness, we performed a between-subjects study involving 40 participants, contrasting the FocusFlex adaptive interface with a static control version across a set of cognitive tasks. The findings show that users of FocusFlex achieved a statistically significant 18.4% decrease in task completion time ($p = .007$) and reported a 25.1% lower cognitive load on the NASA-Task Load Index ($p = .002$). Moreover, the system was linked to a 41.7% reduction in severe disengagement incidents ($p = .015$). This study offers a non-intrusive, replicable model for attention-aware

UI design, presenting a scalable method for managing cognitive load with substantial implications for productivity tools, educational software, and complex information systems.

Keywords:

Adaptive User Interfaces, Attention-Aware Computing, Cognitive Load, Human-Computer Interaction (HCI), Passive Behavioral Sensing, ReactJS, User Engagement.

A Dual Feature Approach to Ransomware Detection Using CatBoost and LightGBM

Venkata Sai Swapna Pallapothu

Department of Computer Science and Engineering, Siddhartha Academy of Higher Education (SAHE),
Vijayawada, Andhra Pradesh, India

Dr. T.Meena

Department of Computer Science and Engineering, Siddhartha Academy of Higher Education (SAHE),
Vijayawada, Andhra Pradesh, India

Abstract:

Ransomware represents a significant cybersecurity risk, leading to data and monetary losses via file encryption and ransom requests. Conventional detection techniques frequently struggle because of changing ransomware strategies. This research introduces a dual-feature detection system that integrates static (PE header) and dynamic (behavioral) features to enhance accuracy. Employing CatBoost and LightGBM classifiers, the system accurately detects ransomware by examining both its structure and behavior. Performance metrics (accuracy, precision, recall, F1-score) indicate robust detection ability, providing a scalable and understandable solution for real time situations.

Keywords:

Behavioral Analysis, CatBoost, Dynamic Analysis, LightGBM, Machine Learning, PE Header Features, Ransomware Detection, Static Analysis.

SE-RIS Enabled OTFS V2X with Semantic Intent Signalling and Onboard RF Sensing Redundancy

Sharon Joseph J

UG Student, Ramco Institute of Technology, Rajapalayam, Venganallur, India

Narendhran SR

UG Student, Ramco Institute of Technology, Rajapalayam, Venganallur, India

Mohamed Abuhanifa S

UG Student, Ramco Institute of Technology, Rajapalayam, Venganallur, India

Abstract:

The rapid evolution of autonomous and connected vehicles demands a communication framework that is reliable, intelligent, and robust against high mobility and harsh propagation conditions. This project proposes a next-generation Connected Intelligent Transport System (C-ITS) integrating Sensing-Embedded Reconfigurable Intelligent Surfaces (SE-RIS), OTFS-SCMA modulation, semantic communication, and onboard RF sensing redundancy to achieve ultra-reliable vehicular connectivity. The SE-RIS dynamically reconfigures the wireless environment by adjusting phase shifts while simultaneously sensing nearby vehicles, enabling both communication enhancement and environmental awareness. To combat Doppler effects and time-selective fading in high-speed V2X links, OTFS (Orthogonal Time Frequency Space) combined with SCMA (Sparse Code Multiple Access) is adopted, ensuring high reliability and support for multiple vehicles simultaneously. Furthermore, instead of transmitting raw data packets, a semantic intent signalling framework using Joint Source-Channel Coding (JSCC) is employed to communicate only meaningful driving intentions such as braking, lane change, or collision risk, thus reducing bandwidth and latency. An additional layer of federated learning-based AI predicts vehicle intent cooperatively without sharing raw data, ensuring privacy and scalability. Onboard RF sensing provides redundancy, ensuring system reliability even under communication blockage or RIS malfunction. Together, these technologies form a robust, scalable, and intelligent framework aligned with 6G V2X communication goals, enabling safer autonomous transportation systems.

Keywords:

SE-RIS, OTFS-SCMA, Semantic Communication, Delay-Doppler Channel, RF Sensing Redundancy, Federated Learning, C-ITS, 6G Vehicular Networks.

A Full-Stack Framework for Mitigating Bias in MERN-based Recommender Systems: Architectural Patterns and Cross-Domain Empirical Validation

ChannaBasava Swamy P

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Dr. Rajani Narayan

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Bhoomika H S

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Abstract:

This research puts forward a unified methodology for the identification and remediation of bias within AI-driven recommendation platforms constructed using the MERN (MongoDB, Express.js, React.js, Node.js) framework. This paper argues that achieving fairness is a comprehensive systems-engineering challenge, not a siloed algorithmic problem, demanding synchronized actions across a system's data, logic, presentation, and operational strata. To this end, this work offers three principal contributions. First, a multi-domain empirical analysis of back-end mitigation tactics is presented, which integrates data pre-processing (re-sampling) with model in-processing (fairness-centric regularization) using the MovieLens 1M and Book-Crossing datasets. Second, findings are reported from a controlled A/B test that empirically validates the positive effect of presentation-tier modifications in a React.js client, showing that user interface adjustments can significantly mitigate exposure bias. Third, a "Fairness-as-a-Service" (FaaS) microservice architecture is proposed as a blueprint for enabling persistent, real-time bias detection and correction as an intrinsic part of the MLOps workflow. The consolidated results demonstrate that this multi-pronged strategy substantially enhances group fairness metrics while introducing only minimal, acceptable trade-offs in recommendation precision, thereby offering a workable and extensible model for creating more equitable recommender systems.

Keywords:

Recommender Systems, Algorithmic Fairness, Bias Mitigation, MERN Stack, Full-Stack Development, Responsible AI, MLOps.

Overcoming the Integration Bottleneck: A Materials-Centric Framework for 6G Terahertz and Quantum Networks

Adil Muhammad

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Dr. Kavya N P

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Aishwarya B C

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Akash M S

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Abhishek P

Postgraduate Student (MCA), RNS Institute of Technology, Bengaluru, Karnataka, India

Abstract:

The sixth-generation (6G) of wireless communication promises a paradigm shift towards a globally interconnected fabric of intelligent systems, necessitating terabit-per-second data rates, sub-millisecond latencies, and novel functionalities such as integrated quantum networking and environmental sensing. While the discovery of materials with exotic electromagnetic and quantum properties has accelerated, this paper posits that the primary bottleneck impeding the realization of 6G is not the lack of novel materials, but the profound challenge of their scalable manufacturing and heterogeneous integration into functional, cost-effective systems. We conduct a comprehensive analysis of the three technological pillars underpinning 6G: terahertz (THz) communication materials, solid-state quantum networking substrates, and AI-enhanced programmable metamaterials. A comparative analysis of foundational semiconductor platforms (III-V vs. Silicon), two-dimensional materials, and quantum platforms (Diamond NV centers vs. SiC color centers) reveals a persistent gap between laboratory-scale device performance and manufacturable, large-scale systems. This work formulates a hypothesis-driven narrative asserting that future research imperatives must shift from material discovery in isolation to a co-design philosophy emphasizing integration science, advanced packaging, and wafer-scale fabrication. Without fundamental breakthroughs in these areas, the performance ceiling imposed by manufacturing constraints will prevent the translation of material potential into the technological revolution envisioned for 6G.

Keywords:

6G, terahertz communication, quantum networks, metamaterials, heterogeneous integration, reconfigurable intelligent surfaces, silicon carbide, material science.

Comprehensive Survey of Deepfake Detection Models: From CNNs to Transformers

Aryan Singh

Student, SRMIST NCR Campus, Ghaziabad, Uttar Pradesh, India

Dr. Randeep Singh

Student, SRMIST NCR Campus, Ghaziabad, Uttar Pradesh, India

Abstract:

Due to the swift progress of generative models, synthetic multimedia has been developed to be referred to as Deepfakes, and can convincingly impersonate the identity of one person by another in a video, image, or audio. Although these technologies are evidence of the innovative capacity of deep learning, there are also many severe risk to privacy, politics, and information integrity. The paper provides a well-structured overview of Deepfake detection techniques that have been published starting in 2019 to 2025, which are characterized by the shift toward handcrafted methods and deep learning and transformer-based models. The review explores benchmark datasets, evaluation criteria and the current research issues like cross-domain generalization, biased data, and real-time implementation. It is proposed to use a taxonomy that categorizes methods based on their feature extraction strategy, network architecture and the type of modality. The paper wraps up with the main conclusions and research directions in the future to interpretable, lightweight, and multimodal DeepFake detection systems.

The Unspoken Fear: Advancing Women's Safety through Real-Time Smart Surveillance

S.S.Ashika

Student, Artificial intelligence and Data Science, Kamaraj College of Engineering and Technology,
Virudhunagar, Vellakulam, Tamil Nadu, India

Anushri M

Student, Artificial intelligence and Data Science, Kamaraj College of Engineering and Technology,
Virudhunagar, Vellakulam, Tamil Nadu, India

Abstract:

Despite advancements in technology, women's safety remains a critical concern in modern society. Traditional surveillance systems such as conventional CCTV networks offer passive observation without real-time intervention, often leading to delayed responses and ineffective deterrence. This paper presents the Smart Real-Time CCTV Monitoring System, an innovative solution designed to bridge the gap between surveillance and immediate action.

The proposed system integrates motion detection, GSM-based alert mechanisms, and real-time mobile accessibility to provide instant notifications and responses during suspicious activities. Its affordability, scalability, and adaptability make it especially suitable for deployment in vulnerable public spaces and urban environments. By transitioning from passive recording to active protection, this solution addresses one of the most pressing social issues of our time, women's safety. Aligned with the goals of sustainable development and social empowerment, this technology offers a practical, impactful step toward building a safer and more inclusive society. The Smart Real-Time CCTV Monitoring System is not merely a technological advancement; it is a necessary instrument in redefining public safety and ensuring that women can move freely, confidently, and securely within their communities. Like a digital guardian angel, our system shields the vulnerable before danger strikes — turning fear into freedom. Together, we stitch a safer tomorrow, where technology becomes the heartbeat of sustainability and equality.

CivicWatch: AI-Powered Public Grievance Alert System

Swati Panwar

Department of Computer Science and Engineering, Chandigarh University, Mohali, India

Akshat Tiwari

Department of Computer Science and Engineering, Chandigarh University, Mohali, India

Samridh Anuj

Department of Computer Science and Engineering, Chandigarh University, Mohali, India

Hrithikvanth VH

Department of Computer Science and Engineering, Chandigarh University, Mohali, India

Shubham Pundeer

Department of Computer Science and Engineering, Chandigarh University, Mohali, India

Abstract:

In hyper-modern civic settings, social concerns that include illegal-leaving, roadblocks, water leakages, importunity and crime are often left unresolved as an outcome of ineffective reporting processes and delayed responses. To overcome such odds this paper presents CivicWatch which is an AI- based policing service that provides a platform to allow citizens to file their grievance and alert through a multimedia-based feature (images and/or videos and/or text messages). The system supports automated issue bracket, prioritization and real time alert generation through artificial intelligence methods, allowing original authorities to respond in real time and in the most effective way. Its combination of sophisticated analytics and a transparent reporting structure enables CivicWatch to not only speed up resolution processes, but also increase community engagement and civic accountability. The suggested system is beneficial in building smarter, safer and responsive civic nations with citizen lead contribution and AI-driven governance.

Keywords:

Civic engagement, public grievance system, artificial intelligence, smart cities, real-time alerts, urban governance, transparency.

ChurnShield: Machine-Learning-Driven Customer Churn Prevention System

Rohan Deshmukh

Information Technology, Vishwakarma Institute of Technology, Pune, India

Vinayak Deshmukh

Information Technology, Vishwakarma Institute of Technology, Pune, India

Dhanshri Deshpande

Information Technology, Vishwakarma Institute of Technology, Pune, India

Pralhad Deshpande

Information Technology, Vishwakarma Institute of Technology, Pune, India

Vedant Deshpande

Information Technology, Vishwakarma Institute of Technology, Pune, India

Samarth Dhagate

Information Technology, Vishwakarma Institute of Technology, Pune, India

Abstract:

An innovative research method involving a dataset with 21 columns and 7,044 cases is employed in an application that possesses a user-friendly interface based on Flask. The users can either input their data manually or upload their CSV files, thereby making the system an easy and effective method to analyze their data. Using the logistic regression and correlation exploration, the resulting model managed to attain high prediction accuracy and achieve a precision of 95.57% and overall accuracy of 92.08% when it makes customer churn predictions. Companies will henceforth regard this application because it provides abstraction of operational complexity with an ability to make predictions, enabling it to predict customer departures in order to offer enhanced customer retention strategies and decision-making. Further, since the research gave timely predictions customer relationship management processes can be enhanced, and assist companies in all industries reduce customer churn and enhance sustainable growth by means of higher operational efficiency and deliver business intelligence that is capable to enhance an organization's competitiveness. It employs continuous monitoring and constant model upgrades which allows the application to remain practical in assisting companies to ride through various environments and continue to deliver performance that will result to long-term impact.

Keywords:

Customer Churn Prediction, Logistic Regression , Ensemble Methods, Feature Engineering, Machine Learning Deployment.

A systematic Review using AI Techniques for Energy Management in Electrical Vehicle

Shishir Sharad Pande

Research Scholar, Department of Electrical Engineering, Priyadarshini College of Engineering, Nagpur, India

Dr. Ujwala B.Malkhandale

Assistant Professor, Department of Electrical Engineering, Priyadarshini College of Engineering, Nagpur, India

Abstract:

As more people switch to electric vehicles (EVs), there's a growing need for smart systems to manage their energy. We want to get the most out of every charge, make batteries last longer, and boost overall vehicle performance. This is where combining the Internet of Things (IoT) with Reinforcement Learning (RL) comes in, offering a promising way to intelligently and dynamically manage EV energy. This study introduces an IoT-driven, RL-based system designed to optimize EV energy. It uses data from vehicle sensors and cloud platforms to make smarter decisions about how energy is distributed and consumed. The RL model learns to adapt to different driving conditions, battery levels, and interactions with the power grid, ensuring the best charging and discharging strategies. By using advanced deep reinforcement learning algorithms, the system constantly improves its approach to minimize wasted energy and extend battery life. Our simulations show that this approach significantly improves energy efficiency and reduces costs compared to traditional methods. This research truly highlights how IoT and RL can advance smart EV energy management, paving the way for a more sustainable transportation future.

Keywords:

Smart System, Energy, Reinforcement, Algorithm, Electric Vehicle.

Intelligent Rails: A Survey on AI and ML Techniques in Railway Traffic Control and Management

Rajdeep Thakur

Department of Information Technology, Pune Institute of Computer Technology, Pune, India

Dr. Shyam Deshmukh

Department of Information Technology, Pune Institute of Computer Technology, Pune, India

Shreyash Ingle

Department of Information Technology, Pune Institute of Computer Technology, Pune, India

Prathamesh Kale

Department of Information Technology, Pune Institute of Computer Technology, Pune, India

Trisha Khimesra

Department of Information Technology, Pune Institute of Computer Technology, Pune, India

Abstract:

Railway traffic management is a safety-critical optimization problem foundational to modern transportation. As railway networks grow, traditional methods struggle to ensure operational efficiency. This paper presents a comprehensive survey of Artificial Intelligence (AI) and Machine Learning (ML) techniques applied to railway traffic control and scheduling. We trace the evolution of methodologies from classical Operations Research, through the predictive power of supervised and deep learning, to the autonomous decision-making of Reinforcement Learning (RL). Our review progresses to the current frontiers of network-aware Graph Neural Networks (GNNs) and the emerging paradigm of trustworthy systems built on Large Language Models (LLMs) and hybrid AI. Our analysis identifies a clear trend: a functional shift from passive prediction to autonomous action, an increase in model complexity toward hybrid systems, and a growing focus on scalability, interpretability, and verifiable safety. We conclude by highlighting critical research gaps and proposing future directions toward developing verifiably safe, explainable, and human-centric AI for real-world railway operations.

Keywords:

Railway traffic management, Artificial intelligence, Machine Learning, Optimization, Intelligent Transportation Systems.

Automated Classification of Lemon Leaf Diseases Using Deep Learning and Transfer Learning Approaches

Dr. Gayatri S. Panicker

Vellore Institute of Technology, Tamil Nadu, India

Isha Rane

Vellore Institute of Technology, Tamil Nadu, India

Abstract:

Lemon cultivation is faced with various foliar diseases and pest disorders, which contribute significantly to the quality and yield of the crop. Traditional techniques involving visual observation for the identification of diseases are time-consuming, subjective, and cannot be applied on a large scale. We present in our work a deep learning-based approach for the automatic classification of diseases in lemon leaves using transfer learning. A manually selected image dataset of lemon leaves—divided into nine categories over eight disease classes and one healthy class—is utilized as input for model testing and training. Four pre-trained Convolutional Neural Network (CNN) models—ResNet50, EfficientNetB3, GoogleNet, and MobileNetV3—are fine-tuned and compared on different metrics such as classification accuracy, F1-score, and inference speed. Data preprocessing techniques such as normalization, resizing, and data augmentation are utilized to promote model generalization. The experiments validate that EfficientNetB3 possesses the highest accuracy and MobileNetV3 possesses the lowest inference, making both models prime candidates for use in real-time applications in agriculture. The study is one step closer to the development of AI-based precision farming technology offering scalable, cost-effective, and precise plant disease diagnosis.

Hypertension Detection using MFCC and Deep Learning

Dr. U Sivaji

Department of IT, Institute of Aeronautical Engineering, Hyderabad, India

E. Kathyayani

Department of IT, Institute of Aeronautical Engineering, Hyderabad, India

B. Harshitha

Department of IT, Institute of Aeronautical Engineering, Hyderabad, India

G. Praveen Kumar

Department of IT, Institute of Aeronautical Engineering, Hyderabad, India

Abstract:

High blood pressure is a medical issue, and it is quite severe being that it has no explicit symptoms. It is essential to detect it at the early stages to prevent serious consequences. This initiative is a brand-new approach toward the forecasting of hypertension through the recognition of speech emotions. This is because the human voice can be used to express emotions such as stress or anger which are normally related to high blood pressure. With the recording of the voices, the system finds out the emotional patterns and based on this they make out the possibility of any hypertension. It is based on Convolutional Neural Network (CNN) and extracts Mel Frequency Cepstral Coefficients (MFCCs) on the samples of the voices. Such characteristics assist the model to interpret and categorize emotions. Training and test data are obtained using RAVDESS data set. CNN model presents high accuracies on the classification of emotions like calm, angry and fearful. Depending on the identified emotion, the system provides a warning in case there is any potential incidence of hypertension. The voice-based resolution presents an easy, touch less, and inexpensive way of detecting early hypertension. It can be particularly practical in the countryside or those individuals who would not avail of routine health checkups. The system is portable and can be incorporated in the mobile applications, hence accessible to and user- friendly in monitoring health on a daily basis.

Keywords:

Hypertension, Speech Emotion Recognition, CNN, MFCC, Deep Learning, Voice- based Detection.

Knowledge Distillation in LLMs using Jensen Channel Diversions

Pankaj Sunil Mirchandani

Student Researcher, Computer Engineering, NMIMS Mukesh Patel School of Technology Management and Engineering, Maharashtra, India

Shree Kolwankar

Student Researcher, Computer Engineering, NMIMS Mukesh Patel School of Technology Management and Engineering, Maharashtra, India

Om Shah

Student Researcher, Computer Engineering, NMIMS Mukesh Patel School of Technology Management and Engineering, Maharashtra, India

Abstract:

The deployment of state of the art LLMs has always been severely hampered by their massive computational requirements as well as memory. Knowledge Distillation offers a solution by transferring the capabilities of a larger “teacher” LLM to a smaller and more efficient “student” model. Recent advancements from distilling simple output labels to distilling intermediate steps of reasoning or rationales that provide a supervisory signal for the student. However, these advanced methods almost completely rely on minimising KL Divergence between teacher and student distributions. As an asymmetric and potentially unbound objective function, KL Divergence can foster an unstable optimisation challenge that is further worsened in the complex multi task setting of labels and rationales.

This paper presents a novel framework that empowers the rationale-based knowledge distillation by replacing the traditionally used KL Divergences with Jensen-Shannon Divergence. It is conjectured that boundedness and symmetry are inherent properties of JSD that serve as a more stable and well balanced training objective. This presents aggressive mode seeking behaviour of KL Divergence in forcing the student LLM to neglect the valuable distributions termed as “Dark Knowledge” encoded in soft targets of the teacher LLM. Experiments across several challenging reasoning benchmarks demonstrate that this JSD-based approach not only regularises training dynamics and props up a more complete transfer of the teacher’s abilities. This gives us a student LLM that outperforms those created via KL Divergence, with large improvements found in data scarce areas. The most impactful contribution of this paper is that divergence metric choice is a crucial, yet all-but-unexplored, factor for the efficacy of rationale-based distillation. By leveraging Jensen-Shannon Divergence, this research provides a more robust method for creating smaller and highly capable language models that retain the nuanced reasoning abilities of their larger counterparts, making AI more accessible.

Artificial Intelligence for Legal Document Analysis and Judicial Efficiency: AI-Driven LegalDocAI Framework

Sameer K. Singh

University Institute of Engineering, Chandigarh University, Mohali, Punjab, India

Sakshi Kumari

University Institute of Engineering, Chandigarh University, Mohali, Punjab, India

Rushan Gupta

University Institute of Engineering, Chandigarh University, Mohali, Punjab, India

Nishant Kumar

University Institute of Engineering, Chandigarh University, Mohali, Punjab, India

Akshit Sharma

University Institute of Engineering, Chandigarh University, Mohali, Punjab, India

Sandeep Kaur

University Institute of Engineering, Chandigarh University, Mohali, Punjab, India

Abstract:

Contemporary courts have large issues since much legal information exists as well as numerous pending cases. Injustice can be caused by delays to such an extent that people struggle to access justice due to delays, which impacts both speed and fairness. These issues might be addressed with new AI tools, particular automatic legal document analysis tools alongside court decision support tools. What ways AI can contribute to legal procedures being faster is examined within this chapter. How such technologies are developed, utilized, and what impacts they can cause is also discussed. What is explored further is key methodology such as natural language processing, machine learning, knowledge graphs, as well as large language models for purposes ranging from contract review to searching prior cases to finding electronic evidence to predicting case outcomes. It comments upon how courtrooms can make better uses of AI systems to support managing case delay, checking for understanding, and resolving conflicts better. It refers to problems related to over-abundant automated tool usage from high-profile legal proceedings such as algorithmic bias, clarification, responsibility, and data security. It provides a balanced report about how AI is helpful with judge decision-making but is incapable of replacing it by discussing recent trends with their respective related ethical, legal, and professional issues. Finally, it suggests that AI has the ability to promote court functioning better if properly used to allow justice systems to be more efficient, transparent, and user-friendly.

Keywords:

Artificial Intelligence, LegalDocAI, Natural Language Processing, Machine Learning, Explainable AI, Judicial Efficiency, Computational Law, Emerging Technologies.

Blockchain and CPS-Based Digital Identity for Smart Cities

Sachin

Chandigarh University, Mohali, Punjab, India

Jasnoor Singh

Chandigarh University, Mohali, Punjab, India

Anuradha Devi

Chandigarh University, Mohali, Punjab, India

Abstract:

The blistering development of smart cities requires safe, open and effective systems of managing digital identities to aid smooth delivery of citizen services and governance. Conventional centralized identity systems are becoming susceptible to information assault, unauthorized access and ineffectiveness in sharing information among intertwined urban infrastructures. To solve these problems, the proposed research project will suggest a decentralized system of managing digital identities, a digital identity management framework based on Blockchain and Cyber-Physical Systems, aimed at providing data integrity, data privacy, and real-time authentication of smart city users. The system uses Blockchain to achieve immutability and decentralized trust, CPS to enable real-time interaction between physical and digital organizations, and AI-based analytics to generate behavioral insights that enhance adaptive identity verification and better governance. The experimental simulations reveal high levels of transparency, security, and data interoperability with conventional systems. The suggested framework brings a scalable core to secure identity ecosystems, strengthening citizen faith and empowering information-driven city legislation.

Keywords:

Artificial Intelligence, Blockchain, Cyber-Physical Systems, Digital Identity.

Multi-Modal Energy Harvesting IoT Sensor Node

Shravani Kurumbhatte

Information Technology, Vishwakarma Institute of Technology, Pune, India

Bhagyesh Lunawat

Information Technology, Vishwakarma Institute of Technology, Pune, India

Chinmay Mandavkar

Information Technology, Vishwakarma Institute of Technology, Pune, India

Manas Patil

Information Technology, Vishwakarma Institute of Technology, Pune, India

Ranjana Jadhav

Information Technology, Vishwakarma Institute of Technology, Pune, India

Abstract:

The growth of Internet of Things (IoT) devices in distant or hard-to-reach places poses a big problem for ensuring constant power supply. Traditional systems that rely on batteries have limitations due to their finite lifetime, impact on sustainability and overall cost of maintenance. By harnessing energy from the surrounding environment(s), we can offer a more sustainable form of energy use, allowing IoT devices to operate continuously in an autonomous manner based on energy drawn from the surrounding environment. In this paper we will explain an energy harvesting system that uses a smart mix of solar energy and harvested thermal energy to provide continuous operation of low-power IoT sensor nodes. Our smart device energy system includes an energy management system with a BQ25570 maximum power point tracking (MPPT) charger and an LTC3108 boost converter that manages available energy based on real-time access. Controlled tests showed stable voltage regulation, continuous operation of the sensors and maintained stable operation during changes in environmental conditions, preparing us for future independent IoT applicate agricultural or environmental monitoring systems.

Keywords:

IoT, energy harvesting, multi-source power management, solar energy, thermoelectric generator, MPPT, embedded systems, sustainable IoT applications, wireless sensor nodes.

Adversarial Vulnerability and Feature-Space Detection in AI-Driven Brain Tumor Diagnostics

Aditya Mulay

Student, Information Technology, Pune Institute of Computer Technology, Pune, Maharashtra, India

Soham Patil

Student, Information Technology, Pune Institute of Computer Technology, Pune, Maharashtra, India

Tina Bhavsar

Student, Information Technology, Pune Institute of Computer Technology, Pune, Maharashtra, India

Tanvi Pattewar

Student, Information Technology, Pune Institute of Computer Technology, Pune, Maharashtra, India

Abhijeet Karve

Student, Information Technology, Pune Institute of Computer Technology, Pune, Maharashtra, India

Abstract:

Deep learning (DL) has enabled transformative progress in medical image analysis, particularly in Magnetic Resonance Imaging (MRI)-based multi-class brain tumor classification. Convolutional Neural Networks (CNNs) now achieve near-radiologist performance in differentiating glioma, meningioma, and pituitary tumors. However, these models exhibit critical fragility to adversarial attacks (AAs)—imperceptible perturbations capable of inducing catastrophic misclassification. Such vulnerabilities raise severe concerns in clinical contexts where diagnostic integrity directly impacts patient safety and financial decision-making [2].

To empirically validate this risk, a Projected Gradient Descent (PGD) attack was implemented on a high-performing VGG-like classifier trained on an MRI dataset. The attack caused classification accuracy to plummet from approximately 95% to 12%, demonstrating the extreme susceptibility of current diagnostic AI systems (Author, 2025). This review synthesizes the taxonomy of adversarial attacks, summarizes existing proactive and reactive defense mechanisms, and focuses on Feature-Space Anomaly Detection as a lightweight alternative to adversarial training. However, our experimental evaluation using a simple feature-based Isolation Forest detector achieved only 47.50% robust accuracy, underscoring a significant mitigation gap in the existing literature. The paper concludes by recommending advanced feature-space modeling approaches—such as Gaussian Mixture Models (GMMs) or Out-of-Distribution (OOD) detection frameworks—to achieve clinically reliable robustness in future medical AI.

Keywords:

Adversarial attacks, Brain tumor classification, Deep learning, MRI, Feature-space detection, Medical AI robustness, Out-of-distribution detection, PGD.

Advanced Ensemble Learning for IoT-Based Healthcare: A Stacking and XGBoost Approach for Enhanced Heart Disease Prediction

Sreeramulu Adigoppula

Research Scholar, Department of Electronics and Communication Engineering, Sri Satya Sai University of Technology & Medical Sciences, Sehore, Bhopal Indore Road, Madhya Pradesh, India

Dr. Mukesh Tiwari

Research Guide, Department of Electronics and Communication Engineering, Sri Satya Sai University of Technology & Medical Sciences, Sehore, Bhopal Indore Road, Madhya Pradesh, India

Dr. G. Karthick

Assistant Professor, Research Co-Guide, Department of Electronics and Communication Engineering, Jyothishmathi Institute of technology and science, karimnagar, Telangana, India

Sravanthi Chiluka

Research Scholar, Department of Electronics and Communication Engineering, Sri Satya Sai University of Technology & Medical Sciences, Sehore, Bhopal Indore Road, Madhya Pradesh, India

Abstract:

The integration of ensemble learning techniques with Internet of Things (IoT) healthcare systems represents a significant advancement in predictive diagnostics. This research presents an enhanced smart healthcare monitoring system that employs stacking ensemble methods and XGBoost algorithms to improve heart disease prediction accuracy beyond traditional single-classifier approaches. We developed a two-tier ensemble architecture where base learners (Support Vector Machine, Naïve Bayes, Random Forest, and K-Nearest Neighbors) are combined through a meta-learning layer utilizing XGBoost. The system processes real-time physiological data from IoT sensors, including pulse rate and body temperature measurements from 4,287 patient samples. Our stacking ensemble approach achieved 98.73% accuracy, representing a 1.81% improvement over the best single classifier (Naïve Bayes at 96.92%). The XGBoost meta-learner demonstrated superior capability in learning optimal combination patterns with precision of 89.4%, recall of 87.2%, and F1-score of 88.3%. The system maintained low computational overhead with training time of 4.2 seconds and prediction latency of 28 milliseconds, making it suitable for real-time clinical applications. Cross-validation results showed robust performance with minimal variance ($\pm 0.87\%$), confirming model stability.

Keywords:

Ensemble Learning, Stacking, XGBoost, Internet of Things (IoT), Heart Disease Prediction, Machine Learning, Smart Healthcare, Real-Time Monitoring.

Design and Implementation of Power-Optimized Ternary Content Addressable Memory Using Reversible Gates

B. Vasudeva

Department of ECE, GMR Institute of Technology, Rajam, India

N. Vijaya Bhaskar

Department of ECE, GMR Institute of Technology, Rajam, India

M. Kishore

Department of ECE, GMR Institute of Technology, Rajam, India

S. D. Chandrasekhar

Department of ECE, GMR Institute of Technology, Rajam, India

M. Vaikuntham

Department of ECE, GMR Institute of Technology, Rajam, India

Abstract:

Ternary Content Addressable Memory (TCAM) is widely used in search-based applications such as IP routing and packet classification however, in conventional designs, TCAM suffers from high power consumption due to its parallel searches and larger footprint because of its complexity. The conventional TCAM architectures and modern architectures still lack control over power dissipation because of the irreversible logic elements that are used. Additionally, the larger transistor count and complex match-line architectures make the design inefficient for both power consumption and scalability, and such designs are not suitable for current low-power VLSI designs. Therefore, this paper presents an optimized TCAM architecture implemented in Verilog HDL. This design is based on reversible logic to enhance power efficiency, and the results obtained after synthesis in Xilinx Vivado show a remarkable reduction in on-chip power consumption of only 1.499 W. This indicates a significant power reduction, and a total of 28 LUTs and 32 flip-flops are utilized from the overall FPGA resources, which is about 0.02% and 0.01% of the available resources, and the maximum operating frequency is 643 MHz. Overall, this power-efficient and scalable TCAM design demonstrates better performance than previous architectures for high-performance computing and networking applications.

Keywords:

TCAM, Power Optimization, Reversible logic, FPGA.

Use of Artificial Intelligence in Tax Filing Applications

Prithvi Prabhu Pani V

Department of Computer Science and Engineering, Atria Institute of Technology, Bangalore, India

Tanmoy Kundu

Department of Computer Science and Engineering, Atria Institute of Technology, Bangalore, India

Sherin Nayana B

Department of Computer Science and Engineering, Atria Institute of Technology, Bangalore, India

Sunnampalli Varshitha

Department of Computer Science and Engineering, Atria Institute of Technology, Bangalore, India

Tejushree R

Department of Computer Science and Engineering, Atria Institute of Technology, Bangalore, India

Abstract:

The fast-changing economic landscape of India and the rise of Artificial Intelligence (AI) as a transformative force in today's technological reality has provided an opportunity to revolutionize the taxation process in the country. The growth of India's gig economy has led to a rise in the number of taxpayers and increased complexity in their financial needs. This paper seeks to elucidate the role AI can play in the realm of taxation. The tax-filing process can be streamlined by use of machine learning algorithms, and compliance too can be better ensured by use of these AI-Driven solutions. Robust NLP-enriched chatbots can be utilized to educate first time tax payers on the various regulatory pitfalls they may face. AI can be leveraged to improve predictive analysis. This paper elaborates the benefits, disadvantages, and possible concerns of using AI-driven solutions in taxation. It provides a comprehensive view of this landscape--the research gaps, possible methodologies that can be incorporated in the solution, the results and their interpretation.

Keywords:

Artificial Intelligence, Natural Language Processing, Taxation, Machine Learning.

Mobile Internet Speed of Things using External Antenna and PSO Algorithm

Dr. S.Saravanan

Assistant Professor, Chennai Institute of Technology, Tamil Nadu, India

Abstract:

Mobile Internet speed affects from noise of internet signal propagation, building coverage. Mobile Antenna coverage limited internet bandwidth coverage by the distribution from Cellular Tower base station. The Cellular Tower provides internet signal by secondary lobe of Radiation that provide limitation of internet speed. For the reason the primary lobe provides high radiation that will affects human healthcare. The primary lobe radiation provides at height of above 100 feet and the secondary lobe radiation lobe allows ground floor of People. The secondary lobe of radiation provides limited internet speed for reason it is low radiation pattern it is not make optimal solution of internet speed. Mobile phone antenna cover limited internet speed, the optimum internet speed is not able to cover by Mobile Antenna for reason, the high gain of mobile antenna will receive high radiation pattern of primary lobe that will affect human health. Mostly Mobile Antenna gain is limited gain and it is allow low radiation access to make limited internet speed it is not able to access optimal solution of internet speed. This situation we need design of external Antenna to improve low mobile internet speed to optimal internet speed. The Particle swarm optimization Algorithm (PSO) is used to compute optimal mobile internet speed of best improved mobile internet speed using design of antenna. [1-15]

Keywords:

Mobile internet speed, PSO Algorithm, Design of Antenna.

Numerical Investigation of Active Secondary Jet Flow Control in Subsonic Free Jets to Enhance UAV Exhaust Systems

Mohammed Owais Ashfaq

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidre, Karnataka, India

G Ananya Prabhu

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidre, Karnataka, India

Mithul Ganesh

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidre, Karnataka, India

Mohammed Shameel T

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidre, Karnataka, India

Abstract:

The use of active flow control techniques in subsonic free jets focuses on the incorporation of secondary jets for performance enhancement. The primary objective is to examine how the strategic injection of secondary airflows at varying angles affects the mixing characteristics, turbulence, and overall stability of the primary jet stream. The intent behind this investigation is to address the gap for a low-cost aerodynamic research for active flow control using secondary injection, particularly in flow mixing, jet spreading, and utilizing computational methods. This approach is to validate theoretical predictions regarding the behavior of jet flows when subjected to secondary injection at specific angles with respect to the jet centerline (30°, 45°, 60° and 90°). The effectiveness is highly dependent on the precise angle and position of injection, which makes real-time control a vital factor. From the results, the secondary slot at angles 30°, 45°, 60° and 90° results in a significant decrease of core length around 10%, 20%, 40% and 60% respectively. Hence, we found that the secondary inlet of 90° has significantly reduced the potential core length by 50-60%, thereby causing stronger shear layers, more turbulence, improved fuel mixing, and also increasing the jet spread. The findings have promising implications for future propulsion systems, particularly in applications for UAVs.

Legal Document Compliance Checking System: A Machine Learning Approach

Dr. Deepali Joshi

Department of Information Technology, Vishwkarma institute of Technology, Pune, India

Susmit Bahadkar

Department of Information Technology, Vishwkarma institute of Technology, Pune, India

Jaywant Avhad

Department of Information Technology, Vishwkarma institute of Technology, Pune, India

Abhilash Baviskar

Department of Information Technology, Vishwkarma institute of Technology, Pune, India

Parth Bhalerao

Department of Information Technology, Vishwkarma institute of Technology, Pune, India

Akash Chimkar

Department of Information Technology, Vishwkarma institute of Technology, Pune, India

Abstract:

Ensuring legal compliance within documents remains a critical challenge for enterprises, with traditional manual reviews being time-consuming and prone to human error. While existing automated solutions leverage machine learning and natural language processing, they often lack transparency, adaptability to jurisdictional nuances, and rigorous validation against domain-specific legal standards. This paper presents a comprehensive Legal Document Compliance Checking System that integrates fine-tuned Large Language Models (LLMs) with structured legal benchmarks to address these gaps. Our system employs a hybrid architecture combining OpenAI's embeddings for semantic clause retrieval and MongoDB for storing jurisdiction-aware compliance templates, enabling granular, interpretable comparisons. Through extensive evaluation on a diverse dataset of 1,200 contracts (covering NDAs, employment agreements, and service contracts), we demonstrate an average F1-score of 95.7%, with detailed error analysis revealing that 82% of discrepancies stem from ambiguous phrasing rather than model limitations. To ensure practical relevance, we collaborated with legal experts to annotate clauses and validate outputs, achieving a 40% reduction in review time during a pilot deployment. While the system relies on Pinecone for scalable vector search and Amazon S3 for document storage, we critically evaluate its dependency on proprietary APIs and propose

mitigation strategies for long-term reproducibility. This work bridges the gap between scalable AI-driven automation and domain-specific legal rigor, offering a blueprint for adaptable, transparent compliance tools.

Keywords:

Legal compliance, Machine learning, Natural language processing, Vector search, Pinecone, MongoDB, Amazon S3, Legal document analysis.

VLSI Realization and Simulation of Hybrid Precoding of Millimeter Wave Massive MIMO Systems using SystemVerilog HDL

K. Ankith

Department of ECE, GMR Institute of Technology, Rajam, India

S. Balaji

Department of ECE, GMR Institute of Technology, Rajam, India

P. V. Murali Krishna

Department of ECE, GMR Institute of Technology, Rajam, India

L. Kavya

Department of ECE, GMR Institute of Technology, Rajam, India

K. Ravindra

Department of ECE, GMR Institute of Technology, Rajam, India

Abstract:

The continuous evolution of 5G and 6G wireless systems demands very high data rates, reliable connectivity, and energy-efficient hardware. Millimeter-wave technology and massive MIMO can satisfy these requirements by providing high-speed and high-capacity data transmission. However, a fully digital architecture is complex and power-consuming. A hybrid precoding concept overcomes these limitations, including both analog and digital processing and achieves high performance with reduced hardware cost. This paper proposes a hybrid precoding architecture based on a VLSI design implemented using SystemVerilog HDL. The design translates the mathematical model of hybrid beamforming into a practical and synthesizable hardware structure and includes the following key functional modules: Analog precoding, complex signal rotation, beam selection, normalization, and control sequencing. The simulation and synthesis conducted on an FPGA platform demonstrate the correctness, speed, and efficiency of the proposed architectural design. The proposed architecture achieves high data throughput with lower circuit complexity and reduced power consumption. Hence, it is suitable for real-time millimeter-wave MIMO communication. These results confirm that the designed architecture offers a very effective trade-off among performance, energy efficiency, and hardware simplicity; thus, it is a potential candidate for next-generation 5G and 6G wireless hardware implementation.

Keywords:

Hybrid Precoding, mmWave MIMO, Verilog HDL, Block Diagonalization, Spectral Efficiency, Equal Gain Transmission.

Adaptive Real-Time Air Quality Prediction Using Deep Neural Networks for Smart City Environments

Sasireka T

PG Student, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

Dr. R T Subhalakshmi

Assistant Professor, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

Abstract:

In this paper, a Multilayer Perceptron Neural Network (MLP) Real-Time Air Quality Index (AQI) Prediction System is suggested to predict air quality accurately. The algorithm derives pollutant features from a city air quality dataset. A StandardScaler replaces missing values and scales features for data preparation. Prepared data is divided into training and testing sets in order to evaluate the model correctly. The neural network employs the ReLU activation function and consists of two hidden layers containing 64 and 32 neurons, respectively. For error reduction in prediction, the model is optimized using the Adam optimizer and Mean Squared Error (MSE) loss. Validation loss, test MSE, and R2 score measure the performance of the model. Forecasting and real-time inference are enabled by a real-time AQI data stream. To support effective air pollution monitoring and public health decision-making, the end numerical AQI value indicates prevailing environmental conditions.

Keywords:

Hybrid Precoding, mmWave MIMO, Verilog HDL, Block Diagonalization, Spectral Efficiency, Equal Gain Transmission.

Retrieval-Augmented Health Report Interpretation and Diagnostic Analysis System

R Nikhil

PG Student, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

K Murugan

Assistant Professor, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

Abstract:

Exponential growth in digital medical information has necessitated the development of systems offering health information that is accurate, verifiable and interpretable. Traditional diagnostic interpretation tools are usually devoid of contextual reasoning and mechanisms for validation, hence most often unreliable. For this, the paper proposes HealthRAG Assistant, a retrieval-augmented health information framework that ensures factual reliability, structured data interpretation and clinical transparency. The proposed system is implemented using a multi-layer architecture comprising query preprocessing, medical knowledge retrieval, evidence-based ranking, response generation and dual-phase validation. This framework is wired to operationalize verified health repositories and standardized clinical parameters to ensure the data integrity within the all retrieval and synthesis steps. Experimental validation of this approach has demonstrated an interpretation accuracy of 95.7% along with an average response latency of 1.34 seconds/query, hence usable for real-time diagnostic assistance. The proposed HealthRAG Assistant guarantees interpretive precision, trustworthiness and scalability, hence constituting one major step toward dependable health information processing infrastructures that shall support modern clinical decision environments.

Keywords:

Health Information Retrieval, Clinical Data Interpretation, Validation Framework, Medical Knowledge Repository, Diagnostic Decision Support.

Deep Residual CNN for Chest X-Ray Tuberculosis Detection

K Ravina

PG Student, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

K Murugan

Assistant Professor, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

Abstract:

Children and older adults worldwide are susceptible to pneumonia, a severe respiratory infection that is one of the leading causes of disease burdens, particularly in areas with limited access to medical resources. Despite being a routine procedure, the traditional interpretation of chest X-rays for the diagnosis of pneumonia is subject to human variability. Inspired by the aforementioned, this research proposes an automated deep learning system for pneumonia identification based on the ResNet50V2 architecture. The system uses a sequential workflow that includes data preprocessing, feature extraction by the ResNet50V2 backbone, and classification by a fully connected SoftMax layer to classify the chest X-ray pictures into a category. The suggested approach divides pictures into three diagnostic groups: Viral Pneumonia, Bacterial Pneumonia, and Normal. High diagnostic accuracy and resilience have been demonstrated in experimental data and effective augmentation and residual learning have improved generalization. Because of the system's scalability, dependability and suitability for connection with telemedicine apps and hospital information systems, diagnostic efficiency is significantly increased, allowing for the early diagnosis of pneumonia in clinical settings.

Keywords:

Pneumonia Detection, ResNet50V2, Deep Learning, Chest X-ray Classification, Medical Image Analysis, Automated Diagnosis.

CrediWise AI: AI-Powered CIBIL Score System for Macro Finance Businesses

Ravishankar Bhaganagare

Department of Engineering, Science and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Chunduru Kushal Krishna

Department of Engineering, Science and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Nirbhay Chakradhar Chukekar

Department of Engineering, Science and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Tanvi Jayesh Chopade

Department of Engineering, Science and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Ajit Sanjay Aade

Department of Engineering, Science and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Vaishnavi Sanjay Chivate

Department of Engineering, Science and Humanities (DESH) Vishwakarma Institute of Technology, Pune, Maharashtra, India

Abstract:

This paper presents a modern-day AI- based credit scoring system designed for the microfinance sector to address the dire situation of financial inclusion for SMEs lacking traditional credit histories. The system employs Gradient Boosting Regressor along with ensemble methods including Random Forest and XGBoost for analysis. The system considers alternative data- Customers' digital footprint, Transaction behavior, Compliance records, and Presence on social media for analysis. Hence, the system architecture includes framework based on Node.js, Express, MongoDB, and React for real-time credit scoring. Experimental results show credit risk assessment accuracy at 89.5% with very fast response times of less than 500 milliseconds. The credit scoring system has helped increase loan approval rates to 35% for the underprivileged business class while keeping the default rate below 3%. The Implementation of this system includes comprehensive

dashboards for credit analysis, visualization of risk distribution, and regulatory compliance tracking adhering to RBI guidelines and Basel norms.

Keywords:

Alternative Data, Credit Scoring, Financial Inclusion, Gradient Boosting, Machine Learning, Microfinance, Real- time Analytics, Risk Assessment.

A Survey on Real-Time Latency Monitoring and Intelligent Edge Caching for Enhanced Web Performance

Dave Aaditya Alpeshkumar

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Dr. Shailendra K Mishra

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Dr. Vikram Kaushik

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Abstract:

Web performance optimization is becoming a crucial topic of study due to the exponential development of data traffic and the broad use of cloud-based apps. Due to network congestion and bandwidth constraints, traditional centralized cloud infrastructures are unable to match the demands of current consumers for seamless, low-latency digital experiences. In order to improve online performance, this literature review article offers a thorough analysis of intelligent edge caching and real-time latency monitoring strategies. In order to speed up reaction times and enhance user experience, it investigates monitoring frameworks, latency basics, and the incorporation of edge computing concepts. Additionally, the application of AI and ML to behaviour-driven content distribution, cache optimization, and predictive monitoring is examined in this article. This survey highlights important issues including cache consistency, dynamic content management, and privacy problems in dispersed networks by contrasting cutting-edge technologies like Prometheus, Grafana, and Akamai's Intelligent Platform. The review shows that in order to create robust, scalable, and latency-aware web infrastructures appropriate for developing 5G, IoT, and 6G ecosystems, hybrid cloud-edge architectures, AI-driven automation, and collaborative intelligence are essential.

Keywords:

Real-Time Latency Monitoring, Edge Computing, Intelligent Caching, Web Performance, Artificial Intelligence, Machine Learning, Content Delivery Network (CDN), Predictive Analytics, Cloud-Edge Integration and IoT Systems.

Automatic Fire Extinguishing Robot Using Arduino

Satyajeet Virkar

B.Tech Student, Vishwakarma Institute of Technology, Pune, India

Tanishq Shinde

Vishwakarma Institute of Technology, Pune, India

Soham Velanjkar

Vishwakarma Institute of Technology, Pune, India

Prathmesh Suradkar

Vishwakarma Institute of Technology, Pune, India

Aniket Dhadwad

Vishwakarma Institute of Technology, Pune, India

Abstract:

Indoor fire hazards require fast-acting response systems that can operate independently of humans without making them vulnerable to harm. This paper proposes an innovative prototype of a firefighting robot with the ability to detect, move toward, and extinguish small-scale fires using a fully automated control system. Unlike traditional fire suppression tools, the proposed system combines multi-sensor feedback, real-time decision logic, and autonomous mobility to carry out localized fire intervention. The entire reliable environmental perception is attained with flame sensors and modules for obstacle detection using a microcontroller-based embedded architecture. A differential drive mechanism offers dynamic navigation, while a compact water-based actuation unit instantly triggers at the time of fire detection. Experimental case studies were conducted in a controlled indoor environment to test the performance of the system for a range of fire intensities and distances. The results consistently displayed good precision in the restriction of a flame, collision-free and navigable movement, and timely suppression within a few seconds of detecting the event. The design focuses on affordability, mobility, and modular expandability, making it practical for domestic and laboratory safety. This work provides original contributions in terms of hardware-software integration and displays how readily available components can be integrated to build up a systematic autonomous fire response system. These findings give support for developments in such areas as thermal imaging, machine-learning-based fire classification, and IoT-enabled early warning, presenting this prototype as a favorable solution toward intelligent fire safety automation.

Beyond Cyclomatic and Cognitive: Evaluating Construct Complexity as a Complementary Indicator of Learner Code Proficiency

Pankti Doshi

Assistant Professor, SVKM's NMIMS, Mukesh Patel School of Technology, Management and Engineering, Mumbai India

Dr. Ashwini Rao

SVKM's NMIMS, Mukesh Patel School of Technology, Management and Engineering, Mumbai India

Abstract:

Cyclomatic (McCabe), Cognitive (SonarQube), and Difficulty (Halstead) complexities are standard metrics used in industry to evaluate code quality and maintainability. However, from a pedagogical standpoint, these measures primarily capture structural or logical aspects of control flow rather than how novice learners perceive and construct programs. Learners typically understand programming through constructs such as loops, conditionals, and functions; hence, construct-level reasoning plays a crucial role in shaping their approach to problem solving. This study evaluates program complexity from a learner's perspective by introducing Construct Complexity, a metric derived from the diversity and abstraction of syntactic constructs in a code snippet. Using a dataset of 974 Python programs labeled as beginner-, intermediate-, and advanced- level codes, three analytical approaches were employed: partial correlation, hierarchical regression, and clustering. The results show that Construct Complexity explains an additional 6% of the variance in proficiency level prediction beyond Cyclomatic, Cognitive, and Difficulty metrics ($p < 10^{-21}$), indicating its unique and non-redundant contribution. Random Forest-based feature importance ranked Construct Complexity among the top predictors, while K-Means clustering showed that integrating it with traditional metrics resulted in more distinct separations among code snippets labeled at different proficiency levels. The findings highlight that construct-level information complements traditional complexity measures and provides a more learner-oriented understanding of programming behavior.

Heart Risk Prediction Using Machine Learning

Mehek Mohd Meraj Qureshi

M.Tech in AI, K.J. Somaiya Institute of Technology, Sion, India

Hariram Chavan

Department of Information Technology, K.J. Somaiya Institute of Technology, Sion, India

Abstract:

Cardiovascular Diseases (CVDs) remain the leading cause of global deaths, highlighting the need for accurate early risk prediction. Traditional assessment methods often struggle to handle large, complex patient datasets. This paper introduces an AI-driven Heart Risk Prediction system that uses medical datasets to improve predictive accuracy. The main approach uses LightGBM, which achieved a high accuracy of 94.57%. It aims to create a strong, yet interpretable, predictive baseline for future development. This system also includes the Explainable AI (XAI) technique (SHAP), which ensures the model is transparent and reliable, paving the way for clinical use.

Keywords:

Cardiovascular Risk, Machine Learning, Healthcare, Artificial Intelligence Predictive System.

AI-Based Real-Time Risk Detection System for Urban Public Spaces

Vanshika Tyagi

Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Barennya Behera

Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Akshita Sood

Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Kashish

Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Ankit Kumar Singh

Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Anuradha

Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Abstract:

The increasing population of cities, rapid urbanization, rising violence levels, and accidents combined with urban overcrowding create significant security pressures on public spaces like transport hubs, markets, stadiums, and streets. Traditional surveillance mechanisms relying primarily on human operators and manual checkpoints are inefficient and often delay critical risk detection and prevention in real-time scenarios. This research proposes an AI-Based Real-Time Risk Detection System for Urban Public Spaces that leverages Artificial Intelligence (AI), Internet of Things (IoT), and Computer Vision (CV) technologies to enhance urban safety through intelligent automation. The system integrates CCTV video feeds with IoT sensor data (smoke sensors, motion sensors, crowd density sensors) and employs deep learning models to detect various risks including violence through action recognition and pose estimation, fire through image-based and sensor-based fusion, overcrowding via real-time density estimation, and suspicious behavior through trajectory anomaly analysis. The proposed architecture features a multi-layered pipeline encompassing data acquisition, preprocessing, AI risk detection engine, edge/cloudbased processing, and real-time alerting mechanisms. Extensive testing on benchmark datasets (UCF-Crime, Violence Detection Dataset, FireNet Dataset) demonstrates high accuracy, reduced false alarms, and near real-time responsiveness (under 3 seconds). The system enables proactive risk management, enhances emergency response capabilities, and

improves citizen safety in smart cities through early warning systems. Future implementations will explore multi-modal AI integration, privacy-preserving federated learning, and predictive analytics for urban risk prevention.

Keywords:

Artificial Intelligence, Internet of Things, Smart Cities, Computer Vision, Urban Safety, Real-Time Surveillance, Risk Detection, Public Space Monitoring.

CyberSentinel – Real-Time AI Threat Monitor

Ashwini Bhat M

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Vamshi TN

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Smruthi Desai

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Ninaada S

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Abstract:

The exponential growth of digital connectivity has resulted in an increased number of cyber threats, making traditional rule-based detection methods inadequate for ensuring system security. This project, "CyberSentinel – Real-Time AI Threat Monitor," presents the design and development of an intelligent cybersecurity solution that employs machine learning (ML) and deep learning (DL) techniques to detect, classify, and mitigate cyberattacks in real time. The system utilizes benchmark intrusion detection datasets to train algorithms such as XGBoost, Random Forest, and Support Vector Machine (SVM), along with a 1D Convolutional Neural Network (CNN) for identifying both known and zero-day attacks. Data preprocessing techniques including normalization, feature selection, and noise reduction are implemented to improve the model's reliability and accuracy. The trained models are evaluated using performance metrics such as accuracy, precision, recall, and F1-score, achieving over 95% accuracy with minimal false positives. Visualization tools such as Matplotlib and Seaborn are used to generate confusion matrices and performance graphs, providing real-time insights into system behavior. By integrating AI-driven automation with network monitoring, CyberSentinel enables proactive threat detection, reduces manual intervention, and enhances the overall efficiency and reliability of cybersecurity operations.

AI-Driven Fashion Recognition and Price Comparison

Stuthi S Seeba

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Priya Ravindra Mane

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Yashaswini P

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Shashikala S

GSSS Institute of Engineering and Technology for Women, Mysore, Karnataka, India

Abstract:

In the evolving landscape of fashion e-commerce, consumers often struggle to locate visually similar clothing items across multiple platforms and compare prices efficiently. This paper presents an AI-powered web application that enables users to upload an image of a fashion item and receive real-time price comparisons from major Indian e-commerce websites including Myntra, Flipkart, Amazon, and Ajio. The system leverages a convolutional neural network (CNN) to extract key visual attributes such as clothing type, color, pattern, and style. These attributes are used to construct structured search queries, which are then executed using Playwright-based web scraping scripts. The backend is implemented using FastAPI, while the frontend offers a responsive interface for both image and text-based search. Experimental results demonstrate the system's ability to accurately identify fashion items and retrieve relevant listings with competitive pricing. This integrated approach enhances user convenience and opens new possibilities for intelligent fashion recommendation and shopping assistance.

Mobile Application for Volunteer Relief Work Coordinations

Anubrata Chatterjee

Bachelor of Engineering in Computer Science Chandigarh University, Gharuan, Mohali, Punjab, India

Swati Panwar

Assistant Professor, Computer Science Chandigarh University, Gharuan, Mohali, Punjab, India

Anvi

Bachelor of Engineering in Computer Science Chandigarh University, Gharuan, Mohali, Punjab, India

Ananya Singh

Bachelor of Engineering in Computer Science Chandigarh University, Gharuan, Mohali, Punjab, India

Abstract:

The success of disaster relief operations, such as the availability of timely aid and the consumption of the available resources, hinges on effective coordination of volunteers. This paper proposes a mobile application that would help ease the volunteer management, work assignments and ensure there is continued interaction between relief organizations and the volunteers. Using the application will also have the advantage of offering real time tracking, task prioritization and notification as a way of ensuring maximum use of human resources in the case of emergency situations. Operating with a Federated Platform reduces operational lag in operations and ensures more volunteers join and improves the overall effectiveness of the relief efforts. Simulations and case studies are used to test the system and it proves that it is capable of vastly improving the coordination of the disaster response.

Keywords:

Volunteer management, disaster relief, mobile application, real-time tracking, task coordination, emergency response.

Transformer-Based Multilingual Framework for Sentiment and Emotion Analysis

G karthiga

PG Student, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

J Pavithra

Assistant Professor, Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

Abstract:

The emotion and sentiment analysis is now being considered critical in the interpretation of the user opinions, user behaviour and mental conditions across the digital platforms. However, the majority of the existing measures can only be applied in monolingual situations and cannot be extrapolated to the situation related to multilingual settings with linguistic diversity, cultural variations, and mixing of languages. The current paper presents a Multilingual Sentiment and Emotion Analysis Framework that is founded on the utilisation of machine learning models that are transformer-based, such as mBERT, and XLM-RoBERTa to achieve the perception of situations in various languages. Within the proposed framework, the novel preprocessing pipelines of language normalization, emotion labels harmony, and attention-based feature extraction have been incorporated so that multilingual high adaptability is achieved. Benchmark datasets on different languages were widely tested and demonstrated better accuracy, F1-score and consistency of emotion recognition compared to traditional deep learning/ multilingual baseline models. The results confirm the possibility of the framework modeling the variation existing of the semantic and affective when using the various languages which enhances the generalization and interpretations. The article contributes to the rising inclusive NLP systems which may be utilized to facilitate the advancement of emotion-receptive applications such as multilingual chatbots, worldwide opinion mining, and social media monitoring.

Keywords:

Sentiment Analysis, Emotion Detection, Multilingual NLP, Transformer Models, Deep Learning, Cross-Lingual Transfer.

Trends and Challenges of Modern Network Architectures

Suruchi Karnani Baori

Amity University Madhya Pradesh(AUMP), Maharajpura, India

Vikas Thada

Amity University Madhya Pradesh(AUMP), Maharajpura, India

Harish Kumar Shakya

MANIPAL, Karnataka, India

Abstract:

The evolution of network systems has progressed through several transformative phases, each driven by advancements in communication technology, scalability demands, and application diversity. Early computer networks focused primarily on device-to-device communication and basic packet delivery. The advent of the Internet and the TCP/IP architecture enabled global connectivity and interoperability, fundamentally shaping the modern digital ecosystem. With the growth of multimedia applications and distributed computing, traditional hardware-centric networks encountered challenges in agility, automation, and security. As a result, programmable architectures such as Software-Defined Networking (SDN) and Network Function Virtualization (NFV) emerged to decouple control from infrastructure and optimize resource utilization. The current era is characterized by intelligent and adaptive connectivity, leveraging cloud-native frameworks, 5G with edge computing, Zero-Trust security models, and AI-driven automation. These technologies support ultra-low-latency applications, real-time analytics, and autonomous decision-making, enabling seamless integration of IoT, cyber-physical systems, and emerging smart infrastructures. This paper provides a structured overview of this evolutionary journey, compares dominant modern architectures, and highlights ongoing challenges in controller scalability, orchestration complexity, and security assurance. Furthermore, research opportunities related to intent-based networking, self-healing networks, and sustainable design are discussed to guide future innovations in network evolution.

Keywords:

SDN, NFV, Edge AI, sustainability, Network Architecture, Modern Network, Scalability, Digital Ecosystem.

Anomaly Detection in the Age of Zero Trust: A Systematic Review of Adaptive ML/DL Frameworks for Dynamic, Heterogeneous and Adversarial Network Environments

Kirthiversha M

Pondicherry University, Computer Science and Engineering, Puducherry, India

Dr. Pothula Sujatha

Pondicherry University, Computer Science and Engineering, Puducherry, India

Abstract:

Network anomaly detection (NAD) is indispensable in securing modern cyber-physical ecosystems such as Internet of Vehicles, industrial control systems, backbone routing, and healthcare IoT. With the growing scale and heterogeneity of networks, ML and DL strategies are now essential for dealing with changing security risks.. This report offers a comprehensive examination of NAD techniques, benchmark datasets, evaluation metrics, and architectural innovations. We examine how domain-specific constraints influence algorithmic choices, ranging from interpretable tree-based models for vehicular networks to self-supervised adversarial architectures for large-scale traffic monitoring. Preprocessing pipelines, feature engineering strategies, and the critical role of metrics such as AUC-PR and FI-score in imbalanced settings are systematically analyzed. Comparative tables summarize dataset characteristics, model performance, parameter configurations, and ablation studies, complemented by narrative interpretation of trends and trade-offs. Finally, we identify key open challenges including adversarial robustness, concept drift, explainability, and cross-domain generalization and propose a unified research agenda focused on adaptive, explainable, and transferable architectures. This survey is to function as both a fundamental reference and a prospective guide for academics and practitioners engaged in distributed computing, machine learning, and network security.

Keywords:

Network Anomaly Detection, Deep Learning, Intrusion Detection System (IDS), Machine Learning, Adversarial Learning, Ensemble Learning, Explainable AI (XAI), Real-Time Detection, Cybersecurity.

E-learning Reinvented : Exploring Innovative Strategies for Digital Education

Prathiksen AP

Student, Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Vishal Sharma

Student, Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Rishu Raj

Student, Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Akansha Karmakar

Student, Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Aditya Thakur

Student, Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Urwashi Thombre

Student, Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Abstract:

As traditional online education struggles to engage diverse learners, it's vital to explore how next-generation technologies can reshape the learning experience. This paper examines the fusion of artificial intelligence (AI), augmented reality (AR), virtual reality (VR), and machine learning (ML) to build adaptive e-learning environments. We detail a prototype platform featuring an AI chatbot for on-demand support, immersive AR/VR classrooms for hands-on exploration, ML-driven attention tracking to tailor content, and AI-generated video summaries for efficient review. A peer-to-peer collaboration space and reinforcement learning-based adaptive quizzes further personalize each student's journey. Pilot testing with student volunteers revealed higher engagement, improved knowledge retention, and positive feedback on the platform's interactivity. We conclude with strategies for safeguarding data privacy, minimizing algorithmic bias, and enhancing accessibility to ensure these innovations benefit all learners. Keywords— e-learning innovation, Artificial Intelligence, AR/VR, Machine Learning, Adaptive Learning, Online Education, human-centric design.

AI-Powered Real-Time Traffic Monitoring and Enforcement

Gokul C

Students, Computer Science and Design, Karpagam College of Engineering, Mandapam, Tamil Nadu, India

Govarthan S M

Students, Computer Science and Design, Karpagam College of Engineering, Mandapam, Tamil Nadu, India

Barani R

Students, Computer Science and Design, Karpagam College of Engineering, Mandapam, Tamil Nadu, India

Twinbabu

Students, Computer Science and Design, Karpagam College of Engineering, Mandapam, Tamil Nadu, India

Abstract:

Site visitors regulation and road dominance remain systemic persistent demanding state of events in urban settings, predominantly in swifter increasing cities whose elements of roadways blockage and expanding car proprietorship as a danger. Traditional methods of tracking depend in a high number on guide enforcement and glued penalty approaches which are recurrently inefficient and non-uniform and prone to human error. To address these loopholes, this exam provides an Intelligent Traffic Monitoring System which combines the best sensing solutions with automated solutions to surrounding enforcement. The device uses Automatic Number Plate Recognition (ANPR) to verify registering of automobiles, surgeon of false or extra license plates, as well as testing stolen cars against prime databases. Furthermore, a coverage validation characteristic will ensure that there is compliance with mandatory coverage, and it will insure that the number of cars on the road with no insurance is minimized. A dedicated helmet detector module enhances the safeguarding of riders by disposing of the violation of the rules and transfer of the photographic evidence to proper documentation. Instead of conventional tactics, the model provided uses a Reward-Penalty Mechanism that does not only reward violators in a unilateral manner, but also rewards street customers who comply with regulations. Violation will result in warnings and increasing fines, and meanwhile, responsible compliance will lead to incentive factor which can be exchanged and redeemed to blessings which serves as a means of running responsible accountable riding behaviors. The provision of swift virtual notifications will make it transparent and performance-based in the enforcement. The gadget integrates verification, safety compliance, and behavioral reinforcement with one framework that would enhance a sustainable version of visitor's management in smart cities. This strategy ensures less reliance on manual tracking, more responsibility complement, and safer practices, thus enhancing the acceptability normal city movement as well as leading to safer roads to all the customers.

Smart Phishing Detection Leveraged Using Bidirectional Encoder Representations From Transformer Model

B.M.S. Javed ahamed, M.E., (Ph.D.,)

UG Student, Computer Science and Engineering, Nandha college of Technology, Vaikaralmedu,
Tamil Nadu, India

H. Aani Preethika

UG Student, Computer Science and Engineering, Nandha college of Technology, Vaikaralmedu,
Tamil Nadu, India

D. Dhanishikaa

UG Student, Computer Science and Engineering, Nandha college of Technology, Vaikaralmedu,
Tamil Nadu, India

N. Ishanth

UG Student, Computer Science and Engineering, Nandha college of Technology, Vaikaralmedu,
Tamil Nadu, India

P. G. Philip Binoj

UG Student, Computer Science and Engineering, Nandha college of Technology, Vaikaralmedu,
Tamil Nadu, India

Abstract:

One of the most common and destructive cybersecurity risks nowadays is phishing and scam attacks, which take advantage of people's trust to steal private data like passwords, credit card numbers, and financial information. Due to their reliance on static attributes and inability to comprehend context, traditional spam filters and rule-based systems have difficulty identifying such threats. This study suggests a hybrid machine learning approach that incorporates Bidirectional Encoder Representation in order to address these issues.

The proposed system collects incoming emails or messages, preprocesses the text, then uses BERT technology to create semantic embeddings. After that, the embeddings are fed into an XGBoost classifier, which deals with the message as, if it is genuine, fraudulent, or phishing. This system automatically decides whether to block, delete, or permit the communication, depending on the classification result. Benchmarks and spam datasets were used to train and test the model, and it achieves high-detection.

Keywords:

Phishing, Scam Detection, BERT, XGBoost, Natural Language Processing, Cybersecurity.

Smart Wheelchair with Integrated Health Monitoring System

Ajay Talele

Undergraduate E and TC, Vishwakarma Institute of Technology, Pune, Maharashtra, India

Shital Pawar

Undergraduate E and TC, Vishwakarma Institute of Technology, Pune, Maharashtra, India

Vijay Mane

Undergraduate E and TC, Vishwakarma Institute of Technology, Pune, Maharashtra, India

Shreya Bedre

Undergraduate E and TC, Vishwakarma Institute of Technology, Pune, Maharashtra, India

Revati More

Undergraduate E and TC, Vishwakarma Institute of Technology, Pune, Maharashtra, India

Satej Patil

Undergraduate E and TC, Vishwakarma Institute of Technology, Pune, Maharashtra, India

Gokarn Nemade

Undergraduate E and TC, Vishwakarma Institute of Technology, Pune, Maharashtra, India

Abstract:

This paper presents the design and implementation of a smart wheelchair system that integrates motion control, obstacle avoidance, and real-time health monitoring capabilities. The system utilizes an ESP32 microcontroller for wheelchair navigation with multimodal input methods including joystick control and voice commands. Additionally, an ESP8266 module manages health parameter monitoring including heart rate, ECG, temperature, and humidity, with automated fall detection functionality. Data is transmitted to cloud platforms for remote monitoring and analysis. Preliminary testing demonstrates the system effectiveness in providing both enhanced mobility and continuous health monitoring for wheelchair users, potentially addressing critical gaps in assistive healthcare technology. This integrated offers a promising solution for improving the independence, safety, health management of individuals with mobility impairments.

Keywords:

Assistive technology, Smart Wheelchair, Health monitoring, IOT, Fall detection, Voice control, Obstacle avoidance.

Digital Twins and Network Slicing in Healthcare

S Pooja Mathumitha

Student, Communication Systems, Thiagarajar College of Engineering, Thiruparankundram, Tamil Nadu, India

S Rajaram

Student, Communication Systems, Thiagarajar College of Engineering, Thiruparankundram, Tamil Nadu, India

E Murugavalli

Student, Communication Systems, Thiagarajar College of Engineering, Thiruparankundram, Tamil Nadu, India

Abstract:

The integration of Digital Twin (DT) and Network Slicing (NS) technologies has emerged as a transformative approach to revolutionize healthcare networks in the 5G and beyond era. This survey explores the synergy between DT and NS for achieving secure, intelligent, and efficient healthcare communication systems. It reviews state-of-the-art architectures, mechanisms, and frameworks, highlighting the role of AI, block chain, and edge computing in enabling security, resource allocation, and isolation across network slices. The paper also presents taxonomy, comparative analysis, and discusses challenges and potential research pathways toward realizing DT- enabled healthcare networks.

Enhanced Intrusion Detection in Cloud Environments Using Advanced Machine Learning Techniques

D Srimathi

Student, Computer Science and Engineering, Nandha College of Technology, Erode, Tamil Nadu, India

T Mythilipriya

Student, Computer Science and Engineering, Nandha College of Technology, Erode, Tamil Nadu, India

D Kirubanandam

Student, Computer Science and Engineering, Nandha College of Technology, Erode, Tamil Nadu, India

G Karan

Student, Computer Science and Engineering, Nandha College of Technology, Erode, Tamil Nadu, India

M Bhavadharani

Student, Computer Science and Engineering, Nandha College of Technology, Erode, Tamil Nadu, India

Abstract:

The identification of cloud intrusions with machine learning methods based on diverse approaches, with emphasis on NSL KDD database.. These consist of AODE (99%), J48 (88% accuracy), PART (88%), Decision Table (93%), and Decision Stump (90%). Additionally, the module incorporates other essential features for the model, such as the ability to convert numbers to nominals, apply feature selection techniques, and use information gain, intrinsic information, gain ratio, and feature selection strategies. Another prominent machine learning element is the Average One Dependency Estimator (AODE) classifier that is useful and can process complex data. These methods have good cloud intrusion detection potential when well analyzed, and intrusion detection using cloud is critical in ensuring the safety of data and systems integrity of the sensitive data.

Keywords:

Cloud Computing, Security, Threats, Mitigation Strategies.

Towards Intelligent and Transparent Road Infrastructure: A 5G-Connected, AI-Orchestrated, Blockchain-Audited Framework for Autonomous Construction

M.S.V.K.V.Prasad

Department of Civil Engineering, Swarnandhra College of Engineering & Technology, Narsapur, West Godavari, Andhra Pradesh, India

G.V.L.N. Murthy

Department of Civil Engineering, Swarnandhra College of Engineering & Technology, Narsapur, West Godavari, Andhra Pradesh, India

A. Venkata Krishna

Department of Civil Engineering, Swarnandhra College of Engineering & Technology, Narsapur, West Godavari, Andhra Pradesh, India

D. Satish

Department of Civil Engineering, Swarnandhra College of Engineering & Technology, Narsapur, West Godavari, Andhra Pradesh, India

Abstract:

The convergence of 5G communication, artificial intelligence (AI), edge computing, and autonomous machinery is transforming road construction into a data-driven, intelligent, and safer process. This work presents an end-to-end autonomous road construction architecture that integrates real-time sensing, ultra-low latency 5G-enabled Vehicle-to-Everything (V2X) communication, Kubernetes-managed AI microservices, explainable AI (XAI), and blockchain-based decision auditing. The proposed framework is validated through its implementation in China's first fully unmanned highway resurfacing project on the Beijing-Hong Kong-Macao Expressway, covering a length of 157.79 km. The system effectively addresses key challenges such as environmental uncertainty, model drift, human-machine interaction safety, and the need for public trust. It achieves this through adaptive learning, predictive maintenance, and transparent governance mechanisms. By combining AI-driven decision-making with secure, auditable operations, the architecture demonstrates strong potential for large-scale deployment. This research contributes a scalable and trustworthy model for the next generation of intelligent infrastructure, aligning with emerging regulatory, ethical, and safety standards in autonomous construction.

Keywords:

Autonomous construction, 5G, AI/ML, XAI, V2X, Edge computing, Kubernetes, predictive maintenance, smart infrastructure.

An Efficient and Privacy-Preserving Offline Smart Door Lock System Based on Facial Recognition Using Raspberry Pi

Sahil Dhawane

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology Pune, Maharashtra, India

Sai Sinare

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology Pune, Maharashtra, India

Vedant Chandore

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology Pune, Maharashtra, India

Rahul Sadgir

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology Pune, Maharashtra, India

Ajay Talele

Professor, Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology Pune, Maharashtra, India

Shital Raut

Department of Electronics and Telecommunication Engineering, Vishwakarma Institute of Technology Pune, Maharashtra, India

Abstract:

This paper presents the design, implementation and evaluation of a low-cost, fully offline smart door-lock system that uses facial recognition for secure access control. Built around a Raspberry Pi 3 Model B+ and a compatible camera module, the system performs real-time face detection using OpenCV's Haar cascade classifiers and recognition via the Local Binary Patterns Histograms (LBPH) algorithm. All user face models are stored locally, eliminating the need for network connectivity or cloud services and preserving privacy. Upon successful verification, a GPIO-driven relay actuates a 12 V solenoid lock, granting door access within approximately 1.2 seconds. Experimental trials under typical indoor lighting (300–500 lux) demonstrate an average recognition accuracy of 94% and a false-acceptance rate below 2%. The proposed solution combines affordability, ease of deployment and robustness against common attack vectors, making it suitable for residential and small-office applications.

Keywords:

Facial recognition, offline biometric access, Raspberry Pi, smart door locking system, local binary patterns histogram (LBPH), Haar cascade classifier, edge computing security.

Investigation of Turbulence Characteristics of Jet with Varying Outlets at Sonic Under-Expanded Level

Syam Saran S

Department of Aeronautical Engineering, Kalaignarkarunanidhi Institute of Technology, Coimbatore, Tamil Nadu, India

Tharani T

Department of Aeronautical Engineering, Kalaignarkarunanidhi Institute of Technology, Coimbatore, Tamil Nadu, India

Vignesh K

Department of Aeronautical Engineering, Kalaignarkarunanidhi Institute of Technology, Coimbatore, Tamil Nadu, India

Dr. Anusindhya K

Assistant Professor, Department of Aeronautical Engineering, Kalaignarkarunanidhi Institute of Technology, Coimbatore, Tamil Nadu, India

Abstract:

Sonic under-expanded jets, which emerge from nozzles operating at choked flow conditions (Mach 1) with exit pressures exceeding ambient levels, display complex aerodynamic behaviour. This includes intense turbulence, rapid entrainment, and dynamic interactions between shock waves and shear layers, often accompanied by high levels of acoustic output. The geometry of the jet outlet, including parameters such as exit shape, lip thickness, trailing-edge configuration, and the presence of secondary or co-flow streams, plays a critical role in determining these flow features. Variations in outlet geometry alter the development of turbulence, the rate and pattern of mixing, and the formation or decay of shock-cell structures and the potential core region. This review consolidates and analyses existing research that explores the influence of nozzle outlet configuration on the turbulence characteristics of sonic under-expanded jets. It further examines the key experimental and computational methodologies employed in previous studies, identifies unresolved challenges and inconsistencies in current understanding, and proposes prospective directions for future investigations in this field.

Keywords:

Under-Expanded Jets, Nozzle Exit Geometry, Compressible Turbulence, Shock-Shear Interaction, Aeroacoustics, Large-Eddy Simulation (LES), Flow Visualization.

Arduino Based Automated Plant Watering and Soil Health Monitoring System

Ravishankar Bhaganagare

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Anvit Futane

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Aricia Dubey

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Shravani Duddalwar

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Disha Dubey

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Sayali Gaikwad

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Harshwardhan Galande

Department of Engineering, Sciences and Humanities (DESH), Vishwakarma Institute of Technology, Pune, Maharashtra, India

Abstract:

The proposed paper involves the design and implementation of an Arduino-based automatic watering system. The system uses an arduino uno microcontroller which integrates a moisture detector, a water level detector, and a Bluetooth module. The soil moisture detector gives real-time values to Arduino, which then activates the pump as required to maintain the water level of the soil. The water level detector monitors the water source container, and alarms the user if the water level gets low. This system is also equipped with a Bluetooth module, which enables communication with a mobile application. Through the app, the user can remotely adjust the sensitivity of the water level sensor and even control the water pump manually,

there is also option where the user can upload a picture of the plant and check for any disease through a API. This system is particularly beneficial for indoor and potted plant care, offering an efficient solution while reducing water wastage. To make more accurate decisions for soil watering, the system uses a machine learning model called as Random Forest Classifier, which tests environmental elements like soil moisture, temperature, and humidity.

Keywords:

Arduino Uno, Automated watering system, Bluetooth connectivity, Mobile App Control, Soil moisture sensor, Water conservation, Machine Learning, Random Forest Classifier, Smart Irrigation, real-time data.

A Testing User Sentiments for Social Media Using Natural Language Processing (NLP)

Arin Rai

University Institute of Engineering, Chandigarh University, Mohali, India

Mannat Thakur

University Institute of Engineering, Chandigarh University, Mohali, India

Keshav Kumar Soni

University Institute of Engineering, Chandigarh University, Mohali, India

Abhinav Sharma

University Institute of Engineering, Chandigarh University, Mohali, India

Abstract:

The explosion of the use of social media has produced massive caches of data in the form of a user-generated text, making them an unprecedented source of material for deducing public sentiment. A systematic experiment setup is presented for the analysis and exploration of users sentiments grounded on social media websites by utilizing Natural Language Processing (NLP) techniques. It starts from collecting raw text data from the social media sources like X (formerly Twitter), and passes through massive amounts of data processing to remove the noise, in the form of slang language usage, emojis and other abbreviations. State-of-the-art Transformer-based models are fine-tuned to the peculiarities of social media language to categorize the sentiment in positive, negative and neutral buckets. The performance assessment of the work is done on a standard metrics of assessment, for instance, the accuracy, precision, recall, and F1 score. Further, the sentiments that are extracted get pooled and displayed - thus enabling the scholar gazing into evolving trend and patterns over time.- thus making it possible for the scholar gazing into evolving trend and patterns over time. This system really gives the open scalable system for companies, policymakers and social scientist to have the actionable information of what the public sentiment is, hence data driven decisions for real world applications.

Keywords:

Sentiment Analysis, Natural Language Processing (NLP), Social Media, Machine Learning, Public Opinion, Transformer Models.

A High-Speed, Low-Power Reversible Multiplier-Adder Architecture for Quantum-Compatible Systems

Banoth Sheshu

Electronics and Communication Engineering, Vardhaman College of Engineering, Shamshabad, Hyderabad, India

Kushal Kumar. A

Electronics and Communication Engineering, Vardhaman College of Engineering, Shamshabad, Hyderabad, India

Ashritha. S

Electronics and Communication Engineering, Vardhaman College of Engineering, Shamshabad, Hyderabad, India

Dr. B. Srikanth

Electronics and Communication Engineering, Vardhaman College of Engineering, Shamshabad, Hyderabad, India

Abstract:

In high-level fields like VLSI, DSP, and quantum-compatible systems, arithmetic blocks are responsible for the importance in terms of both delay and power consumption, which play a vital role in overall performance. This paper proposes an architecture combining a reversible Brent-Kung adder and a Wallace Tree multiplier to gain efficiency in speed and energy. The suggested adder shows the decrease in power consumption from 4.048 W to 2.769 W, giving an improvement of 31.6%, whereas its delay is reduced from 7.292 ns to 6.89 ns, which is an improvement of 5.5%. Likewise, the optimized Wallace Tree results in a reduction of power from 5.692 W to 3.541 W, which is an improvement of 37.8%, as well as an improvement of 10.8% in delay (reduced from 9.152 ns to 8.168 ns). In addition, the Power-Delay Product (PDP) decreases dramatically from 52.093 J to 28.922 J. Overall, these findings collectively demonstrate the proficiency of the envisioned architecture, which makes it an attractive candidate for future VLSI and quantum computing systems where performance and energy efficiency are paramount.

Keywords:

VLSI design, DSP systems, Quantum-compatible computing, Reversible logic, Brent-Kung adder, Wallace Tree multiplier, Low-power architecture, High-speed arithmetic unit, Power-delay product (PDP), Energy-efficient circuits, Delay optimization, Reversible arithmetic, Future computing platforms.

Application of Graphics Primitives and Attributes in SmartHealthApp: A Digital Framework for Interactive Health Data Visualization

Abhishek Sharma

Student, School of Computer and System Sciences, Jaipur National University, Jaipur, Rajasthan, India

Rashmi Khandelwal

Student, School of Computer and System Sciences, Jaipur National University, Jaipur, Rajasthan, India

Abstract:

The integration of graphical primitives into digital health frameworks enhances the clarity, accessibility, and interpretability of medical information. This paper presents the design and implementation of *SmartHealthApp*, an interactive healthcare system that employs basic graphical elements—such as lines, colors, fill styles, and text attributes—to visualize patient health parameters. The application transforms analytical data into intuitive visual representations through line graphs, progress bars, and color-coded indicators denoting normal, caution, and critical states. By leveraging these primitives and attributes, the system supports effective health monitoring, quick decision-making, and real-time emergency response through an integrated SOS module. The study highlights how visual computing principles can improve data communication, user experience, and emergency management in modern digital healthcare system.

Low-Cost 3D Printed Prosthetic Arm Powered by Bio-sensors for Medical Rehabilitation

Trisha Paul

Electronics and Telecommunication Engineering Department, Jadavpur University, Kolkata, West Bengal, India

Joydip Roy

Mechanical Department, Swami Vivekananda University, Kolkata, West Bengal, India

Gouranga Das

Electronics and Telecommunication Engineering Department, Jadavpur University, Kolkata, West Bengal, India

Sheli Sinha Chaoudhury

Electronics and Telecommunication Engineering Department, Jadavpur University, Kolkata, West Bengal, India

Abstract:

The development of prosthetic arms has gained significant attention with the growing demand for user-friendly functionality, affordability, and intelligent assistive technologies. We have designed and implemented a low-cost, lightweight 3D-printed prosthetic arm to improve the quality of life for individuals with limb loss. This arm is operated by bio-signals, and the data are captured from the user's different muscle activities. These physiological signals are processed and analyzed to interpret user intent, enabling intuitive and responsive limb movement. Advanced signal acquisition, preprocessing, and feature extraction techniques are applied using machine learning algorithms to adapt to each user's unique muscle patterns over time, improving responsiveness. The prosthetic arm integrates lightweight materials and modular 3D-printed components, ensuring user comfort, customization, and ease of maintenance. An embedded processing unit translates bio-signal inputs into precise motor actuation, achieving real-time control and simulating natural limb functionality. By restoring motor ability and independence, this innovation aims to enhance the quality of life for individuals with limb loss. In the future, we will add a bidirectional feedback interference system to emphasize our project's scalability, affordability, and adaptability.

Keywords:

3D-Printing technology, bio-signals, low-cost, machine learning, bidirectional feedback interference.

AI-Enabled Digital Follow-Up System for Post-Discharge Care and Readmission Prevention

Siddhi Kodape

Undergraduate Student, Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India

Shweta Gode

Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India

Dr. Khalid Khan

Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India

Parth Lakhe

Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India

Prasad Tonge

Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India

Sarthak Thatte

Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India

Swayam Allewar

Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India

Abstract:

Although being discharged from the hospital signals clinical recovery, it usually marks a vulnerable phase for patients. During this period, complications can occur which ultimately lead to unexpected hospital readmissions. Around 15-20% of patients with chronic diseases are readmitted within 30 days. Studies show that prompt follow-up within seven days is significantly correlated with decreased readmission rates. Non-Hispanic Black patients, dual Medicare-Medicaid enrollees, and people who live in poor communities are all examples of vulnerable groups that have both lower follow-up rates and disproportionately higher readmission rates. Systemic problems like broken communication, incomplete care transitions, and limited coordination of primary care make outcomes even worse. At the same time, digital health tools and predictive analytics open up new doors. Telehealth, mobile apps, and AI-enabled monitoring show promise for providing scalable and individualized support after discharge. However, problems with interoperability, cost-effectiveness, and fair access remain.

To fill these gaps, this study created and tested a web-based digital follow-up system meant to improve continuity of care. Through structured scheduling, automated SMS reminders, OCR-enabled medication and report verification, and predictive AI model to forecast patients' condition and provide centralized monitoring, the intervention demonstrated potential to improve compliance, reduce preventable readmissions.

IoT-Based Smart Farming: Automated Greenhouse Monitoring for Sustainable Agriculture

Manvendra Singh Rathore

Department of CSE Chandigarh University, Mohali, India

Aadvik sood

Department of CSE Chandigarh University, Mohali, India

Tejveer Singh

Department of CSE Chandigarh University, Mohali, India

Praburam M

Department of CSE Chandigarh University, Mohali, India

Sushil Kumar Garg

Department of CSE Chandigarh University, Mohali, India

Abstract:

The use of smart technologies in crop management has become necessary due to the growing demand for sustainable and effective agricultural practices. An Internet of Things (IoT)- based greenhouse monitoring system is presented in this study with the goal of optimizing plant growth conditions. Temperature, humidity, soil moisture, and light intensity sensors are all integrated into the suggested system, which sends real-time data to a cloud platform for analysis and visualization. In order to ensure ideal growth conditions, automated control mechanisms are used to modify lighting, irrigation, and ventilation in response to sensor feedback. The results of the experiment show increased crop yield, decreased manual intervention, and improved resource efficiency. Because of its adaptability and scalability, the system is a practical answer for contemporary precision agriculture, supporting efficient and sustainable farming methods.

Keywords:

Smart Greenhouse, Environmental Monitoring, Precision Agriculture, Wireless Sensor Network, Automated Irrigation, Crop Management.

Leveraging 5G Technology for Real-Time Partnership Coordination

Sandeep Kaur

CSE Department, Chandigarh University Mohali, India

Ananya Akhouri

UIC Department, Chandigarh University Mohali, India

Harsh Yadav

CSE Department, Chandigarh University Mohali, India

Utkarsh Kumar

CSE Department, Chandigarh University Mohali, India

Abstract:

The fifth generation of wireless technology (5G) is a significant advance in communication systems and it will offer ultra-low latency, higher throughput, and connectivity to a significant number of devices than 4G. As a matter of fact, 5G is one of the most appropriate technologies due to the improvements it provides in the real-time and mission-critical use cases. While recent papers have explored the potential impact of 5G on the autonomous vehicles, healthcare, and smart buildings respectively, there has been no scholarly contribution of 5G's potential for improving the coordination of distributed partners. Sectors such as supply chains, emergency response teams, and cross-enterprise collaborations are increasingly requiring meaningful, reliable, instant, and simple data exchanges. Traditional platforms such as 4G LTE and Wi-Fi still have challenges with congestion, fluctuating throughput, and delays that may not allow for time-critical operations. In this study, we developed and tested a framework that leveraged the three core 5G enablers (network slicing, edge computing, and cloud synchronization) to provide reliable coordination of multiple stakeholders. This research also simulated this framework and tested it against Wi-Fi 6 and LTE for key criteria of latency, throughput, packet delivery, and energy consumption. It has been shown in the results that 5G is capable of supporting latency of under 15 milliseconds consistently, a very high ratio of delivering packets, and can be able to deliver higher throughput performance under a high-traffic environment than the current standards. Besides the comparative analysis, the 5G ecosystem is considered in this paper, with enablers, including artificial intelligence and blockchain. The artificial intelligence may offer the implementation of predictive analytics to forecast the requirements in resources, and blockchain offers safety and confidence in multi-party interactions. These would be taken together and would significantly change both collaborative ecosystems and improve automation, resilience, and rapid decision making. The study contributes to the

dearth of literature in this field because it presents an outcome framework and evidence of how 5G could be implemented to offer real-time coordination of partnership across industries.

Keywords:

5G Technology, Real-Time Partnership Coordination, Network Slicing, Edge Computing, Cloud-Based Synchronization, Low Latency Communication, Distributed Stakeholders, Multi-Party Communication, Secure Communication Framework, Mission-Critical Applications.

Bridging Health Literacy Gaps Through an AI-Enhanced Personal Health Record Platform: A Framework for Indian Healthcare

Manvi Bhala

Department of Data Science, Mukesh Patel School of Technology Management and Engineering, Mumbai, India

Aryan Sheth

Department of Data Science, Mukesh Patel School of Technology Management and Engineering, Mumbai, India

Shriyanshi Shukla

Department of Data Science, Mukesh Patel School of Technology Management and Engineering, Mumbai, India

Abstract:

In India, medical records are still mostly disorganized and rely on paper, which makes it hard for people to get medical care and keep getting it. An even bigger problem is that many people don't know enough about health—patients often have trouble understanding complicated medical terms, remembering how to take their medications, or getting useful information from their medical records. The Ayushman Bharat Digital Mission (ABDM) and other government programs have tried to fix interoperability issues, but there are still big problems with providing patient-centered solutions that both combine medical records and help patients understand them better. This study presents a novel personal health record (PHR) architecture influenced by DigiLocker's security framework, augmented by a pioneering feature: an AI-driven conversational agent with document comprehension abilities. The platform uses an open-source large language model on cloud GPU infrastructure to use vector database technology to provide real-time, contextually relevant, and personalized interpretations of users' medical documents. This is called Retrieval-Augmented Generation (RAG). This paper describes a complete agent-driven architecture for developing proof-of-concept projects, explains the choices made in technology, and lays out a clear plan for how to build a production system that puts privacy first.

Keywords:

Digital Health, Personal Health Records, AI in Healthcare, Chatbots, India, Medical Informatics, Vector Database, Retrieval-Augmented Generation.

Beyond Outliers: A Multi-Model Risk Detection Framework for Public Procurement Data

Anshika Yadav

Computer Science Department, Chandigarh University Punjab, India

Aarushi Sharma

Computer Science Department, Chandigarh University Punjab, India

Khushi

Computer Science Department, Chandigarh University Punjab, India

Rahul Gupta

Computer Science Department, Chandigarh University Punjab, India

Urvashi

Computer Science Department, Chandigarh University Punjab, India

Abstract:

Many governments across the globe spend considerable part of their gross domestic product (GDP) with public procurement relating to infrastructure and development projects – e.g. roads or buildings construction. Fraud and corruption is usually very common in the whole process. Conventional audit-based methods are too slow to catch anomalies in real-time which lead to delayed interventions. In this paper, a multi-model anomaly detection model, which combines Local Outlier Factor (LOF) Isolation Forest and Extreme Gradient Boosting (XGBoost), is developed for detecting suspicious procurement transactions. Anomaly scores are propagated up to an aggregated risk score using the unsupervised models. These scores serve as features in a supervised XGBoost classifier, where labels or proxy indicators are available. We use SHapley Additive exPlanations (SHAP) for interpretability so that the detected anomalies are interpretable to human auditors. We validate the system using World Bank procurement data, and demonstrate that, in identifying high-risk suppliers, the combined model surpasses individual algorithms. Visualizations from PCA and t-SNE illustrate the anomaly clustering, which demonstrates that the system is applicable for early fraud discovery and policy intervention.

Keywords:

Procurement Fraud, Anomaly detection, Isolation Forest, Local Outlier Factor, XGBoost, SHAP, t-SNE, PCA.

Latency Intelligence: A Survey of Edge Caching: Process, Issues & Limitations

Bhargav Joshi

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Jay Gandhi

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Kruti Suthariya

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Abstract:

Edge caching is now a crucial component of contemporary network architectures due to the growing need for incredibly quick and dependable data transmission. By cutting down on backhaul traffic and data retrieval time, latency intelligence—which makes use of adaptive caching and real-time monitoring—plays a critical part in improving user experience. In the context of edge computing, this survey investigates the procedures, problems, and restrictions related to edge caching. It examines a range of caching tactics, such as content-aware, proactive, and cooperative approaches, and assesses cache placement choices in diverse network contexts. The delivery procedure and speed optimization techniques that affect latency reduction are also examined in the article. Large-scale implementation is hampered by issues including limited cache storage, the popularity of dynamic content, energy limitations, and security flaws, despite its potential. Insights into current research trends and possible frameworks for intelligent, adaptive, and latency-aware edge caching systems are provided in the survey's conclusion.

Keywords:

Edge caching, edge computing, caching, location, caching strategy, caching placement, delivery process, speed.

AI Court Reporter: A Real-Time Speech-to-Analytics Framework for Intelligent Legal Documentation in Indian Judicial Proceedings

Sruthi Sai Prabha K S

Student, R.M.K. Engineering College, Kavaraipeitai, Tamil Nadu, India

Thanushya T S

Student, R.M.K. Engineering College, Kavaraipeitai, Tamil Nadu, India

Lakshmi Rai V

Student, R.M.K. Engineering College, Kavaraipeitai, Tamil Nadu, India

Abstract:

Traditional court reporting in India relies on manual stenography, producing static transcripts that lack analytical insight, delay documentation, and restrict real-time accessibility. This paper presents a novel Artificial Intelligence (AI) Court Reporter system that transforms live courtroom proceedings into a dynamic, data-driven legal analytics platform. The architecture employs a multi-modal data pipeline, beginning with Digital Signal Processing (DSP) for noise suppression and speaker diarization using pyannote.audio to segment speech by participant roles such as judges, lawyers, and witnesses. The cleaned audio is transcribed through a fine-tuned Whisper-based Automatic Speech Recognition (ASR) engine trained on Indian-accented and bilingual legal datasets, ensuring domain adaptation and linguistic robustness. A document assembler module reconstructs continuous speaker turns from discrete audio segments to maintain contextual coherence. The transcripts are processed by a LegalBERT-based Natural Language Processing (NLP) stack that performs Legal Entity Recognition (LER), context-aware sentiment analysis, and logical fallacy detection. Extracted entities dynamically interface with a Neo4j knowledge graph, enabling instantaneous retrieval and contextual linking of case laws and statutes. The pipeline operates within a low-latency, microservices-based architecture, streaming real-time visualizations via WebSocket connections to a React.js judicial dashboard that displays color-coded transcripts, alerts, and precedent insights. By uniting domain-adapted AI models with scalable real-time infrastructure, the proposed system establishes a paradigm shift from passive transcription to active judicial intelligence, enhancing transparency, efficiency, and strategic depth in India's judicial ecosystem.

Keywords:

Artificial Intelligence, Legal Technology, Speech-to-Text, Knowledge Graph, Legal Entity Recognition, Speaker Diarization, Judicial Analytics, Logical Fallacy Detection, Real-Time Systems.

AI for Skin Melanoma Cancer Detection

Umme Habiba

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Vipul Vekariya

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Rohit Gupta

Department of Computer Science & Engineering, Parul Institute of Engineering and Technology, Parul University, Vadodara, Gujarat, India

Abstract:

Melanoma is among the most lethal types of skin cancer due to its rapid progression and high metastatic potential. Early detection is critical to improving patient survival rates, yet traditional diagnostic methods such as visual inspection, dermoscopy, and biopsy are often time-intensive and dependent on specialist expertise. With the advent of artificial intelligence (AI) and deep learning, automated melanoma detection systems are increasingly recognized as effective, scalable, and cost-efficient solutions for clinical support. This review explores recent advancements in AI-powered skin cancer detection, emphasizing convolutional neural networks (CNNs), hybrid deep learning architectures, and their validation in clinical practice. Studies demonstrate that models integrating CNNs with support vector machines, U-Net optimizations, and ensemble approaches achieve superior classification accuracy compared to conventional techniques. Furthermore, real-world applications such as FDA-approved trials and NHS-recommended AI systems highlight the growing acceptance of these technologies in healthcare systems. Despite promising outcomes, significant challenges persist, including dataset diversity, model generalizability across skin tones, ethical concerns, and regulatory barriers. Addressing these limitations is essential for the future development of robust, accessible, and ethically sound melanoma detection systems that can complement dermatologists, reduce diagnostic disparities, and ultimately enhance patient outcomes.

Keywords:

Melanoma, Skin Cancer Detection, Artificial Intelligence, Deep Learning, Convolutional Neural Networks, Hybrid Models, Clinical Applications, Healthcare AI.

An IoT-Based Bio-Filtration System for Urban Stormwater Management

R. A. Kayastha

UG Students, Civil Engineering Department, Sanjivani College of Engineering, Kopergaon Maharashtra, India

K. A. Barshile

UG Students, Civil Engineering Department, Sanjivani College of Engineering, Kopergaon Maharashtra, India

S. R. Mahale

UG Students, Civil Engineering Department, Sanjivani College of Engineering, Kopergaon Maharashtra, India

S. S Kokane

UG Students, Civil Engineering Department, Sanjivani College of Engineering, Kopergaon Maharashtra, India

S. R. Korake

Assistant Professor, Civil Engineering Department, Sanjivani College of Engineering, Kopergaon Maharashtra, India

Abstract:

Rapid urbanization and reduced infiltration areas in cities have resulted in increased surface runoff, flooding, and deterioration of water quality, creating the need for sustainable alternatives to conventional drainage systems. This study presents the development and assessment of a lab-scale IoT-based bio-filtration system (rain garden) designed for efficient urban stormwater management. The system incorporates four filtration layers—coarse aggregates, fine aggregates, fine river sand, and loamy soil—combined with native plant species such as Vetiver grass and *Canna indica* to enhance pollutant removal through natural filtration and biological uptake. The innovative aspect of this project lies in the integration of an IoT-based real-time monitoring system that measures temperature, Total Dissolved Solids (TDS), and turbidity of the treated water, enabling continuous performance evaluation. Experimental results showed noticeable improvement in water quality with significant turbidity and suspended solid reduction after treatment. The integration of IoT technology not only facilitates real-time analysis but also supports predictive maintenance and data-driven optimization. Hence, the proposed bio-filtration model demonstrates a sustainable, smart, and eco-friendly solution for stormwater quality improvement and can serve as a scalable approach for urban water resource management.

Keywords:

Stormwater management; Rain garden; Bio-filtration system; IoT monitoring; Water quality improvement; Sustainable drainage; Nature-based solutions; Urban runoff; Smart water management.

Leveraging NLP for Automated Medical Record Analysis and Disease Pattern Detection

Kulvinder Singh

Computer Science and Engineering, Chandigarh University, Mohali, Punjab , India

PremPrakash Motwani

Computer Science and Engineering, Chandigarh University, Mohali, Punjab , India

Rahul Kumar Pandey

Computer Science and Engineering, Chandigarh University, Mohali, Punjab , India

Mohit Mathur

Computer Science and Engineering, Chandigarh University, Mohali, Punjab , India

Abstract:

The rapid growth of electronic health records (EHRs) has created a critical need for efficient methods to analyze unstructured medical data. Manual review of clinical documents is time-consuming, error-prone, and infeasible at large scale. Natural Language Processing (NLP) offers powerful techniques to automate medical record analysis, enabling the extraction of essential entities such as symptoms, diagnoses, medications, and procedures. This research paper explores the theoretical framework behind NLP-driven medical text mining, emphasizing entity recognition, disease pattern detection, and clinical decision support. It examines existing methods and their effectiveness in processing large-scale healthcare datasets. Additionally, the study highlights potential strategies for enhancing automated analysis, including the use of advanced machine learning models, domain-specific embeddings, and privacy-preserving approaches. While primarily conceptual, the paper also discusses a prototype framework for an NLP-based medical record analyzer, outlining its potential implementation in real-world healthcare systems. By addressing current challenges and exploring future advancements, this research aims to contribute to improved clinical efficiency, reduced diagnostic errors, and enhanced patient care.

Keywords:

Natural Language Processing (NLP), Electronic Health Records (EHRs), Medical Text Mining, Disease Pattern Detection, Clinical Decision Support.

“A Review on Machine Learning for Cost-Efficient Cloud Resource Management”

Rupali Balasaheb Pekhale

Department of Computer Engineering, Late G. N. Sapkal College of Engineering, Nashik, India

Dr. N.R.Wankhade

Department of Computer Engineering, Late G. N. Sapkal College of Engineering, Nashik, India

Abstract:

Cloud computing has completely changed the de-ployment and scalability paradigm of application and has offered elastic infrastructure on demand. However, the cost of such environments is a hidden cost: resource distribution may often become inefficient, which leads to over-provisioning, unnecessary spending, or performance penalties in case of peak load scenarios. This paper presents the AI-based Cloud Resource Optimizer—a new model that is a combination of real-time monitoring, predictive analytics, and evolutionary optimization to dynamically distribute resources in cloud environments. Using Particle Swarm Optimization (PSO) to identify the best resource settings in real time, our system taps into Particle Swarm Optimization (PSO) to utilize Prometheus as the backbone of monitoring and apply XGBoost and Long Short-Term Memory (LSTM) models to predict the workload demand. Experimental analysis of Azure, based on Internet of Things workload traces shows that cost can be saved by up to 85 per cent compared to fixed allocation and baseline autoscaling algorithms, and service performance is maintained. This paper explains the ways in which the concept of machine-learning-enhanced feedback-based scaling can upend the cost management in modern cloud infrastructures.

In-vitro Assessment of ABCG2-mediated Efflux of Antiseizure Medications in Human Blood-brain Barrier Cell Model

Shivangi

PhD Student, Department of Biotechnology, Delhi Technological University, Delhi, India

Abstract:

Despite the availability of around 35 clinically used antiseizure medications (ASMs), pharmacotherapy remains ineffective for 30–40% of epilepsy patients. In this study, we aimed to investigate the potential of commonly prescribed ASMs to act as substrates of ATP-Binding Cassette (ABC) transporter G2 (ABCG2) and whether ABCG2 genetic variants affect transporter-mediated ASM efflux using human blood-brain barrier cell model, hCMEC/D3 cells. In competitive substrate efflux and ATPase assays, N-Desmethyl clobazam (DCLB), and oxcarbazepine (OXC) exhibited substrate-like interaction with ABCG2, while no interaction was recorded for carbamazepine (CBZ), topiramate (TPM) or levetiracetam (LEVI). Furthermore, bidirectional transport assays revealed the potential of DCLB, OXC, valproic acid (VPA), and lamotrigine (LTG), and not phenytoin (PHT) to be transported by ABCG2, and ranked by net efflux ratios (ER) as follows: DCLB>OXC>LTG>VPA. Additionally, hCMEC/D3 cells were transfected to overexpress ABCG2 wildtype or variant proteins (ABCG2 S248A and D296H) to evaluate their effect on CBZ and DCLB efflux. In subsequent RT-PCR and western blot experiments, we demonstrated that ABCG2 variants reduced ABCG2 mRNA and protein expression. Moreover, compared with ABCG2-wildtype cells, net ER of DCLB decreased to 1 in ABCG2 variants-transfected cells. In contrast, ABCG2 variants caused no change in the transport of CBZ. In summary, our work indicates that DCLB and OXC are definite substrates of ABCG2 at a clinically relevant concentration range. Also, these ABCG2 variants might contribute to the inter-individual variability in ASM brain levels. Our in vitro findings could serve as a crucial basis for future clinical research in epilepsy multidrug resistance.

Keywords:

Antiseizure medications, ABCG2, blood-brain barrier, hCMEC/D3 cells, genetic variants, multidrug resistance.

Transformer-Based Multilingual Framework for Sentiment and Emotion Analysis

G karthiga

PG Student, Computer Science and Engineering, Hindusthan Institute of Technology, Malumichampatti, Tamil Nadu India

J Pavithra

Assistant Professor, Computer Science and Engineering, Hindusthan Institute of Technology, Malumichampatti, Tamil Nadu India

Abstract:

The emotion and sentiment analysis is now being considered critical in the interpretation of the user opinions, user behaviour and mental conditions across the digital platforms. However, the majority of the existing measures can only be applied in monolingual situations and cannot be extrapolated to the situation related to multilingual settings with linguistic diversity, cultural variations, and mixing of languages. The current paper presents a Multilingual Sentiment and Emotion Analysis Framework that is founded on the utilisation of machine learning models that are transformer-based, such as mBERT, and XLM-RoBERTa to achieve the perception of situations in various languages. Within the proposed framework, the novel preprocessing pipelines of language normalization, emotion labels harmony, and attention-based feature extraction have been incorporated so that multilingual high adaptability is achieved. Benchmark datasets on different languages were widely tested and demonstrated better accuracy, F1-score and consistency of emotion recognition compared to traditional deep learning/ multilingual baseline models. The results confirm the possibility of the framework modeling the variation existing of the semantic and affective when using the various languages which enhances the generalization and interpretations. The article contributes to the rising inclusive NLP systems which may be utilized to facilitate the advancement of emotion-receptive applications such as multilingual chatbots, worldwide opinion mining, and social media monitoring.

Keywords:

Sentiment Analysis, Emotion Detection, Multilingual NLP, Transformer Models, Deep Learning, Cross-Lingual Transfer.

Multimodal Deep Graph Neural Network for Autism Spectrum Classification

Chithra B

PG Student, Computer Science and Engineering, Hindusthan Institute of Technology, Malumichampatti, Tamil Nadu India

Dr. A.JameerBasha

Assistant Professor, Computer Science and Engineering, Hindusthan Institute of Technology, Malumichampatti, Tamil Nadu India

Abstract:

Autism Spectrum Disorder is a multifaceted neurodevelopmental disorder, where the patient has a problem with communication, social behavior, and repetitive activity patterns. Traditional diagnosis methods depend on behavioral observation and clinician interpretation that in most cases may result in inconsistent and delayed diagnosis. To overcome this issue, the current paper introduces a Deep Graph Neural Network built multimodal framework, which combines functional Magnetic Resonance Imaging and phenotypic data to contribute to the objectivity and accuracy of ASD classification. Suggested system creates brain connectivity graphs based on fMRI data with the help of correlation with edges between specified brain areas and a Weight Learning Network estimates personal similarity based on demographic and clinical variables. The multimodal features are then submitted to a Deep Graph Convolutional Network to learn the local and global connectivity representations after which they are then classified using a Multi-Layer Perceptron network. The experimental evaluations indicate that the proposed model is more accurate and robust than the conventional deep learning models, which underscores the importance of considering imaging and non-imaging modalities. It is possible that multimodals are better understood and interpreted, the integration of multimodal features has the potential to make diagnosis of ASD early, data-driven and less reliant on guesses, and pre-empt further applications in neurodevelopmental disorders.

Keywords:

Autism Spectrum Disorder, Functional MRI, Graph Neural Network, Multimodal Integration, Brain Connectivity Analysis.

Deep Convolutional Framework for Plant Disease Detection and Severity Estimation

Melvin Savio

PG Student, Computer Science and Engineering, Hindusthan Institute of Technology, Malumichampatti, Tamil Nadu India

Dr. A.JameerBasha

Assistant Professor, Computer Science and Engineering, Hindusthan Institute of Technology, Malumichampatti, Tamil Nadu India

Abstract:

The importance of plant diseases is tremendous because it causes colossal losses to the economy and low quality of the crops. The conventional methods of identification that are related to searching manually are not only time consuming, inaccurate, but also depend on the skills of investigators. The provided paper presents the automated and effective method of the detecting and classifying leaf diseases in plant based on the use of Convolutional Neural Networks. The proposed solution would involve image preprocessing, image segmentation, and Grad-CAM to detect and identify the spot of the infections such as Cercospora Leaf Spot in maize and determine the spread of the infection. It is a classification with a confidence of 94.82 and a severity index of 3.36 on a scale of 0-5 which indicates a high measure of reliability in determination of disease and progression measure. The system also generates interpretable heatmaps of affected spaces which enhances the decision making and the transparency. The results confirm that CNN-based models are an appropriate, scale-able, and field-adaptable example of addressing the issue of addressing plant diseases, which has a significant role on sustainable agriculture and early intervention mechanisms.

Keywords:

Convolutional Neural Network, Image Segmentation, Plant Disease Detection, Grad-CAM, Precision Agriculture.

AI-Powered Smart Traffic Signal Synchronization

Ranit Pal

Department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India

Ravi Prakash Singh

Student, Department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India

Sapna Aggarwal

Student, Department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India

Veer Bajpai

Student, Department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India

Vishal Bhateria

Student, Department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India

Vemula Narendra

Student, Department of Computer Science and Engineering, Chandigarh University, Gharuan, Mohali, Punjab, India

Abstract:

Urbanization is the major driver of the global population increase, resulting in a higher number of vehicles on the roads and a more difficult traffic pattern that the traditional traffic lights manage inefficiently. To counteract these drawbacks, the paper suggests an AI-supported Intelligent Traffic Signal Control System that has the ability to adapt through the real-time changes of traffic volume and environmental conditions. The intention behind the system is to maximize the signal adjustments and consequently, to improve the road efficiency by considering different factors, for instance, the traffic amount, average vehicle speed, weather, and incidents occurrence. A massive dataset was employed for the training and testing of the three machine learning models which are—Logistic Regression, Random Forest, and XGBoost—designed to predict the best signal state in various situations. The evaluation of model's performance was done on the basis of accuracy, precision, recall, and F1-score metrics, with Random Forest being declared the most powerful model due to its excellent performance in coping with complex data interactions. The analysis of feature importance revealed that both traffic volume and average vehicle speed had the strongest influence on the prediction results. The implications of the research are that AI can play a significant role in producing intelligent, adaptive

and eco-friendly traffic management solutions that will drastically cut down both congestion and waiting time. This study has broadened the horizon for the AI technology incorporation into the future of transport systems marked with intelligence, and it has also indicated the importance of mechanisms like automation, data-informed decision-making, and adaptive management in efficient and sustainable urban mobility alternatives.

Keywords:

Artificial Intelligence (AI), Machine Learning, Smart Traffic Management, Intelligent Transportation System (ITS), Traffic Signal Synchronization, Random Forest, XGBoost, Data-Driven Decision Making, Urban Mobility, Traffic Optimization.

Cyber-Physical System for Automated Hospital Resource Management

Sarthak Kumar

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Aman Kumar

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Harsh Raj

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Krishna Kumar

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Vanshika

Assistant Professor, Chandigarh University, Mohali, Punjab, India

Abstract:

The ever-increasing healthcare demands have put the pressure on efficient management of hospital resources that help them provide their patients with high-quality services and make their hospital operations effective. The Automated Hospital Resource Management Cyber-Physical System (CPS) is linked together with data analytics, embedded devices, and Internet of Things (IoT) sensors to facilitate real-time monitoring and logic decision-making. The system designed to improve operations in hospitals by automatically controlling key resources such as beds, medical equipment and infrastructure availability of staff. This would ensure faster, efficient treatment of the patient and reduce unnecessary wastage of time. Sensors and data analytics can help the CPS predict when a facility needs maintenance, monitor real-time resources, and optimize those facilities to fulfil the requirements. The model promotes smart innovation within healthcare, as well as greater day-to-day efficiency. As experiments and results of the comparison indicate, CPS is capable of overcoming challenges such as scalability, data security and dependability leading to more patient-oriented and sustainable hospital operations.

Keywords:

Cyber-Physical Systems (CPS), Hospital Resource Management, Internet of Things (IoT), Data Analytics, Embedded Systems, Real-Time Monitoring, Smart Healthcare, Automation.

IOT Based Application for Healthcare

Yash Kataria

SET, Department of Computer Science and Engineering, (CSE-N) MRIIRS, Faridabad, Haryana

Ravindra Kumar

SET, Department of Computer Science and Engineering, (CSE-N) MRIIRS, Faridabad, Haryana

Ritika Sharma

SET, Department of Computer Science and Engineering, (CSE-N) MRIIRS, Faridabad, Haryana

Kumari Soumya

SET, Department of Computer Science and Engineering, (CSE-N) MRIIRS, Faridabad, Haryana

Abstract:

The inclusion of the Internet of Things into healthcare has revolutionized the monitoring, diagnostic, and real-time analysis of patient-related data. This study mainly focuses on the design and implementation of a healthcare-optimized IoT-specific protocol that allows different devices to communicate with the healthcare server safely, efficiently, and reliably. The designed system combines wearable sensors, cloud data storage, and an alarm system for detecting anomalies in real-time. The protocol is tested for latency, energy consumed, data collected, and security parameter. The results show that the protocol increases the efficiency levels of the performance of IoT healthcare systems; this is proof of the effectiveness of the system as it can be used in real life where patients are monitored throughout to detect for early disease detection we can.

Keywords:

Machine Learning, IOT, Random Forest Classifier, Gradient Descent, Health Monitoring application.

Robotic Process Automation Platform for Enhancing Public Sector Productivity

Debajyoti Paul

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Sunidhi Singh

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Sneha Gupta

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Amit Anand

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Preeti Verma

Computer Science and Engineering, Chandigarh University, Mohali, Punjab, India

Sharandeep Kaur

Assistant Professor, Chandigarh University, Mohali, Punjab, India

Abstract:

Robotic Process Automation (RPA) has become a revolutionary technology that can be used to enhance repetitive and rule-based work in various fields. Automation in the case of public administration where processes are usually characterized by large data entry volumes, report generation volumes and document processing can save a substantial amount of time of operational delay and human error. This study aims at creating an RPA platform specific to the use of the public sector organizations to make office activities a routine that can be automated with few to no human touch. The offered system is based on the use of automation tools and workflow designs to become more efficient, deliver services faster, and use resources optimally. The platform will enhance the quality of offering its services to people by minimizing the time taken to complete a turnaround and ensuring the services are more accurate. It is possible that the results of the change will reflect quantifiable productivity, cost-effectiveness, and satisfaction rates among citizens.

Keywords:

Digital Governance, Robotic Process Automation, Service Delivery, Public Sector, Efficiency, Workflow Automation, Productivity.

AI-Powered Braille Translation System

Sharon A Dobbin

Department of Computer, Science & Engineering, Atria Institute of Technology, Bangalore, Karnataka, India

Mary Angel Y

Professor, Department of Computer, Science & Engineering, Atria Institute of Technology, Bangalore, Karnataka, India

P Shreya

Department of Computer, Science & Engineering, Atria Institute of Technology, Bangalore, Karnataka, India

Sandhya S

Department of Computer, Science & Engineering, Atria Institute of Technology, Bangalore, Karnataka, India

Pooja Vijay Bijapur

Department of Computer, Science & Engineering, Atria Institute of Technology, Bangalore, Karnataka, India

Abstract:

Accessing textual content is quite challenging for visually impaired people due to the lack of Braille resources and the costly and inefficient nature of current translation systems. This study presents a multi-modal, web-based, AI-powered Braille translation system that delivers accurate translation by utilizing artificial intelligence, optical character recognition and natural language processing, along with context-aware translation algorithms. The platform aims to promote digital diversity and accessible learning for both sighted and visually impaired users, including teachers, transcribers, and students. There is support for both Grade 1 Braille (direct transliteration) and Grade 2 Braille (contextual translation with contractions) translations, as well as an intuitive interface that can be tailored to satisfy a range of user needs. The system is developed using a Typescript-React.js frontend, a Python backend for the braille translation logic processing, and Tesseract OCR for image-to-text extraction and translation. This integrated architecture ensures real-time, scalable, and user-friendly Braille translation across multiple input formats.

Keywords:

Natural Language Processing (NLP), Artificial Intelligence (AI), Optical Character Recognition (OCR), Braille Translation System, Audio Input/Output, Text Extraction, Assistive Technology.

Comparative Analysis of YOLOv11, YOLOv7, and YOLOv5 for Seat Belt Detection in Intelligent Transportation Systems

Praveen Sai Talupuri

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Ankit Mishra

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Rakesh Kumar Mandal

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Subranshu Sekhar

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Sneha Saini

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Abstract:

Safety on roads continues to be a priority, especially in densely populated city environments where driving culture continues to be an issue. Traditional techniques for seatbelt use enforcement and compliance verification were based on manual visual inspection or primitive image processing, both of which have poor accuracy, are unreliable, and are prone to human errors. These methods also require huge amounts of labor and time, making them non-scalable and less efficient for real-time applications. This paper submits a YOLOv11-based smart seatbelt detection system, an optimized deep neural network for real-time monitoring of traffic. The approach has been extensively assessed on a self-developed dataset with various driving scenarios and vehicle models. It obtains 94.6% mean Average Precision (mAP), proving its robust performance with modest computational cost. The findings show that the system can be suitably deployed in automatic traffic monitoring installations with a useful solution for compliance enforcement and public safety.

Keywords:

Deep learning, Object Recognition, Seat Belt Detection, Traffic Surveillance, Road Safety.

Internet of Things (IoT) Tool to Enhance Data Collection in Global Partnerships

Mohd Aakib

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Sanket Sharma

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

YashVeer Singh

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Annu

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Sandeep Kaur

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Akamjyot Singh

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Abstract:

The international relationship growth in any industry requires definite, reliable and realtime information transfer. This paper advises the researcher to come up with an Internet of Things (IoT)-based tool that would facilitate the data collection process within the international collaboration. It is a framework that involves smart sensors and networked devices that communicate with cloud-based applications to facilitate successful acquisition, conveyance, and examination of data of scattered geographical cause. The proposed tool can be deemed as accurate, duplicable, and subjected to cross-border collaborations due to the implementation of the IoT networking protocols and the principles of cloud computing. The framework is not just a method of automation of data gathering but is also expected to provide the stakeholders with timely information that may assist in making superior decisions, optimization and resources, and possessing a plan. This strategy not only plays the facilitator role in the geographical aspect, yet it also brings in believability in the transfer of information, and further enhances international cooperation in the study, business, and governance.

Keywords:

Internet of Things, Smart Sensors, Interconnected Devices, Data Transparency, Automated Data Acquisition, Real-time Data Collection, Global Partnerships, Cloud Computing, Cross-border Collaboration.

IoT Enabled Smart Benches with Energy Usage and Footfall Tracking

Gaurav Kumar

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Nikhil Kumar Singh

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Eshant

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Moksh Chawla

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Amartya Raj

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Seema Kharod

Bachelor of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Abstract:

The increased need in the sustainable and energy-efficient use of the infrastructure in the urban communities has further propelled the use of Internet of Things (IoT)-based solutions in urban settings. This study concentrates on the design and development of IoT enabled smart benches that have built in sensors that make them detect energy usage as well as footfall activity. The system architecture is built on both embedded hardware and cloud-based data management, allowing obtaining real-time data and visualizing them. The application is a mobile application that is got using Android frameworks and gets linked to Firebase/Cloud database to allow users and administrators to monitor and get interactive analytics. Footfall and energy consumption data are manipulated into actionable information that is useful in energy optimization, better manage community utility, and inform urban planning decisions that are made using data. Through IoT technologies, embedded systems and cloud integration, this work presents a scalable method to building smarter infrastructures of the populace, as a part of sustainable urban development and increased citizen engagement.

Keywords:

Water Quality Monitoring, Water Level Monitoring, AIoT, Cloud Computing, Smart Environment, IoT Sensors, AquaSentinel.

Systematic Review of Academic Papers and Key Players of Voice Assistant Technology

Ibrahim Abdullahi Aliyu

School, Computational Science and Engineering, Shobhit Institute of Engineering and Technology, Meerut India

Aliyu Ishaq Abdullahi

School, Computational Science and Engineering, Shobhit Institute of Engineering and Technology, Meerut India

Nura Yunusa Isa

School, Computational Science and Engineering, Shobhit Institute of Engineering and Technology, Meerut India

Ruchi Holker

School, Computational Science and Engineering, Shobhit Institute of Engineering and Technology, Meerut India

Abstract:

Among the new technologies that have taken center stage in the twenty-first century is voice assistants, or VAs. Human-computer interface and user experience studies have become very popular because it is easy and intuitive. In addition to examining the dominant industrial and scientific actors in the ecosystem, this paper undertakes a review of the voice assistant literature in academia. Software programs referred to as voice assistants are capable of understanding human language and replying using artificially created voices. The majority of successful voice assistants, according to the metrics, are presented in the role of services provided by influential platform vendors, i.e., Google Assistant, Microsoft Cortana, Amazon Alexa, and Apple Siri, which are embedded in smartphones or specific devices. The users are able to pose questions to the virtual assistants, use voice commands to command media playbacks and home appliances, and complete many routine activities such as viewing calendars, task lists, and mail. Through voice detection and interpretation to action, the core objective of VAs is to minimize users' hassles on a daily basis. Aside from this, the analysis concludes the contemporary deficits of evaluation standards, cross-platform support, low-resource language capability, and open privacy practice. In providing methodological rigor, ethical transparency, and universal design in future VA studies and implementations, we summarize with particular research and policy recommendations.

Keywords:

voice assistants, systematic review, speech recognition, dialogue systems, privacy, accessibility, platform ecosystem.

Machine Learning in Antenna Design: A Comprehensive Survey of Applications and Advancements

Nazia Farooq

Department of Electronics and Communication Engineering, IUST, India

Khalid Muzaffar

Department of Electronics and Communication Engineering, IUST, India

S A Malik

Department of Electronics and Communication Engineering, IUST, India

Abstract:

The integration of machine learning (ML) in antenna design has emerged as a transformative approach to optimizing electromagnetic structures, overcoming challenges associated with traditional analytical and numerical methods. This survey explores the applications of ML across various domains of antenna engineering, including antenna synthesis, array optimization, metasurface engineering, computational electromagnetics (CEM), and other advanced applications. By leveraging techniques such as deep neural networks (DNNs), support vector machines (SVMs), deep reinforcement learning (DRL), and generative adversarial networks (GANs), ML enhances the efficiency, adaptability, and performance of modern antenna systems. The study provides a comprehensive review of recent advancements, highlighting potential use cases and associated challenges. The findings suggest that ML-driven approaches are poised to revolutionize antenna design by reducing computational complexity, accelerating design iterations, and enabling novel, high-performance antenna architectures.

Keywords:

Machine learning, antenna design, computational electromagnetics, metasurfaces, deep learning.

CNN-Based Early Detection and Grading of Diabetic Retinopathy

Piyush Ghorela

Department of Computer Science and Engineering, Chandigarh University Mohali, Punjab, India

Bashar Rizwan

Department of Computer Science and Engineering, Chandigarh University Mohali, Punjab, India

Md Adnan Aziz

Department of Computer Science and Engineering, Chandigarh University Mohali, Punjab, India

Inakshi Garg

Department of Computer Science and Engineering, Chandigarh University Mohali, Punjab, India

Abstract:

Diabetic Retinopathy (DR) is a transpiring eye disease caused by diabetes, which damages cognizant retina, making it unable to function effectively leading to lifelong loss of sight in the topic of absence of inspiration. This study offers a fully implementable deep learning-based framework in the early diagnosis and grading of Diabetic Retinopathy on retinal fundus shoots. Suggested framework consists of an optimized Convolutional Neural Network (CNN) implemented in the tool of TensorFlow and Keras to categorize the severity of the DR into five stages (04) between normal retina and proliferative DR. A number of pretemplate processes such as image cropping, image enhancement with CLAHE, image normalization, and image augmentation were applied to enhance model robustness and characteristic extraction. The system had high diagnostic potential with a general classification accuracy of over 90%. Grad-CAM visualizations were activated to increase clinical understandings, to identify the key retina areas contributing to model predictions, including microaneurysms, haemorrhases, and exudates. This project contrasts with existing studies by being the first approach to provide an end-to-end, user-interactive app with an attractive CSS-based interface to be opened in the terminal that builds analytical reports and provides graphical summaries to visualize the severity of the DR. The findings indicate that the developed system is precise and interpretable, as well as can be deployed in the field, and thus is a feasible and scalable means of early retinopathy screening in diabetics.

Keywords:

Convolutional Neural Network (CNN), Diabetic Retinopathy, Retinal Fundus Images, Deep Learning, Image Enhancement, Early Disease Detection, Severity Classification, Explainable Artificial Intelligence (XAI), Grad-CAM Visualization, TensorFlow, Keras, Medical Image Analysis, Automated Screening System, CSS-Based Interface, Deployable AI Model.

Cyber-Physical Robots for Automated Medication Dispensing

Varnika Srivastava

Bachelor of Computer Science and Engineering, Chandigarh University, Punjab, India

Prachi Sharma

Bachelor of Computer Science and Engineering, Chandigarh University, Punjab, India

Arushi jaggi

Bachelor of Computer Science and Engineering, Chandigarh University, Punjab, India

Vanshika

Bachelor of Computer Science and Engineering, Chandigarh University, Punjab, India

Abstract:

Growing need for accuracy, safety and efficiency in drug dispensing has given rise to automated dispensing systems; however, current solutions lack flexibility, inadequate integration with healthcare networks and development of dispensing errors and/or data breaches. This paper presents a Cyber-Physical Robotic Framework for Automated Medication Dispensing to seamlessly integrate intelligent robotic manipulators, secure IoT communication, and adaptive control algorithms to enable medication delivery in real-time to eliminate both errors in clinical and home-care environments. The system facilitates sensor-based feedback loops and AI-based verification modules to ensure that the dosages for each patient would be accurate, biometrics and block-chain enabled data security for authentication, and cloud-based healthcare interfaces for constant monitoring of healthcare. Extensive simulation and prototype validation determined significant enhancements in dispensing accuracy, system responsiveness and resilience with respect to cybersecurity when compared to conventional systems. The originality of the work lies in the adaptive cyber-physical integration which allows context aware decision making and self-correcting behavior under dynamically varying health care conditions. Apart from reducing the human error rate to a minimum, this method helps to increase patient compliance, operational efficiency, and data integrity, which will pave the way for the next generation of smart healthcare ecosystems - that of smart tenure adoption for smart medication dispensing capabilities within intelligent robots.

Keywords:

Adaptive control, Artificial intelligence, Automated medication dispensing, Blockchain security, Cyber-physical systems, Healthcare robotics, Internet of Things, Patient safety, Real-time monitoring, Smart healthcare.

A Review on Healthy Leaves Detection Using Deep Learning

Devender Prasad

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Sanjay Kumar Mandal

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Rohan Yadav

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Amandeep Kumar

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Ashish Kumar Singh

Department of Computer Science Engineering, Manav Rachna International Institute of Research and Studies, Faridabad, Haryana, India

Abstract:

A crop's leaves are an essential component. Any sickness or infection that affects the leaves causes the overall crop yield to fail, and any farmer's first priority is prevent any diseases. However, the conventional techniques, such as visual detection and laboratory testing, are costly, time-consuming, slow, and inconsistent. Every year, farmers worldwide suffer from crop loss as a result of these restrictions. However, recent advancements in deep learning have produced a new, dependable, and reasonably priced method of disease monitoring for leaves. CNNs and YOLO-based techniques not only helps us to automate these manual tasks, but they also achieve great accuracy levels of over 95% with real-time performance on mobile devices, making them really useful for farmers in the crop fields. This overview summarizes the most recent developments in this area and demonstrates how they are advancing agriculture toward quicker, more intelligent, and more sustainable methods.

Keywords:

Visual detection, Laboratory Techniques, CNNs, Deep Learning, YOLO.

Numerical Investigation of the Influence of Conical and Hemispherical Dimples with Varying Configurations in a Circular Tube on Heat Transfer Rate and Thermal Performance in a Circular Tube

Ebrahim Alabdali

Ph.D, Mechanical Engineering, Vishwakarma University, Pune, Maharashtra, India

Dr. Kedar Sant

Professor, Mechanical Engineering, Vishwakarma University, Pune, Maharashtra, India

Abstract:

This paper numerically investigates the heat transfer rate and thermo-hydraulic performance of tubes enhanced with conical and hemispherical dimples. Dimples have garnered considerable attention in a range of thermal applications, including heat exchangers, gas turbine blade cooling, electronic cooling systems, and solar thermal collectors. Their efficacy, combined with ease of manufacturing and structural integrity, renders them a compelling option for enhancing heat transfer in both industrial and specialized contexts. The presence of conical and hemispherical dimples within a circular tube generates a disruptive fluid flow pattern, significantly altering the thermal boundary layers adjacent to the tube wall. This induced vortex facilitates enhanced mixing of the fluid, resulting in a substantial increase in the heat transfer rate and subsequently improving the overall thermal performance of the device. Three distinct dimple configurations were examined, each with unique characteristics: inline, staggered, and variations in angular deviations (0° , 30° , 60°) from the initial dimple position. The investigations were conducted using the advanced computational fluid dynamics software, STAR-CCM+, and carried out in a laminar flow regime that encompasses a wide range of Reynolds numbers, spanning from 600 to 2100, employing air as the working fluid, and constant wall heat flux is maintained throughout the investigation. The numerical results indicate a consistent increase in the heat transfer rate with the application of conical and hemispherical dimples as the Reynolds number is increased. However, it is important to note that the pressure drop also rises concomitantly. The highest thermal performance factor observed was 1.3, achieved with hemispherical dimples arranged in a staggered configuration.

Agriculture-based Project on Deep Learning

Akshita Sharma

Department of Computer Science Engineering, Chandigarh University Mohali, India

Khushi

Department of Computer Science Engineering, Chandigarh University Mohali, India

Aditya Raj

Department of Computer Science Engineering, Chandigarh University Mohali, India

Parichay Sharma

Department of Computer Science Engineering, Chandigarh University Mohali, India

Amit Kumar Jaiswal

Department of Computer Science Engineering, Chandigarh University Mohali, India

Abstract:

Agriculture is an essential sector in feeding the world; however, it is still facing numerous problems such as plant diseases, the unpredictable health of crops, and the inefficient use of resources. The traditional agricultural methods are greatly dependent on manual inspection and the intuition of the farmers, which in most cases lead to late disease detection, the misuse of fertilizers, and low productivity. A shift in agriculture has been foreshadowed by the recent successes of deep learning and image processing techniques in disease identification automation, health trend forecasting, and provision of data-driven recommendations. This paper presents one comprehensive framework that applies the CNNs (Convolutional Neural Networks) concept to image-based plant leaf disease identification, the LSTM (Long Short-Term Memory) network for time-series crop health prediction, and the decision support module for fertilizer recommendation. The system is designed to prompt the farmers, thus, facilitating immediate decision-making situations which lower the loss of yields and assure the quality of crops. Experiments are performed using standard datasets such as PlantVillage and time-series agricultural datasets, paired with scenarios from the real world. The proposed framework is validated across different deep learning model configurations, supporting versatility, dependability, and the level of success of the solution. Results reveal that the CNN-based disease detection system can classify the target diseases with the accuracy of more than 95%. LSTM model is highly accurate in predicting crop health trend patterns over time. Besides that, the recommendation unit is an enabler for fertilizer application that is 18% more efficient than current usage. This research is intended to lead to the creation of intelligent farming systems with increased productivity, diminished economic losses, and the promotion of sustainable agriculture.

Keywords:

Natural Deep Learning, Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), Plant Disease Detection, Crop Health Prediction, Fertilizer Recommendation, Precision Agriculture, Smart Farming.

Design and Analysis of an S-Shaped Slot-Loaded Microstrip Antenna for Broadband 5G Applications

A. Sudhakar

Department of ECE, GMR Institute of Technology, Rajam, India

K. Kesava

Department of ECE, GMR Institute of Technology, Rajam, India

I. Vasu Vardhan

Department of ECE, GMR Institute of Technology, Rajam, India

T. M. Venkat Subhas

Department of ECE, GMR Institute of Technology, Rajam, India

D. Chandhu

Department of ECE, GMR Institute of Technology, Rajam, India

Abstract:

This work showcases the design and analysis of a compact microstrip antenna with an S-shaped slot for broadband fifth-generation wireless networks. The antenna is designed and simulated using CST Studio Suite, with an FR4 substrate measuring $100 \times 100 \times 10$ millimeters. The radiating patch measures 50×50 mm and has a curved S-shaped slot with inner radii of 8.6 mm and 12.2 mm. The slot width is 1.5 mm. This design improves impedance bandwidth and supports several resonant modes. Simulation results identify three resonances at 4.088 GHz, 5.69 GHz, and 7.30 GHz. The operation bandwidth extends from 3.70 GHz to 7.87 GHz. This design provides a compact, low-cost, and efficient option for applications regarding sub-6 GHz and mid-band 5G.

Keywords:

Microstrip patch antenna, S-shaped slot, broadband, sub-6 GHz, 5G communication, CST simulation.

Real-Time Monitoring and Automation of Greenhouse Conditions Using Crop Specific Actuation Mechanisms

Neha Rajas

Department of Multidisciplinary Engineering, Vishwakarma Institute of Technology, Pune, India

Aditya Narke

Department of Multidisciplinary Engineering, Vishwakarma Institute of Technology, Pune, India

Chetan Niwate

Department of Multidisciplinary Engineering, Vishwakarma Institute of Technology, Pune, India

Pratham Chintawar

Department of Multidisciplinary Engineering, Vishwakarma Institute of Technology, Pune, India

Prasanna Khebade

Department of Multidisciplinary Engineering, Vishwakarma Institute of Technology, Pune, India

Abstract:

Advances in greenhouse automation have dramatically improved agriculture through precise environmental control, improving yield while minimizing resource use. Unfortunately, most existing systems still require manual configuration of crop-specific thresholds, require cloud-available connection, and necessitate some technical expertise. These conditions-only ease of use for smallholder and resource-poor farmers. This work presents a low-cost, easy-to-use smart greenhouse system that eliminates the need for manual calibration and persistent internet connection to regulate environmental control. A web-based dashboard allows individuals to select a crop (e.g., lettuce, tomato, basil), after which the smart greenhouse system automatically pulls optimal temperature, humidity, soil moisture, light cycle, and CO₂ levels from an onboard library. The greenhouse automatically regulates actuators, like fans, pumps, vents, and LED lights, to produce the ideal environmental conditions. A lightweight local web server also provides real-time remote monitoring, visual trend analysis of historic data, and allows threshold configuration through the intuitive use of a web portal, while minimizing the need for a technical background.

Keywords:

Agriculture, Greenhouse, Automation, IoT.

A Smart Mobile Application for Enhancing Women's Safety Using Real-Time Alerts and Geo-Analytics

Gaurav Kumar

Department of Computer Science Engineering, Chandigarh University Mohali, India

Rajan Mishra

Department of Computer Science Engineering, Chandigarh University Mohali, India

Mayank Sharma

Department of Computer Science Engineering, Chandigarh University Mohali, India

Prince

Department of Computer Science Engineering, Chandigarh University Mohali, India

Abstract:

The safety of women in urban settings is still a major social issue, and problems are frequently made worse by a lack of real-time monitoring systems and a delayed emergency response. The design and development of a clever mobile application that uses geo-analytics and real-time alerts to improve women's safety is presented in this paper. To provide a responsive safety network, the suggested system combines GPS APIs, Firebase cloud services, and IoT-enabled components with cross-platform mobile computing (Android and iOS). The app enables users to share their location in real time with trusted contacts, instantly initiate emergency alerts, and use geo-analytics to pinpoint high-risk areas in urban areas. While analytics modules offer predictive insights on dangerous areas, a multi-layered architecture is used to guarantee smooth data flow between user devices and cloud storage. The system's ability to produce precise alerts, facilitate prompt interventions, and provide useful urban safety intelligence is demonstrated by prototype testing. By integrating mobile computing, the Internet of Things, and data-driven analytics, the suggested framework enhances safety measures for women in urban settings and advances the larger goal of smart cities.

Keywords:

Smart cities, Women's Safety, Real-time Alerts, Geo-analytics, Mobile Computing, IoT.

AI-Powered Mental Health Assessment from Text and Speech

Harshit Mishra

Department of Computer Science Engineering, Chandigarh University Mohali, India

Vicky Lakhan

Department of Computer Science Engineering, Chandigarh University Mohali, India

Abhay Dwivedi

Department of Computer Science Engineering, Chandigarh University Mohali, India

Krish Chaudhary

Department of Computer Science Engineering, Chandigarh University Mohali, India

Dr. Abha Agrawal

Department of Computer Science Engineering, Chandigarh University Mohali, India

Abstract:

With the increasing global prevalence of mental health conditions, there is an accelerated need for scalable, affordable, and accessible 'real-time' diagnostic tools. Traditional evaluation methods typically rely on face-to-face interviews and self-report surveys, accompanied by costs and delays in provision and access due to stigma and underreporting. Advances in technology and artificial intelligence (AI) have enabled the successful development of real-time assessment systems for mental health, by applying speech and text analysis. This study examines the prospects of machine learning models, speech emotion recognition (SER) and natural language processing (NLP) for assessing mental health using AI. These systems can then identify early indications of disorders such as stress, anxiety, and depression, by analyzing linguistic markers, sentiment, prosody and acoustic features. This study critically reviews the existing literature, highlights issues around data privacy, model interpretability, and cultural bias, and discusses possible developments of AI evaluations for telehealth and remote- deployment settings. It also evaluates the ethical implications of automated mental health monitoring and the importance of clinician oversight, to facilitate safe implementation. Overall, the findings suggest that when appropriately designed, AI- based tools can complement existing clinical assessments, reduce barriers to care and enhance early intervention. Ongoing development of inclusive and approachable mental health evaluation tools is warranted and supported by this study.

Keywords:

Artificial Intelligence (AI), Mental Health Assessment, Natural Language Processing (NLP), Emotion Recognition in Speech, Multimodal Data Analysis, Machine Learning Techniques, Sentiment Analysis, Early Detection of Mental Health Disorders.

Applying the Theory of Planned Behaviour for Analysing Behavioural Intentions to use Public Transport in the UAE

Ahmad Abdallah Mohamad

Student, College of Business Administration, Master of Science in Business Analytics (MSBA), University of Sharjah, UAE

M. Azhar Hussain

Professor, College of Business Administration, Master of Science in Business Analytics (MSBA), University of Sharjah, UAE

Abstract:

Public transport plays a critical role in advancing sustainable urban mobility and reducing private vehicle reliance. Despite substantial investments in public transport infrastructure in the United Arab Emirates (UAE), private vehicle usage remains dominant, highlighting the need to understand the behavioural drivers of public transport adoption. This study analyses the determinants of intention to use public transport in the UAE by applying an extended Theory of Planned Behaviour (TPB) framework, incorporating Attitude (AT), Subjective Norm (SN), Perceived Behavioural Control (PBC), and Behavioural Capability (BC).

A quantitative research design was employed, and primary data were collected through an online survey from 197 UAE residents. Measurement and structural models were assessed using Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and Structural Equation Modelling (SEM). Reliability and validity criteria were satisfied for most constructs, confirming the robustness of the measurement model.

The findings reveal that Perceived Behavioural Control is the only significant direct predictor of intention to use public transport ($\beta = 0.411$, $p < 0.05$). In contrast, Attitude and Subjective Norm did not significantly influence intention. Behavioural Capability demonstrated significant positive effects on Attitude, Subjective Norm, and Perceived Behavioural Control, confirming its role as an antecedent variable within the extended TPB model; however, it did not directly predict intention. These results underscore the importance of perceived ease, confidence, and ability in shaping public transport usage intentions in the UAE context.

The study contributes to transport behavioural research by validating an extended TPB model in a Gulf setting, where cultural and mobility characteristics differ from previously studied regions. Practical implications highlight the need for initiatives that enhance commuter capability and system familiarity—such as route information tools, journey-planning support, and public awareness programmes—alongside continued improvements in accessibility and service quality. Recommendations for future research include expanding

sample diversity and incorporating additional behavioural constructs such as habit, perceived service quality, and environmental concern.

Keywords:

Public Transport, Theory of Planned Behaviour, Behavioural Capability, Structural Equation Modelling, UAE, Mobility Behaviour, Sustainable Transport.

An Optimized Ensemble Model for Climate-Induced Disaster Prediction

Vidya Bhausaheb Kale

Department of Computer Science Engineering, Late G.N. Sapkal College of Engineering, Trimbakeshwar, Nashik

Dr. N.R.Wankhade

Professor, Department of Computer Science Engineering, Late G.N. Sapkal College of Engineering, Trimbakeshwar, Nashik

Abstract:

Natural disasters such as floods, earthquakes, cyclones, and landslides cause immense damage to human lives, property, and the environment. To minimize these impacts, this project proposes an intelligent disaster prediction system that leverages advanced machine learning and deep learning techniques for accurate forecasting and timely decision-making. The system integrates Neural Networks (TensorFlow Keras) for efficient feature extraction and pattern recognition from large-scale environmental datasets. To address data imbalance and ensure fair learning across disaster categories, the SMOTE (Synthetic Minority Over-sampling Technique) algorithm is applied, generating synthetic samples of underrepresented classes for improved model generalization. The extracted features are further classified using the XGBoost (Extreme Gradient Boosting) algorithm, which offers high predictive accuracy through gradient boosting, regularization, and parallel processing. The model analyzes historical and real-time parameters such as temperature, rainfall, humidity, wind speed, and seismic activity to predict potential disaster occurrences. Performance metrics such as F1-score, ROC curve, and confusion matrix validate the system's robustness. The proposed framework provides an efficient, scalable, and reliable solution to support early warning systems, disaster preparedness, and risk management, ultimately contributing to enhanced community resilience.

Keywords:

Disaster Prediction, Neural Network, TensorFlow Keras, XGBoost, SMOTE, Machine Learning, Early Warning System, Risk Mitigation.

Intelligent Browser-Extension for Real- Time Phishing Detection Using Hybrid Machine Learning: A Review

Aishwarya Sanjay Sanap

Department of Computer Engineering, Late G. N. Sapkal College of Engineering, Nashik, India

Dr. N. R. Wankhade

Department of Computer Engineering, Late G. N. Sapkal College of Engineering, Nashik, India

Abstract:

Phishing remains one of the most pervasive and damage- ing cyber-attacks, deceiving users into divulging credentials, installing malware or transferring funds to attackers. Traditional blacklist- and heuristic-based defences cannot keep pace with rapidly evolving phish- ing tactics, resulting in high false negatives and poor protection against zero-day attacks.

This paper presents a comprehensive review of client-side and browser-extension-based phishing detection systems with an emphasis on hybrid and machine-learning approaches. We classify existing work into URL-based, content-based, visual-based and ensemble methods, comparing datasets, feature sets, algorithms, and deployment settings and reported per- formance. From this synthesis we identify key research gaps including zero-day detection, concept drift, explain ability, mobile browser support and lightweight deployment.

Finally, we outline a proposed hybrid client-side framework that com-bines URL, content and visual features with a lightweight Random For- est-SVM-CNN ensemble for real-time blocking in browsers. The frame- work aims to deliver the high accuracy of deep models while remaining efficient enough for client-side deployment, thereby advancing robust, scalable and trustworthy phishing protection for end users.

Keywords:

Phishing, Hybrid Machine Learning, Browser Extension, Client-Side Defence, Review.

Human Rights Case Analysis Using AI and Transformer Models

Deepali Shivaji Jadhav

Student, Computer Kalyani Charitable Trust's Late G. N. Sapkal College of Engineering, Trimbakeshwar, Nashik

Dr. N.R.Wankhade

Professor, Computer Kalyani Charitable Trust's Late G. N. Sapkal College of Engineering, Trimbakeshwar, Nashik

Abstract:

The rapid increase in human rights cases worldwide demands intelligent, automated systems capable of efficiently analyzing vast volumes of legal documents. Manual review of these documents is time-consuming, error-prone and limits the ability to identify critical patterns or precedents. This project proposes an AI-powered framework that leverages advanced Natural Language Processing (NLP) and Machine Learning (ML) algorithms specifically TF-IDF with Logistic Regression, XGBoost, and LegalBERT to automate human rights case classification and pattern recognition. The TF-IDF + Logistic Regression model serves as a baseline for efficient term-based classification, while XGBoost enhances predictive accuracy through non-linear learning on high-dimensional text features. LegalBERT, a domain-specific adaptation of BERT pretrained on legal corpora, provides deep contextual understanding of legal terminology and semantics, enabling superior performance in case classification, violation detection, and semantic similarity analysis. By combining traditional and deep learning methods, the system ensures high interpretability, scalability, and continuous learning from newly added cases. The proposed hybrid approach significantly reduces manual workload, improves accuracy in legal document analysis and aids legal professionals, NGOs, and policymakers in identifying human rights violations and relevant precedents effectively.

Keywords:

Human Rights, LegalBERT, TF-IDF, Logistic Regression, XGBoost, NLP, Legal Document Analysis, Case Classification, Semantic Similarity, Machine Learning.

Inversion Based Face Swapping with Diffusion Model

Archana Subhash Kolhe

Student, Computer Engineering, Late G N Sapkal College of Engineering, Trimbakeshwar, Nashik

Dr. N R Wankhade

Professor, Computer Engineering, Late G N Sapkal College of Engineering, Trimbakeshwar, Nashik

Abstract:

Inversion-Based Face Swapping using Diffusion Models presents a novel approach to achieving high-quality, realistic and identity-preserving face swaps. Traditional GAN-based techniques often suffer from visual artifacts, limited generalization, and weak identity retention. To overcome these limitations, the proposed system employs Denoising Diffusion Probabilistic Models (DDPMs) integrated with an Inversion-Based Attribute Encoder (trained in PyTorch) for precise latent-space manipulation. The encoder inverts the target image into the diffusion latent space, capturing critical facial attributes such as lighting, expression, and texture while preserving contextual background information. For identity preservation, ArcFace is utilized to extract discriminative facial embeddings, ensuring accurate source identity transfer throughout the generation process. The face synthesis stage is powered by DiffFace, an Identity-Conditional DDPM, which performs diffusion-based face generation conditioned on the source identity and target attributes. Furthermore, the Stable Diffusion algorithm enhances the reconstruction quality, promoting smoother blending, fine-grained detail generation, and improved visual coherence. These modules form a robust and controllable face-swapping framework capable of producing photorealistic and identity-consistent results. This approach advances current face-swapping research by combining inversion, identity conditioning, and diffusion-based synthesis, offering strong potential for applications in digital filmmaking, virtual avatars, privacy protection, and creative media.

Keywords:

Face Swapping, Diffusion Models, Stable Diffusion, Denoising Diffusion Probabilistic Model (DDPM), DiffFace, ArcFace, Inversion-Based Attribute Encoder, Identity Preservation, Deep Learning, Latent Space Inversion, PyTorch, Generative Models.

A Smart Application Framework with Predictive Analytics and Logistics Optimization for Minimizing Urban Food Waste

Monika Tiwari

Student, Department of Computer Science Engineering, Chandigarh University Mohali, India

Monika Devi

Assistant Professor, Department of Computer Science Engineering, Chandigarh University Mohali, India

Suraj Raj

Student, Department of Computer Science Engineering, Chandigarh University Mohali, India

Poonam Malik

Student, Department of Computer Science Engineering, Chandigarh University Mohali, India

Abstract:

Urban food waste represents a significant economic, environmental, and social challenge, coexisting with widespread food insecurity. This paper introduces "FoodShare-Analytics," a comprehensive mobile and web application framework designed to mitigate this issue. The proposed system creates an integrated ecosystem connecting food donors, non-governmental organizations (NGOs), and volunteer couriers in real time. Its core innovations lie in the application of a hybrid machine learning model for predictive demand forecasting, enabling NGOs to transition from reactive to proactive operations, and the implementation of a dynamic route optimization engine based on Adaptive Large Neighborhood Search (ALNS) to manage last-mile logistics with high efficiency. By synergizing these components, the framework aims to significantly increase food rescue rates, improve the alignment of donations with recipient needs, and reduce the environmental footprint of food waste, thereby enhancing urban food security and sustainability.

Keywords:

Food Waste, Data Analytics, Predictive Modeling, Logistics Optimization, Mobile Application, Sustainable Technology, NGO, Food Security, Last-Mile Delivery, Vehicle Routing Problem.

Bio-Inspired Solar-Powered 3-D Printed Blended Wing UAV

Praveen

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidri, Karnataka, India

Sagar H

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidri, Karnataka, India

Vishnu prasad M G

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidri, Karnataka, India

Yashwith Nayak K

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidri, Karnataka, India

Vishwaretha K R

Department of Aeronautical Engineering, Mangalore Institute of Technology & Engineering, Moodbidri, Karnataka, India

Abstract:

This paper presents the design and development of a bio-inspired, solar-powered, 3D-printed blended wing unmanned aerial vehicle (UAV) to improve aerodynamic efficiency, structural performance, and flight endurance. Inspired by bird flight, the UAV uses a blended wing body (BWB) design, integrating the wing and fuselage to minimize drag, optimize lift, and increase internal space for payloads. Fabricated with lightweight PLA via 3D printing, it allows precise production of complex geometries and rapid prototyping. Solar panels on the upper wing surface harness renewable energy, extending flight duration. Bio-inspired features, including tapered wings, smooth surface transitions, and optimized sweep angles, enhance aerodynamic stability, while carefully selected internal infill patterns balance strength and weight. Ground testing and controlled flight trials validate performance and durability. This work highlights the potential of combining bio-mimicry, additive manufacturing, and solar energy to create efficient, sustainable UAV platforms for surveillance, environmental monitoring, and aerial data collection.

Keywords:

Biomimicry, Solar-Powered UAV, Blended Wing Body, 3D Printing, Additive Manufacturing.

Audio-Based Scream Voice Detection for Women's Safety: A Review

Kavita Dhananjay Jagtap

Department of Computer Engineering, Late G. N. Sapkal College of Engineering, India

Dr. N.R.Wankhede

Professor, Department of Computer Engineering, Late G. N. Sapkal College of Engineering, India

Abstract:

Women's safety remains a critical societal concern, with rising incidents of harassment and violence underscoring the need for rapid, unobtrusive emergency alert systems. Among various technologies, audio-based scream/voice detection has emerged as a promising approach for recognising distress signals and triggering automatic responses without requiring manual activation. This paper presents a comprehensive review of scream and distress-voice detection methods, ranging from classical signal-processing techniques such as MFCC and GMM/SVM classifiers to deep learning approaches including CNNs, RNNs, and hybrid architectures, as well as IoT-enabled mobile safety devices. We classify existing work by feature types, algorithms, and deployment settings; compare their reported performance; and visualise trends in accuracy and latency. From this synthesis, we identify key research gaps including small and non-diverse datasets, lack of noise robustness, privacy concerns, and limited explainability. To address these gaps, we propose a lightweight, hybrid CNN-RNN-IoT framework for real-time scream detection and emergency alerting on smartphones and wearables. This framework aims to combine the high accuracy of deep models with the practicality and privacy of on-device inference, thereby advancing robust and scalable safety solutions for women and vulnerable populations.

Keywords:

Women Safety, Scream Detection, Voice Recognition, Deep Learning, IoT, Emergency Alert.

Non-Fungible Tokens in the Blockchain Era: Ownership, Applications and Emerging Challenges

Avula Venkata Naga Venu

Department of Computer Science and Engineering, MRIIRS, Faridabad, India

Shobha Tyagi

Department of Computer Science and Engineering, MRIIRS, Faridabad, India

Gopi Raju Muvva

Department of Computer Science and Engineering, MRIIRS, Faridabad, India

Alladi Srikanth

Department of Computer Science and Engineering, MRIIRS, Faridabad, India

Aditya Jha

Department of Computer Science and Engineering, MRIIRS, Faridabad, India

Abstract:

Blockchain technology has revolutionized digital asset ownership through decentralized mechanisms for verifiable and transferable assets. A key innovation is the non-fungible token (NFT), which uniquely represents the ownership of digital content without relying on centralized authorities. This uniqueness and immutability, rooted in blockchain and Ethereum, has transformed industries such as art, gaming, fashion, and entertainment, with potential applications in education, intellectual property, and real estate. However, the rise of NFTs has raised significant concerns, including high energy consumption, security vulnerabilities, privacy issues, and complex legal ownership questions. Security is paramount because human factors such as phishing attacks, social engineering, and inadequate user education can lead to substantial losses in NFT transactions. Additionally, smart contract vulnerabilities can expose users to hacks and fraud, thereby undermining trust in the ecosystem. Although sustainability in energy consumption remains a challenge, advancements in blockchain scalability, such as a shift from proof-of-work to proof-of-stake mechanisms, offer hope. Despite these developments, the NFT market is unstable and plagued by pricing speculation, a lack of regulation, and fraud. This study analyzes the current NFT landscape, exploring technological advancements and their transformative impacts while addressing the challenges of mainstream adoption.

Keywords:

Blockchain, NFTs, Ethereum, Tokenization, Digital Assets.

Smart Meeting Minutes: Literature Review on Hybrid Summarization Systems for Online Meetings

Mrunmayi Pradeep Chavanke

Student, Computer Late G N Sapkal College of Engineering Kalyani Hills, Nashik

Dr. N R Wankhade

Student, Computer Late G N Sapkal College of Engineering Kalyani Hills, Nashik

Abstract:

The rapid growth of remote communication platforms such as Zoom, Google Meet, and Microsoft Teams has emphasized the need for efficient and automated methods of generating Minutes of Meeting (MoM). Manual preparation of MoM is time-consuming, inconsistent, and error-prone, especially in long or multi-speaker discussions. To overcome these challenges, researchers have proposed integrating speech processing, Natural Language Processing (NLP), and summarization techniques into automated systems. This literature review critically examines existing approaches, focusing on speaker diarization, Automatic Speech Recognition (ASR), and hybrid summarization frameworks. Studies highlight that ASR models like Whisper and speaker diarization methods such as YAMNet with UIS-RNN improve transcription accuracy and speaker identification. Furthermore, hybrid summarization, combining extractive and abstractive strategies, ensures both factual accuracy and readability. Despite these advancements, challenges such as overlapping speech, multilingual support, and real-time performance persist. This paper provides a comparative review of recent contributions, identifies research gaps, and outlines future directions for building robust, structure-aware systems capable of producing reliable and actionable MoM. The study concludes that hybrid frameworks, coupled with structure-aware post-processing, offer a promising path towards practical adoption in academia, corporate sectors, and government applications.

Low-Code Dashboard for Waste Management

Anuradha

Department of Computer Science and Engineering, Chandigarh University, India

Amisha

Department of Computer Science and Engineering, Chandigarh University, India

Ananya

Department of Computer Science and Engineering, Chandigarh University, India

Pranshul

Department of Computer Science and Engineering, Chandigarh University, India

Navneet

Department of Computer Science and Engineering, Chandigarh University, India

Abstract:

The management of trash needs to be effective in sustainable urban development. The study proposes a low-code, serverless Internet of Things (IoT) dashboard to track real-time garbage in municipalities and provide supporting decisions. The architecture will combine distributed IoT sensing, event-driven cloud services, and deep learning analytics to predict bin overflow, detect anomalies, and optimize collection routes. The data between smart bins and cars is delivered to a serverless backend using MQTT/LoRaWAN and processed on it and shown on a low-code dashboard. The results of the simulation using an LSTM-based fill-level prediction achieve a mean absolute percentage error (MAPE) of 2.1% to predict the expected 27% reduction in route distance and 25% drop in fuel consumption. To cities that require cheap smart-waste systems, the proposed solution has scalability, minimal maintenance, and accessibility.

Keywords:

Smart Waste Management, IoT, Serverless Architecture, Low-Code Dashboard, Deep Learning, Route Optimization.

Fraud Detection in Financial Transactions using Advance Analytical Techniques

Rama Devi Burri

Professor, Institute of Aeronautical Engineering, Telangana, India

Manishree Patlola

Institute of Aeronautical Engineering, Telangana, India

Srivalli Parveda

Institute of Aeronautical Engineering, Telangana, India

Varsha Emmadi

Institute of Aeronautical Engineering, Telangana, India

Abstract:

Transactions have surged due to rapid advancements in technology and e-commerce, leading to an increase in banking fraud and financial losses. Detecting fraudulent transactions requires addressing the problem of unbalanced data using class weight-tuning, optimized using Bayesian hyperparameter optimization. Enhancing model performance and fairness, this preprocessing step significantly improves results. Evaluation of two powerful gradient boosting models—XGBoost and LightGBM—relies on a majority voting ensemble learning strategy. Experimental findings from real-world datasets highlight strong performance, with ROC-AUC of 0.95, precision of 0.79, recall of 0.80, and F1-score of 0.79 were attained by LightGBM and XGBoost. Implementing deep learning for hyperparameter tuning further enhances outcomes, reaching a \ ROC-AUC of 0.94, recall of 0.82, and precision of 0.80 and F1-score of 0.81. Blockchain technology strengthens security by ensuring data integrity and secure transaction handling, making the system more robust and trustworthy.

Keywords:

Fraud Detection, Credit Card Transactions, Class Imbalance, XGBoost, LightGBM, Ensemble Learning, Bayesian Optimization, Blockchain Security, Precision, Recall, F1 Score.

Comparative Analysis of Seismic Behavior of Conventional and Retrofitted RC Buildings Using Response Spectrum Method

Prachi Yennawar

Post Graduate Student, Deogiri Institute of Engineering and Management Studies, Chh. Sambhajinagar, Maharashtra, India

Zubair Shaikh

Professor, Deogiri Institute of Engineering and Management Studies, Chh. Sambhajinagar, Maharashtra, India

Abstract:

Earthquakes rank among the most devastating natural hazards, often resulting in severe human casualties, economic losses, and structural collapses. Consequently, improving the seismic resilience of buildings, especially aged structures and high-rise or economically significant buildings has become a major engineering priority. Structures designed under outdated seismic codes frequently exhibit deficiencies in strength, ductility, and overall performance when compared with modern standards. To overcome these shortcomings, structural retrofitting techniques are implemented to enhance their seismic capacity.

Retrofitting improves the performance of existing buildings by increasing their load-bearing strength, stiffness, ductility, and global stability. In this research, a conventional reinforced concrete (RC) building with a G+25 configuration is analyzed and compared with its retrofitted version using ETABS software, employing the Dynamic Response Spectrum Analysis method. Critical seismic response parameters including base shear, storey drift, lateral displacement, and natural time period are evaluated to assess the enhancement in structural behaviour following Retrofitting.

Keywords:

Dynamic analysis, Retrofitting, Bracing, Storey drift, Story shear, Displacement, Time period.

Chatbots for Healthcare a Review of Technology, Adoption, and Impact

Shivani Sharma

Department of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Ritvik Jindal

Department of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Shivkant Yadav

Department of Computer Science & Engineering, Chandigarh University, Mohali, Punjab, India

Abstract:

Artificial intelligence (AI)-driven chatbots are increasingly shaping healthcare, education, and research by providing scalable, accessible, and interactive support. Their applications range from self-diagnosis and patient triage to mental health support, lifestyle management, and improving operational efficiency. This review synthesizes recent developments from 2019 to 2025, including case studies, scoping reviews, and technical deployments, to capture the breadth of chatbot adoption and design. Findings reveal that in healthcare, chatbots enhance patient self-management, improve triage accuracy, and deliver empathetic guidance in digital consultations. Technological progress has shifted chatbot design from rule-based approaches to advanced natural language processing and machine learning models, enabling more natural and context-aware interactions. Emerging evidence highlights the importance of patient engagement in development processes to improve usability, adherence, and acceptance. Despite rapid progress, challenges remain, including limited real-world adoption, ethical concerns, trust, and lack of standardized evaluation frameworks. This review offers a thematic synthesis and bibliometric perspective, identifying gaps and outlining future directions for effective, ethical, and interdisciplinary chatbot integration.

Keywords:

Artificial Intelligence, Chatbots, Digital Health, Healthcare Technology, Patient Engagement, Natural Language Processing, Mental Health Support, Chronic Disease Management, Telemedicine, Human-AI Collaboration.

Bacterial Foraging Optimization Based Improved Energy Efficient Routing Protocol for Wireless Sensor Network

Kirpal Singh Rajana

Electronics & Communication, NITTTR, Chandigarh

Dr. Kanika Sharma

Associate Professor, Electronics & Communication, NITTTR, Chandigarh

Dr. S.S.GILL

Professor, Electronics & Communication, NITTTR, Chandigarh

Abstract:

Energy conservation remains one of the most critical challenges in Wireless Sensor Networks (WSNs) due to the limited battery power available to sensor nodes. Conventional routing protocols often result in uneven energy utilization, thereby reducing the overall network lifetime. To address this issue, this paper introduces an Improved Bacterial Foraging Optimization Routing Protocol (I-BFORP) that employs a multi-parameter fitness function for intelligent neighbor selection during the routing process. The proposed approach optimizes four key factors: residual energy, traffic load balance, proximity to the sink node, and node connectivity. Through simulations conducted over 100 independent trials spanning 3000 communication rounds, the results show significant performance gains. The I-BFORP achieves the first node death at approximately round 2784, marking a 52% improvement over the standard BFORP protocol and a 322% improvement compared to PEGASIS. By integrating multi-criteria optimization, I-BFORP ensures a more balanced energy distribution across the network, effectively extending its operational lifetime while sustaining reliable data transmission.

Keywords:

Wireless Sensor Networks, Energy-Efficient Routing Protocol (EERP), Bacterial Foraging Optimization, Routing Protocol, Energy Efficiency, Cluster Head Selection, Network Lifetime.

A Novel Approach Based on Machine Learning, Blockchain, and Decision Process for Securing Smart Grid

Priyanka U Mandlik

Department of Computer Engineering, LGNSCOE, Nashik, Maharashtra, India

Dr. N.R.Wankhade

Department of Computer Engineering, LGNSCOE, Nashik, Maharashtra, India

Abstract:

The increased demands of electricity, increase in cost, and sustainable use of electricity have made it a critical issue to manage energy. This review looks at more recent developments of smart energy monitoring systems that combine IoT hardware with a Blockchain and Machine Learning, to enhance transparency, security, and efficiency in the use of electricity. IoT devices (microcontrollers, sensors) can be used to monitor the voltage, current, and energy consumption at the appliance level in real-time to provide fine-grained information on patterns of consumption. Data integrity and security are guaranteed by the use of Blockchain to ensure that the data is not tampered with and the record of energy use that is provided is trustworthy. At the same time, the Machine Learning models process the past records to forecast energy consumption patterns, discover inefficient machines, and calculate the monthly expenses on electricity. Through the combination of these technologies, smart energy systems can help increase awareness of the users, maximize energy consumption, and decrease costs of operation. This review brings out the possibilities of integrating IoT sensing, secure data storage and predictive analytics as a complete answer towards residential and industrial energy management. Moreover, it highlights the limitation, opportunities and research direction in coming up with secure, intelligent and scalable energy monitoring systems that can support sustainability and cost-effective use of electricity.

Keywords:

Smart Energy Monitoring, Internet of Things (IoT,) Blockchain Technology, Machine Learning, Energy Efficiency, Predictive Analytics.

Autonomous Fixed-Wing UAV System for Early Fire Detection And Surveillance Near Railway Infrastructure

Nandini Chitteti

Undergraduate Student, Institute of Aeronautical Engineering, Telangana, India

Neha kengerla

Undergraduate Student, Institute of Aeronautical Engineering, Telangana, India

Abstract:

Railway tracks located in remote and forest-covered regions face a high chance of fire outbreaks due to dry vegetation, climatic conditions, or accidental sparks. These fires can spread quickly and cause damage before human monitoring teams are able to notice them. To address this challenge, this work focuses on a fixed-wing UAV system that can automatically fly along railway routes and continuously monitor the surroundings for early signs of fire. The UAV carries a thermal camera for heat detection and uses GPS for accurate positioning. A Raspberry Pi processes the thermal data onboard and identifies unusual heat spots in real time. The Pixhawk flight controller provides stable autonomous navigation with minimal ground input. During field testing, the UAV maintained steady flight, covered long distances, and successfully detected heat sources with good accuracy. The location of detected hotspots was immediately sent to the ground station for action. The system shows strong potential for early fire detection and large-area surveillance across railway corridors, especially in regions where regular manual inspection is difficult.

Hybrid Hardware–AI Image Processing Framework Using Verilog–Based Sobel Edge Detection and YOLO Object Recognition

Hakkem B

Assistant Professor, Electronics and Communication Engineering, Hindusthan Institute of Technology,
Malumichampatti, Tamil Nadu, India

Yogesh S V

PG Student, Electronics and Communication Engineering, Hindusthan Institute of Technology,
Malumichampatti, Tamil Nadu, India

Abstract:

The images should be made efficient regarding processing and methods of image processing which rely on hardware and the resources possessed by the hardware of completing the process of processing the visual data in the right and verifiable way. The conventional software implementations are not deterministically timed, and often they are marked by latency. The paper will describe a hardware implementation of image processing system which applies the method of Sobel edge detection to Verilog HDL which is a behavioral model of the FPGA. The algorithm proposed will use the grayscale images, and after the workings on the pixel values and conversion to hexadecimal numbers, the 3x3 convolution filter will be used to get the horizontal and vertical gradient. The Waveform analysis (wave.vcd) of the size of the edges is done and verified to achieve proper timing and logic-level behavior. There is the generation of visualization and validation by the system output of edge maps (out.hex) and reconstructed images (Sobel.png). The hypothesis of the hypothesis that the hardware simulation is practical in localizing image boundaries and transitions at minimal computational cost is proven in the experimental analysis. This framework displays a good varying verifiable scalable way of edge detector algorithm execution and application in embedded image processing and digital hardware design environment.

Keywords:

Verilog HDL, Sobel Edge Detection, FPGA Simulation, Waveform Verification, Image Processing.

Focus Review on Abstraction-Based Text Summarization for Low-Resource Languages like Marathi Using Deep Learning Techniques

Tapesh Bharti

G H Raisonni University, Saikheda, Borgaon, Madhya Pradesh, India

Dr. Hansaraj Wankhede

G H Raisonni University, Saikheda, Borgaon, Madhya Pradesh, India

Abstract:

Low-resource languages such as Marathi suffer from limited high-quality datasets and fewer specialized models for abstractive summarization. This paper presents a comprehensive study on abstractive summarization for Marathi using transformer-based sequence-to-sequence models. We (1) detail the MahaSUM dataset (largest publicly released Marathi abstractive summarization corpus), (2) fine-tune and compare state-of-the-art models adapted for Indic languages (IndicBART, mBART, mT5, PEGASUS variants), and (3) analyze design choices (tokenization, script normalization, copy-mechanisms) that matter for low-resource settings. We report and discuss published baselines where available, propose a reproducible experimental setup for fresh runs, and present qualitative error analysis highlighting common failure modes. Our experiments show that language-aware pretraining (IndicBART) achieves better content preservation on MahaSUM than generic multilingual models; further improvements come from data curation and copy-aware architectures. [1][2][3].

Keywords:

Abstractive summarization, Marathi, Indic languages, IndicBART, mBART, mT5, MahaSUM, XL-Sum, ROUGE, low-resource NLP.

Neural Real-Time Voice Conversion System Using Speaker Embedding

Priyanka Vijay Sangale

Department of Computer Engineering, KCT's Late G.N.Sapkal College of Engineering, Nashik, India

Dr. N. R. Wankhade

Professor, Department of Computer Engineering, KCT's Late G.N.Sapkal College of Engineering, Nashik, India

Abstract:

Voice conversion (VC) seeks to modify the speaker identity of a given utterance while preserving its linguistic content. Over the past decade, VC has evolved from parallel-data statistical mapping methods to modern neural frameworks capable of any-to-any, real-time speech transformation. This paper presents a comprehensive review of recent advances in neural VC with an emphasis on four core components: (i) content representation using phonetic posteriorgrams, self-supervised units, and automatic speech recognition (ASR) features; (ii) speaker modeling through fixed embeddings, transfer learning, and multi-layer adaptation; (iii) decoders and vocoders ranging from parametric to lightweight neural generators such as SEANet and LPCNet; and (iv) unified any-to-any architectures that combine these elements for real-time deployment.

We analyse representative systems such as NeuralVC, A2A VC, and AR+ LPCNet, comparing their mean opinion scores (MOS), latency, and training setups. Our comparative analysis highlights a clear trend toward end-to-end pipelines that leverage self-supervised content units, compact speaker encoders, and efficient decoders to balance fidelity and computational efficiency. Despite this progress, several challenges remain, including cross-lingual and code-switched conversion, robustness to noisy conditions, expressive prosody transfer beyond average pitch, and deployment on low-resource or embedded devices. By consolidating recent trends, identifying open problems, and outlining promising future directions, this survey provides a timely roadmap for researchers and practitioners working on the next generation of controllable, multilingual, and real-time VC systems.

Keywords:

Voice Conversion, Any-to-Any VC, Neural Networks, Real-Time Speech Synthesis, Speaker Embeddings.

A Deep Learning Framework for Early Detection of Diabetes and Hypertension Using Biometric Time-Series Data

Vinayagam S

Department of Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

D. Vidhya

Assistant Professor, Department of Computer Science and Engineering, Hindusthan Institute of Technology, Kelambakkam, Tamil Nadu, India

Abstract:

Diabetes and high blood pressure are two of the most common chronic illnesses that cause death worldwide. Early detection and ongoing monitoring are key to effective illness management and the avoidance of consequences. In this study, we offer a deep learning system for early identification of diabetes and hypertension using biometric time-series data. Long Short-Term Memory (LSTM) networks are used to record temporal dependencies and patterns of advancement in physiological indicators, including heart rate, blood pressure, glucose levels, and other vital signs. It leveraging the "Chronic Disease Progression Tracker Dataset" from Kaggle, which includes longitudinal health metrics of patients with chronic conditions. The primary goal of this work is developing a predictive model it will reliable and accurate to identify early stage of warning signs of these chronic conditions. LSTM has the capacity to maintain long-term dependencies and handle sequential data it is need in medical time-series analysis. Our model uses metrics including precision, accuracy, recall, and F1-score to recognize early-stage prediction. This research goal is to assist medical professional's patient outcomes and reduce healthcare costs through preventive care by suggesting AI-assisted tools for immediate action.

Keywords:

LSTM, diabetes, hypertension, early detection, biometric time-series, deep learning, healthcare AI.

Advancing Structural Health Monitoring through YOLO-Based Deep Learning for Bridge Crack Identification

Prasaath V R

PG Scholar, Department of Computer Science Engineering, Hindustan Institute of Technology, Kelambakkam, Tamil Nadu, India

D. Vidhya

Assistant Professor, Department of Computer Science Engineering, Hindustan Institute of Technology, Kelambakkam, Tamil Nadu, India

Abstract:

This being the case, the monitoring of structural health or SHM plays an important role in the preservation of structures like bridges, which should ensure viability, reliability, and security. The traditionally followed methods of inspection were largely manual, tedious, and prone to human errors, thus delaying the recognition of early signs of structural decay. With rapid advancement in artificial intelligence, deep-learning-based object detection models, above all, the You Only Look Once (YOLO) series have emerged as highly recommended candidates for automatic crack detection. The study compared such models for highway bridge crack detection among YOLOv5, YOLOv7, and YOLOv8. The robustness and generality of the model were enhanced by preparing a large dataset with bridge surface images with added augmentations of other images. Performance metrics used for analysing and comparing the models in terms of precision, recall, mAP, and inference speed were used. Experimental results are presented that reveal the highest average mAP of 96.3 and detection speed of 45 FPS for the YOLOv8 model compared with all others. This model is highly capable of detecting even the tiniest crack in changing surface and daylight conditions. The end result, therefore, leads to a landmark achievement with regard to the application of YOLO deep learning techniques toward real-time systems, with very accurate and efficient automated bridge crack detection that will enhance operability in SHM systems and preventive maintenance programs for safer infrastructure management.

Keywords:

Structural Health Monitoring, Bridge Crack Detection, YOLO, Deep Learning, Object Detection, Infrastructure Safety.

Generative AI-Based Flight Price Prediction Platform

M.A. Kumar

AIT-AIML, Chandigarh University, Mohali, India

Teppala Niraj

AIT-AIML, Chandigarh University, Mohali, India

Mutharam Manideep

AIT-AIML, Chandigarh University, Mohali, India

Shriramdasu Abhiram

AIT-AIML, Chandigarh University, Mohali, India

Dadireddy Nithineshwar Reddy

AIT-AIML, Chandigarh University, Mohali, India

Abstract:

The ever-changing airline pricing models are a major headache for both travelers and service providers who want to make the best decisions regarding the ticket prices. This study introduces a Generative AI-based web platform for real-time flight price forecasting, which combines cutting-edge deep learning architectures and Generative Adversarial Networks (GANs) to simulate complex and nonlinear pricing trends. The system uses data pre processing, feature engineering, and historical airfare datasets to understand time changes and other factors influencing the prices of airfares such as seasonality, demand, and route popularity. The platform is designed as a web-based interface, thus enabling users to get accurate, continuously updated predictions of airfares along with visual analytics. Performance evaluation through experiments indicates that the forecasting accuracy and the system's ability to generalize are better than those of the traditional regression and ensemble models. This work is a step forward in the use of AI for financial prediction, as it demonstrates the potential of generative learning in the estimation of airfare prices.

Keywords:

Generative AI, Deep Learning, Flight Price Prediction, Web-Based Platform, Airfare Forecasting, GANs, Machine Learning, Data Mining, Time-Series Analysis.

Recommending Agricultural Crops Based on Productivity and Seasonal Data Using ML

Sneha. M

PG Student

Pavithra. J

Assistant Professor

Abstract:

The proposed project is called Recommending Agricultural Crops Based on Productivity and Seasonal Data Using Machine Learning, which aims to give intelligent crop advice to farmers, designating the soil type and environmental conditions. In farming, the issue of choosing an appropriate crop is critical in enhancing crop output and a viable farming enterprise. The front-end technologies that are used in the development of this system are HTML, CSS, and JavaScript, whereas the back-end is developed with the help of Python. It uses a Decision Tree algorithm to manipulate all important parameters, including Nitrogen (N), Phosphorus (P), Potassium (K), humidity, pH, and rainfall. According to these types of inputs, the model anticipates the most appropriate crops to grow in particular environmental situations. Machine learning method acquires patterns of past agricultural data to provide valid and correct recommendations. The suggested system will enable farmers to make sound decisions, manage resources, and minimize the chances of crop failure. In addition, it promotes sustainable farming methods through combining technology with conventional farming experience. The interface is user-friendly, hence making it easily accessible to farmers in other regions. All in all, this ML-based solution can help to increase productivity, ensure effective land utilization, and help to create intelligent and sustainable farming systems using data-driven understanding.

Keywords:

Agriculture, Crop Recommendation, Machine Learning, Decision Tree, Soil Analysis, Environmental Factors, Productivity, Sustainability, Data-Driven Farming, Smart Agriculture.

Design and Performance Evaluation of Al 7075 and Aramid-Fiber Reinforced Composite in Aerospace Applications with Sandpaper-Induced Surface Roughness

Shrusti Patil

Department of Aeronautical Engineering, Mangalore Institute of Technology and Engineering, Moodabidri, Karnataka, India

Nidha Rahma

Department of Aeronautical Engineering, Mangalore Institute of Technology and Engineering, Moodabidri, Karnataka, India

Shrujan Anand

Department of Aeronautical Engineering, Mangalore Institute of Technology and Engineering, Moodabidri, Karnataka, India

Ramya K G

Department of Aeronautical Engineering, Mangalore Institute of Technology and Engineering, Moodabidri, Karnataka, India

Sujesh Kumar

Department of Aeronautical Engineering, Mangalore Institute of Technology and Engineering, Moodabidri, Karnataka, India

Abstract:

This study examines the design and mechanical performance of five-ply Fiber Metal Laminates (FMLs) comprising Aluminum 7075 and Kevlar fiber, fabricated via the vacuum bagging technique. Eight surface preparation methods Plain Sanding, Rolling, Mechanical Abrasion, and Grinding (Grades 100/120) were evaluated for their influence on laminate properties. Surface analysis confirmed that Rolling and Grinding treatments produced optimal roughness for improved mechanical interlocking. Among all variants, the R2 (High-Intensity Rolling) sample exhibited the highest tensile, compressive, and flexural strengths. Post-failure analysis revealed cohesive fracture behaviour, indicating strong interfacial bonding. The findings validate controlled mechanical surface modification as an effective approach to enhance the structural integrity of aerospace-grade composites.

Keywords:

Aluminum 7075, Kevlar (Aramid) fiber, surface roughness, mechanical texturing, Fiber Metal Laminates (FML), Interfacial adhesion.

Development of Framework for Finding Missing Individual using Machine Learning

Aadi Yadav

Undergraduate Students, Department of Computer Science and Engineering, Netaji Subhas University of Technology, Delhi, India

Arpita Arora

Undergraduate Students, Department of Computer Science and Engineering, Netaji Subhas University of Technology, Delhi, India

Aarav Jain

Undergraduate Students, Department of Computer Science and Engineering, Netaji Subhas University of Technology, Delhi, India

Abstract:

Time is the most important factor in the global missing persons crisis because the likelihood of a successful recovery decreases drastically in the first 24 to 48 hours. Given the size and urgency of the issue, traditional investigation techniques which primarily rely on the manual review of enormous volumes of visual evidence from sources like CCTV footage and public tips—are essentially insufficient. These procedures are slow by nature, prone to human error and fatigue, and result in major operational bottlenecks that put a burden on law enforcement resources and prolong the suffering of families. This research directly addresses this urgent need by developing an integrated, machine learning-driven pipeline for the automated detection and identification of missing persons. The proposed model is not merely a simple facial recognition tool, but rather a unified multi-algorithmic framework that functions as a full detection system. First, a thorough facial analysis is carried out using MediaPipe Face Mesh, which is capable of recognizing 468 3D facial landmarks in real-time. In order to abstract a face from a raw pixel array into a structured, geometric representation, it must be able to withstand real-world variations in pose, illumination, and image quality. The core of our system employs a hybrid feature extraction strategy, where geometric data from facial landmarks is processed by a custom, lightweight Convolutional Neural Network (CNN). This design enables the learning of highly discriminative features from landmark spatial relationships, generating compact, high-fidelity embedding vectors that uniquely represent an individual's facial geometry. This approach ensures high accuracy while maintaining the computational efficiency required for resource-constrained environments. For identification, a K-Nearest Neighbours (KNN)-based matching engine indexes all registered embeddings into a searchable feature space. Upon processing a new query, the algorithm performs a high-speed similarity search. A

dynamically calibrated distance threshold validates potential matches, ensuring high confidence and minimizing false positives. A reliable and scalable identification workflow is produced by the combination of landmark detection, deep feature extraction, and effective similarity search. This work offers a powerful tool to support community and law enforcement efforts by converting a traditional search procedure into an automated and data-driven procedure. It seeks to expedite the crucial task of locating missing persons, decrease investigation times, and increase success rates.

Personalized Candidate Evaluation Using GPT-Based Virtual Interview Simulation

Vijayasree M

Karpagam College of Engineering, Othakkal Mandapam, Tamil Nadu, India

Priyanka S

Karpagam College of Engineering, Othakkal Mandapam, Tamil Nadu, India

Nivedha R

Karpagam College of Engineering, Othakkal Mandapam, Tamil Nadu, India

Kavipriya M

Karpagam College of Engineering, Othakkal Mandapam, Tamil Nadu, India

Abstract:

It is a common practice that evaluating candidates during recruitment, education, and certification is time consuming, subjective and can be inconsistent. The paper introduces a new simulator of virtual interviews based on AI and relying on the feature of GPT-4 to operate under natural language processing to facilitate a more effective evaluation of candidates. This site uploaded resumes in PDF format which the site will automatically process to extract pertinent skills, qualifications and experience to provide personalized interview questions based on the received resume. Dynamic questioning is responsive, and changes depending on the responses of the candidates, but offers a thorough assessment without losing interest. The system is able to use facial recognition to check the identity and create an immediate alert in case of suspicious behavior to avoid impersonation and guarantee security and authenticity. The feedback mechanism uses AI to provide insights to both recruiters and candidates in a more personalized way leading to better decision-making and better candidate experience. The experimental simulations show that the proposed system is able to cut down the amount of manpower used in evaluation significantly and enhance the reliability and consistency of evaluation. The platform is scalable, secure, and can be used in the recruitment, educational assessment, and professional certification settings. The proposed solution will be a disruptive change in the direction of smarter, interactive, and reliable candidate data analysis by integrating automated resume analysis, adaptive questioning, and biometric verification.

Design and Implementation of Reversible Quantum Multiplexer and De-Multiplexer Using IBM Quantum Composer

Vasudeva Bevara

Student ECE, GMR Institute of Technology, Andhra Pradesh, India

Bongu Tanusri

Student ECE, GMR Institute of Technology, Andhra Pradesh, India

Datti SriBhargavi

Student ECE, GMR Institute of Technology, Andhra Pradesh, India

Vuppala Tejaswi

Student ECE, GMR Institute of Technology, Andhra Pradesh, India

Veturi vaishnavi

Student ECE, GMR Institute of Technology, Andhra Pradesh, India

Kshatri Surya pavan singh

Student ECE, GMR Institute of Technology, Andhra Pradesh, India

Abstract:

The rapidly evolving CMOS technology has now reached its limits ,prompting the semiconductor industry to actively explore alternatives beyond CMOS technology .It faces challenges such as high power dissipation ,current leakage and thermal instability at nanoscale level .This enabled researchers to extend their view in quantum computing .Reversible logic circuits and reversible computing are major building blocks of quantum computing .It emerges as one of the promising alternative for the CMOS technology . It offers fundamentally different ways of processing information by using superposition ,entanglement and reversibility to achieve computations that are both powerful and energy efficient . This work focusses on designing and implementing Quantum Multiplexer(QM) and Quantum Multiplexer ana De-Multiplexer(QMD) using IBM quantum composer .These circuits explain how the traditional logic circuits are adopted to new quantum frameworks. Unlike CMOS quantum circuits helps to conserve information reducing energy loss and is a platform to scalable and efficient circuits .And also quantum technology paves a route in shaping the next generation in computing technologies. The circuit is designed and implemented in IBM quantum composer environment.

Keywords:

IBM quantum composer, Reversible logic, Reversible MUX, Reversible De-MUX, Quantum computing.

Lung Cancer Prediction Using Machine Learning Based on Health Parameters

Shanmathi Shanmuganathan

Senior Assistant Professor, Electronics and Communication Engineering, GMR Institute of Technology, Andhra Pradesh, India

Domana Krupavaram

Senior Assistant Professor, Electronics and Communication Engineering, GMR Institute of Technology, Andhra Pradesh, India

Abstract:

Lung cancer continues to be one of the most common causes of cancer mortality worldwide, mainly because of late detection and treatment. With early detection, treatment outcomes and survival can be significantly improved. As Artificial Intelligence (AI) and Machine Learning (ML) have matured, predictive models have developed as useful tools for assessing lung cancer risk. By assessing patient characteristics such as age, smoking history, lifestyle factors, anxiety, and genetic factors, these models can potentially group patients into risk cohorts. This can facilitate early diagnosis, prevention, and personalized therapy. This research evaluates several ML algorithms such as Logistic Regression, K-Nearest Neighbor, Random Forest Add Boost, Passive Aggressive, Multi-Layer Perceptron, Naive bayes, and other ensemble techniques as risk prediction tools for lung cancer.

Towards Intelligent Hematology: YOLOv5-Based Automated Blood Cell Detection

Ashwini Gorakh Gaikwad

Department of Computer Engineering, Late G. N. SAPKAL College of Engineering, Nashik, India

Dr. N.R. Wankhade

Department of Computer Engineering, Late G. N. SAPKAL College of Engineering, Nashik, India

Abstract:

The detection and classification of blood cells are critical components of hematological analysis and disease diagnosis. Manual microscopic examination is laborious, subjective, and prone to human error, while traditional image processing lacks robustness under varying stain conditions. With advancements in computer vision, deep learning models like the YOLO family have shown promising results for real-time biomedical detection. This review paper surveys recent literature in automated blood cell detection, emphasizing architectures derived from YOLOv5s and its variants incorporating Transformer encoders, BiFPN, and CBAM modules. Comparative analysis of earlier methods—including classical segmentation, two-stage CNN detectors, and lightweight one-stage YOLO frameworks—is discussed. The study concludes that the YOLOv5s-TRBC (Transformer-BiFPN-CBAM-EIoU) variant provides an optimal balance between speed, accuracy, and clinical feasibility, achieving $mAP@0.5 \approx 93.5\%$ on benchmark datasets.

Keywords:

YOLOv5s, Blood Cell Detection, Deep Learning, Biomedical Image Analysis, Transformer, BiFPN, CBAM, EIoU, RBC/WBC/Platelet Classification.

Intelligent Image Analysis for Automated Detection and Classification of Diabetic Retinopathy

Inakshi Garg

Department of Computer Engineering, Chandigarh University, Mohali, India

Harsh Raj Choudhary

Department of Computer Engineering, Chandigarh University, Mohali, India

Nitish Kumar

Department of Computer Engineering, Chandigarh University, Mohali, India

Jasleen Kaur Sohali

Department of Computer Engineering, Chandigarh University, Mohali, India

Harika Gokaraju

Department of Computer Engineering, Chandigarh University, Mohali, India

Jayanth

Department of Computer Engineering, Chandigarh University, Mohali, India

Abstract:

Diabetic retinopathy (DR) is a major cause of visual impairment and blindness in diabetic patients globally. Early recognition and correct diagnosis are needed to prevent the progression of DR. The research reported in this paper offers an automated detection and classification approach to DR using a combination of deep learning techniques and a deeper analysis based on image analysis techniques of retinal fundus images. In this project, CNNs (convolutional neural networks) are embedded into the analysis to extract important features and classify images of retinas having different stages of the severity of DR. Image preprocessing methods (i.e. contrast enhancement and noise reduction) were applied to enhance the performance of the model. The high accuracy, sensitivity, and specificity of this system make it a dependable automated screening model for detecting DR and potentially making quicker diagnoses. The implications suggest that it is possible to integrate deep-learning-based automated systems into clinical practice to the advantage of ophthalmologists while also requiring less diagnostic capacity.

Keywords:

Diabetic Retinopathy, Deep Learning, Convolutional Neural Networks, Retinal Image Analysis, Automated Detection, Fundus Imaging, Medical Image Processing.

Blockchain Tool for Secure and Transparent Partnership Agreements

Shreya

Department of Computer Engineering, Chandigarh University, Gharuan, Punjab, India

Karampreet Kaur Sodhi

Department of Computer Engineering, Chandigarh University, Gharuan, Punjab, India

Shubhanker Singh

Department of Computer Engineering, Chandigarh University, Gharuan, Punjab, India

Sandeep Kaur

Department of Computer Engineering, Chandigarh University, Gharuan, Punjab, India

Abstract:

Organizations increasingly engage in cross-border and cross-industry collaboration contracts in the contemporary era of globalization to facilitate innovation, resource sharing, and common objective realization. Traditional systems for drafting, managing, and verifying these agreements are typically centralized and paper-based, making them susceptible to manipulation, document forgery, delayed verification, and lack of transparency. These limitations create significant trust gaps among stakeholders, particularly in international partnerships with diverse legal and regulatory frameworks. This research presents a blockchain-supported tool for secure and transparent partnership agreements that employs a decentralized approach using smart contracts and distributed ledger technology (DLT) to guarantee contract immutability, authenticity, and verifiability. The tool automatically prepares, verifies, and records digital partnership contracts via Ethereum smart contracts while storing document metadata in IPFS (InterPlanetary File System) for tamper-proof referencing. The system minimizes administrative costs, legal controversies, and operational delays by incorporating SHA-256 hashing for data integrity and Proof-of-Stake (PoS) consensus mechanisms. Performance evaluations demonstrate the tool's ability to handle and authenticate up to 1000 partnership agreements with minimal latency of 114.4ms and virtually negligible data spoilage risks. This innovation establishes a stable, auditable, and trust-inspiring operating system for secure international collaborations, paving the way for blockchain-driven LegalTech 4.0.

Keywords:

Smart Contracts, Distributed Ledger, Partnership Agreements, Transparency, Legal Technologies, Data Integrity, IPFS, Ethereum, Blockchain Technology.

