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2ⁿᵈ International Conference on
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ICSET-2022

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ICSET- 2022

2nd International Conference on

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Singapore
28th– 29th January, 2022

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Editorial:

We cordially invite you to attend the **2nd International Conference on Science, Engineering & Technology (ICSET-22)** on **28th–29th January, 2022.**The main objective of **ICSET-22** is to provide a platform for researchers, students, academicians as well as industrial professionals from all over the world to present their research results and development activities in Multidisciplinary studies. This conference will provide opportunities for the delegates to exchange new ideas and experience face to face, to establish business or research relationship and to find global partners for future collaboration.

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

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

Since November 2021, the Organizing Committees have received more than 80 manuscript papers, and the papers cover all the aspects in Multidisciplinary skills. Finally, after review, about 22 papers were included to the proceedings of **ICSET-22**.

We would like to extend our appreciation to all participants in the conference for their great contribution to the success of **ICSET-22** We would like to thank the keynote and individual speakers and all participating authors for their hard work and time. We also sincerely appreciate the work by the technical program committee and all reviewers, whose contributions made this conference possible. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard work.

Acknowledgement

IFERP is hosting the **2nd International Conference on Science, Engineering & Technology - 2022** this year in the month of January. The main objective of **Science, Engineering & Technology** is to grant the amazing opportunity to learn about ground breaking 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 session will 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 be known as a thoughtful leader.

I express my gratitude to all my colleagues, staffs, professors, reviewers and members of organizing committee for their hearty and dedicated support to make this conference successful.

Rudra Bhanu Satpathy
Chief Executive Officer
Institute for Engineering Research and Publication (IFERP)

2nd International Conference on

Science, Engineering & Technology

(ICSET- 2022)

Singapore

28th – 29th January, 2022

Keynote Speakers

Prof. Dr. M. Amr Sadik

Chairman & Chief Executive Officer at Quodrat
Adjunct Professor & DBA Program Director, IPE Management
School,
France

Message

Dear colleagues, professors, lecturers, researchers, ladies and gentlemen.

On behalf of the organizers, I am honored and delighted to welcome all of you in this 2nd International Conference on Science, Engineering, and Technology.

The global pandemic has accelerated the advancement of technologies, in particular AI, this is new era we have entered, and it became the emerging trends of challenges for all of us, for Engineering Professionals, Scientists as well as Researchers and Academics.

It is my hope that this conference would be able to achieve its objective in providing an effective forum for academician, researchers, and practitioners to advancing knowledge, research, and technology for humanity.

Therefore, the focal drive of this conference is to exchange ideas, and by participating in this exchange, it is hoped that all parties who may benefit from the conference can apply it in managing activities in their areas.

It is pleasing to note that the agenda of this conference covers a wide range of interesting topics related to all theoretical and practical aspects.

On behalf of all, I welcome you and wish you a successful conference.

Mr. Deepak Shripat Mane

Senior Data Scientist/Enterprise Solution Architect
Tata Consultancy Services,
Australia

Message

Dear Professors/Researchers/Participants

It was great opportunity to participate as a keynote speaker in ICSET-2022 which will be held on 28th - 29th January 2022 at Singapore. This conference is providing unique platform for all researchers/professors to present research papers in this conference. I will give talk on Machine learning apporaches to detect cyber war and terrorisms

It was 4th time , i am participating as a keynote speaker which organizes by IFERP

Regards
Deepak

Prof. Ram Ramanathan
Professor
Essex Business School, Southend Campus, University of Essex,
United Kingdom

Message

"I look forward to speaking at the ICSET conference – 2022 to showcase the science, engineering an technological aspects related to food waste reduction. Food waste is a serious global problem. The twelfth sustainable development goal titled "responsible consumption and production", is closely linked to reduction of food waste by propelling policies to achieve responsible consumption and production patterns. In 2016, 13.8 % of food was wasted across supply chains globally, while the European and North American regions accounted for 15.7 % wastage across food supply chains. Food waste has economic, social and environmental implications. In line with these concerns, the REAMIT project aims to reduce the fresh food wastage across North West Europe by at least 10% with the use of IoT sensors, big data analytics and AI."

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2nd International Conference on
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PAPERS

A Framework to Operationalize Human Performance Learning and Improvement

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Abstract

Learn and improve human performance is crucial to managing the complexity of work-as-done. The success of an organization in operationalizing the human performance principles depends on the organization's ways that empower the frontline workers to learn and improve. Thus, establishing a human performance learning and improvement framework is essential to achieve a high-reliability organization vision and build a learn and improve culture. This paper explores the plan–do–check–act cycle to integrate operational learning steps and put human performance principles as the framework's foundation. We also provide maturity indicators as the checkpoint to deploy human performance learning and improvement. A focus group discussion was conducted to enhance the proposed maturity indicators by involving human performance improvement and operational learning subject matter experts from one of Indonesia's largest oil producers. Therefore, the outcome of this study can extend the academic and practical discussion.

Keywords

Human performance, operational learning, framework.

I. INTRODUCTION

Nowadays, the industrial safety approach has been shifting from reinforcing rules and compliance to ensuring safeguards/barriers and building individual capacity to fail safely [1], [2]. The concept of human performance improvement is recognized by the high-risk industries such as aviation, oil and gas, mining, transportation, and nuclear as one of the best practices to achieve high-reliability organization [3]–[8]. Human performance is closely related to understanding and preventing human mistake's interacting with an individual, process, system, and organizational culture [7], [9]. While operational learning is related to understanding, work gets done using operational knowledge to build a continuous improvement culture towards a high-reliability organization [10]–[12].

Furthermore, integrating human performance aspects into operational learning implementation creates synergy between the two domains. The goal includes strengthening safeguards/barriers through the implementation of continuous learning activities performed by front-liners. Previous works describe in various ways to operationalize the human performance aspects and operational learning. They propose the integration of human and organizational performance into operations [13], the deployment of human performance solely [14], [15], the implementation of human performance into major capital projects [16], and the use of a continuous improvement approach to operationalize learning teams [17]. However, those works did not clearly outline what should be deployed first, whether human performance or operational learning, the maturity indicators of the implementation, and how to streamline from the strategic to tactical activities towards strengthening safeguard and building learning culture.

This paper discusses how a deployment framework of human performance improvement and operational learning is established. We explore a plan–do–check–act cycle to integrate operational learning steps into a strategic framework of human performance deployment. We study the literature and conduct a focus group discussion involving experts from human performance and operational learning in one of the largest Indonesian oil and gas producers to define the maturity indicators. Finally, the framework can be used as a reference to the company or organization adopting human performance improvement and operational learning through a streamlined approach.

II. METHODS

A. Literature Review

Conceptually, human performance conveys the importance of having trust within an organization and discouraging the blame approach to building more worker's accountability [1], [18], [19]. Being more accountable can be defined as becoming more ownership of the work [18]. Each individual must trigger it without much reinforcement from the leaders to sustain the effect of accountability [20]. Therefore, strong encouragement is expected by the leader to learn from failure and success towards creating a learning climate [21], [22]. The operationalization of human performance concepts requires understanding the philosophy about human fallibility and familiarization with the tools designated for individuals, teams, and organizations to prevent human error [3], [21], [23].

The concept of operational learning emphasizes an evergreen process to learn from everyday works involving the workers [24]. Operational learning can be done proactively before a failure happens or reactively beyond an event that occurs. Operational learning is aimed to understand what the actual work looks like and enable the safeguards to prevent the event occurring towards creating safety resilience [11], [25]–[27]. The process supports some theories such as safety-I/safety-II [28]–[30] and safety differently [31]–[33]. Learning teams are considered an operational learning tool consisting of two main steps: learning and improving the process [10], [17]. Typically the process requires facilitators from safety professionals and is led by the operational leaders [17], [34].

The interplay between human performance and operational learning is powerful. Human performance principles support the operational learning implementation [1], [3], [35]. If the workers better understand human performance principles, they can enhance their operational learning quality [36]–[38]. Meanwhile, leaders who are fluent in human performance principles can create a conducive climate for the workers to learn without being blamed [18]. Learning teams is considered able to operationalize human performance principles [10], [11], [17]. However, storytelling in the learning team creates personal bias [39], [40]. Therefore, it can be combined with a Gemba walk (site tour) to reduce the bias [41]–[43]. Furthermore, an implementation framework can help the organization effectively implement operational learning and human performance simultaneously [13]. There were some insights about building a continuous improvement culture through the framework, including plan–do–check–act [17], [44].

B. Focus Group Discussion

A single focus group discussion was conducted involving the five subject matter experts of human performance and operational learning practitioners from one of Indonesia's largest oil producers [45]. Those subject matter experts are safety professionals serving the company as one human performance champion, one operational learning coordinator, two learning team mentors, and one learning team facilitator. The focus group discussion aims to get insight and lessons from the implementation to develop implementation framework and maturity indicators.

Two main questions are discussed in a 3 hours workshop session: (1) What are the critical success factors in implementing human performance improvement and operational learning? (2) What are the critical leader's behaviors to strengthen a learning culture? We summarize the result of the focus group discussion in Table I.

TABLE I.   Result of Focus Group Discussion

Questions	Results
What are the critical success factors in implementing human performance	1. *Strong leadership support with clear direction.* It can be achieved through leadership engagement, discussion, and dialogue. 2. *Set the condition for learning.* It
improvement and operational learning?	includes how to shift a leader's reaction and language with the failures. 3. *Develop robust organizational capability.* The processes can be through continuous training, mentoring, and coaching. 4. *Select and prioritize high-value topics to operationalize human performance learn to learn.* This includes directing the organization to implement operational learning focus on complex/nonlinear issues, applicable across the organization, or repetitive problems. 5. *Apply operational learning proactively and reactively.* The integration into existing process improvement and investigation tools can enhance existing processes towards creating multiple effects to learn and improve, 6. *Never forcing or targeting the organization to learn.* Always check the pre-condition/readiness for learning from a leadership and resources point of view. 7. *Leaders continuously message* the team about the importance of learning. They have to support operational learning activities. 8. *Focus on strengthening the safeguards.* The high curiosity of the workforces with the new approach can create a trap with less focus on safeguards. When doing operational learning, leaders and facilitators should emphasize the team focus with the safeguard learnings.
What are the critical leader's behaviors to strengthen a learning culture?	1. Visible commitment to learn and improve. 2. Convey human performance in daily work conversation. 3. Positive reaction to mistakes/errors/failures. 4. Be a solid supporter for the team for learning more. 5. Be a more active listener rather than a commander. 6. Invest time to create trust with the team. 7. Prioritize learning to understand the problem rather than fixing

Questions	Results
	the problem.
	8. Be a barrier removal to the team who are willing to learn.
	9. Never overtaking the learning process and result.
	10. Ask – what supports that I can do for my team to learn and improve the safeguards.

The literature study and focus group discussion provide insights and references to develop an integrated implementation framework, including how a deployment of human performance and operational learning can be streamlined. The next chapter discusses a framework aligned with the organization's vision, objective, maturity stages, improvement actions, and operational learning steps that focus on the safeguards.

III. DEVELOPING FRAMEWORK

The proposed integration framework is achieved as a strategic objective in a management system cycle of plan–do–check–act. While the maturity stage improvement actions are considered tactical actions to understand when the plan is required to deploy the human performance learning and improvement. Figure 1 presents a house of human performance learning and improvement implementation framework for an organization. The framework describes strategic and tactical actions to build, learn and improve culture to achieve high-reliability organization as the top of safety culture stages to ensuring safeguards/barriers and building individual capacity to fail safely [46], [47]. Human performance is a critical concept and the foundation for the organization to understand before implementing operational learning. Understanding human performance principles can set the condition for learning. When a learning environment has existed, the organization can start to learn using operational learning.

House of human performance learning and improvement. The assimilation of enhanced operational learning steps with Gemba walk (site tour) into a plan – do – check – act framework is presented in Table II. The integration process uses theory synthesis by summarizing the step and integrating the nature of the operational learning steps to categorize them into a plan–do–check–act cycle [48].

TABLE II.   Integration of Operational Learning into Plan–Do–Check–Act Cycle

Operational Learning Steps	Plan – Do – Check – Act
Prepare [10], [11], [13], [17] - Identify topics and define scope. - Determine resources (sponsor, facilitator, and member).	Plan
Learn [10], [11], [13], [17] - Kick off the session. - Focus on learning how the work gets done. - Identify error trap, weak signal, and latent condition. - Determine critical points and plan to learn more in-depth during the site tour.	Do
Soak [10], [11], [13], [17] - Take time for deeper reflection. - Identify if any information that is essential to be shared in the next step.	Do
Gemba (Site Tour) [41], [49], [50] - Get the deeper context. - Observe the "shop-floor".	Do
Define and Improve [10], [11], [13], [17] - Evaluate the safeguards (in-place, missing, broken). - Brainstorm the proposed solutions - Categorize improvement actions plan (nice-to-have, must-have).	Do
Report and Track [10], [11], [13], [17] - Complete the report without filtering. - Obtain endorsement. - Steward and track the action	Check
Take action and Share [10], [11], [13], [17] - Ensure actions closure. - Share the lesson learned.	Act

Furthermore, the implementation of operational learning can follow a plan–do–check–act cycle to have a continuous improvement. Figure 2 describes the process flow of implementing operation learning as a continuous improvement process. Some critical roles contribute to ensuring the process can be executed. They are (1) *Human performance champion* – an individual who is accountable to lead overall coordination, deployment, and implementation of human performance learning and improvement; (2) *Leader* – a department manager/ team supervisor who stewards and is responsible for the success of human performance learning and implementation; (3) *Teams* – Frontline workers who participate in operational learning.
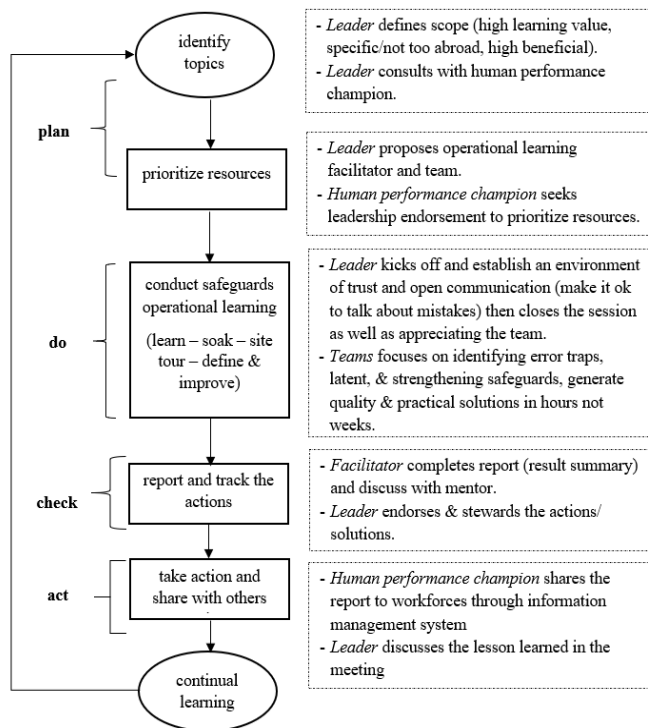
Plan–do–check–act of operational learning.

IV. DEVELOPING MATURITY INDICATORS

This section provides a summary of how human performance learning and improvement is implemented. Progression should be condition-based on the organization. It should not be time-driven. Each leader must assess their organization's maturity and determine when the time is right to move from step to step. The stages describe how the organization can learn, increase capacity, and continuously create a learning culture from learnings. That is why it is essential to explore normal and successful work and do proactive learning. It also allows the organization to evaluate safeguards and examine whether it has been aligned with continuously understanding how work is done. Table III shows how maturity stage improvement actions are set up based on insights obtained from focus group discussion.

TABLE III. Maturity Stages Indicators And Improvement Actions

Maturity Stage Indicators	Improvement Actions Check Point
Stage 1: *Dialogue and discussion on human performance*	a) Multiple engagement sessions: encourage positive debate and talk to shift mindset. b) Appoint a human performance champion to drive the organization's change. c) Develop governance to define the roles and responsibilities of the leader, champion,

Maturity Stage Indicators	Improvement Actions Check Point
	coach/mentor.
Stage 2: *Reaction to the failure*	Exercise and demonstrate ten desired leader's behaviors within the organization (see Table I for the list).
Stage 3: *Training and mentoring on operational learning*	a) Conduct operational learning awareness for managers/ supervisors: provide operational learning steps overview with sponsor's roles responsibilities. b) Conduct training for operational learning facilitators: include co-facilitating as part of mentoring.
Stage 4: *Process understanding of operational learning*	a) Identify operational learning topics considering learning value and not targeting the number of operational learning within the organization. High learning value topics such as repeated events or near misses, complex/ nonlinear issues, serious injury fatality related, applicable across multiple sites, previous approaches, or conventional investigation tools do not get the answer. b) Review operational learning topics opportunities, and prioritize resources to participate in operational learning activities.
Stage 5: *Operational learning application proactively and reactively*	Integrate operational learning application into the investigation process for learning from events reactively, and normal business process work for learning proactively.
Stage 6: *Pre-conditions checking*	Check the organization's readiness before learning using operational learning: human performance understanding, appropriate topic selection and scoping, realistic expectations from leadership, resources.
Stage 7: *Messaging and supporting operational learning*	Promote and convey operational learning for continuous learning within the organization: provide visible support on operational learning activities.
Stage 8: *Strengthening the safeguards*	Continuously encourage to conduct operational learning and follow up the solutions. Share the learning results with others.

V. DISCUSSION

This section discusses how the proposed framework is superior compared to other frameworks in part A. We also identify some opportunities as a research agenda in part B.

A. Enhancing Previous Frameworks

The proposed house of human performance learning and improvement provides a visualization of streamlining human performance improvement and operational learning. This framework puts human performance as a foundation knowledge before implementing operational learning following plan–do–check–act cycle. The maturity stage indicators and improvement actions of the implementation is included to provide strategic to tactical directions towards strengthening safeguard and building learning culture. The proposed framework also enhances previous human and organizational performance frameworks into operations [13] by providing the vision, strategic objectives, maturity indicators, and additional site tour step of operational learning.

Moreover, the proposed framework has streamlined strategic to tactical actions that improve the previous framework, focusing solely on human performance or operational learning deployment. We argue that human performance improvement and operational learning frameworks cannot be separated. However, each other must be streamlined because they interplay to strengthen learning culture and safeguards. We support the previous 'just culture' theory that people's mistakes become a learning opportunity to increase a mindset to grow [18], [20]. Furthermore, the integration of plan–do–check–act cycle into the proposed framework creates a simplification of operational learning steps where the cycle is easier to be operationalized according to common continuous improvement steps. We support the previous framework by [17] for using a plan – do–check–act cycle for learning teams implementation. However, we argue that the progression of human performance is essential to be checked before conducting operational learning. Thus, in the proposed framework, we include maturity stage indicators and improvement actions to review the deployment journey.

We argue that the proposed framework can better guide the organization seeking references to deploy human performance learning and improvement for the business. In the next part, we provide a list of ideas as future research agendas from this study.

B. Future Research Agenda

We provide a summary of the list of opportunities that need further works as future research agenda. Table IV is the future research agenda related to the proposed framework.

TABLE IV. List of Opportunities as Future Research Agenda

No	List of Opportunities as Future Research Agenda	Types
1	Implement and evaluate the proposed framework in various sectors/industries.	Applied research (case study)
2	Implement and evaluate the proposed framework in various	Applied research (case study)

No	List of Opportunities as Future Research Agenda	Types
	scales of industries.	
3	Implement the proposed framework to enhance various process improvement and incident investigation methodologies.	Applied research (case study)
4	Integrate into the International Organization for Standardization (ISO), which recognizes plan–do–check–act cycle.	Experimental research
5	Explore the flexibility of the framework with other management system cycle frameworks.	Experimental research
6	Assess the effects of the proposed framework on organizational culture changes by the period.	Longitudinal research
7	Investigate the influence of maturity indicators to reflect the construct of human performance learning and improvement	Quantitative/Cross-sectional research

CONCLUSION

In this paper, we propose a framework to operationalize human performance learning and improvement into practice. This study has resulted in a streamlined strategic and tactical deployment framework of human performance improvement and operational learning. A 'house of human performance learning and improvement implementation framework' was developed where human performance's principles as foundation knowledge before operationalize learn to learn using operational learning, following the plan–do–check–act cycle to improve continuously. The framework was established to support the organization in building a learning culture and strengthening safeguards. The proposed framework also includes tactical improvement actions to reflect the maturity indicators of deployment.

This study provides extensions as future research agenda. First, there are ample opportunities to perform case studies using the proposed framework in various sectors/industries, the scale of industries, and enhance any process improvement/incident investigation methodologies. Second, the researchers may conduct an experimental study to see how the proposed framework is applied to ISO or other management system cycle frameworks. Lastly, researchers may investigate the effects of the framework on organizational culture changes using longitudinal study and analyze the influence of maturity indicators to reflect the constructs of human performance learning and improvement.

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Automated Pili Fruit Sorting Device using L-SVM Image Classification Model

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Abstract

Bicol is famous because it is one of the regions in Southeast Asia where the indigenous pili trees (scientific name: canarium ovatum) are growing. One of the precious products from the pili tree is the pili fruit. The properties of the pili pulp, especially its color, make it possible to be sorted automatically. The study's primary purpose is to create an automated device that can sort fresh harvested pili fruits according to their maturity using digital image processing. The proposed system used a low-cost digital camera for image acquisition, Linear Support Vector Machine (L-SVM) as the classification algorithm, a microcontroller, a servo motor, an automatic pili feeder, and a conveyor belt system. Two hundred (200) pili fruit images were collected as training data, and 50 sample pili fruits were used for real-time testing. One hundred seventeen (117) of the images for training were ripe pili fruits, and 83 were a mixture of unripe and almost ripe pili. A total of nine (9) fruits were misclassified out of the 200 samples during validation, having an overall average accuracy of 95.5%. Misclassifications were observed from varying colors of almost ripe pili samples and the defects or deformations on the pulp of the sample pili fruits. Real-time testing resulted in all 50 pili samples having one misclassification only, leading to an accuracy of 98.0%. The test images comprised 25 combined unripe and almost ripe pili and 25 ripe pili fruits. The system can classify approximately 720 pili fruits in an hour which is efficient enough to help the farmers process the fruits after harvest. Ultimately, the device is also applicable to sort fruits with similar properties as the pili since the algorithm only evaluates and classifies the maturity utilizing the mean and standard deviation of the segmented binary images of the pulp.

Keywords

Automated Sorting, Fruit Sorting, Pili Fruit Sorting, SVM Model.

I. INTRODUCTION

Bicol Region is famous because it is one of the regions in Southeast Asia where the indigenous pili trees (known in the scientific world as Canarium ovatum) are growing. The production of what they call java nut became one of the trademarks of Bicol, and that is why private and public sectors are eager to spearhead innovations towards the improvement of the pili industry in the province. The emergence of industries that use pili as one of their main products impacts pili production in the region that challenges the pili growers to be more competitive to meet the market needs. Due to the numerous products generated from the pili pulp, sorting them according to maturity is one of the laborious tasks the harvesters face. Pili Industry confronts problems with the slow progress of technology and incomplete end-to-end automation of the processes during post-harvest. After the pili fruits are harvested from the tree, the next step is sorting them out according to maturity. This process is done manually in the current setup, requiring human resources to separate the ripe fruits and unripe ones into different containers. Manual sorting may take 2-3 seconds per pili fruit, and it also depends on the sorting skills of the person doing the task. Although human beings can classify ripeness immediately, there are still chances that our judgment is wrong due to blurred vision, stress, poor eyesight, and other uncontrollable human factors. This step must be mechanized if the goal is to automate the pili production process fully.

Evaluating the available machines for pili processing in Bicol, automated sorting of pili fruits according to color or maturity is missing. The assessment of the advantages and disadvantages of the prior methodology from the current studies will make the proposed system more efficient. The classification accuracy and performance offered by the individual and modular IR and color sensors are not very reliable as they depend on the individual photodiodes' sensitivity. The random color of pili fruits from green, light purple, and dark purple will not allow the sensors to detect its color quickly and accurately. A simple image processing model must be implemented since it does not need high computing power and is very reliable for real-time classification and sorting.

The study's primary purpose is to create an automated device that can sort harvested pili fruits according to their maturity. The specific objectives of the study are: (1)harness the properties of the pili pulp and sort them based on ripeness using an image processing and classification model, (2)provide a definite result of the Linear-Support Vector Machine's (L-SVM) performance, accuracy, and learning rate, (3) disclose the sorting rate of the device to assess if it is comparable to the speed of manual sorting, and (4)assess the cost of the device if small-pili harvesters can consider it for procurement.

II. RELATED LITERATURE

Current studies provided different approaches in sorting objects, from detection, classification, and eventually separating them according to specific qualities. Soloman [1] shared great insights about the importance of color vision in realizing essential agricultural and industrial applications such as color-based inspection, detection, classification, and sorting. Humans can efficiently deal with multi-colored objects, intricate patterns, and random orientations under normal or poor lighting conditions. Fully automated color-based sorting machines should be trained and tested to perform with almost the same capabilities as humans. In order to obtain this objective, a refined machine learning or image processing and classification model should be designed to perform the designated task.

Embuscado [2] has revealed promising technologies for pili processing in his article. Some offices in Bicol collaborated to identify the problems related to the pili industry and gave birth to the development of mechanized devices and equipment. To enumerate some, the harvester with cutter and collecting net, de-pulping machine, pili nutcracker, tesla removal machine, and oil extractor. Assessing the available devices, automated sorting of pili fruits according to color or maturity, size, shape, and quality is missing.

Batra et al. [3] developed a simple, efficient, and affordable tomato sorting machine that helps get good-quality ripe tomatoes without human error. The machine separates ripe and unripe tomatoes utilizing IR, color, weight sensors, a microprocessor, a servo motor, and a conveyor belt system. Their study opened the possibility of using cheap and simple devices to perform essential industry applications. Low-cost cameras nowadays can offer better imaging performance and hold more opportunities for further image processing and analysis due to the variability of the colors on the fruit pulp.

Alaya et al. [4] stated that Arduino could be developed so that the combined light intensities reflected from the product and frequency of the wavelength can be converted from the RGB space to the HSL domain. The study proposed a sorting machine of the coated chocolate candy. An Arduino directs the machine to command the servo, stepper motor, and color sensor TCS3200. The research could not resolve the only limitation of classifying colors at shorter ranges (i.e., yellow and orange). This issue can significantly impact the system's performance as candies usually have bright colors, and yellow and orange are some.

Capucao et al. [5] created a system to detect ripe pili fruits using the Haar-like features, Adaboost classifier, and color analysis to establish a dataset of canarium ovatum with a phantom IV professional drone attached with a 20-megapixel camera as a means for image acquisition. The result of the pili fruit detection using this method is not yet sufficient to estimate how many pili fruits are ripe and are expected to be harvested. Only the top and front view of the pili tree was captured, and multiple detections of pili fruits caused this restriction. Their recommendation is to perform the pili fruit maturity detection and classification after fruits are harvested and under controlled lighting.

Sharif et al. [6] stated that enhancing the pre-processing methods would improve the segmentation accuracy in return. Their study focused on creating a hybrid method of detecting and classifying diseases on citrus plants consisting of two primary phases: detecting lesion spots on the citrus fruits and leaves and classifying citrus diseases. Their investigation showed that a good pre-processing method is needed to obtain better results during classification.

Sakr et al. [7] proved that SVM is more advantageous than using a Convolutional Neural Network (AlexNet) in separating waste categories, specifically plastic, paper, and metal. The analysis of two different models showed a big difference in which method is appropriate for every scenario. The use of AlexNet requires sophisticated hardware such as GPU to train the model and preserve high accuracy output. Compared to SVM, the model does not require a lot of computing power to train the model – thus, it delivered more than AlexNet. The best model tested from the output of AlexNet has an accuracy of 83%. On the other hand, SVM delivered 94.8% accuracy, which is way higher than that of AlexNet.

The work of Pascual et al. [8] regarding the automated detection of rice plant diseases presented the results of using two different classification models, namely, the SVM and Random Forest algorithm. Results show that the blue pixels that are indicators of rice disease and the SVM as its classifier have yielded better outcomes than the other model. Finally, the study of Ayllon et al. [9] about fruit maturity detection shared insights that fruits is the ninth (9th) most exported good in the Philippines. The researchers utilized Convolutional Neural Networks through Image Processing to determine the fruit maturity of bananas, mango, and calamansi. They classified said fruits into three categories for the fruit maturity as pre-matured, matured, and over-matured.

III. Methodology

A. Proposed Device's Conceptual Framework

Fig. 1 demonstrates the conceptual framework of the proposed system. The properties of the pili pulp, especially its color, make it possible to be sorted automatically through the assembly of hardware supported by software elements. The system's inputs were fresh pili fruits dropped by the automatic pili feeder to the conveyor belt system and the snapshots of the pili fruits on the detection platform captured by the low-cost digital camera. Image pre-processing was necessary to extract the ripe and unripe pili features into two classes. The process stage contains the (1)segmented images using the morphological structuring element method, (2)comparison of the mean and standard deviation of the segmented image with the validation database, (3)classification result using the L-SVM image classification model, and (4)initialization of the triggers of the microcontroller and the servo motor. The output of the system was the sorted ripe and unripe pili fruits.
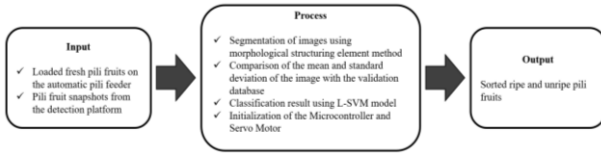
Fig. 1. Automated Pili Fruit Sorting Device using L-SVM Image Classification Model Conceptual Framework.

B. Image Acquisition and Dataset

The study has collected 200 images of fresh pili fruits under uniform distance and controlled lighting using a 320x240 pixels A4Tech digital camera. Proper lighting was secured using two 13W led lamps to eliminate unnecessary shadows in the region of interest (ROI). The camera was positioned at the height of 0.28 meters, and both lamp tips were at 0.19 meters from the conveyor belt. A total of 50 ripe and unripe pili fruits were selected for real-time testing and served as the input for the assessment of the actual accuracy of the device. Eighty-three (83) were used for training, and 25 for testing are the combined samples of unripe and almost ripe pili fruits. One hundred seventeen (117) images used for training and 25 images for testing are the samples for the ripe ones. The two-hundred pili images were fed to MatLab as the training validation database, where the test samples were compared for real-time classification. Fig. 2 shows the three major stages of the pili fruit. Images (a) and (c) illustrate the unripe pili having a green pulp and the ripe pili, black, respectively. The variability of pulp's color, especially when it is almost ripe, as shown in (b), puts the use of individual color and infrared sensors at a disadvantage compared to using digital cameras for color detection. Part of the system's design was to position the digital camera at such a height that it could capture the moving pili fruits in the conveyor, eliminating any unnecessary objects and components that may affect the image classification.

a) unripe pili   b) almost ripe pili   c) ripe pili
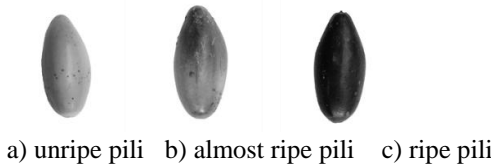
Fig. 2 Sample images acquired for training the L-SVM Classifier.

C. Image Classification using L-SVM Model

Linear Support Vector Machine (L-SVM) is an image processing algorithm used in classification. The concept is to find a suitable learning boundary while maximizing the margin or distance between the closest learning samples (the support vectors) corresponding to the classes. In the case of pili fruit sorting, the model was designed to separate the ripe and unripe pili fruits. Numerous SVMs are available in Matlab as classification learner apps; however, the L-SVM best suits the classification requirement for a two-class data set. The program includes converting the colored image to its binary equivalent using the global thresholding technique. Thresholding is a type of image segmentation where the pixels of an image are changed to make the image easier to analyze. In thresholding, an image should be converted from color or grayscale into a binary image that is simply black and white. For Global Thresholding, the Threshold (T) is constant and applies to the whole image. Equation (1) shows the function of how thresholding is performed.

$$g(x,y) = \begin{cases} 1, & if\ f(x,y) > T \\ 0, & if\ f(x,y) \le T \end{cases} \quad (1)$$

where $g(x,y)$ is the output pixel, $f(x,y)$ is the input pixel and T is the threshold value.

The initial estimate of the threshold is generated after the RGB image is converted to grayscale and adjusted through contrast stretching. What happens is that each pixel is compared to the threshold value. If the individual pixel is greater than T, it will be considered one or white. If the pixel value is less than or equal to T, the output value will be zero or black after thresholding [10]. Moreover, a morphological segmentation technique used a structuring element to break narrow bridges and eliminate thin structures on the captured images before proceeding to the classification section. Implementing the "opening" morphological segmentation differed between the segmented images for unripe and ripe pili fruits. The mathematical equations below represent the morphological segmentation.

$$A \ominus B = \{z | B_z \subseteq A\},\ Erosion \quad (2)$$
$$A \oplus B = \{z | \hat{B}_z \cap A \subseteq A\},\ Dilation \quad (3)$$
$$A \circ B = \{(A \ominus B) \oplus B\},\ Opening \quad (4)$$

where A is the original set and B is the structuring element. The opening method (4) requires both erosion (2) and dilation (3) process. For erosion, the set of points z such that the structuring element (B) translated by a vector (z) fits fully inside the original set (A). On the other hand, dilation finds pixels such that shifted structuring element (B) has any overlap with the original set. The opening starts with erosion, followed by dilation.

The first step of implementing L-SVM is to evaluate the extracted features from the segmented images [11]. Those are the mean and standard deviation. The mean (μ) was computed as the average of the pixels on the entire image (5),

$$\mu = \frac{\sum x_i}{n} \quad (5)$$

and the standard deviation was computed using the fundamental formula (6) below,

$$\sigma = \sqrt{\frac{\sum(x_i - \mu)^2}{n}} \quad (6)$$

where σ is the standard deviation of the image, x_i is the value of each pixel, μ is the mean of the image, and n is the sum of the pixels on the entire image.

The next step is to determine the support vectors. Support vectors denoted by $(\tilde{s}_1, \tilde{s}_2, \& \tilde{s}_3)$ on the sample formula are data points closer to the decision boundary and influence the position and orientation of the hyperplane (7) & (8). Data points falling on either side of the hyperplane can be attributed to different classes. Once the support vectors are selected, a bias of (1) will be added to the features creating a 3x1 matrix. After solving the dot product of the matrices, three equations are generated, thus the variables (α_1, α_2, & α_3) can be computed.

$$\alpha_1\widetilde{s_1} \cdot \widetilde{s_1} + \alpha_2\widetilde{s_2} \cdot \widetilde{s_1} + \alpha_3\widetilde{s_3} \cdot \widetilde{s_1} = 1 \qquad (7)$$
$$\alpha_1\widetilde{s_1} \cdot \widetilde{s_2} + \alpha_2\widetilde{s_2} \cdot \widetilde{s_2} + \alpha_3\widetilde{s_3} \cdot \widetilde{s_2} = 2 \qquad (8)$$

where α_1, α_2, & α_3 are the variables for computing the weight vector and $\widetilde{s_1}, \widetilde{s_2},$ & $\widetilde{s_3}$ are the support vectors with bias. The weight vector is made up of a 1x3 matrix. The elements on the first two rows are the weight, and the element on the third row is the bias. The weight vector was computed using the equation (9) below.

$$\widetilde{w} = \sum_i \alpha_i \widetilde{s_i} \qquad Eq. (9)$$
$$(9)$$

For the L-SVM model, the hyperplane equation looks the same as the slope of the line equation, which is y=mx+b, where m is the slope and b is the y-intercept. Equation (10) shows the hyperplane function.

$$y = wx + b \qquad (10)$$

the weight vector (w) signifies the slope of the hyperplane, and the bias (b) is the y-intercept of the line. Using these support vectors, we maximize the margin of the classifier. Deleting the support vectors will change the position of the hyperplane. These are the points that helped build the L-SVM. The Matlab code also contains commands for the webcam to capture a snapshot under a specified time and triggers the Arduino and servo motor to eventually guide the pili fruits to their respective containers. The system used 11th Gen Intel(R) Core(TM) i5-1135G7 to run the program in Matlab.

D. Microcontroller and Actuation System

A microcontroller is used in programming and robotics due to its user-friendly or easy-to-use setting. Like any microcontroller, an Arduino is a circuit board with a chip programmed to perform desired tasks. It collects information from the computer program and finally triggers the circuit or machine to execute the specified command. Arduino Uno was used in this study to interface the system's input (sensing section) and output (actuation section) which is the servo motor. Servo Motor SG90 was the actuator used to swing the sorting chute to its appropriate position. The Arduino board was connected to a computer using USB 2.0 Cable Type A/B. The servo motor was connected to the Digital pin 3 of the Arduino board, including its supply voltage with a position set to 0.5 as its default angle. If the classification model resulted in a ripe pili fruit, the servo motor's position would change to 0.25 angle. Hence, if the classification resulted in unripe pili, the angle would change to 0.60.

E. Conveyor Belt System

Belt conveyors are thick rubber bands stretched at high tension and threaded through a brush of rolling components, moving at the desired speed to carry materials from one place to another. The conveyor belt system was responsible for transporting the pili fruits from the reservoir to the detection platform until they reach the containers after sorting. A 0.63 x 0.29 x 0.13 meters conveyor system was improvised to run by a 680W impact drill connected to a 220V AC supply. The design was bearingless, making the construction simpler and more affordable than the usual conveyor belt setup. The rollers were fabricated with ¾" PVC Pipes and 10" Water Filter Cartridges. The conveyor belt was made of 0.02 meters

elastic bandage cloth, wide enough to avoid the pili fruit from moving out of track and falling off the conveyor.

F. Automatic Pili Feeder

The automatic pili feeder was linked to a DH48S-S timer connected to a 220V supply and a fabricated roller setup using a 12V DC motor to drop pili fruits one by one to the conveyor belt for a specified time. The timer will turn the DC motor for 0.1 seconds for a pili fruit to drop from the reservoir to the conveyor belt and then turns off for 5 seconds to make way for the pili fruit to be classified and reach its designated container. A 12V Dimmer was necessary as part of the feeder and was connected in series with the motor so that strong spins will be prohibited that may cause the pili fruits to trickle out of the platform. The succeeding pili fruit drops on the next cycle of the timer. The process will repeat until all pili fruits loaded on the automatic pili feeder are sorted.

G. National Standard Used

The ISO 21183-1 set the light conveyor belt systems' principal characteristics and applications. Based on the review, light conveyor belt systems are usually found in chemicals, pharmaceuticals, cosmetics, food, agriculture, wood, and tobacco. They are mostly used in indoor applications and outdoors under cover [12]. The assessment of the different light conveyor belt systems, their characteristics, designs, and applications guided the research to implement the most appropriate belt system to transport the pili fruits from the automatic pili feeder down to the sorting containers.

H. System's Process Flow

This research implemented the process flow as demonstrated in Fig. 3 to obtain the set of objectives of the study.
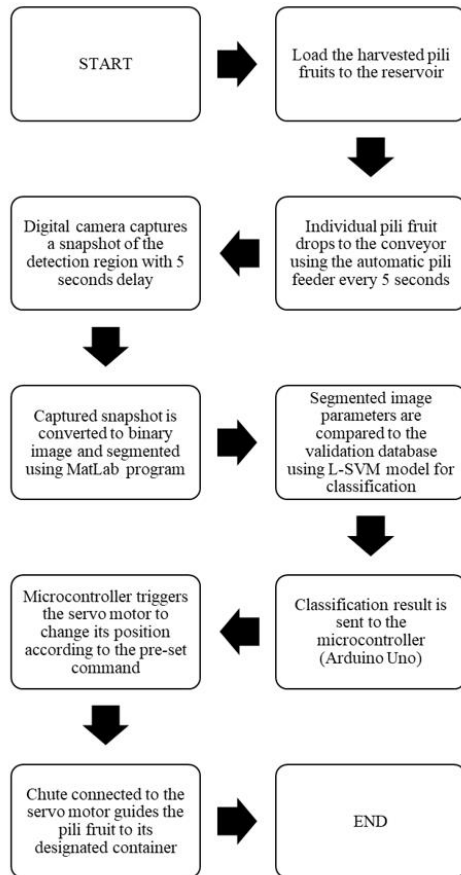
Fig. 3 Process flow of the proposed system.

The process begins from the pili reservoir linked to the automatic pili feeder, where the harvested pili fruits are loaded. The individual dropping of the pili fruits is controlled by the DH48S-S timer and the roller setup. The cycle relay timer automatically uses 2 watts of power, switches the DC motor on by 0.1 seconds, and turns off 5 seconds. An additional device was used to control the DC motor. A 12V Dimmer was connected in series with the motor so that strong spins will be prohibited that may cause the pili fruits to trickle out of the platform. Once the pili are dropped successfully to the platform, they will move and pass through the detection stage. The camera is connected to a computer that runs MatLab codes to determine the mean and standard deviation of the segmented pili fruit images. The L-SVM model implemented in MatLab determines the boundary and maximizes the margin so that for every test image, the model compares its parameters to the pili validation database. The MatLab code has a command to control the response of the servo motor for each pili fruit that was captured. The servo motor was connected to the digital pin 3 and 5V power inputs of the Arduino Uno responsible for guiding the pili fruits into the designated containers through a sliding chute. Finally, designated round plastic containers for the ripe and unripe pili used for sorting were placed at the end of the conveyor line to separate the classified ripe and unripe pili fruits. Fig. 4 displays the prototype of the proposed device.

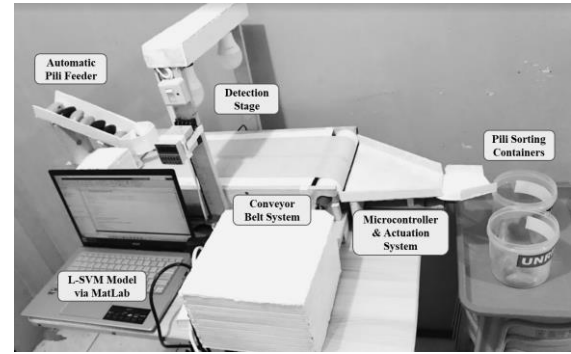**Fig. 4 Prototype of the Automated Pili Fruit Sorting Device.**

I. Data Analysis

The equations below express the calculation of the validation and testing accuracy of the classification model.

$$TPR = \frac{CC}{TS} \qquad (11)$$

$$FNR = \frac{MC}{TS} \qquad (12)$$

$$OVA = \frac{CC_{combined}}{TS_{combined}} \qquad (13)$$

where TPR (True Positive Rate) is the percentage of the correct classification, and FNR (False Negative Rate) is the percentage of the misclassification. CC is the number of correct classifications, and MC is the number of misclassification. TS is the total number of samples for each class. OVA is the overall validation accuracy, the ratio of the combined number of correct classification, and the combined number of ripe and unripe pili samples.

IV. RESULTS AND DISCUSSIONS

The proposed setup of the automated pili fruit sorter using the L-SVM Classification model showed satisfactory results based on the validation and testing outcomes of the model. The succeeding discussions provided the results and the procedures performed to sort the pili fruits.

J. Results of the Pre-processing using Morphological Segmentation Technique

Classifying the pili fruits require pre-processing techniques to efficiently obtain the mean and standard deviation of the sample pili fruits. Fig. 5 shows the output of the segmentation using the morphological structuring element.

a) Segmented Unripe Pili   b) Segmented Ripe Pili
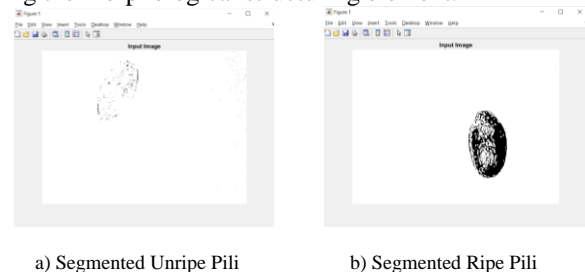
Fig. 5 Sample segmentation output using morphological structuring element method.

The segmented images exhibited a huge difference where the unripe pili displayed a small portion of black compared to the ripe pili, which showed the black color covering the entire pili area. Mathematically, the average segmented mean of an unripe pili fruit was 0.987, and its average standard deviation

was 0.089. On the other hand, the average segmented mean and standard deviation of ripe pili fruits were 0.961 and 0.154, respectively. This finding proved that a simple classification model could be implemented to classify the pili fruits into two different maturity classes in real-time.

K. Training Validation Result of the L-SVM Image Classification Model

The significant margin or gap between the parameters of the sample data will justify why the Linear SVM delivered exemplar results in classifying the maturity of the pili fruits. The numbers provided were gathered from the 200 images to train the model. One hundred seventeen (117) of the images for training were ripe pili fruits, and 83 were unripe and almost ripe pili. The validation accuracy of the model was evaluated using the True Positive Rates (TPR) and False Negative Rates (FNR). The TPR was 92.8% and 97.4% for the unripe and ripe pili fruit classes. On the other hand, 7.2% for the unripe and 2.6% for the ripe class were the algorithm's FNR. Six (6) fruits were misclassified as ripe though they should be unripe, and three (3) samples were misclassified as unripe; they should be in the ripe class. Nine (9) out of 200 samples were misclassified during validation, having an average training accuracy of 95.5%. Additionally, it took 6.19 seconds to complete the training validation. The issue was due to the property of the pulp of almost ripe pili, which has nearly parametric values as with the ripe pili fruits. Other factors such as deformations, irregularities in the pulp, and extrinsic defects also caused misclassifications and were not corrected nor eliminated during the segmentation process.

L. Test Result of the Automated Pili Fruit Sorting Device

Although the model's validation accuracy was 95.5%, the overall real-time test accuracy obtained was still great at 98.0%. A total of fifty (50) pili fruits were used for testing, composed of 25 combined unripe and almost ripe pili and 25 ripe pili fruits, as shown in Table I.

The table includes the classification accuracy for both pili classes. With the classification rate of roughly 5 seconds, including the travel time of the pili fruit in the conveyor and sliding chute, the system can classify approximately 720 pili fruits in an hour – which is efficient enough to help the pili farmers process the fruits with minimal human intervention after harvest.

V. CONCLUSION AND FUTURE WORKS

The method to harness the properties of the pili pulp to sort them according to ripeness was performed using the combination of multiple devices. Using a computer and MatLab version R2021a software, the Linear Support Vector Machine (L-SVM) Classification Model, an image processing and classification model, served as the backbone for categorizing the ripe and unripe pili fruits. With the help of a digital camera to capture images, a microcontroller (Arduino Uno) connected with a servo motor used as actuation devices, an automatic pili feeder, and a conveyor belt system for transporting the pili fruits from beginning through the end, the automation of the pili fruit sorting developed into a novel work.

The L-SVM showed an exemplar performance in classifying the maturity of the pili fruits. The sorting rate of the device is approximately 5 seconds per pili fruit making it 720 pili fruits in an hour. The sorting rate of the proposed device is lower than the manual sorting rate; however, this automation will benefit the pili growers as they will no longer need to dedicate many efforts or hire a resource to sort the harvested pili fruits. The system's performance can be enhanced by using more sophisticated and high specification detection components such as the camera, which can perform multiple detections.

Regarding the economical aspect, an amount of ₱4,544.00 was spent to create the prototype of the proposed device. Based on the cost assessment, the Automated Pili Sorting Device is still reasonably priced compared to the existing small-scale fruit sorting machines in the market ranging from ₱50,000.00 - ₱300,000.00. The largest expenditure made on the device was from the conveyor belt system. The conveyor belt system can be procured as a whole and in bulk for wide-range production and will lessen the cost of creating the sorting device.

The bearingless conveyor belt setup powered by an impact drill can be replaced with a conveyor composed of a motor, bearings, speed control, and belts for a more stable performance versus using the improvised setup. The impact drill was very unstable because it speeds up after running for a prolonged period. The alignment of the drill's shaft and one of the conveyor tubes made it difficult for the proposed setup to maintain its speed.

Other classification models can also be reviewed to compare L-SVM regarding the validation accuracy and processing time as part of future endeavors. The possibility of multiple detections of pili fruits is promising to tremendously improve the device's sorting rate. Ultimately, the device is also applicable to sort fruits with similar properties as the pili

Table I. Overall Test Data Confusion Matrix.

No. of Samples	Ripe Pili Fruit Class		
	Correct Sorting	Incorrect Sorting	Accuracy
25	25	0	100.0%

(a) Classification accuracy for the Ripe Pili Fruit Class.

No. of Samples	Unripe Pili Fruit Class		
	Correct Sorting	Incorrect Detection	Correct Sorting
25	24	1	96.0%

(b) Classification accuracy for the Unripe Pili Fruit Class.

No. of Samples	Combined Class		
	Correct Sorting	Incorrect Detection	Correct Sorting
50	49	1	98.0%

(c) Overall classification accuracy for the combined pili fruit samples.

since the algorithm only evaluates and classifies the maturity utilizing the mean and standard deviation of the segmented images of the pili pulp.

ACKNOWLEDGMENT

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Effects of Particle Size and Composition of Rice Husk Silica on the Characteristics of Ceramic Tile

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Abstract

Rice husk waste is known to have high silica content. This study investigated the effects of particle size and composition of silica from rice husk waste on the characteristics of ceramic tile. The rice husk silica was added as filler, mixed with kaolin, feldspar, quartz sand, and water. The silica particle size was varied in 2 groups, macrosilica (200 mesh) and microsilica (> 200 mesh). To obtain the silica, the rice husks were burned in a furnace at 400°C for 90 minutes. The rice husk ash was sieved with 200 mesh to be macrosilica, and part of the sieve was milled to obtain microsilica. The ceramics were made by varying the silica composition in the mixture (0; 2.0; 2.7; 3.3; 5.0; and 6.3%), and the ceramic molds were burned at a temperature of 500°C for 1.5 hours. The ceramic characteristics were measured from the compressive strength, density, water absorption, and porosity. The macrosilica filler produced ceramic with compressive strength of 3.5-8.0 kN, density of 1.24-1.44 g/cm^3, water absorption of 0.46-0.63%, and porosity of 13.89-40.14%. The microsilica filler gave a compressive strength of 1.0-4.2 kN, a density of 1.17-1.44 g/cm^3, water absorption 0.46-0.59%, and a porosity of 15.27-68.31%.

Keywords

Rice husk, silica, ceramic, compressive strength, porosity.

I. INTRODUCTION

Ceramic is made by shaping and firing inorganic-nonmetallic material at a high temperature. This material has a stable conductivity and is very hard and strong but breaks easily under unbalanced pressure. In industry, ceramics are commonly used because of their magnetic and non-magnetic properties [1]. Several studies have been conducted to improve the quality of clay-based ceramics as the development of the creative ceramic industry in Indonesia. [2] varied the particle size and milling time on the physical properties and compressive strength of clay-based ceramics. The size of the constituent particles affects the physical properties and compressive strength of ceramics, where the smaller the size of the constituent particles, the compressive strength, density, and porosity of ceramics will decrease. In these studies, ceramics were made using clay as the basic material and microcarbon particles. The carbon particles are expected to fill the empty space between clay particles so as to produce additional binding force on clay particles due to the formation of new contacts.

The Indonesian Central Statistics Agency (BPS) informed that the area of rice fields in Indonesia in 2018 was around 10,903,835 hectares with a total rice production reaching 56,537,774 tons. The high rice production makes Indonesia renowned as an agricultural country. The milling process of rice produces rice and rice husks as by-products. Each ton of rice that is processed through the milling process can produce up to 300 kg of rice husk, or about 30% of the total rice yield.

Amorphous silica is the most abundant type of silica contained in rice husks. Thus, rice husks have a high potential to be used as microsilica, which can be applied in various fields including cement manufacturing, ceramic filling materials, and so on. This study aims to study the manufacture of ceramic tiles with a filler of rice husk silica. In particular, the effect of particle size and composition of rice husk silica on ceramic characteristics was investigated. The ceramic characteristics were measured from the compressive strength, density, water absorption, and porosity.

II. METHOD

The materials used in this work included silica, kaolin, feldspar, quartz sand, and water. The silica material was obtained from processing rice husk waste. The silica preparation started with the cleaning of rice husks with water, followed by drying in the open area under the sun. The dry rice husks were burned in a furnace at 400°C for 90 minutes. The rice husk ash was sieved with 200 mesh to obtain macrosilica, and part of the sieve was milled to obtain microsilica.

The manufacture of ceramics was conducted by varying the silica particle size (200 mesh of macrosilica, > 200 mesh of microsilica) and mixing it with other materials with certain variations in silica composition (0; 2; 2.7; 3.3; 5; 6.3% mass) with kaolin as the highest composition. The ceramic dough was then molded and dried, then was burned in a furnace at a temperature of 500°C for 1.5 hours. The ceramics were then

cooled in an open room until the ceramic temperature was the same as the ambient temperature.

The ceramic samples were tested their characteristics in terms of compressive strength, density, water absorption, and porosity. The compressive strength test was carried out using a hydraulic press, in which the ceramic was pressed until it cracked and crumbled. The density testing was based on the measurement of mass per volume of material. For mixed solid materials such as ceramics, the density measured is a bulk density [3]. To determine the water absorption capacity of ceramics, the ceramics were immersed in water for a certain time (considered to be in equilibrium) and were weighed. The absorption of ceramics to water was calculated using the equation:

$$Water.absorption(\%) = \frac{(m_w - m_d)}{m_d} x100\%$$

where m_w and m_d are the mass of wet ceramic and dry ceramic, respectively.

III. RESULTS AND DISCUSSION

A. Average Size of Rice Husk Silica

Two variations of average particle size were used, namely macrosilica, which was defined as the silica particles passing through the 200 mesh-screen, and microsilica, the macrosilica which was milled further. A Particle Size Analyzer (PSA) was used to measure the particle size of silica, and the results show the particle size is relatively monodisperse for both macrosilica (average size of 6.24 μm) and microsilica (average size of 0.171 μm) as shown in Fig. 1, 2.

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	6235.4 nm	770.8 nm	6729.0 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	6235.4 nm	770.8 nm	6729.0 nm

Cumulant Operations
Z-Average : 2288.5 nm
PI : 5.658
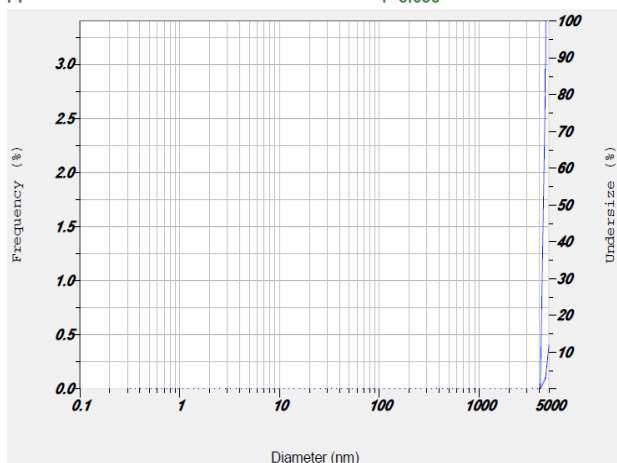
Fig. 1. The result of PSA for macrosilica.

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	170.8 nm	38.1 nm	161.4 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	170.8 nm	38.1 nm	161.4 nm

Cumulant Operations
Z-Average : 983.8 nm
PI : 0.763
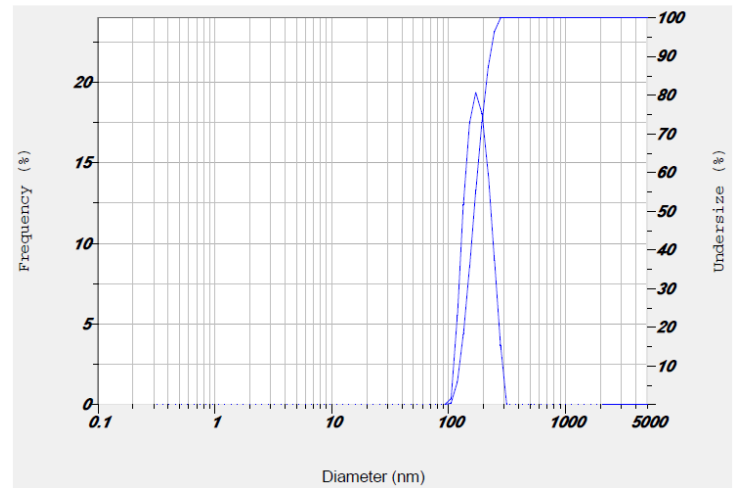
Fig. 2. The result of PSA for microsilica.

B. Compressive Strength Test

The effect of particle size and composition of rice husk silica filler on the compressive strength of ceramic is shown in Table 1 and Fig. 3. It can be seen that macrosilica gives higher compressive strength than microsilica. The compressive strength produced by macrosilica ranges from 3.5-.08 kN, while microsilica ranges from 1.5-5.0 kN. In the investigated range of silica composition (0-6.3%), there is an optimum point, where the highest macrosilica compressive strength is obtained at the 2% composition, which is 8.0 kN, and 4.2 kN for the addition of 2.7% microsilica.

Table 1. The compressive strength of ceramic as a function of particle size and composition of silica.

Composition (% Mass)	Compressive Strength, kN	
	Macrosilica	Microsilica
0	5.0	5.0
2.0	8.0	3.0
2.7	4.0	4.2
3.3	4.8	2.5
5.0	3.5	1.0
6.3	3.5	1.5
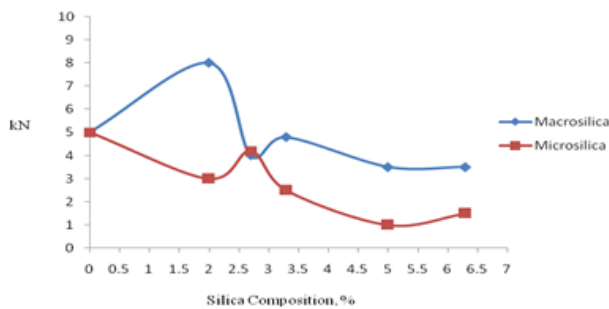
Fig. 3. Effects of rice husk silica addition on the compressive strength of ceramic.

In general, it can be said that the more silica is added, either macrosilica or microsilica, the compressive strength tends to decrease, although not significantly. This is because the addition of silica which has grain size larger than that of kaolin causes the phenomenon of substitution of kaolin grains by larger silica grains so that the ceramic is easily deformed [4]. The quartz sand which also contains a lot of silica also has an effect on reducing the strength of ceramics because the melting point of kaolin is lower than that of quartz sand; in this condition the kaolin material granules shrink faster when the combustion process and the void of the ceramic cavity is filled by quartz sand [5].

C. Density Test

Table 2 and Fig. 4 show the effect of particle size and composition of rice husk silica on the ceramic density. It is clear that the addition of rice husk silica in the mixture decreases the density of ceramic. The highest density was obtained at the addition of 0% (S0) or without the addition of silica, which was 1.44 g/cm^3.

Table 2. Results of density tests of ceramic.

Composition (% Mass)	Density, g/cm^3	
	Macrosilica	Microsilica
0	1.44	1.44
2.0	1.40	1.31
2.7	1.37	1.29
3.3	1.35	1.17
5.0	1.27	1.27
6.3	1.24	1.22
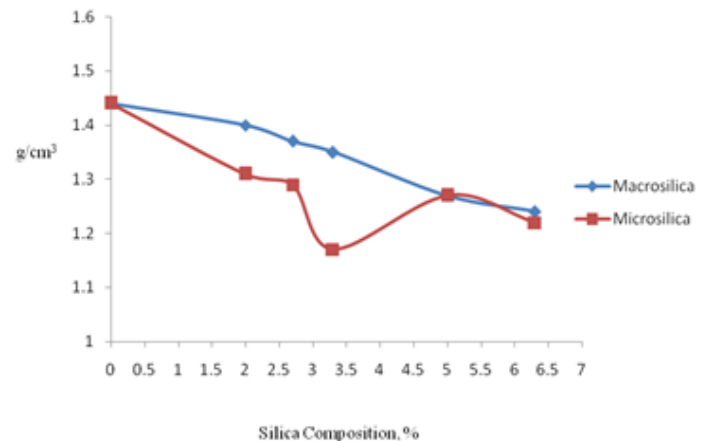
Fig. 4. Effects of rice husk silica addition on the density of ceramic.

Theoretically, the density of the mixture is influenced by the composition and density of its constituent components, where the density of the mixture will be in the range of the pure density of its constituents including water (density of 1 g/cm^3). The density value of pure silica (2.03 g/cm^3) is lower than that of pure kaolin (2.5 g/cm^3) [6]. Consequently, the higher the silica composition, the lower the density of the ceramic tile.

The size of silica particles in ceramic tiles also affects the density, where microsilica gives a lower density than macrosilica. The finer the particle size, the faster the interparticle diffusion process will tend to be. During the sintering process in which combustion occurs continuously at high temperature (500°C), there is a density and reduction of pores or voids.

D. Water Absorption Test

The comparison of water absorption by macrosilica and microsilica based ceramics is shown in Table 3, and Fig. 5.

Table 3. Results of water absorption tests of ceramic.

Composition (% Mass)	Water Absorption (wa), %	
	Macrosilica	Microsilica
0	0.46	0.46
2.0	0.54	0.48
2.7	0.58	0.50
3.3	0.60	0.54
5.0	0.61	0.57
6.3	0.63	0.59

Fig. 5. Effects of rice husk silica addition on the water absorption of ceramic.

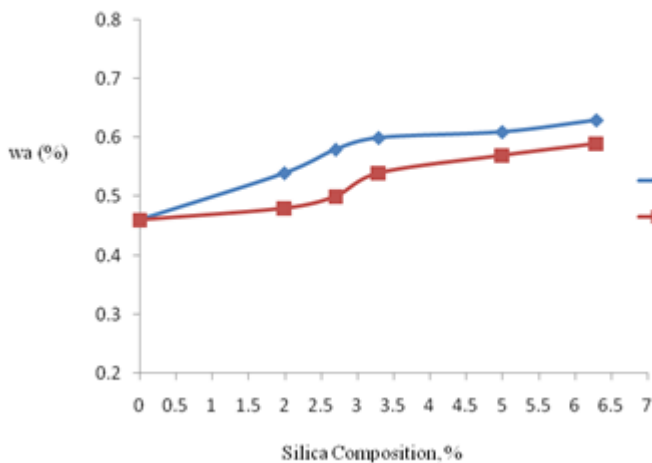**Fig. 6. Effect of rice husk silica addition on the porosity of ceramic.**

From Fig. 4 it can be seen that the addition of rice husk silica in the form of macrosilica and microsilica can affect the level of water absorption in ceramics. The water absorption in macrosilica and microsilica-based ceramics increases as the increase of macrosilica and microsilica compositions. The water absorption increases due to the presence of rice husk silica because silica is a substance that has a high capacity of adsorption particularly on polar substances such as water [7]. It can also be seen that the water absorption of microsilica-based ceramics is lower than that of macrosilica-based ceramics. The difference in water absorption is influenced by the particle size of each added silica. The smaller the particle size, the water content will decrease [8]. From the test results of macrosilica and microsilica-based ceramics, which have water absorption rates between 0.46-0.63% and 0.46-0.59%, all the investigated compositions of microsilica meet the requirements of SNI ISO 13006-2010 which states that the maximum water absorption in ceramics is 0.6% [9]; while, the macrosilica meets the SNI requirement up to composition of 3.3%.

E. Porosity Test

The particle size in nanoparticles affects the porosity of ceramic specimens, that the smaller the size of the silica used, the greater the porosity [10]. In this study, the effect of particle size and composition of silica on the ceramic porosity is shown in Table 4 and Fig. 6.

Table 4. Results of porosity test of ceramic.

Composition (% Mass)	Porosity (%)	
	Macrosilica	Microsilica
0	21.90	21.90
2.0	13.89	15.27
2.7	17.86	27.90
3.3	25.92	54.70
5.0	33.58	61.97
6.3	40.14	68.31

Fig. 6 shows that the addition of silica tends to increase the porosity of the ceramic, especially at the addition of 2% and above. With the addition of 0-2% silica, the silica particle size has less effect on the porosity of the ceramic. However, at the addition of silica above 2%, microsilica increases the porosity of ceramics more significantly than macrosilica. This is in line with the research results conducted by [11], that for every addition of nanosilica, the porosity will increase.

It can be seen that without the addition of rice husk silica, the ceramic porosity is in the range above the porosity with the addition of 2% rice husk silica, both macrosilica and microsilica. The porosity arises from the contribution of the presence of quartz sand in the mixture. Quartz sand is an additive as a reinforcement that can increase the porosity.

IV. CONCLUSION

The study of making ceramic tiles by adding silica filler from rice husk waste has been carried out. The effect of particle size and composition of rice husk silica on the ceramic characteristics was investigated, including compressive strength, density, water absorption, and porosity. In general, the addition of rice husk silica in the mixture decreases the density of the ceramic, increases the water absorption by the ceramic, and increases the porosity of the ceramic. Meanwhile, the effect of particle size and composition of rice husk silica on the compressive strength tends to fluctuate. In the range of particle size and composition studied, macrosilica (200 mesh) gave the highest compressive strength at 2% composition (8.0 kN), and at 4.2 kN for microsilica (> 200 mesh) with a composition of 2.7%. Macrosilica provides higher compressive strength, density, and water absorption than microsilica, but lower porosity. The macrosilica filler produces ceramic characteristics with compressive strength of 3.5-8.0 kN, density of 1.24-1.44 g/cm^3, water absorption of 0.46-0.63%, and porosity of 13.89-40.14%. Meanwhile, the microsilica filler successively produces a compressive

strength of 1.0-4.2 kN, a density of 1.17-1.44 g/cm^3, water absorption 0.46-0.59%, and a porosity of 15.27-68.31%. These characteristics generally fulfill the Indonesian product standard of ceramic tiles.

V. ACKNOWLEDGEMENT

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Artificial Intelligence in Terms of Spotting Malware and Delivering Cyber Risk Management

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Abstract

Cyber security is an effective area of "Computer Science and Engineering (CSE)" and this system generates a detailed idea to students of CSE, a hands-on practical experience to mitigate risk related to cybercrimes and system malware. Use of Artificial Intelligence (AI), Machine learning to reduce the risk of cybercrimes is another essential part of CSE. Cyber risk management refers to a subpart of CSE that focuses on network protection, malware attacks, protecting systems and programs from digital hacking process and many other cybercrime related issues. This research article has focused on demonstrating various areas, where AI has taken a crucial role to managing the risk of cyber-attacks within management and CSE field. Number of malwares that are increasing within the business world, rate of cyber-attacks, and importance of cyber security management within CSE and management fields has been discussed in this research article.

Technology investment within cyber security management has been identified in this study by comparing it with investment towards various other fields. Various challenges and opportunities of AI to manage cyber risk and malware attacks have been identified in this research article with the help of various journal articles, secondary sources and primary survey questionnaires based on 50 employees from the IT industry. A mixed method data collection has been considered for this study to get first-hand information from the IT industry and go through a wide range of investigation regarding this topic. The main conclusion from this study is that Cyber security and risk management has accelerated in today's modern world with the help of AI.

I.   INTRODUCTION

Artificial Intelligence (AI) is an effective way of making complex decisions on behalf of humans within this modern competitive world. In today's world, big data makes decisions more complex in terms of any kind of field. AI is essential for every aspect of lives including security and privacy management as well. Cybercrimes are being identified and actions are taken after using AI-based solutions within businesses. AI is essential for augmenting work, which humans regularly do. In terms of cyber risk management, malwares are a common term. AI-based technologies are used intensively to detect malware within systems. Malware detection processes are categorized by several sections such as authentication, security, and confidentiality [1]. All these three aspects are being managed by different AI-based solutions to detect malware and protect computer systems from their vicious attacks. In the modern world, individuals, who directly or indirectly linked to the internet, are highly exposed to Cyber-attacks. Hackers use different types of malwares to attack any computer system and hack it to get essential information. Different types of attacks are there, which is a serious threat for all the internet users.
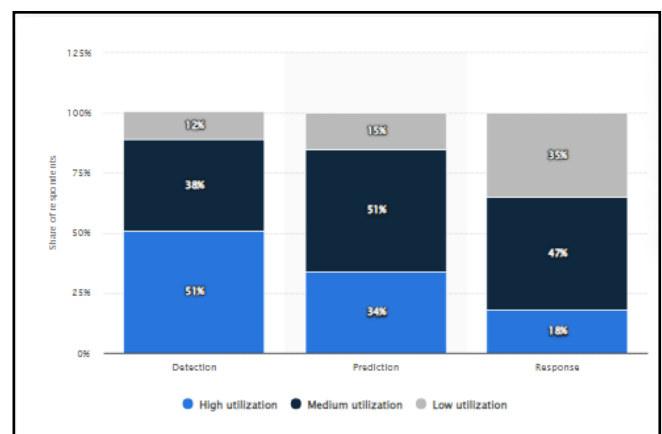
Figure 1: Utilization of AI as a Cyber security Function in Different Organization of this World
(Source: [2])

As per this above figure, it can be stated that, almost 51% of respondents from different organizations across the world have stated that their organizations have utilized AI-based solutions largely to develop cyber threat detection. On other hand, only 18% of respondents have stated that they have utilized the AI-based solutions within their organizations' responses to cyber threats, not as a detection tool [2]. Use of AI within the Android operating system ranks first in the

world, to detect and handle features, that attract cyber criminals [3]. As a result, this research article will investigate different aspects of AI-based solutions to identify the ways under which it manages cyber risks and malware attacks within the managerial as well as IT section of a company. This was a main feature to mitigate the issues within their business by enhancing skills of computer science engineering process. Another objective of this research article was to recommend some effective strategy that companies can take to implement AI-based solutions within their organizational structure for managing cyber security and malware detection processes.

II. Literature Review

A. Concept of artificial intelligence and malware

AI is the capability of computers or human beings do robots controlled by other computers for doing tasks that, as they need human intelligence. Some common examples of AI are speech recognition, visual perception, and decision-making. AI is about reasoning, learning and problem solving in general and it has four different types such as limited memory, reactive machines, self-awareness, and theory of mind [4]. AI offers transformational potential throughout different industries and sectors ranging from supply chain to medicines to automobiles. It gives opportunities for reinventing business models, changing future works, improving performance, and enhancing human capabilities [5]. In contrast, malware is intrusive software, which is designed for damaging and destroying computer systems and computers. This is a contraction regarding malicious software and some examples of this type of software are spyware, adware, viruses, worms, and ransomware. Detection of malware is important with prevalence of malware because this functions as an initial warning system for computers regarding cyber-attacks and malware [6].

B. Concept of Cyber risk management (CRM)

CRM is the method of analyzing, identifying, addressing, and evaluating cyber-security threats of an organization. This method is completed by taking different steps and the foremost step is cyber risk assessment [7]. It gives a snapshot of threats, which could compromise the cyber security of an organization. Then based on risk appetite CRM program determines the prioritization process to respond effectively to each risk. The process of CRM includes six major steps, the first step identifies risks, then in the second step it analyses severity of every risk through assessing how probable these risks to occur as well as the significant impact of these risks. In the third step, this process evaluates how every risk fit within risk appetite and based on this, organizations priorities the risks. In the next step, organizations set strategies to respond to every risk and lastly, organizations review whether these strategies fit the risks and fulfil the purposes. Organizations use efficient and proactive methods for assessing cyber security risks and it helps organizations about risks that are associated with their organizational works on a regular operation level [8].

C. Role of AI for spotting malware

AI is not able to resolve and detect each potential cyber threat or malware; however, when AI combines modelling of good and bad behavior, it could be a powerful and effective weapon as opposed to advanced malware.
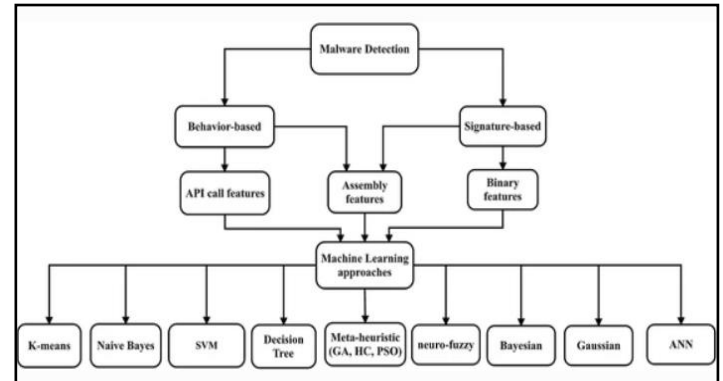
Figure 2: Approaches of Malware detection
(Source: [6])

In case of detecting malware, there are two types of approaches, which are behavior-based and signature-based. Research has suggested that API calls, binary features and assembly features are the present approaches regarding the method of malware detection [6]. Tools of malware detection must evolve for staying up to date with the ever-changing crimeware. A significant evolution with malware detection is migration through trapping and hunting. In terms of spotting malware, AI has been used significantly, which automates a good-behavior modelling; however, products of malware detection that are based on this model are not easy. Additionally, application of AI towards tasks of development good-behavior model resolves several resources and technical challenges to detect advanced malware [9]. Some Indian companies use AI for cyber security, and these are Infosys, Seconize, and TCS.

D. Importance of AI for delivering cyber security

In this digital era cyber security has become a critical thing as it protects data of all categories from damage and threat. It includes sensitive data, PHI (*"protected health information"*), intellectual property, industry, and governmental data, and PII (*"personally identifiable information"*). To make cyber-security stronger AI has been used and it endeavours for simulating human intelligence. AI has a huge potential within cyber-security, and it can be trained for generating alerts regarding threats, identifying new kinds of malware, and protecting sensitive data of any organization [10]. In organizations, AI-based systems help in threat detection as well as response capabilities regarding advanced attacks. Additionally, it helps in responding to data exfiltration, malware, encrypted attacks, and ransomware [11].

E. Challenges of using AI for enhancing cyber security in organizations

Although AI has been extensively used regarding cyber-security, it has some challenges to enhance

cyber-security within organizations. Some common challenges within AI are as follows.

Biometric authentication

Biometric authentication is popular with users, and it is equally dangerous. If biometric data is in the wrong hands, it can be utilised for surveillance of privacy of users [12]. AI technology enables collecting and processing enormous amounts of data, which causes further deterioration of security and digital privacy.

Cost of implementation

Another challenge of using AI for cyber-security is implementation cost. Information has suggested that implementation of AI can be expensive because software experts and programmers are required to create the whole system from scratch [12].

AI-tech is not invincible

Lastly, AI-technologies are not invincible and a few tasks that are done by artificial intelligence can be exploited if hackers manage for accessing them. For instance, AI-enabled programs can be misled into labelling the malicious software as normal or safe.

F. Benefits of utilizing AI regarding cyber-security

AI endeavors for stimulating human intelligence and it has huge potential within cyber-security. Security professionals require robust support from AI for working successfully and protecting organizations from any type of cyber-attacks. Some of using AI in terms of cyber-security is as follows.

AI identifies unknown threats

Humans could not identify all threats an organization experiences and each year, a significant number of hackers launch enormous numbers of attacks with several motives [9]. These unknown threats may cause huge damages towards a network and to mitigate the issues AI has been considered as one of best technologies for stopping and mapping these threats through ravaging an organization.

Secure authentication

Majority of websites have user accounts where an individual's log-in for accessing services and purchasing products. An organization needs an extra layer for running this type of site as it involves sensitive and personal information of users [13]. However, AI secures the authentication anytime users want to login to their accounts. AI uses several tools including CAPTCHA, fingerprint scanner and facial recognition, which help to detect whether long-in attempts are genuine or not

III. Theories and Models

Theory of Technological determinism

Technological determinism (TD) is the reductionist theory, Technological determinism (TD) is the reductionist theory, which assumes that technology of society determines development of their cultural values and social culture. Since technological advancement has increased in the past decade, people are now more exposed to technologies, from online shopping to online food ordering they use technologies, and they share their personal information on different sites [14]

Literature gap

This literature has discussed relevant topics from the selected research topic. However, while conducting the literature review, some gaps have been identified, which is related to theoretical perspectives. There are a limited number of theories that can be used to analyses the selected topic.

IV. Methodology

Data collection	Mixed method
Data analysis	Thematic and descriptive
Research philosophy	Pragmatism
Study design	Descriptive
Research approach	Inductive

Table 1: Overview of methodology

V. Data Collections Method

Mixed method that incorporates both quantitative and qualitative data has been used in this research paper for expanding and strengthening the paper's conclusions and providing a complete comprehensive vision on this selected research topic [15]. Regarding quantitative data collection, the paper has conducted an online survey on 50 employees from different organizations of the IT industry and three closed-ended questions have been asked to participants.

Additionally, in the case of secondary data, this paper has considered different secondary sources regarding cybersecurity and AI such as company reports, journals, government databases, articles, newspaper articles and magazines to collect topic-related information. It has used Google Scholar to gather relevant journals and articles, which are published within last ten years and in English language. While collecting secondary data, it has considered some keywords, which help to get relevant resources and some examples, are "cyber-security".

VI. Data Analysis

Since this research has used a mixed method, it has considered two different data analysis methods. Regarding primary quantitative data, Microsoft Excel has been utilised for analyzing data from different charts and graphs. Additionally, for analyzing secondary data, this study has used thematic analysis and with help of thematic analysis the study uses a large amount of data on relevant topics to get broader and appropriate conclusions [16].

VII. Research Paradigm

This research has considered pragmatism philosophy because it used a mixed method to collect data and as per studies, pragmatism philosophy fits appropriately with research that used a mixed method. With help of pragmatism philosophy, this study can identify what secondary information wants to highlight and whether primary data matches with it or not

[17]. Next, this paper has chosen descriptive study design for describing, explaining, and validating some hypotheses when it comes to a specific topic, the importance of AI to spot malware and deliver cyber risk management. Lastly, it has considered an inductive approach for exploring phenomena, identifying themes, and creating a clear concept on the role of AI to spot malware and deliver cyber-security risk management.

VIII. Ethical Considerations

In order to complete the research work ethically, it has considered some research ethics and the first one is about taking voluntary consent. Since it has surveyed 50 respondents it took consent from the participants and allowed voluntary participation, where they have the right to withdraw their participation anytime, they want. Additionally, it has ensured privacy of participants so that their personal information would not be disclosed in public. Lastly, it has ensured data security to protect the data from any type of cyber-attacks. It has complied to regulations regarding "Data Protection in India" and followed its legal framework and regulation for protecting digital information and enhancing data security [18].

IX. Result and Collection

G.Primary Data Collection
1) Survey Results
Question 1
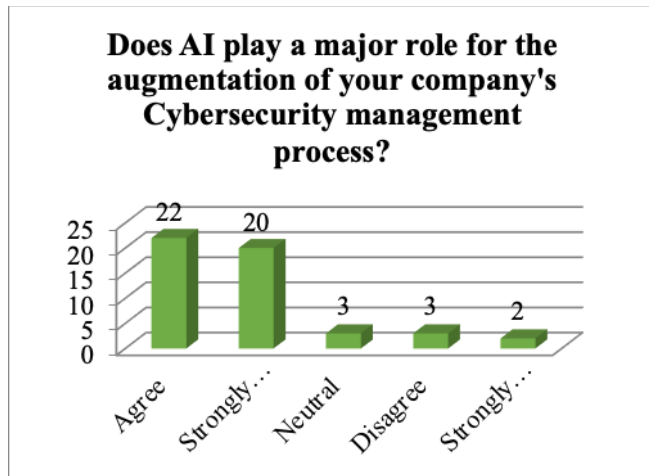
Figure 3: AI plays a major role within the augmentation process of company's cyber -security management system

According to the above figure, it can be observed that almost 42 respondents out of total 50 have agreed to the fact that AI-based solutions and its use have a major role within their business in terms of the cyber security management process. The use of AI-based solutions to analyse cyber threats are categorized into two different prices such as dynamic process and hybrid process. Companies use different phases to detect malware within their computer system through machine learning techniques such as android apps, extraction of

features, pre-processing, CVS file, and proposed modelling through "GRU (Gated Recurrent Unit)" and others [3].
Question 2
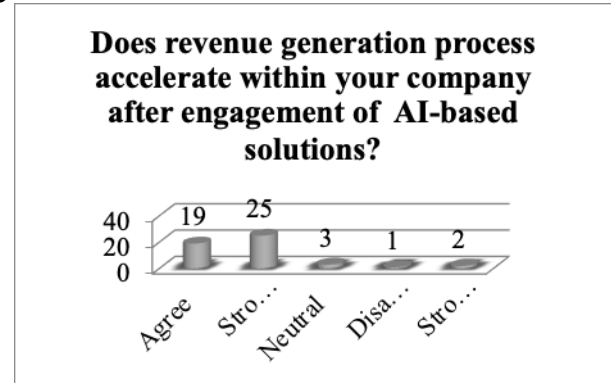
Figure 4: Revenue Generation Process of Companies have increased due to use of AI-based Cyber Security Risk Management Solutions

According to the above figure, it can be illustrated that most respondents have agreed with the fact that the overall revenue generation process of their company has been increased after their implementation of AI-based malware detection tools. As per reports, it has been found that, companies whether it is from IT industry, or any other industry uses antimalware scanner to maintain the agility and integrity of their recommendation engines that helps to enhance advertising campaigns. Cyber security systems with the help of AI-based solutions are an integral part of business processes that drive additional revenue [19].

Question 3
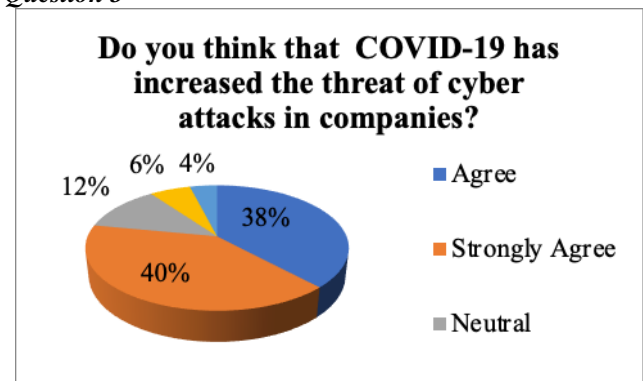
Figure 5: COVID-19 has increased the risk of cyber-attacks in different domain of the Society

As illustrated by this above figure, it can be stated that almost 78% of respondents point to a total of 50 employees having agreed that after COVID-19 pandemic, the risk within their organizations related to Cyber security have increased drastically. Due to this pandemic, employees are working remotely, and this has widened the scope for hackers to attack their computer system due to lack of a strong cyber security risk management process at home.

H.Secondary Data Collection (Thematic Analysis)

Themes	Main Focus
Theme 1	Effect of increasing technology investment in AI
Theme 2	AI for "ROS Forensic Investigation Process"
Theme 3	Java Malware detection by Microsoft 365 defender

Table 2: Overview of Themes

1) *Theme 1: Increase in Technology Investment for AI and MI has accelerated the focus on combating Cyber Risks*
Investment increased on AI-based cyber security, which has accelerated the process of combating cyber risk in various industries all over the world. It has been estimated that global spending on cyber security will exceed $1 trillion from 2017 to 2021. As per various reports, it has been found that almost 82% of firms have implemented "Machine Learning Cyber Security Solution", which is another part of AI Solution, into their Computer Science Engineering process, embedded within their IT section along with their entire management system. Apart from this 82%, almost 53% of remaining companies have a plan to implement AI-based cyber security solutions within their business process.
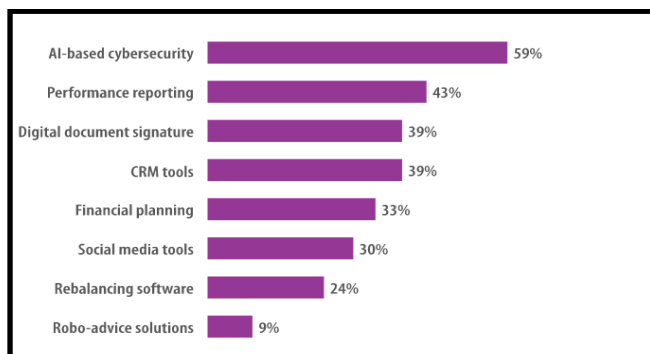
Figure 6: Investment in AI-based Cyber security Technology all over the World
(Source: [20])

According to this above figure, it can be observed that technology investment is highest for AI-based cyber security across the world. Investment in performance reporting and financial planning is lower than the fund allocated for implantation of AI-based cyber security risk management processes. This is effective for mitigating the risk of cybercrimes as much as possible within various industries and companies. Results from the third question of survey have stated COVID-19 as a major aspect of Cyber risk. It has been found that, the current COVID-19 pandemic has increased the level of cyber-attacks; as criminals have taken the advantages of changes in existing workplace [20].
As a result, the traditional cyber security management in most of the cases could not cope up with the new threats. As a result, increase in the technical investment by various countries to implant AI-based cyber security solutions can modern defers to companies within their CSE process [20]. AI-based solutions can provide a holistic cyber security risk management technology to secure several vital infrastructures for a company's IT process, which is essential of CSE. This increasing investment will also be effective for introducing technologies that are essential for assessing cyber risk posture proactively and accurately.

1) *Theme 2: AI helps in Ensuring Cyber Security to "ROS (Robotic Operating System)" Forensic Investigation Procedure*
COVID-19 outbreaks all over the world have been a major reason to transfer all the business and technology related processes to be done in an online platform. As a result, security differences are essential for this new world. AI-based security strategy has been a major area of concern for businesses all over the world to enhance their security system, which is an essential part of Computer Science Engineering. In various developed countries, it has been found that robots are used within the medical sector to fight against COVID-19 pandemic [21]. Robotic is a major part of computer science engineering, which is used within the NHS to combat with COVID-19 diseases by doing activities that are essential for care homes and hospitals as well. However, issues within the Robot Operating System are an essential part of robotic technology.
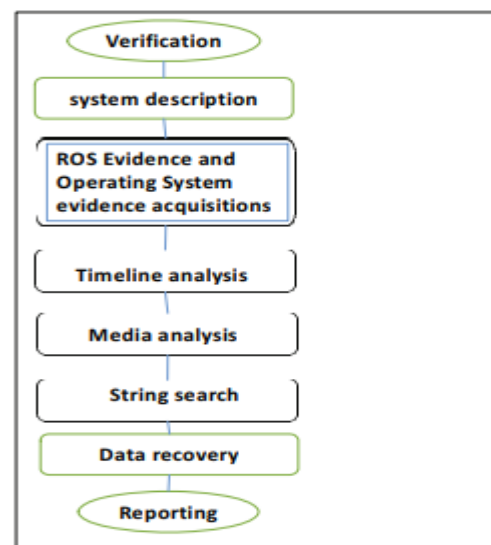
Figure 7: AI-based Framework for ROS Forensic Investigation
(Source: [21])

As a result, AI-based framework for ROS forensic investigation to resolve these issues is designed with different steps such as verification, system description, Acquisition of evidence from ROS, Timeline and Media analysis along with string research. Apart from these, data recovery and reporting forensic results are also included in this AI-based framework. This forensic investigation process of ROS is slightly different from any other normal investigation process of other digital devices [21]. This differentiation has mainly

been incorporated due to distinction of AI-based element characteristic within a robotic system. The security resilience based on the AI build framework for Robotic systems are mainly followed by different guidelines provided from Cyber Law, Network Security Act, and others.

2) Theme 3: Combating Java Malware is possible after considering Real-Time Machine Learning by Microsoft

Microsoft is a multinational technology corporation that deals with technical goods and services in the market. Some years earlier and still now, the Security research team members of this company have investigated that a surge in emails with malicious java has been found within their company. This malicious java malware uses new technologies for evading antivirus protections within their system. However, their technical team have engaged an automated expert system and real time protection with the help of machine learning technique, which is a major part of AI to avoid this particular risk of malware. It has been found that attackers use "Webtoos malware" to target Linux and Windows systems way before any vulnerability found within the process and Microsoft defender is useful to protect computers from malicious hackers [22].

Microsoft Defender 365 portal has a toolbar that includes a malware view to detect emails that have malware zip in it. Security team of this company works 24*7 to maintain this system portal (Microsoft). Attackers mainly change their methods and tools to attack system software with malware by going through various programming languages. The company has identified that they have changed the process of installation of NSIS for evading AV and delivering ransomware. Researchers of this company's IT field have used "Microsoft intelligent security graph" for monitoring threats generated from a wide range of network sensors [23].
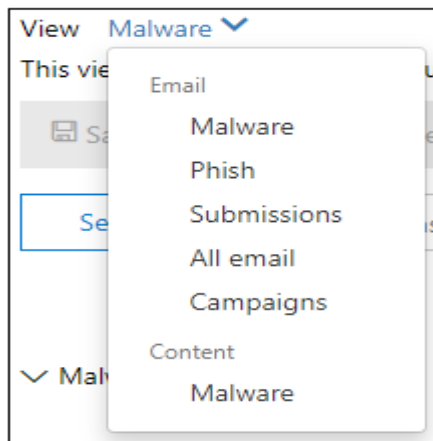
Figure 8: Microsoft 365 Defender Portal for Combating Malicious Content

(Source: [24])

The above figure shows the way under which Microsoft 365 defender identifies suspicious emails that have Java malware attached with a zip file. Moreover, Search Azure Resource Graph data is essential for those resources that are found to be affected by malware attacks generated from Webtoos. This could query a resource with complex filtering, grouping, and sorting processes [25]. Cloud-based machine learning

protections used by this company within their Microsoft defender antivirus can block many new and unknown variants.

X. Conclusion

AI has become a major part in this digital era and people now extensively use AI-related services and products. Nowadays, people use AI for making intelligent machines for helping needy people. This research has done a robust literature review on the selected topic as it has reviewed the role of AI in case of cyber-security and spotting malware. The findings of this paper have paid attention to several areas that highlighted use of AI by different organizations and their employees to ensure cyber-security and cyber threats. This research has found that if technology investment regarding machine learning and artificial intelligence is increased then businesses or IT companies can effectively reduce the risk of cyber-attacks. Therefore, it can be concluded that in this digital era, when people are connected to internet for 24*7 and share their information, the chances of cyber-attacks and cyber threat is very high. Thus, by investing in technology such as AI and ML, organizations can do cyber security management.

Additionally, study findings showed that AI-based security systems play a crucial role in business concerns for enhancing security systems that are also a critical part of Computer Science and Engineering. AI ensures cyber security towards robotic operations systems and forensic investigation, which means AI, has been successfully implemented in several industries from technological industry to healthcare. Therefore, it can be concluded that implementation of AI systems can help businesses to enhance their security systems like Microsoft who changes their tools and systems to attack malware systems by implementing various useful programming systems.

XI. Recommendations

Securing decision-making system of AI

One of the major security-related risks towards AI system potential regarding adversaries is for compromising integrity of decision-making procedures so that these adversaries do not create any choice in the way that design would desire [10]. Therefore, to accomplish this, businesses can directly control AI systems so that it can decide what output system generates as well as what decision this new AI system makes. With help of this new AI system businesses can ensure cyber risk management, where if attackers try to influence those decisions, it fails their input.

Investment on Technology and cyber security management

Since this research has found that AI has proved that it has a huge positive impact on cyber-security, businesses can focus on technology investment, where they can implement new AI-systems, which will reduce the risk of cyber threat and ensure cyber-security management [12].

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Techno-Economic Analysis of Distributed Solar Photovoltaic Using the Third-Party Ownership Business Mode

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Abstract

The automotive industry continues to grow in Indonesia, this field was chosen as a priority for the five manufacturing sectors in the government's Making Indonesia 4.0 program. It will have an impact on the growth of electricity consumption in the automotive sector by 6% per year in the fourth quarter of 2021. It is necessary to increase electricity capacity using renewable electricity to achieve green manufacturing industry. The application of distributed solar photovoltaic (DSPV) on the consumer side is one of the best alternatives to compete internationally as clean energy-based companies. As is well known, DSPV investment is still a challenge for industry players, so the third-party ownership (TPO) business model is an alternative solution to overcome this problem. The purpose of this study is to analyze the techno-economic of DSPV with TPO business model with three schemes, namely on-grid, stand-alone, and hybrid, with a case study of the ATPM – S1 factory. The methodology used is to design the capacity and operating system of DSPV and its technical performance using Homer Pro software, then analyze the economic performance with the cash flow method using 3 tariff scenarios (the ceiling price is equivalent to the PLN I-3 tariff, varied, and the base price is when IRR equals WACC), he TPO business scheme is analyzed by leasing solar fixed rent (FR) and performance-based rent (PBR) schemes. The results of this study indicate that the on-grid scheme with a DSPV capacity of 204 kWp, operates from 06.00 s.d. 18.00, with an investment value of 185,740 USD. The IRR values of the three FR tariff scenarios are 10.17%, 10.032%, and 9.24%, respectively, while the PBR are 9.305%, 9.168%, and 8.386%, respectively. The stand-alone scheme produces a DSPV capacity of 1,570 MWp with a Battery Energy Storage System (BESS) of 9,000 kWh, operating for 24 hours, with an investment value of 2,803,988 USD. The IRR values for the three FR and PBR tariff scenarios are the same at -13.44%, 10.295%, and 9.24%, respectively. The hybrid scheme produces a DSPV capacity of 800.28 kWp with a BESS of 4,000 kWh, operating for 24 hours, with an investment of 1,376,712 USD. The IRR values of the three FR scenarios are -3.89%, 10.77%, and 9.24%, while the PBR are -4.93%, 9%, and 7.48%, respectively. The IRR value for PBR is lower than FR, because PBR inhibits the decrease in solar panel power. The hybrid scheme with scenario 1 has O&M always above revenue. So, the application of TPO DSPV distributed to ATPM – S1, is only feasible to use the fixed rent on-grid solar leasing scheme.

I. INTRODUCTION

Industry in Indonesia is currently growing, especially the automotive manufacturing sector, which has a major role in advancing the national economy. Currently, as many as 22 four-wheeled or more automotive companies have been appointed by the government as sole agents for brand owners (ATPM) in charge of managing vehicle brand distributors. For ATPMs who have a manufacturing business license, they can carry out the manufacturing process to assembly, while ATPMs who do not have a business permit only place orders for the type of vehicle that can be sold [1]. The total investment of all ATPMs is IDR 99.16 trillion, with a total production of up to 2.35 million units per year in Indonesia and can absorb 38.39 thousand human resources [2]. Providing a positive economic impact and having eligibility criteria in accordance with the market, making automotive selected as a priority for the five manufacturing sectors in the government's Making Indonesia 4.0 program, with the target of Indonesia becoming the largest car producer in ASEAN.

To support this development target, the government must ensure the availability of industrial infrastructure. One of them is the energy source as stipulated in the Industrial Law no. 3 of 2014, in the form of obligations of the central and local governments in providing energy for small and large industries. This of course has the impact of increasing energy demand, as can be seen from the growth rate of electricity consumption in the automotive sector by 6% year on year in the fourth quarter of 2021. However, to ensure the availability of electricity, the government cannot rely on additional fossil energy capacity in the future, because Indonesia has committed to implement the renewable energy (RE) portfolio mix of 23% by 2025 [3].

Investing in distributed solar photovoltaic (DSPV) is an alternative source of environmentally friendly electricity that can be used alone and supplied directly to the load. Without investment in distribution lines, land, and operating costs of raw materials, this plant can utilize the energy contained in solar irradiation to reduce or replace electricity consumption from the PLN grid. Indonesia as a tropical country has an abundant average daily irradiation potential of 4.8 kWh/m2, if this potential is maximized, the potential electricity capacity that can be generated is 207.8 GW [4]. However, capital investment in DSPV is still quite high, there are several obstacles, especially the lack of innovative business models and appropriate financing mechanisms.

There is an innovative business model that can distribute the burden of capital investment of DSPV and operational costs to customers, namely the third-party ownership (TPO) business model. In the United States, the adoption of this model grew DSPV installations from a rate of 10-20% in 2009 to 65% in 2013 [5]. In the last few decades, the TPO business model has become very popular where DSPV is owned by the developer, then can be leased under a solar leasing scheme or purchased with a Power Purchase Agreement (PPA) scheme, replacing the owned-host (OH) scheme which all investment cost by customer. Previous research has examined the comparison of OH and TPO business models in DSPV in America, China, Europe, and developing countries [5][6][7][8] and another study analyzed the techno-economy of distributed solar power plants on-grid and stand-alone configurations with the OH scheme [1][9]. Since the lack of research analyzing the technical and economic aspects of DSPV and TPO will face challenges in the administration of electricity transactions to industrial parties, because the supply of electricity has been controlled by the state, PLN is declared to have had a business license in terms of providing electricity to the wider community, as stated in Law no. 30 the year 2009 [13]. Therefore, this study conducted technical analysis using the DSPV design optimization method for on-grid, stand-alone, and hybrid configurations and economic analysis using the cash flow method using three scenarios of electricity tariffs using the TPO model in ATPM – S1, one of the ATPMs used has an automotive manufacturing business license, headquartered in Japan and has a branch in Sunter, Central Jakarta.

II. METHODOLOGY

The research process starts from identifying the potential for sunlight using Solargis and the electrical load profile in ATPM – S1 as the object of research. Both data were designed using Homer Pro to obtain the capacity and system operation of three distributed on-grid, stand-alone, and hybrid DSPV schemes to determine the most optimal design. Furthermore, the investment value of the two schemes will be obtained and tested with three tariff scenarios. The economic feasibility of the power plant is approached with the cash flow method and the TPO business model of the solar leasing scheme, namely fixed rent (FR) and performance-based rent (PBR), to obtain the IRR value for each scenario.

The location of ATPM – S1 manufacturing is in North Jakarta, Indonesia, with coordinates 6.2° south latitude and 106.9° east longitude, precisely in the Sunter area, Tanjung Priok District [1]. ATPM – S1 receives a full power source by PT PLN at a regular I-3 tariff of one feeder 20kV. The electrical system in the assembly line area is 400 V, 3-phase. The potential land used for the DSPV area in the ATPM – S1 area is to utilize the factory roof area to avoid shadows that will cover the solar panels. The estimated roof area of the building is 10,000 m^2 in Figure 1.
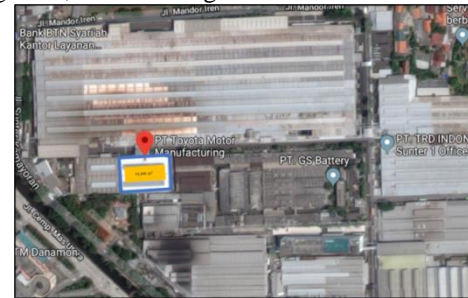
Figure 1. ATPM – S1 General Plan

A. Irradiance Potential

Solar irradiation is the power per unit area received from the Sun in the form of electromagnetic radiation. The SI unit of solar radiation is watts per square meter W/m^2 [10]. ATPM S-1 is located in Indonesia, a country with a tropical climate and close to the equator that gets abundant sunlight throughout the year, has an average global horizontal irradiance (GHI) potential of 1,732 kWh/m^2, with an average annual temperature of 27.5° C. The data is taken based on a map from solargis (https://solargis.info/imaps/) with avarage daily GHI is 4.76 kWh/m^2.

B. Load Profile

Figure 2 shows the daily electrical load profile of the assembly line system before getting dispatch from DSPV during 24 hours. The peak load at 155.064 kW and total energy 3,137.29 kWh per day, as considered of power losses in the electrical system, both wiring, panels, and in motor windings, the calculation of the total power and energy added by 30% and obtained from the values of demand factor 0.3 and power factor 0.8 [1].
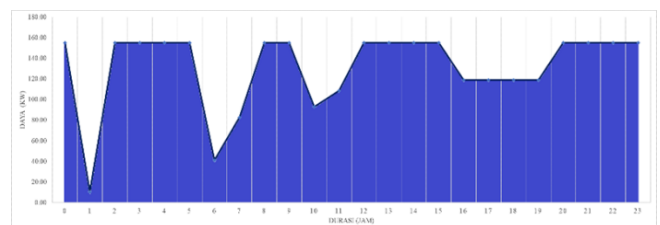
Figure 2. Daily Electrical Load Profile Assembly Line System

The electricity consumption in the assembly line process is dominated by the test bench package system, bolt tightening machines, and conveyors with intermittent or non-continuous operating time.

C.Homer Modeling

After obtaining load profile data and irradiation potential at the research object location with Solargis, DSPV can be designed to produce the required operating system and capacity.

Furthermore, the power capacity that can be generated can be based on equation 1.

$$P_{gen} = Irradiance \times Available\ Area \times \eta \qquad (1)$$

P$_{Gen}$ is DSPV power generated (kW), irradiance in W/m², and η is the solar cell module efficiency. Then, the total area required for the installed modules can be calculated in equation 2.

$$Area = N_{inst} \times Area\ module \qquad (2)$$

Area shows the required total area for solar panels in m², N$_{inst}$ is the number of solar cell modules, and area module explains area on each solar cell module (m²).

Moreover, to calculate BESS capacity, for stand-alone and hybrid schemes, firstly determine the amount of energy needed for 24 hours when the solar panels are not producing power, shows in equation 3.

$$Cap_{Battery} = \frac{E_{Save} \times Dur}{V_{Batt} \times \eta_{Batt} \times DoD} \qquad (3)$$

Cap$_{Battery}$ is required battery capacity (Ah) to represent E$_{save}$ as energy saved (Wh) multiply Dur as duration, the length of time the electrical energy stored in the battery is used when it is not there is sun (autonomy). Divided by V$_{batt}$ as battery voltage, η_{Batt} as Battery Efficiency, DoD as Depth of Discharge of battery. This study uses a Li-ion battery, because it has many advantages in energy density, efficiency, lifetime, and environment friendly comparing to other types of batteries [11].

The diesel generator capacity, for hybrid scheme, is determined from the peak load on the ATPM – S1 with a minimum load value of 30%.

A. Economic Analysis

IRR stands as an indicator used to measure the profitability of an investment project. The higher the IRR, the greater the profitability of the project. In addition, the IRR is the discount rate that makes the NPV of all cash flows equal to zero or break even, calculated by equation 4 [12].

$$IRR = \sum_{t=0}^{N} \frac{C_t}{(1+IRR)^t} = 0 \qquad (4)$$

Variable t is used to express time period, with N for period year. C$_t$ is for annual cash flow in year N.

The NPV value is an indicator used to evaluate the profitability of an investment project by adding up all cash inflows and outflows over the life of the project. A positive NPV indicates that the project's revenue exceeds the expected costs, meaning the project is profitable, while a negative NPV will cause a net loss. The NPV value can be seen in equation 5 [12].

$$NPV\ (i,N) = \sum_{t=0}^{N} \frac{C_t}{(1+i)^t} \qquad (5)$$

i is financial discount rate which refers to bank interest, t shows time period, N expresses period year of contract, and C$_t$ for showing annual cash flow in year N.

DSPV on-grid scheme produces electrical energy (kWh) directly to customers on the downstream side, so revenue is calculated from the energy savings consumed from PLN on equation 6.

$$Revenue = SE \times T_{year} \qquad (6)$$

SE is saleable energy (kWh) which consumed by customer during contracted period and multiply with T$_{year}$, as tariff DSPV. PLN Tariff I-3 (USD/kWh) which is used as the ceiling price. Meanwhile, for the stand-alone and hybrid scheme used by factories for 24 hours will be subject to time of use (ToU), namely Peak Load Time (WBP) and Outside Peak Load Time (LWBP).

B. Business Model

The third-party ownership (TPO) business model used in this research is a solar leasing scheme, shown in Figure 3, since PPA contracts directly to customers cannot be carried out in Indonesia in accordance with Decision Number 111/PUU-XIII/2015 [13]. Special purpose vehicle (SPV) arranges the financing from debt and equity to owning the DSPV then sell the generated energy to customer.
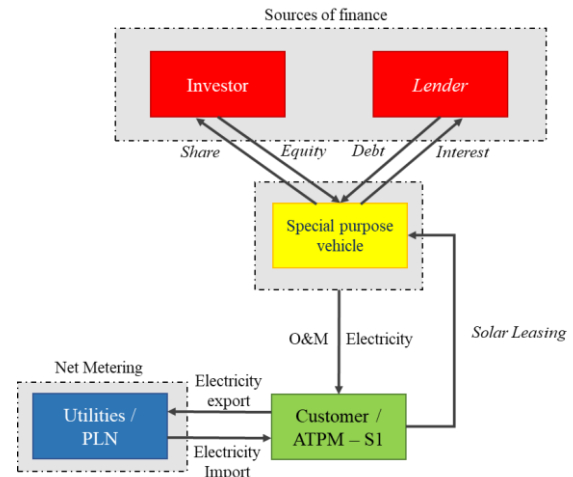
Figure 3. Model TPO Solar Leasing

Customer pays monthly DSPV rental fees with a no-upfront cost scheme or no investment costs, customers only prepare DSPV rooftop or land area. Moreover, if the energy produced is greater than the factory load, then the energy is exported by customer to the PLN network (net metering regulation from Minister of Energy and Mineral Resources Regulation 26 of 2021). Table I shows fixed rent (FR) and performance-based

rent (PBR) solar leasing schemes with their characteristics [6].

TABLE I. SOLAR LEASING CONTRACT SCHEMES

Description	*Fixed Rent*	*Performance-Based Rent*
Payment	Irrespectively generated energy	Based on generated energy
Tariff	Fixed	Fluctuate based on utilities' or PLN's tariff trend
Net-metering to grid	Customer	Customer

III. RESULTS AND DISCUSSION

3.1 Technical Assessment

A. On-Grid

In the on-grid scheme, the optimal DSPV capacity result is 204,120 kWp. With details of DSPV performance in Table II. The area required is 1,099.98 m^2, the factory roof area covers the required area. The schematic is shown in Figure 4, where the solar panel is connected to an inverter of 177 kW to convert DC electrical power into 3-phase AC that can be used by the factory load needs during the day.
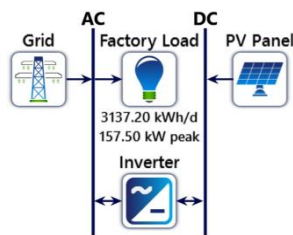
Figure 4. On-Grid Schematic

The load system is connected to the grid which indicates that the factory load outside of the solar cell production time will be supported by the PLN distribution network.
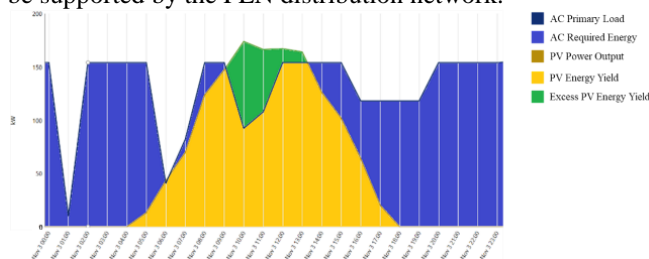
Figure 5. On-Grid Scheme Dispatch Profile

The curve in Figure 5 shows the comparison of the amount of on-grid DSPV production against the daily load profile, taken on November. Solar cells can allocate factory electricity use during the day on a yellow curve with an average daily energy produced of 801 kWh with a capacity factor (CF) of 16.3%. There is more energy because when DSPV produces maximum electricity from 10:00 to 14:00, the factory electricity load is reduced from 09.00 to 12.00, so that excess energy can be exported to the PLN network.

B. Stand-Alone

In the stand-alone scheme, the power source will depend on solar cells and not connected to the PLN network, so the DSPV capacity needed to support electricity for 24 hours is 1,570.32 kWp with details of DSPV performance in Table II. The area needed is 8,462.28 m^2. This scheme has a schematic as shown in Figure 6, where the solar panels are connected to a DC bus with a Battery Energy Storage System (BESS) with a total capacity of 9,000 kWh which is equipped with a battery charger controller, each battery has a capacity of 100 kWh arranged in parallel as many as 90 batteries.
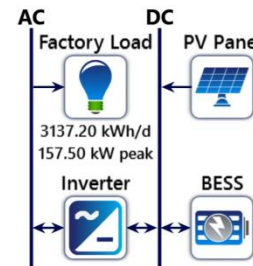
Figure 6. Stand-Alone Schematic

Furthermore, the DC bus is also connected to an inverter with a total power of 250 kW to convert DC voltage from solar cells and batteries into 3-phase AC to load. The AC power can be used by the factory load for 24 hours.
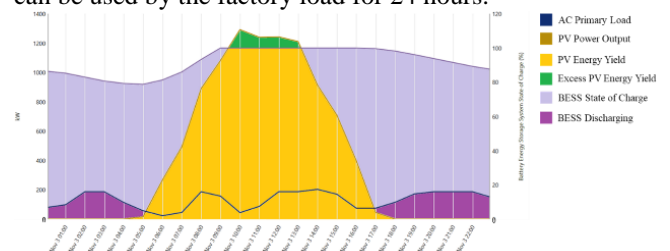
Figure 7. Stand-Alone Scheme Dispatch Profile

Figure 7 is a simulation result of the solar cell production curve and BESS status on the daily load profile curve taken on November. It can be seen that solar cells can allocate factory electricity use during the day and charge batteries on a yellow curve with an average daily energy produced of 5,930 kWh with a capacity factor (CF) of 15.7%.

There is more energy because at 08.00 to 16.00 the battery is already at 100% SOC status. Excess energy can only be utilized by adding batteries or loads, because the system is not connected to the PLN electricity network. This generally occurs in the dry season, which has high irradiation, but during the rainy season, the solar cells do not expend more energy than the BESS capacity. It can be seen at 17.00 SOC the battery begins to decrease continuously until 05.00 or called the discharging process, this is in order to support the electricity needs of the factory outside of solar production time. It can be seen that the total area comparison between battery energy capacity and energy at load for 24 hours, this capacity has been considered when solar cells are not producing optimally due to low irradiation due to weather, especially rain, with an autonomy value of 55.1 hours.

C. Hybrid

In the Hybrid scheme, the power source will depend on solar cells and generators when insufficient solar irradiation is stored in the BESS, so the DSPV capacity required to support electricity for 24 hours is 800.28 kWp with details of DSPV performance in Table II. The area needed is 4,312.62 m^2. This scheme has a schematic as shown in Figure 8, where solar panels are connected to a DC bus with a Battery Energy Storage System (BESS) with a total capacity of 4,000 kWh

Figure 8. Hybrid Schematic

which is equipped with a battery charger controller, each battery has a capacity of 100 kWh arranged in parallel as many as 40 batteries. Furthermore, the DC bus is also connected to an inverter with a total power of 246 kW to convert DC voltage from solar cells and batteries into 3-phase AC to load. The AC power can be used by the factory load for 24 hours by getting a backup power source from the generator.

Figure 9. Hybrid Scheme Dispatch Profile

In condition BESS cannot support the load, due to low solar panel irradiation, the generator will penetrate intermittently. Figure 9 shows that the generator does not operate every day or is not continuous, BESS status, and generator operating time against the daily load profile curve taken on April 30. It can be seen that solar cells could allocate factory electricity use during the day and charge batteries on a yellow curve with an average daily energy produced of 3,022 kWh with a capacity factor (CF) of 15.7%.

There is more energy around 10:00, because the solar panel production exceeds the 100% BESS SOC capacity. Excess energy can only be utilized by adding batteries or loads, because the system is not connected to the PLN electricity network. Generally, the system will support 24-hour electrical loads using BESS, but during the rainy season or certain times of the year, solar panels cannot produce optimal power. It can be seen at 17.00 SOC the battery starts to decrease continuously until 05.00 or called the discharging process. The generator will operate when BESS which is filled with solar panels cannot meet the needs of the electrical load, thus helping BESS for the charging process. It can be

seen that the total area comparison between battery energy capacity and energy at load for 24 hours, this capacity has been taken into account when solar cells are not producing optimally due to low irradiation due to weather, especially rain, with an autonomy value of 24.5 hours.

TABLE II. DSPV CAPACITIES

Parameter	On-Grid	Stand-Alone	Hybrid
PV Capacity	204.12 kWp	1570.32 kWp	800.28 kWp
Required area	1,099.98 m^2	8,462.28 m^2	4,312.62 m^2
Battery Capacity	-	9,000 kWh	4,000 kWh
Genset Capacity	-	-	230 kW

All required areas are smaller than 10,000 m^2. So, that technically all schemes are feasible to be installed in the ATPM – S1 area.

3.2 Economic Assessment

Table III presents the total investment in three DSPV schemes. It can be seen that the ratio of on-grid, stand-alone, and hybrid solar panel investment comparisons is equivalent to a ratio of 1: 7.7: 3.9 and the overall system is 1: 15: 7.4.

TABLE III. CAPITAL EXPENDITURE

Description	*On-Grid* (USD)	*Stand-Alone* (USD)	*Hybrid* (USD)
Solar PV	110,650	851,572	434,074
BESS + Charger Control	-	1,404,000	624,000
Inverter + Monitoring	4,692	6,628	6,521
Diesel Generator	-	-	35,949
Balance of System (BoS)	16,320	125,600	64,022
Mounting	40,800	314,000	160,65
Engineering & Installation	13,278	102,189	52,089
Land / Rooftop	-	-	-
Total	**185,740**	**2,803,988**	**1,376,712**

The amount of investment in the stand-alone scheme is dominated by BESS components which exceed the main components of solar panels because of their large capacity to meet the factory's electricity needs for 24 hours and must be replaced in the 11th year. Meanwhile, for the hybrid for 24 hours of electricity supply, the capex for solar panels and BESS is significantly reduced, with the addition of the generator capex value.

Each scheme produces O&M values based on the capacity of solar cells, BESS, and diesel generator. In the on-grid scheme there is a monthly capacity charge fee that is accumulated in 1 year, because this system is included in the PLN parallel

operation category, while it does not apply to the stand-alone and hybrid schemes as shown in Table IV, the high O&M value in the hybrid scheme is generated by the consumption of diesel.

TABLE IV. ANNUAL EXPENDITURE

Description	*On-Grid* (USD)	*Stand-Alone* (USD)	*Hybrid* (USD)
O&M	1,481	22,431	14,107
Capacity Charge	668.61	-	-
Total	**2,150**	**22,431**	**14,107**

TABLE V. CASHFLOW COMPARISON

Scheme	Tariff			IRR		NPV		PBP	
	Scenario	USD/month	USD/kWh	FR	PBR	FR	PBR	FR	PBR
On-grid	Scenario 1	1,740.65	0.0714	10.17%	9.305%	59,415	52,596	11.36	11.82
	Scenario 2	1,730.18	0.0710	10.03%	9.168%	58,508	51,655	11.45	11.91
	Scenario 3	1,669.69	0.0685	9.24%	8.386%	52,837	46,226	11.99	12.49
Stand-Alone	Scenario 1	6,816.32	0.0714	-13.44%	-13.44%	-1,338,350	-1,338,350	85.6	85.6
	Scenario 2	28,559.30	0.2992	10.29%	10.29%	860,803	860,803	12.36	12.36
	Scenario 3	27,559.23	0.2888	9.24%	9.24%	761,948	761,948	13.35	13.35
Hybrid	Scenario 1	6,816.61	0.0714	-3.89%	-4.93%	-300,753	-331,600	38.7	41.87
	Scenario 2	20,731.37	0.2172	10.77%	9.00%	447,196	356,576	10.45	13.16
	Scenario 3	20,014.08	0.2097	9.24%	7.48%	376,360	288,876	13.15	14.97

All scenarios are re-examined with the FR and PBR solar leasing schemes, where with three tariff scenarios in Table V. PBR on-grid resulted in a lower IRR value, because the income adjusted for the performance of solar panels decreased gradually by 0.55% per year. This impact puts scenario 2 PBR under the WACC, making it economically infeasible. Whereas in the stand-alone scheme, the IRR value between FR and PBR is the same, because the amount of excess energy in the stand-alone BESS system, worth 886,218 kWh/year, causes a total decrease in solar panel performance of 12.3% for 25 years, can be fully covered. In addition, the solar leasing scheme for stand-alone, all ATPM – S1 loads are fully dependent on DSPV, so there is no reduction in electricity consumption. In the hybrid scheme, the comparison of the IRR value between FR and PBR is very large, because the amount of solar consumption value increases to replace the performance of solar panels that decreases every year.

The comparison of the tariffs for the three schemes can be seen in scenario 3, with IRR value equal to 9.24%, the required tariff is a ratio of 1: 4.2: 3.06. This scenario is not feasible because generated IRR is allocated only for WACC. On the other hand, in scenario 1 on-grid is the only scheme that has positive IRR and NPV, while stand-alone and hybrid are negative, it caused by the tariff following PLN I-3, 0.0714 USD/kWh, could not give the proper turnover to supply continuously the electricity in 24 hours. Although, scenario 2 distributes all IRR and NPV positive in every configuration and solar leasing schemes, only on-grid FR has IRR above WACC and tariff is below the ceiling price.

Before applying the TPO, ATPM – S1 regularly pay the electricity bill to PLN around 90,942 USD per year. TPO provides different form and benefit on three configuration schemes that summarized on Table VI. It shows all schemes and scenarios that impacting electricity bill efficiency for customer and revenue for SPV during the TPO contract both for FR along contract and PBR on first year.

TABLE VI. COMPARISON OF CUSTOMER BENEFIT BUSINESS MODEL TPO DSPV ON-GRID

Scheme	Scenario	SPV Revenue (USD/year)	Customer Efficiency (USD/year)
On-Grid	Scenario 1	20,888.7	-
	Scenario 2	20,762.1	126.6
	Scenario 3	20,031	857.7
Stand-Alone	Scenario 1	81,799	-
	Scenario 2	342,620	(251,678)
	Scenario 3	330,711	(248,911)
Hybrid	Scenario 1	81,799	-
	Scenario 2	248,720	(166,921)
	Scenario 3	240,132	(158,332)

After undergoing an on-grid TPO contract (efficiency), without incurring upfront costs, total allocated electricity from PLN is 20,888 USD/year showed by scenario 1. Then, scenario 2 shows lower revenue for SPV with customer efficiency is 126.6 USD per year or a decrease of 0.139% from the previous payment to PLN. Furthermore, after the contract is completed, the efficiency of 20,888 USD per year will be obtained by customers continuously. Scenario 3 shows the cumulative benefit for SPV and customer is 857.7 USD/year.

Moreover, for the stand-alone scheme, Table VI shows on the customer side, none of the scenarios provides benefits, because the leasing rate obtained in this scheme is higher than the PLN tariff. During the contract customer pays 342,620 USD/year to SPV or equivalent to 3.7 times of the initial cost. There is an additional cost of 251,678 USD/year to replace the customer's existing system with a fully distributed DSPV power source. Benefits to customers begin to be received when the contract has been completed and the DSPV depreciation value has been exhausted, customers do not need to pay to PLN and SPV for electricity for industrial operational needs.

For the hybrid scheme, on the customer side, none of the scenarios provides benefits, because the leasing rate obtained in this scheme is higher than the PLN tariff. During the contract pays 248,720 USD/year to SPV or equivalent to 2.7 times the initial cost. There is an additional cost of 157,778 USD/year to replace the customer's existing system to a fully distributed DSPV power source. Benefits to customers begin to be received when the contract has been completed and the DSPV depreciation value has been exhausted, customers do not need to pay to PLN and SPV for electricity for industrial operational needs.

IV. CONCLUSION

The capacity of DSPV on-grid scheme is 204,120 kWp, daily energy is 801 kWh, area is 1,099.98 m^2. Stand-alone capacity is 1,570,320 kWp, BESS 9,000 kWh, daily electricity of 5,930 kWh, area 8,462.28 m^2. Hybrid capacity of 800.28 kWp, daily electricity of 3,021.73 kWh, BESS of 4,000 kWh, generator of 230 kW, area of 4,312.62 technically all three are feasible to be applied in ATPM - S1.

The total investment in materials and services in on-grid DSPV is USD 185,740, on stand-alone it is USD 2,803,988, and USD 1,376,712 for hybrid. The total annual cost for on-grid DSPV is USD 2,150, USD 22,431 for stand-alone and USD 14,107 for hybrid. Capex in the hybrid scheme can be reduced by replacing the capacity of solar panels and BESS with generators, but increases the O&M value for diesel fuel. The IRR values of the three scenarios of the on-grid solar leasing fixed rent scheme are 10.17%, 10.032%, and 9.24%, while the PBR are 9.305%, 9.168%, and 8.386%. In the stand-alone scheme, the IRR values of the three scenarios between fixed rent and HBWs are the same, amounting to -13.44%, 10.295%, and 9.24%. In the hybrid solar leasing fixed rent scheme, it is -3.89%, 10.77%, and 9.24%, while PBR is -4.93%, 9%, and 7.48%. All IRR values

for PBR are lower than fixed rent, because PBR refers to the actual performance of solar panels that experience power degradation of around 0.55%/year.

A proper TPO application is to use the on-grid scenario 2 solar leasing fixed rent (FR) scheme. SPV has an annual revenue of 20,762 USD and the customer gets an annual efficiency of 126.6 USD during the contract.

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Modification of a window-type air conditioning unit using heat energy recovery system as a demonstration equipment

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Abstract

This study aims to develop a demonstration unit for a heat recovery system using a window-type air conditioning unit. This demonstration unit intends to equip students with the knowledge necessary to improve the utilization of energy in air conditioning systems. The modification includes the combined integration of heat energy recovery ventilation and evaporative cooling which involves mainly an evaporative cooler, enthalpy wheel, and blowers and air filters for indoor and outdoor air.

The performance of the unit was evaluated at various conditions such as a) idle pump, b) operational pumps with variable combinations of speed and discharge categorized as low, medium, and high. The dry-bulb temperature, humidity ratio, and relative humidity were recorded and are used to determine the temperature difference, moisture effectiveness, and sensible effectiveness. The result showed a significant improvement in the performance of the unit indicated by the following findings for the supply and return air:

a) a decrease in the temperature indicating positive sensible effectiveness, b) decrease in humidity ratio indicating positive moisture effectiveness, c) a and b has resulted to a heat recovered in the system indicating a lower energy consumption. A better result was observed when the evaporative cooler was used.

Keywords

enthalpy wheel, evaporative cooling, moisture effectiveness, sensible effectiveness, temperature difference

I. BACKGROUND, MOTIVATION AND OBJECTIVE

For mechanical engineering and air conditioning technician students, it is very important that they must have in-depth knowledge and understanding of the concept of air conditioning systems and learn the potential ways to improve its performance. In understanding and learning the concept of air conditioning, it is imperative that they must be thought through both the theory and practicum. Connecting theory and practice has always been a challenge for faculty. Laboratory work is seen as an important component of students' formation [1]. Practicum activities are done using the laboratory enhance both the knowledge and skills of students. The laboratory experiments help students understand science subjects effectively; hence, these are an integral part of science education [2]. Analysis based on recalling learning showed that students remember observable aspects of the practical task such as identification of apparatus and the testing procedure within one year, but it does not assist them to learn theory and calculations though it has been totally covered during the practical lesson [3].

The air conditioning market in the Philippines reached $8.45 billion in 2018, growing at a CAGR of 4.55% during 2019-2025 [4]. This entails a potential increase in demand for air conditioning technicians and experts aside from the need to find potential ways to improve its performance particularly in terms of energy consumption and the negative environmental impact.

II. STATEMENT OF CONTRIBUTION/METHOD

Air Conditioning is defined as the process of treating air, to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of the conditioned space. To achieve this, several mechanical components are being used. A basic air conditioning system is composed of a compressor, condenser, expansion valve, and evaporator. Each component is very vital to control the properties of air to achieve the desired condition.

Some of the issues with the use of air conditioning systems are the negative impacts of the refrigerant and the high energy consumption of the system. The negative impacts of refrigerants are normally measured using indices such as Ozone Depletion Potential (ODP), Global Warming Potential (GWP), and Total Equivalent Warning Impact [5]. Without major efficiency improvements to cooling equipment, electricity demand for cooling in buildings could increase by as much as 40% globally by 2030 [6].

This study made use of a modified air conditioning system by using a heat energy recovery system. This system took advantage of the heat transfer between the cold indoor and hot exhaust air by using the concepts of energy recovery ventilation (ERV) and evaporative cooling system (ECS).

Energy recovery systems; also called total energy recovery, transfer both the latent and sensible heat by using enthalpy or rotary wheel [7]. In the enthalpy wheel, the heat and moisture from the fresh air is absorbed by the exhaust air through the enthalpy wheel and thus the fresh air is cooled and dehumidified to an extent closer to the room condition [8] [9]. Through the rotation of the wheel, heat and moisture is absorbed or transferred [10]. The desiccant and the substrate will absorb the moisture resulting in the dehumidification of the supply air and humidification of the exhaust air [8].
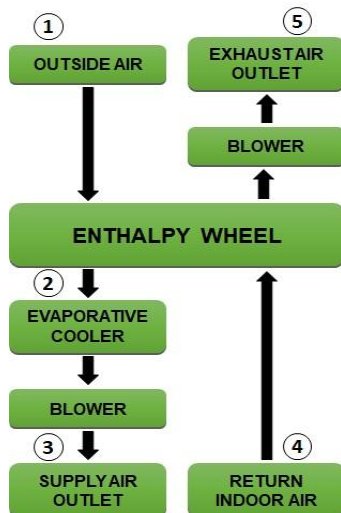
Figure 1. Process flow of the air conditioning system with heat energy recovery ventilation and evaporative cooling system

The process flow of the system is shown in Figure 1. As the ambient outside air enters the system, it will pass through the enthalpy wheel resulting in a decrease in temperature and moisture (see Figure 2). Then, further cooling and dehumidifying occur as it passes through the evaporative cooler. The significant decrease in temperature and humidity increases the ability of the air to absorb heat and moisture in the conditioned space. The air is then supplied to the conditioned space using a blower. Then it will leave the conditioned space as return indoor air with higher temperature and humidity. The loss of energy and moisture in the supply air in the enthalpy wheel is due to the heat and moisture transferred to the exhaust air.
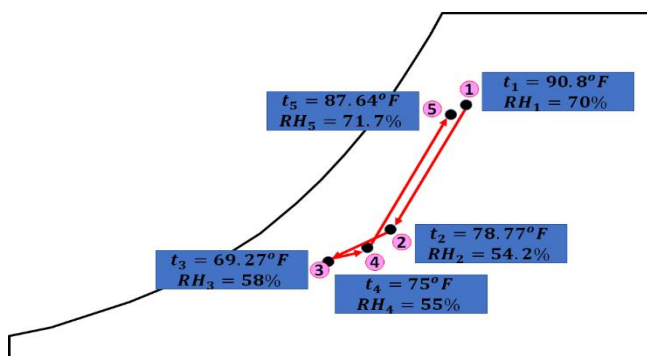

Figure 2. The psychometric processes in the air conditioning system integrated with heat recovery ventilation and evaporative cooling system

The basic components of the air conditioning system with ERV and ECS is shown in Figure 3. The system is provided with air filters to remove impurities from the air. A centrifugal blower is used to regulate the speed and volume of an air stream and then displaces air radially. The enthalpy or rotary wheel made of aluminum foil sheets with a honeycomb structure coated with a silica gel layer is where the partial transfer of heat and moisture between the supply and exhaust air occurs. A direct evaporative cooler made of cellulose material with honeycomb structure is used for further cooling and dehumidifying of the supply air.
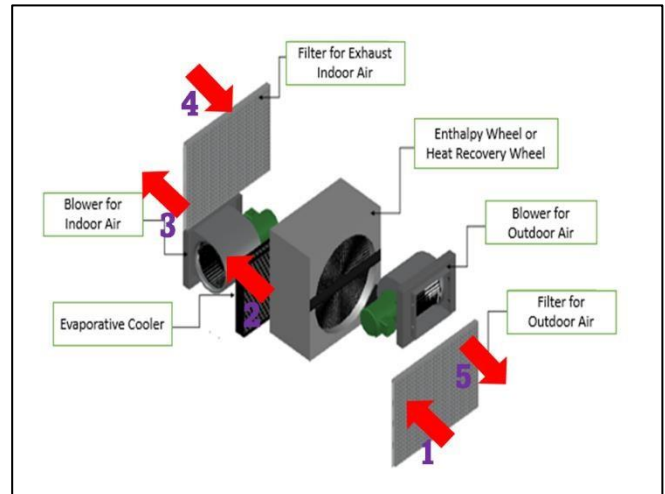
Figure 3. The basic components of the air conditioning system integrated with heat recovery ventilation and evaporative cooling system
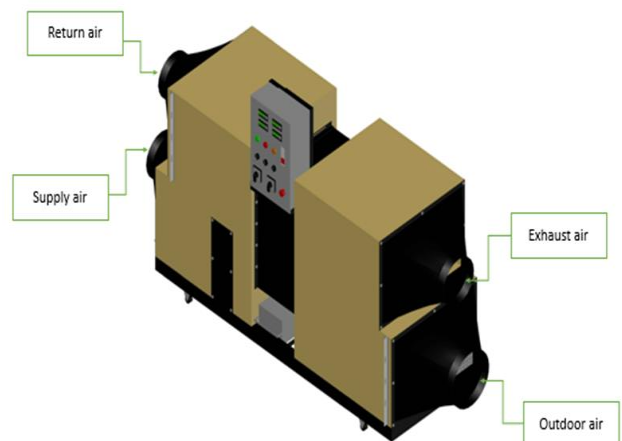
Figure 4. The flow of air in the system showing the outdoor, supply, return, and exhaust air.

To test the prototype, the dry-bulb temperature, humidity ratio, and relative humidity of the supply, return, outdoor, and exhaust air was recorded at various times and conditions, see Figure 4. The performance of the unit was evaluated at various conditions such as a) idle pump, b) operational pumps with variable combinations of speed and discharge categorized as low, medium, and high; see Table 1 and 2.

Table 1. Blower set conditions used during the test

Blower	Mode	Air Velocity, m/s	Volume Flow Rate, m³/hr	Mass Flow Rate, kg/s
1	Low	0.82-1.76	155.68-334.73	0.05-0.11
	Medium	1.52-2.88	289.49-546.67	0.10-0.19
	High	2.43-8.13	462.27-1545.73	0.16-0.53
2	Low	0.82-1.76	155.68-334.73	0.05-0.11
	Medium	1.52-2.88	289.49-546.67	0.10-0.19
	High	2.43-8.13	462.27-1545.73	0.16-0.53

Table 2. Setup conditions used for every trial

Setup No.	Blower 1	Blower 2
1	Low	Low
2	Low	Medium
3	Low	High
4	Medium	Low
5	Medium	Medium
6	Medium	High
7	High	Low
8	High	Medium
9	High	High

III. RESULTS, DISCUSSIONS, AND CONCLUSION

To investigate the performance of the air conditioning unit integrated with energy recovery ventilation (ERV) and evaporative cooling system (ECS), the unit is tested with (a) varying blower supply and exhaust discharge and (b) idle and operational pump.

(a) Effects of varying blower supply and exhaust discharge.
The results of the test performed showed that the air flowrate has a significant effect on the performance of the system.

I. *(a.1) Effects in temperature*
The efficiency of ERVs refers to the amount of temperature adjustment of the incoming fresh air that the outgoing stale air can accomplish in the heat exchanger [11]. Figures 5 showed that the velocity and volume flow rate of the air affects the temperature difference between the supply and outdoor air as well as between the return and exhaust air.
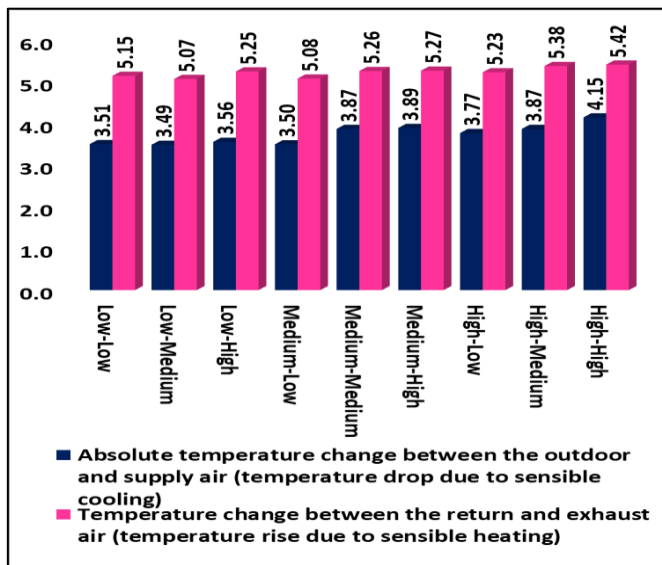
Figure 5. Average temperature difference between the supply and outdoor air and between the return and exhaust air

Generally, a lower temperature difference was observed between the outdoor and supply air than between the return and exhaust air which indicates the sensible heat transfer between the two air streams. The highest temperature drop between the outdoor and supply as well as between the return and exhaust air was observed when both the supply and exhaust blowers are at the high-high set condition at -4.15°C and +5.42°C, respectively. This indicates a higher sensible heat exchange between the two air streams at higher discharge.

The high-high condition shows a more efficient heat transfer having the lowest difference in the temperature difference (1.27°C) while the low-high condition is the least efficient (1.69°C).

The data also showed that a higher mean temperature drop was observed when the discharge of the supply air is higher than the exhaust. The mean temperature difference when the supply is higher (medium-low, high-medium, high-low) is 3.71°C and when the supply is lower (low-medium, mediumhigh, low-high) is only -3.65°C between the outdoor and supply air. While in between the return and exhaust air, the mean temperature rise when the discharge of the supply is higher than the exhaust is +5.23°C and +5.20°C when the exhaust is higher than the supply air.

II. *(a.2) Effects in relative humidity*
In the case of relative humidity, as shown in Figure 6, a higher average change in RH was observed when the supply blower is set at medium discharge. The highest change in RH was measured when both blowers are set in medium-medium condition with a value of +9.73% in between the return and exhaust air while in between the outdoor and supply air, the highest mean drop in RH with a value of -6.48% is when the supply and exhaust blowers are set at medium-high condition.

Still, a higher mean change in RH was normally observed when the discharge of the supply blower is higher than the exhaust blower. The mean drop in RH between the outdoor and supply is -6.14% when $V_{supply} > V\ discharge$ and 6.03% when the condition is reversed. While in between the return and exhaust air, the mean increase in RH is +8.57% and +8.04% in both conditions. It is desirable to lower the RH of the supply air to increase its capacity to absorb moisture from the conditioned space.
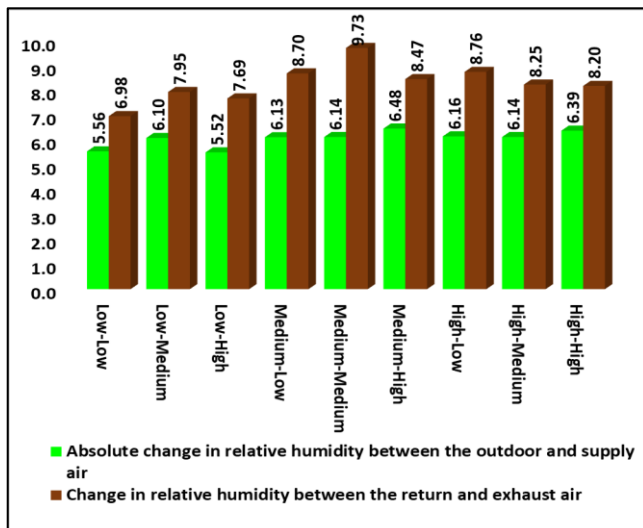
Figure 6. Average change ins relative humidity (RH) between the outdoor and supply air and between the return and exhaust air

III. *(a.3) Effects in humidity ratio*

Figure 7 shows the effect of the blower setting on the humidity ratio in the system. The highest change was measured at medium-high condition in between the outdoor and supply air equivalent to -0.0061 and in between the return and exhaust air is +0.0068 when the blowers are set at medium-medium condition.

A lower change in humidity ratio in between the outdoor and supply air (dehumidifying) than in between the return and exhaust air (humidifying). Likewise, higher change was observed when the discharge of the supply blower is higher than the exhaust blower. In between the outdoor and supply air, the mean drop in RH is -0.0057 when $\dot{V}_{supply} > \dot{V}_{discharge}$ and -0.0056 when the condition is reversed. While in the other air stream, the mean increase in RH is +0.0064 and +0.0063 for both conditions.
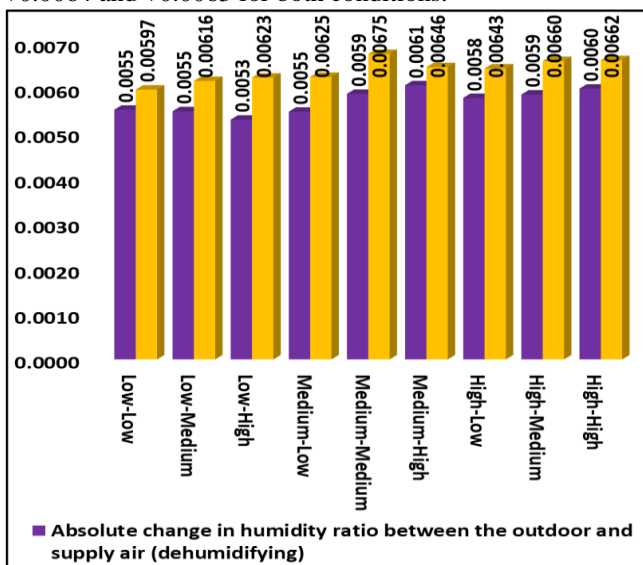

Figure 7. Average change in humidity ratio between the outdoor and supply air and between the return and exhaust air

In summary, higher sensible heating is achieved when the discharge of supply air is higher than the exhaust air. This indicates that in the design of an air conditioning system with ERV, it is better to allow the supply blower to have a higher discharge than the exhaust blower.

(b) Effects of the evaporative cooling system

The next tests aim to evaluate the effect of the evaporative cooling system and blowers on the performance of the air conditioning unit.

IV. *(b.1) Effects in the sensible effectiveness*

Figure 8 shows the sensible effectiveness of the system when the evaporative cooling system is not in use (idle condition). The graph shows that generally lower sensible effectiveness was observed when the discharge of the supply blower is low. The lowest sensible effectiveness was observed when the blowers are set at low-medium with a value of 0.54 and 0.63 for both supply and exhaust. While the highest was in the high-low condition with a value of 2.23 and 1.55 for both the supply and exhaust air. Also, exhaust air shows a higher sensible effectiveness.
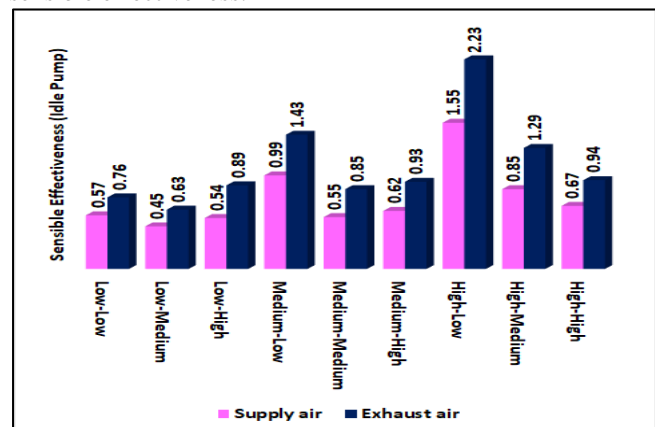

Figure 8. Average sensible effectiveness for the supply and exhaust air with idle pump

Figure 9 shows the performance of the air conditioning system when the evaporative cooling system was used (operational pump). The graph shows that a higher sensible effectiveness was obtained when the discharge of the supply blower is higher than the exhaust blower. Similar to the idle pump, the highest sensible effectiveness was when the blowers are set at the high-low condition with a value of 2.07 and 2.90 for both supply and exhaust air. While the lowest was obtained when the blowers were set at low-high condition, with a value of 1.21 and 0.83 for both the supply and exhaust air. Likewise, higher sensible effectiveness was observed in the exhaust air than the supply air.
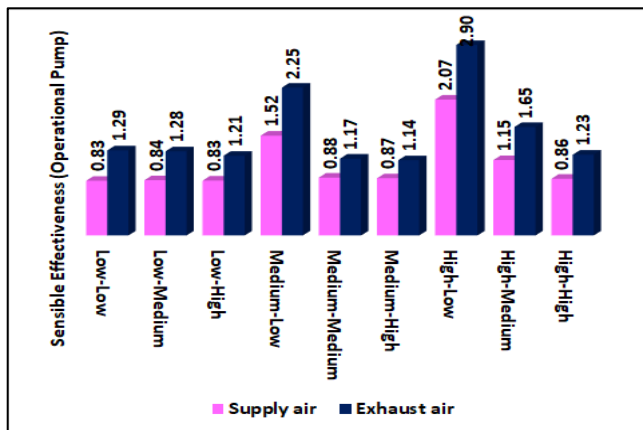
Figure 9. Average sensible effectiveness for the supply and exhaust air with operational pump
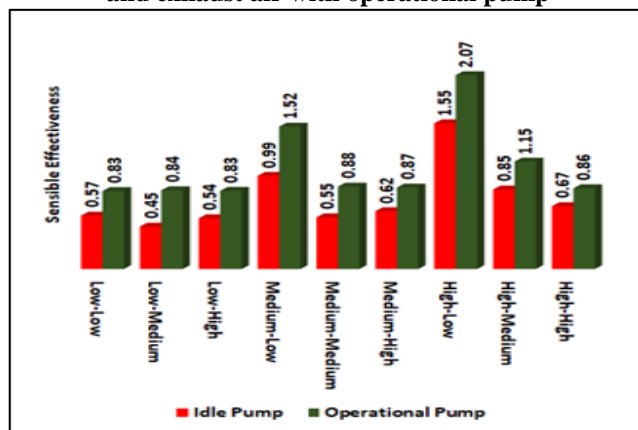

Figure 10. Comparison of the average sensible effectiveness for the supply air in between the idle and operation pump
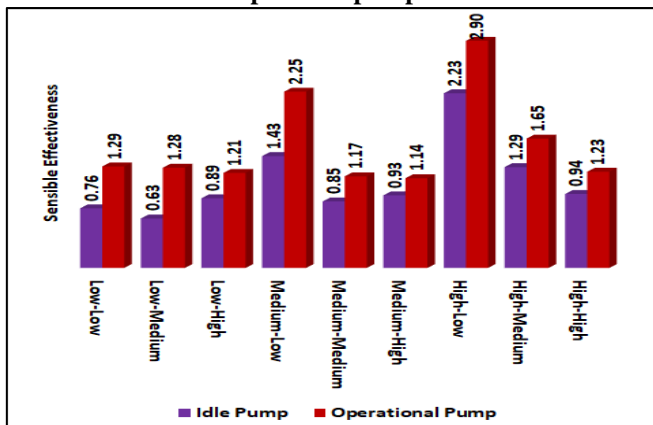

Figure 11. Comparison of the average sensible effectiveness for the exhaust air in between the idle and operation pump

Figures 10 and 11 show the significant increase in the sensible effectiveness of the system using an evaporative cooling system. It has been found that the average increase in the sensible effectiveness for the supply air is 48.35% while 46.27% for the exhaust air.

V.(b.2) *Effects in the moisture effectiveness*

Figure 12 shows the moisture effectiveness of the system at idle condition. The highest moisture effectiveness for the supply air was observed at the high-low condition with a

value of 1.80 while the lowest is 0.71 at low-high condition. For the exhaust air, the highest value was 1.52 at low-high condition and the lowest is 0.46 at low-low condition. This indicates that to achieve high moisture effectiveness for supply air, the discharge of the supply blower must be higher than the exhaust blower. However, an opposite condition must be met in the case of the exhaust air.
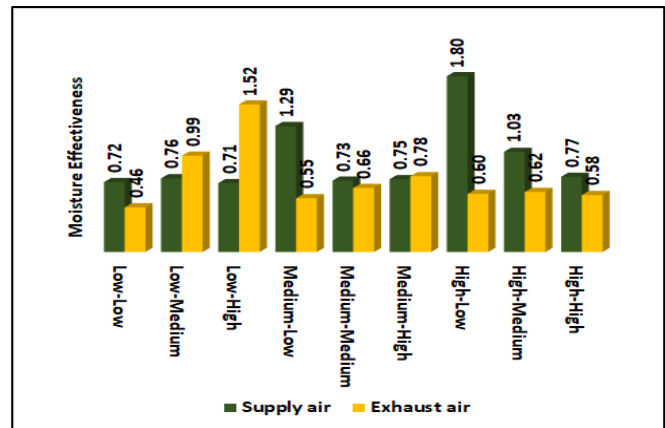

Figure 12. Average moisture effectiveness for the supply and exhaust air with idle pump

In Figure 13, similar to the idle condition, the highest moisture effectiveness for the supply air was obtained at highlow condition with a value of 1.03 while the lowest is 0.38 at low-medium condition. For the exhaust air, the highest value is at low-high condition with a value of 1.52 and the lowest is at low-low condition with a value of 0.39.
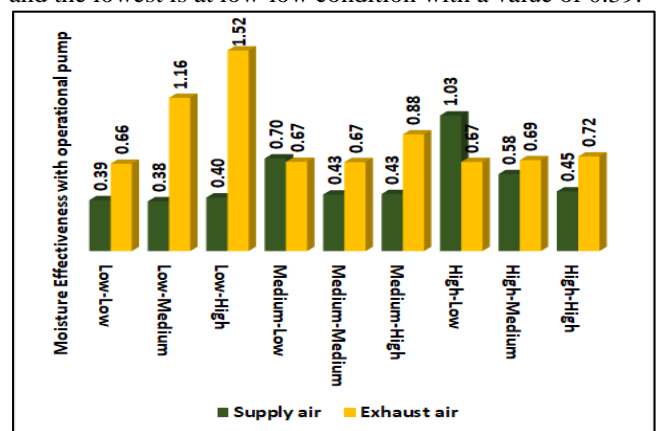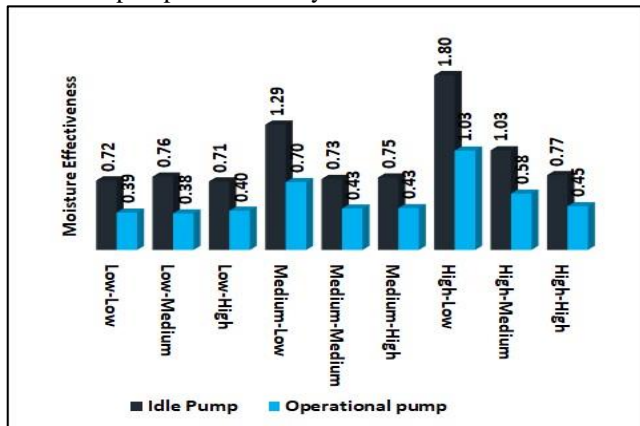

Figure 13. Average moisture effectiveness for the supply and exhaust air with operational pump

Figures 14 and 15 show the effect of using the evaporative cooling system on the moisture effectiveness for both the supply and exhaust air. This shows that using the ECS significantly decreases the moisture effectiveness of the supply air while slightly increasing the moisture effectiveness of the exhaust air. The average decrease in moisture effectiveness of the supply air is 44.16% while the average increase for the exhaust air is 16.15%.

This test shows that the effectiveness of a heat exchanger is heavily dependent on the airflow direction and pattern of the supply and exhaust airstreams. The supply and exhaust relation of the system dictate that the supply moisture effectiveness must maintain a high-speed supply and a lowspeed exhaust, while the exhaust moisture effectiveness

must maintain a high supply and a high-speed exhaust. This also implies that the effectiveness of moisture with a functional pump affects the system.

Figure 14. Comparison of the average moisture effectiveness for the supply air in both idle and operational pump
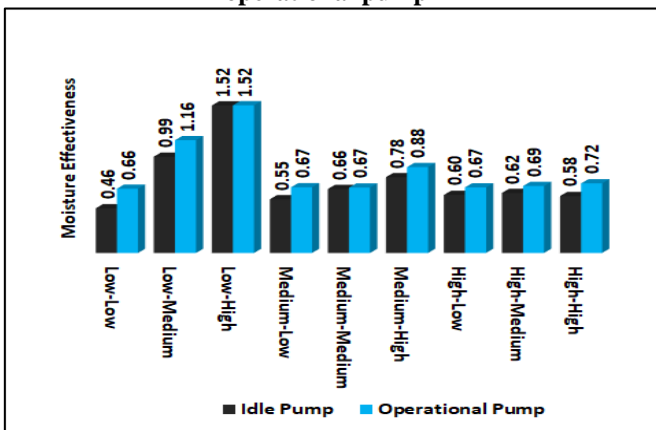

Figure 15. Comparison of the average moisture effectiveness for the exhaust air in both idle and operational pump

The data showed that running the unit with an operating pump recovers more heat than running it with an idle pump. This is because evaporative cooling adds extra volume to the airstream due to the water moisture that humidifies the air stream.

**VI.** *(b.3) Effects in the heat recovered*

Figure 16 shows the amount of heat recovered in the system with an idle pump. This shows that a higher amount of heat can be recovered if the supply blower discharges more air than the exhaust blower. While a lower heat recovery was observed when the discharge of the supply fan is low. The highest heat recovered for both supply and exhaust air was obtained when the blowers are in high-high condition at a value of 33.06 and 29.16 kW. The lowest heat recovery for the supply air was 11.72 kW at low-high condition while 10.56 kW for the exhaust air at low-low condition.
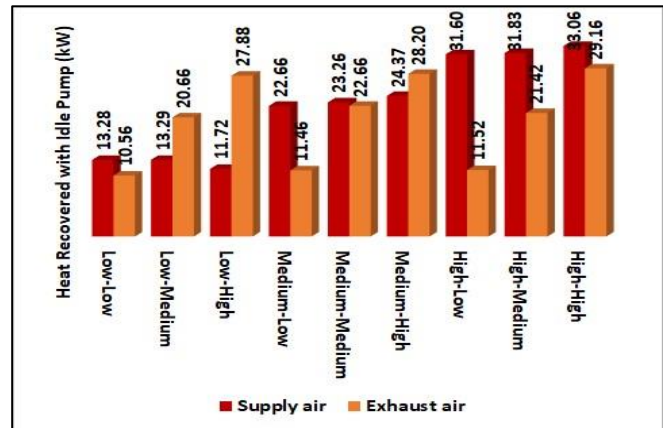
Figure 16. Heat recovered in the supply and exhaust air with idle pump

For the operational pump, a similar observation is shown in Figure 17. A higher discharge rate on the supply blower is needed to increase the heat recovery for both the supply and exhaust air. The highest heat recovered was 26.47 kW for supply air and 39.60 kW for the exhaust air both at high-high blower set-up. While the lowest heat recovery for the supply air is 9.03 kW at low-medium condition and 15.29 kW for the exhaust air at low-low condition. Meanwhile, a higher recovery rate was obtained at the exhaust air.

Figure 18 shows that higher heat was recovered in the idle condition for the supply air. This is mainly because of the evaporative cooling that reduces heat while adding moisture. This is consistent with the effect on moisture effectiveness. The average decrease in the heat recovered was 20.57% with the maximum difference at the low-medium condition equivalent to 32.01%.
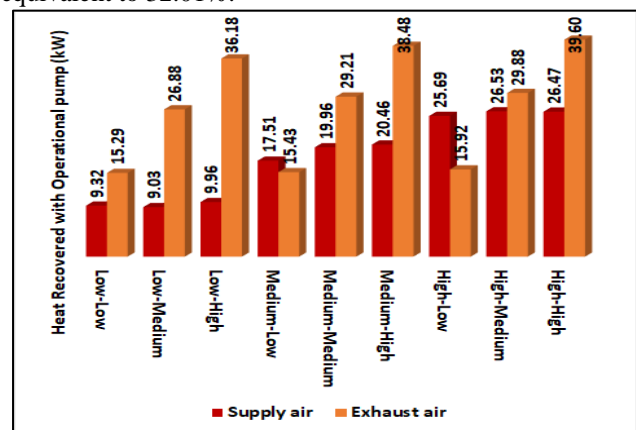
Figure 17. Heat recovered in the supply and exhaust air with operational pump

Meanwhile, it was observed that higher heat recovery for the exhaust air was obtained with the use of the ECS, as shown in figure 19. This confirms the trend of the moisture effectiveness in the exhaust air. The average rate of increase in the rate of recovery is about 35.34%.
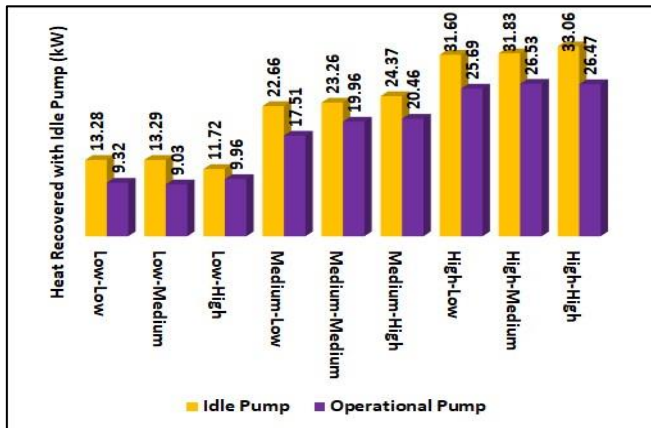
Figure 18. Comparison of the heat recovered in the supply air between the idle and operational pump setup
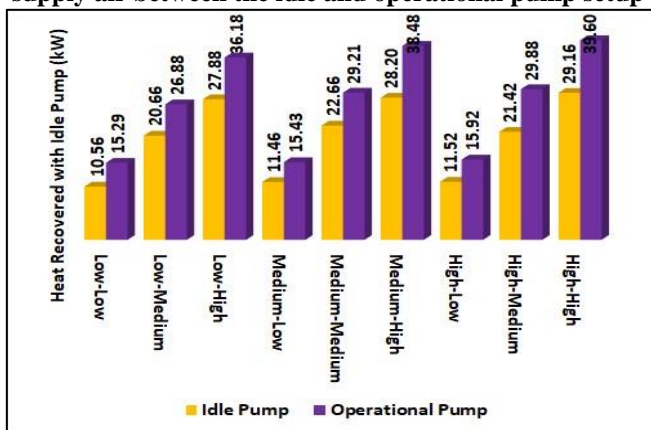

Figure 19. Comparison of the heat recovered in the exhaust air between the idle and operational pump setup

VII. SUMMARY FINDINGS AND CONCLUSION

This study proves that an air conditioning system can be modified using a heat energy recovery system consisting of energy recovery ventilation (ERV) and an evaporative cooling system (ECS). The result showed that the effectiveness of a heat exchanger is heavily dependent on the airflow direction and pattern of the supply and exhaust air streams.

A higher change in temperature and humidity ratio can be achieved when both the supply and exhaust air blowers discharge a high amount of air. Exhaust air stream has higher sensible effectiveness than supply air stream.

The evaporative cooling system effectively increases the sensible effectiveness of both the supply and exhaust air streams. Whereas it decreases the moisture effectiveness of the supply but increases the exhaust air. This also results in a decrease in heat recovered in the supply stream and a significant increase in the rate of heat recovery in the exhaust stream.

Sensible effectiveness is higher than moisture effectiveness [12]. To achieve optimum sensible and moisture effectiveness in the supply and exhaust air streams, regardless of whether the evaporative cooling system is active or idle, the supply air stream blowers must be set higher than the exhaust air stream blowers.

Further study about the effects of the different materials for rotary wheel desiccant, as well as the effect of the ambient air condition in relation to time, weather, and season, will further enhance the result of this study. Likewise, it is also recommended to conduct a further assessment on the effect of varying the capacity of the enthalpy wheel on the performance of the air conditioning unit. Lastly, further evaluation also is required to determine the effectiveness of the demonstration unit to enhance the learning and skills of the students.

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Influence of using Nano-clay Hydrophilic bentonite on Mechanical Properties of Concrete

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Abstract

The properties of concrete are strongly influenced by its microstructure. The addition of nano-clay to cement can control the calcium-silicate hydrate reaction, leading to improvements in the mechanical properties. So, in this study, the effect of adding hydrophilic nano-clay on the concrete fresh and hardened properties of Portland cement mortar was investigated. The main objective of this research is to figure out the optimum replacement percentage of cement by nano clay that gives the highest compressive strength and flexural strength. Four percentages of nano clay were used to replace cement content by 0%, 3%, 5%, and 7%. The tests conducted in this study were compressive strength and flexural strength for 7 and 28 days of moist curing, and the load deflection curve of each concrete mix was drawn. Absorption and specific gravity were determined for all concrete mortar samples with nano-clay of different percentages. The results showed that the compressive strength and the flexural strength of the concrete mortars with nano-clay were higher than the control sample. The highest enhancement in both compressive strength and flexural strength of mortar was when using 3% nano-clay to replace Portland cement.

Keywords
cement, compressive strength, concrete mortars, flexural strength, Nano clay.

INTRODUCTION

Concrete is one of the most important and widely used building materials, so many researchers have recently attempted to improve the environmental aspect of concrete to make it more environmentally friendly by using pozzolanic materials such as fly ash, silica fume, and metakaolin as partial substitutes for cement, resulting in a reduction in cement while maintaining the concrete's mechanical properties [1-5]. Using nanomaterials in concrete can reduce the permeability and enhance the strength of concrete due to the small paricle size of these materials, which results in a large surface area with high reactivity with cement [6].

Some researchers studied the use of different nanoclay materials in concrete since it is available and contains high silica content. Before considering these materials for large-scale applications, more research and experiments on the use of various types of nano clay in concrete and their impact on durability and mechanical properties are required. The size of nano materials which makes it very effective has encouraged researchers to incorporate these materials in concrete [7]. Micro-scaled contents, as well as nano-sized particles, have a significant impact on the performance of concrete [8].

Mohamed (2015) investigated about how nanosilica and nanoclay affect concrete. The findings indicate that these nanoparticles can significantly improve the mechanical characteristics of concrete. Nanomaterials react with calcium hydroxide Ca(OH)2 crystals at the interfacial zone (ITZ) between solidified cement paste and aggregates to form C-S-H gel, as well as the filling action of nanoparticles, resulting in a more densified microstructure. The optimum mechanical characteristics were found in a 3% nanoparticle mixture composed of 25% NS and 75% NC, as measured by compressive and flexural strengths, among other percentages. He also discovered that having a high percentage of nanoparticles in concrete had a negative impact on its mechanical qualities. Also Langaroudi, and Mohammadi, (2018) found that the same percentage of 3% nano clay achieves the optimum mechanical properties.

The effect different percentages of nano-clay including (5, 7.5, and 10%) as cement partial replacements was studied [11]. The tests that were conducted including compressive strength, split tensile strength, flexural strength, with XRD and SEM. The optimum percentage of nano clay was 7.5 % by cement content.

Although there are few studies on the effect of incorporating Nano clays in concrete on mechanical properties and durability, according to [12], the effect of the Halloysite nanoclay type on concrete is investigated in this study by conducting compressive strength and permeability tests on mortars with 1, 2, and 3% replacement of cement by halloysite nanoclay. The results demonstrate that a 2%

replacement resulted in a 56 percent improvement in compressive strength.

The objective of this study is to see how nanoclay hydrophilic bentonite improves the mechanical characteristics of mortar concrete and to figure out what the best nanoclay replacement percentage is. The physical properties of mortar concrete with different percentages of nano clay were compared to a control sample with no nano clay material.

I. Materials and methods

A. Cement
The cement that is used for this study is manufactured according to the European Standard EN 197-1:2011. It is a type of Portland cement with limited amount of C3A (maximum of 3.5%) it complies with Iraqi standard IQS 5-1984 type V.

B. Fine aggregates
The used aggregates for preparing all the concrete mortar samples were fine aggregates passing through sieve No.4 and mixed with cement in SSD condition.

C. Nanoclay montmorillonite
The most common natural nanomaterial used by industry is nanoclay montmorillonite hydrophilic bentonite, which is a smectite clay substance made from bentonite ore [13]. With a single layer thickness of 1 nm, it comprises a layered structure with a silica tetrahedron connected to an alumina octahedron, coordinated by oxygen atoms or hydroxyl groups [14]. For quicker dissipation of the nanoclay hydrophilic particles in asphalt, the raw nanoclays are altered by replacing metal cations for the interlayer and layered in a multilayer. Figure 1 and Table 1 show the X-Ray analysis as well as the chemical composition of the nanoclay material used.
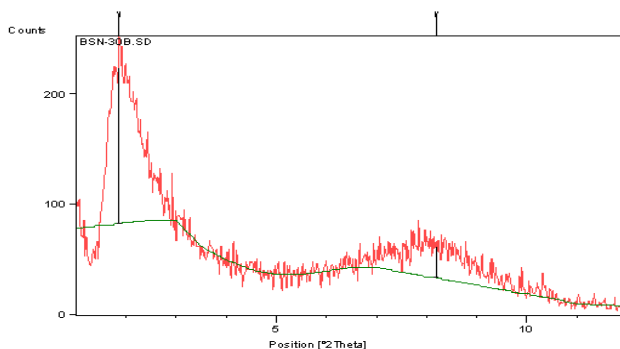

Figure 1: Nanoclay analysis X-Ray.

Table 1: Physical and chemical properties.

Physical properties	
Appearance	Powder
pH	2,5 - 3,5
Bulk density	300 - 370 kg/m3
Chemical composition	
O	52.6%
Si	**18.5%**
Fe	**10.0%**
Al	**9.4%**
Mg	**2.3%**
Na	**2.0%**
Ca	**1.9%**
K	**1.7%**
Ti	**1.6%**

D. Testing Methods
Compressive strength, flexural strength, toughness measured from the load deflection curve, absorption, specific gravity, and workability measured from the flow table test were all performed on concrete mortar samples with varying nanoclay percentages.

The standards for the tests conducted in this study are listed in Table 2

Table 2: The mechanical tests that were performed in this study.

Mechanical tests	Specifications
Compressive strength	*ASTM C109*
Flexural strength	*ASTM C348*
Workability (flow table)	ASTM C1437
Load deflection curve (toughness)	ASTM C-1018
Absorption	ASTM C1403
specific gravity	ASTM C127

E. Test samples
Mortar samples were prepared for four replacement percentages of nanoclay including (0%, 3%, 5%, and 7%). Six cubes and six prisms were casted for each percentage tested for 7 days and 28 days moist curing.

RESULTS AND DISCUSSION

F. Compressive strength
For the compressive strength, three mortar cubes of a size equal to 5 cm x 5 cm x 5 cm were tested in the compressive testing machine for each concrete mix of different percentages of nano clay, including the control samples. Figure 2 illustrates the comparison of the compressive strengths of all the concrete mixes in this study.
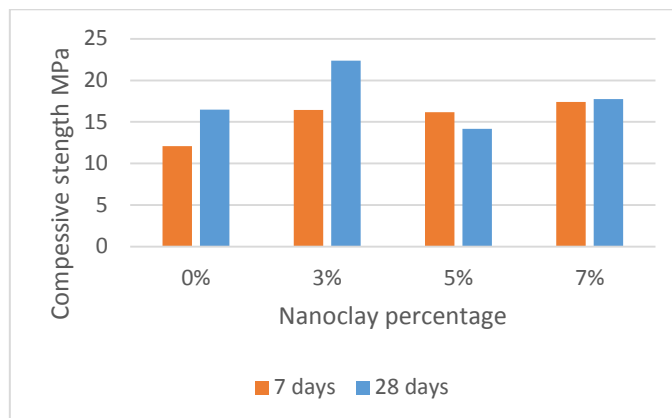
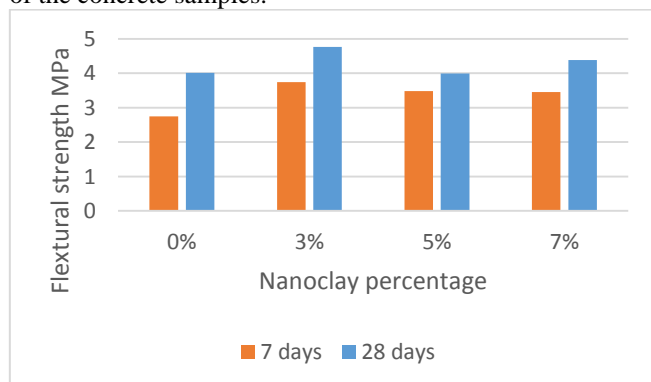**Figure 2: concrete compressive strengths**

It can be figured out in general from this figure that using nano clay in replacement of cement content in mortar modifies the compressive strength even when using large percentages. Also, the best percentage of replacement was 3% nanoclay for 7 and 28 days of moist curing, which resulted in increasing the compressive strength by 36.3% and 35.7%, respectively.

G. Flexural strength

In the flexural strength test, three mortar prisms measuring 4 cm x 4 cm x 16 cm were evaluated in the flexural testing machine (three point loading) for each concrete mix containing varying percentages of nano clay, including control samples. Figure 3 shows the flexural strengths of all of the concrete samples.


Figure 3: concrete flexural strengths

From this figure, it is obvious that the nano clay enhances the flexural strength for all the studied percentages. Besides that, as well as the compressive strength, 3% nano clay replacement for 7 and 28 days of moist curing has the highest increments in flexural strength among the other percentages, by 36% and 18.7%, respectively.

H. Other mechanical properties

The load deflection curve is drawn from the load of the flexural test with the dial gage recordings. The dial gage was attached to the tested mortar sample. The area under the load deflection curve was calculated to indicate the toughness of the mortar samples as shown in Figure 4 and Figure 5.
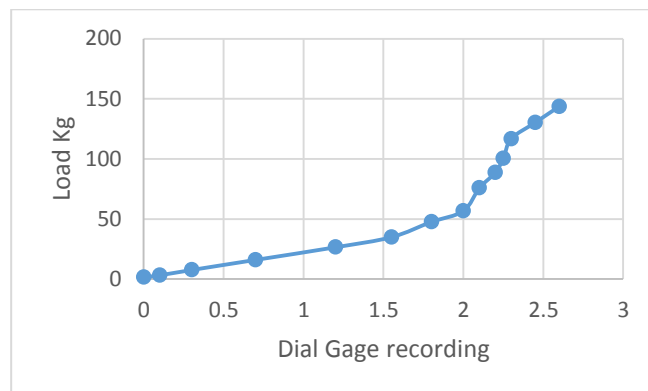
Figure 4: Load deflection curve for mortar mix of 3% nano clay after 28 days curing.
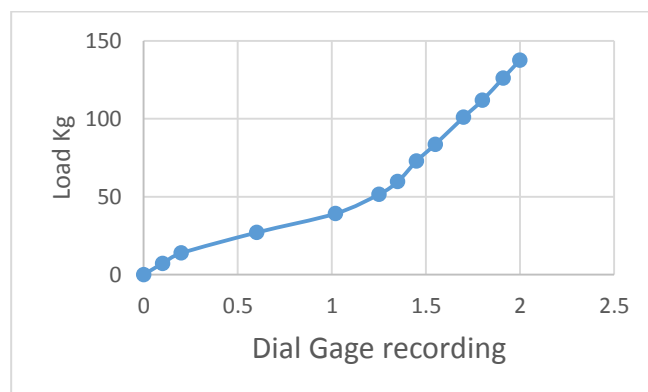
Figure 5: Load deflection curve for control mortar mix after 28 days curing.

Also the other properties were calculated including the absorption and the different types of densities for all mortar samples after 7 and 28 days as listed in Table 3 and Table 4 respectively.

Table 3: Absorption, densities and Toughness of mortar samples after 7 days curing.

Absorption	13.92173	12.61459	13.18109	12.94877
Relative density OD	1.876099	1.887176	1.929648	1.911334
Relative density SSD	2.137285	2.125235	2.183997	2.158828
Apparent RD	2.539337	2.476802	2.587869	2.539959
Toughness	78.86375	100.1785	62.0825	66.82125

Table 4: Absorption, densities and Toughness of mortar samples after 28 days curing.

Absorption	14.48404	12.98266	13.74718	13.71646
Relative density OD	1.845507	1.908271	1.880925	1.877444
Relative density SSD	2.112811	2.156015	2.139499	2.134962
Apparent	2.518789	2.536732	2.536902	2.528608

RD				
Toughness	101.8803	102.7968	41.1285	42.98725

From Tables 3 and 4, the highest toughness is observed in mortar mix with 3% nano clay in both 7 and 28 days curing. All types of measured densities of 3% nano clay mortar mix was higher than the other mixes for 7 and 28 days. The absorption also of the 3% mortar samples were the minimum for 7 and 28 days curing among the other mortar samples with different percentages.

Conclusions

From this study it can be concluded that:

1. Using nano clay hydrophilic bentonite as a partial replacement of cement can improve the mechanical properties of concrete even when increasing the replacement percentage to 7%.

2. The optimum replacement percentage of nano clay is 3% according to the compressive and flexural strength results for both 7 and 28 day curing.

3. Based on the other measurements of absorption, density, and toughness, the results indicate that using 3% nano clay has the highest improvements in concrete mechanical properties.

4. Using nano clay in large scale applications can reduce environmental pollution that results from reducing the amount of consumed cement.

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Low-Cost Smart Glasses for Blind Individuals using Raspberry Pi 2

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Abstract

Blindness is the inability of an individual to perceive light. Due to the lack of visual sense, blind individuals use guiding tools and human assistance to replace their visual impairment. The study developed a smart glass that can detect objects and text signages and give an audio output as a guiding tool for blind individuals. In creating the prototype, Raspberry Pi 2 Model B will use as the microprocessor. It will be using a camera module that will be a tool for detection. The algorithms used for object detection and text detection are YOLOv3 and OCR, respectively. In-text detection, OCR helps recognize both handwritten and digitalized texts. MATLAB is the software used for the application of OCR. It is composed of three parts (3): image capturing, extraction of text, and conversion of text-to-speech. In object detection, YOLOv3 is the algorithm used in the process. It comprises four (4) parts: data collection, data preparations, model training, and inference. Then the conversion of text-to-speech will take into place. The objects that the prototype can detect are limited to 15 objects only. The prototype can function at both the 150 lux luminance and 107527 luminance in object detection. However, there are discrepancies in the detection of some objects due to distance; the detection cannot detect the specific thing at certain trials. In-text detection, the detection of the text signage has 100% reliability. In addition, text detection used five font styles. In the testing, the font style Calibri has a 30% percentage error (using the word ENTRANCE) and a 20% percentage error (using the phrase EXIT) due to the structure. The processing time of the prototype has an average time of 1.916s at maximal walking and 1.673s at a slow pace walking.

Keywords

blindness, Raspberry Pi 2, Raspberry Pi Camera Module v2, YOLO v3, OCR, object detection, text detection

I. INTRODUCTION

The eyes allow humans to determine objects through light and process the gathered details in the brain. An individual with no perception of light is considered total visual impairment or, in general terms, blind. These visually impaired individuals, most especially the blind, depend on the human body's other senses. In addition, some of them use human assistance, guiding tools, or well-trained animals to replace their visual impairment. The researchers aim to design a low-cost smart glass that detects objects and even text signages that impact blind individuals.

Different technological advancements and new devices emerged, introducing a navigation tool for visually impaired individuals, including smart sticks and smart glasses. [3] Various researches support the creation of low-cost navigation tools with unique features and different algorithms such as YOLO and OCR. Smart glasses are an aid for blind individuals. It will serve as a navigation tool to guide them because it can detect objects and English text signages. It will alert the individual through an earpiece by text-to-speech.

This research aims to create a low-cost prototype smart eyeglass that can help the blind. It will detect objects and determine different text signages seen in an environment. The objects that the prototype can detect are limited to 15 objects since the prototype is programmed to detect objects in the living and garage space. The prototype can only acknowledge English text signages. It cannot recognize other signages such as logos, symbols, and figures. It is only limited to signages whose edges are sharp, specifically those that are red-bordered, rectangular, and square in shape. Moreover, it will not consider other types of visually impaired individuals. The prototype is dedicated only to blind people. It cannot give specific directions of the wearer to the detected object.

II. METHODOLOGY

This chapter incorporates the overall setup of the system, from the components to the algorithms to be used to design a low-cost wearable smart glass for blind individuals. The methodology extensively discusses the conceptual framework, system process flow, simulation process, and testing process.

2.1 System Process Flow
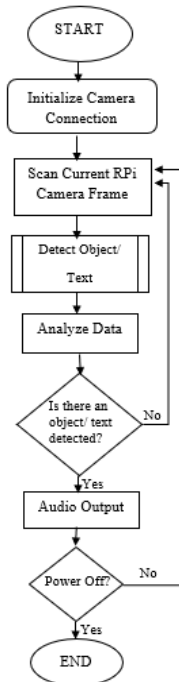
Figure 2.1 System Flow Diagram

Figure 2.1 represents the system flow diagram of the smart glass that signifies the building blocks of the system. Once the system starts by pressing the button from the power bank, the camera will initialize for connectivity. It will then scan the current Raspberry Pi camera frame to detect the object or text. Once the system detects an object or text, it will analyze the data. The processed image will be converted into an audio output if the analyzed data is successful. On the other hand, if it did not successfully analyze the data, the system will repeat the process from scanning the current raspberry pi camera frame. Once the system process is complete, the user will decide if the power will be turned off by pushing the button from the power bank or continuing the process.

2.2 Block Diagram
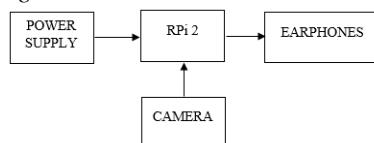
Figure 2.2 Block Diagram of the System

Figure 2.2 shows the components' connections that are relative to each other. The power supply comes from the power bank connected to the Raspberry Pi 2. The Raspberry Pi Camera Module v2 connected with the Raspberry Pi 2 that are both pasted into the frame of an eyeglass so that when it is worn, it could recognize on the same level of what ordinary people see. The programmed data will then have the recognized subject as audio output. The user, through an earphone, will hear the audio output.
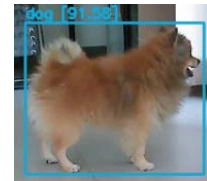
2.3 Methodology for the Objective

Figure 2.3 Prototype Setup

Figure 2.3 shows the system and actual prototype setup. The prototype setup is composed of the following components: glasses, Raspberry Pi camera module v2, Raspberry Pi 2 Model B, and earphones.

2.3.1 Object Detection

Figure 2.4 Object Detection

For object detection, YOLOv3 is the algorithm used for the prototype. Figure 2.3 shows the process for the YOLO algorithm. This algorithm divides an image into grid cells. The cells represent predictions for the five (5) bounding boxes, where these boxes are the rectangles enclosing an object detected.

There are four (4) parts for object detection: data collection, data preparations, model training, and inference. The data collection process uses images of objects in the living room and garage space to create the dataset. In this process, things from the living room and garage space will use 5675 images to create the dataset. It will be labeled and applied with annotations.

The captured images will undergo the process of data preparation. Data preparation is when the annotations will be subjected to corrections, resizing, and updating of the images if the annotations match the photos and the color corrections of the pictures. In the model training process, YOLOv3 is the algorithm to use. Lastly, the inference is the application of the trained models to make predictions. This process will take place by setting up the YOLOv3 architecture and the custom weights introduced with the architecture.

2.3.2 Text Detection

Table 2.1 Text Detection Process

	This is the initial part of the text signages extraction, the text will be captured live using the Raspberry Pi Camera Module v2.

Binary Image	Binarization is the process of converting the image captured from the camera module into grayscale for the program to easily recognize the red border format.
Thresholding / ENTRANCE	A program will be coded in MATLAB using the color thresholding code whereas the red border will be recognized by the system.
Hough Transform / ENTRANCE	Hough transform is a system that recognizes the lines that are present in the binarized image. It is introduced through the equation represented in Equation: $x \cos \cos \theta + y \sin \sin \theta = r$
Extraction / ENTRANCE	Extraction is the last stage of text signage extraction. This process includes image cropping, enhancement, and background subtraction.
Text-to-Speech	Text-to-speech transcription is used as third-party APIs from MATLAB. It is the conversion of extracted text into an audio output. The OCR algorithm will be called to save the processed image into the desired format for the conversion of the filet. After that, the software installed converts the saved text file into an audio output.

III. RESULTS AND DISCUSSION

This chapter presents the results and discussion of the test result of functional testing of the object detection and text detection and the accuracy testing of both object and text detection.

3.1 Functionality Testing

Figure 3.1 Functionality testing

Shown in Figure 3.1 is the functionality testing conducted for the prototype. The functionality testing is halved into three parts: object detection functionality testing, text detection functionality testing, and functionality testing of both the text and object detection. For each functionality testing, there are ten (10) trials conducted. Moreover, the gathered data will be computed using the reliability percentage formula.

$$Reliability\% = \frac{Number\ of\ successful\ trials}{Total\ number\ of\ trials} \times 100 \qquad (1)$$
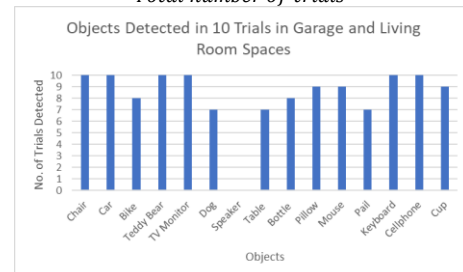
Figure 3.2 Objects Detected in the Garage and Living room space

Shown in Figure 3.2 is the data for the objects detected in both the garage and the living room space. The testing of the prototype, Raspberry Pi 2, will use a camera that relies on the luminance of the place. The testing for the detection of the objects will conduct at 150 lux luminance at the living room space and 107527 lux luminance at the garage space. The data shown in Figure 3.2 shows object detection. This figure shows the objects detected by the prototype from the actual setup in both the living room and garage space. In addition, things like speakers have no number of detection since it does not belong in the dataset used for the prototype.

Table 3.1 Functionality Testing of the objects in garage space

Measured Distance (m)	Object	Actual Distance (m)	No. of Times the object identified	Reliability Testing
10	Chair	10.02	10	100%
10	Car	9.87	10	100%
10	Bottle	9.96	8	80%
10	Pail	9.76	7	70%
10	Bike	9.90	8	80%

Table 3.1 shows the functionality testing of the objects seen in the garage space. As observed, the chair and car were the only objects that were able to detect successfully in 10 trials over the distance of 10 meters measured distance. On the other hand, 80% and 70% reliability results for the bottle and bike, and pale, respectively.

Table 3.2 Functionality testing of the objects in the living room space

Measured Distance (m)	Object	Actual Distance (m)	No. of Times the object identified	Reliability Testing
5	Chair	4.98	10	100%
5	Couch	4.87	10	100%
5	TV Monitor	4.94	10	100%
5	Teddy Bear	4.7	10	100%
5	Dog	4.65	10	100%
5	Bottle	4.89	10	100%
5	Mouse	4.92	9	90%
5	Keyboard	5.00	10	100%
5	Pillow	4.79	10	100%
5	Cup	4.86	9	90%

Table 3.2 presents the measured distance of five (5) meters to the objects vs. the actual distance and the number of times that the object is identified. It is observed that the mouse and the cup were the only objects that had a little discrepancy, having a reliability result of 90%; other than that, all the objects were detected successfully in 10 trials.

Table 3.3 Functionality Testing of Text Detection in the Living Room (5m) and Garage (10m) Spaces

Measured Distance (m)	Signage	Actual Distance (m)	No. of Times the signage identified	Reliability Testing
5	Entrance	4.67	10	100%
5	Exit	4.89	10	100%
10	Entrance	10.09	10	100%
10	Exit	9.98	10	100%

Table 3.3 presents the functionality testing of the prototype for the text detection in both signages: Entrance and Exit in the living room and garage spaces. Both in the garage and in the living room spaces accumulated a reliability result of 100% for both signages.

Table 3.4 Processing Time of the System 0

Trials	Processing Time	
	Slow Pace	Maximal Walking
1	1.82s	1.98s
2	1.67s	2.12s
3	1.49s	1.87s
4	1.86s	1.86s
5	2.03s	1.96s
6	1.78s	2.08s
7	1.72s	1.93s
8	1.61s	1.78s
9	1.33s	1.82s
10	1.42s	1.76s
Average	1.673s	1.916s

Table 3.4 shows the average processing time of the object and text detection of the system while the person wearing the prototype is walking at a slow pace walking. The values show the processing time ranges from 1.33 to 2.03 seconds. The average processing time of the smart glass was 1.673 seconds. Moreover, it also shows the average processing time of the object and text detection of the system while the person wearing the prototype is maximal walking. The values show the processing time ranges from 1.76 to 2.12 seconds. The average processing time of the smart glass was 1.916 seconds.

3.2 Accuracy Testing

The accuracy testing of the text detection is conducted with ten (10) trials. It is done in accordance with the functionality testing. Moreover, the gathered data will be computed using the formula in Equation 2. Percent Error will be used to determine the accuracy of the test performed for the object and text signage detection. In this equation, the Vo is the variable for the number of Yes in the trial. Va is accepted as the truth in the system which is the Yes.

$$Percentage\ Error = \left(\frac{|V_o - V_a|}{V_a}\right) X\ 100\%$$

(2)

Table 3.50 Accuracy Testing for Object Detection

Objects	% Error	Objects	% Error	Objects	% Error
Chair	0%	TV Monitor	0%	Bottle	20%
Car	0%	Dog	30%	Pillow	10%
Bike	20%	Speaker	100%	Mouse	10%
Teddy Bear	0%	Table	30%	Pail	30%
Keyboard	0%	Cellphone	0%	Cup	10%

Table 3.5 shows the accuracy testing for object detection. With the conducted trials, 100% error was the computed value for the speaker. It is because the object is not configured in the system. On the other hand, some objects

have little to no errors. These minimal errors were caused by some factors: distance (garage space) and identifying and detecting different objects (e.g., dog to a cat).

Table 3.6 Accuracy Testing for Text Detection (Entrance)

Detection of the Word "ENTRANCE" using fonts styles:	No. of times the word "ENTRANCE" is detected out of 10 Trials	Percentage Error
Arial	10	0%
Calibri	7	30%
Garamond	10	0%
Times New Roman	10	0%
Bodoni MT	10	0%

As shown in Table 3.6 the results for the accuracy testing for the text detection. In this testing, five (5) different font styles were used to determine if the system was able to detect the word "ENTRANCE". It can be seen that out of all the font styles used, the font style Calibri has the greatest percentage error. It is observed that the font style Calibri has a small structure thus, the system cannot detect the word "ENTRANCE" properly.

Table 3.7 Accuracy Testing for Text Detection (Exit)

Detection of the Word "EXIT" using font styles:	No. of times the word "EXIT" is detected out of 10 Trials	Percentage Error
Arial	10	0%
Calibri	8	20%
Garamond	10	0%
Times New Roman	10	0%
Bodoni MT	10	0%

As shown in Table 3.7 the accuracy testing for the text detection of the word "EXIT". Five (5) different font styles were used. It is observed from the data that out of the five (5) font styles used, Calibri has the highest percentage error of 20%. It is observed that the font style Calibri has a small structure thus, the system cannot detect the word "ENTRANCE" properly.

IV. CONCLUSION AND RECOMMENDATION

The researchers could design a low-cost smart glass using Raspberry Pi 2 for blind individuals. To achieve this, the algorithms used for the prototype are YOLOv3 as the object detection tool and OCR for the text detection. The audio output will give the detected object or text. In object detection, the objects seen in the garage were identified and detected at 10 meters distance. The pail was the least in the reliability test, having a 70% result in 10 trials.

Meanwhile, in the living room space, the objects were detected and identified well in 5 meters distance in 10 trials with 100% reliability test except for the mouse and cup having 90% reliability. For the text detection, it was observed that Arial, Times New Roman, Bodoni MT, and Garamond were the best font style leading to a percentage error of 0% for both signages: Entrance and Exit that was conducted in 10 trials. On the other hand, Calibri was a result of a 30% error for the word Entrance and a 20% error for the word exit since the font style Calibri was smaller in characters. The average processing time of the system in slow pace walking was 1.673 seconds and 9.196 seconds in maximal walking.

The study is about detecting objects and texts. The researchers recommend that others who desire to pursue the same topic take a more significant step in detecting different languages and even symbols, figures, and logos. Moreover, for future studies, give specific directions, warning messages, and audio output to prevent unwanted accidents. Additionally, since there were many restrictions because of the pandemic, the researchers recommend testing the prototype on a broader environment, and lastly, providing a GPS notification for navigation purposes of the blind person.

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Smart Inventory Management System (SIMS) for SUCs Using Qr Code Technology

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Abstract
Managing inventory at state universities is one of the most difficult tasks facing higher education. This is especially true for institutions that are vast, varied, and research-oriented. As a university, you must keep a close eye on every cent spent. If you don't keep track of your instructional supplies, you'll end up losing money. There is no way to manually handle all of the things. Smart Inventory Management System for SUCs utilizing QR Code Technology is the appropriate solution for the ever-growing state university to address this problem. The system reduces the hassles of manual data input and continuous maintenance, as well as guessing, mistakes, as well as time and money lost. Smart Inventory Management System for SUCs using QR Code Technology underwent two stages namely, the development and assessment phases. The evaluation was according to the ISO 25010 Software Quality Product Standards. The result of the evaluation shows that the system is functionally suitable, performance is efficient, compatible, usable, reliable, secure, maintainable, portable, and effective.

Keywords
Inventory, Higher Education, QR Code

INTRODUCTION

Technology is progressing at a faster rate than it has ever been. Various approaches have been developed to make people's lives and jobs easier. Automation is at the forefront of these tactics. Automation provides answers to a wide range of challenges and organizational issues. Automation is defined as the functioning of system and equipment in a desired manner at the proper time, under control of mechanical or electrical devices that operate with or without human intervention (Arani, Namusonge, & Mbuvi, 2017). Most businesses today utilize it in conjunction with other ways and processes to meet everyone's information needs.

Some universities still practice the traditional or manual process of doing some office transactions in spite of current technological developments. The practice resulted to common problems such as slow procurement processing, lack of inventory, poor monitoring, data inaccuracy and issues on transparency that further resulted to misinformation and other related problems. One problem commonly encountered in the Supply Office is the absence of precise inventory system to track the status of issued supplies and transferred equipment, which often led to data inaccuracy, loss of records, and human errors (Arkady, 2015).

This study sought to address these above-cited problems through the development of Smart Inventory Management System using QR Code that will automate the tracking and monitoring of tools and equipment. The study involves the development of system that features the computerization of the processes and transactions in the supply monitoring of the University. This involves the development of a web application that will track and monitor the assets of the University. QR code will be used to monitor and track the tools or equipment. It has the ability to check, transfer and return assets by simply scanning the QR code.

Successful implementation of the Smart Inventory Management System using QR Code can help the university to make the most of their budget without sacrificing any of their school's programs.

It will not only help the University's Property Custodian, but also the teachers and staff of the whole university. They will be able to track the assets entrusted to them.

The QR Code

Technology is constantly evolving. Every day, human deals with the progress of technology. The goal is to create a more advanced technology and able to bring great changes in helping every human task. One of the technological developments that is developing is the QR code. Specifically, QR Code or "Quick Response" Code is a barcode type that contains scanned dots matrix / scan using QR scanner or smartphone with built-in camera. QR code is widely developed in various fields for reasons of its practicality (Rochmawati et al., 2018).

Furthermore, QR code is a 2D matrix code that is designed by keeping two points under consideration. It must store large amount of data as compared to 1D barcodes and it must be decoded at high-speed using any handheld device like phones. QR code provides high data storage capacity, fast scanning, omnidirectional readability, and many other advantages including, error-correction (so that damaged code can also be read successfully) and different type of versions. Different varieties of QR code symbols like logo QR code, encrypted QR code, iQR Code are also available so that user can choose among them according to their needs. Nowadays,

a QR code is applied in different application streams related to marketing, security, and academics and gain popularity at a really high pace. Day by day, more people are getting aware of this technology and use it accordingly. The popularity of QR code grows rapidly with the growth of smartphone users and thus the QR code is rapidly arriving at high levels of acceptance worldwide (Tiwari, 2016).

QR Codes consist of black modules arranged in a square pattern on a white background. They are designed to decode the data quickly. It is quite easy to create and use these codes (Pons, 2011). Using QR Codes for education is another way of using the Internet. Likewise, QR codes are versatile where a piece of long multilingual text, a linked URL, an automated SMS message, a business card or almost any information can be embedded into the two-dimensional barcode. With moderate equipped mobile devices, QR Codes can connect users to the information quickly and easily (LAW & SO, 2010).

QR Code technology will be used in the proposed system in replace with the traditional sticker that the Supply Office is using. With the use of QR Code technology it would be easier to track and monitor the tools and equipment by simply scanning the code. QR Code labels are easy to design, print and scan.

In comparison with manual data entry, QR Code scanning eliminates possibility of human error for check-in and check-out.

2.1 Tracking and Monitoring System

Tracking and Monitoring System is an integrated system for tracking assets (tools and materials) and personnel associated with a work site. Personnel are equipped with tracking devices having at least geolocation capability. Assets are tagged with RFID tags, which are interrogated at portals, by mobile scanners, or by personnel tracking devices having RFID reading capability (Fike et al., 2004). The tag readers and tracking devices are all in communication with a common "information backbone" and all data are delivered to, and processed by, a common command and control subsystem.

The findings of Amann & Essig (2015) provided evidence on the existence of hindrances for public procurement of innovation across European Union member states through the analysis of data from a large-scale survey. Further, differences in terms of the perception of barriers become evident depending on the availability of monitoring system for innovation performance.

Likewise, the study on public procurement monitoring system in the EU countries proved that it was possible to use and to adapt foreign monitoring instruments to the domestic realities of the public procurement market in order to achieve maximum effect in the form of budgetary savings (Dubinina et al., 2017).

1. Computer Programme: Validation and Verification

After gathering the needed information from the interviews conducted with the Supply Officer and Property Custodian, the researcher began the development of the system by following the six stages of the System Development Life Cycle namely planning, analysis, designing, coding, testing and implementation. Initially, the proponent planned and analyzed different sets of activities necessary for the identification of the required resources, system requirements, and the work schedule. After which, she prepared the design and conceptual framework needed for the development of the graphical user interface. The Coding phase then followed where the proponent prepared the required software to create and develop the web-based application. PHP was used as the main coding language for the web-based application, while Angular JavaScript and SCSS were used for creating the main interface of the application. Microsoft SQL server on the other hand, served as the database or the repository of all the information that will be entered by various users in the system.

Further, after the program was developed, the next step entailed testing that involved performing the system's real time test to make sure that the system functioned well, and has no error or bug, thus ensuring that all needs of the users were met. The system was initially presented to the supply officer and property custodian to ensure that the processes were aligned with what they expected from the beginning. The end-users and some IT experts were then requested to evaluate the system based on the ISO 25010 Software Product Quality Standards. The IT experts were requested to answer the questionnaire based on all the criteria while end-users were requested to answer based only on the selection criteria which include functional suitability, performance efficiency and usability. The questionnaires were administered personally to the IT experts, the supply officer, property custodian, faculty and staff representatives.

Recommendations and suggestions derived from the questionnaires were also given action to ensure that the system fits on what the end-users need. After all functions needed were finalized and agreed upon by the supply office and the proponent, the next stage of the process was the implementation where the system was installed in the University's server and was used by the Supply Office. After the successful implementation of the developed web-based application, the final stage of evaluation, regarding the level of effectiveness of the implementation of the developed system was conducted. The IT experts, supply officer, property custodian, faculty and staff representatives evaluated the level of effectiveness of the implementation of the web-based application based on the valid and reliable questionnaire made by the proponent.

The questionnaire for the effectiveness of the implementation of the developed system was also administered personally to the IT experts, supply officer, property custodian, faculty and staff representatives. The proponent then collected, interpreted and analyzed the data obtained from the respondents' evaluation on the level of effectiveness of the implementation of the system using frequency, percent and weighted mean. To determine the acceptability of the web-based application, the results of the evaluation were calculated using weighted scores and weighted mean of the responses. Consequently, these were then analyzed on the different software criteria based on the ISO 25010 Software Quality Standards.

Results and Discussion

The Smart Inventory Management System for SUCs using QR Code Technology was found conformed to the software quality requirements adapted from the ISO 25010 Software Product Quality Standards such as functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability and portability, based from the results of the evaluation made by the IT experts, Technical Staff and End-users.

4.1 IT Experts' Evaluation of the Smart Inventory Management System for SUCs using QR Code Technology (SIMS) based on the ISO 25010 Criteria

The evaluation made by the IT experts showed that the SIMS outstandingly exceeded the criteria indicated in the ISO 25010 Software Product Quality Standards on assuring the technical characteristics of the system. The IT experts consistently scored the system with the general rating of 3.61 having constantly high ratings on each criterion.

From the data collected and analyzed, SIMS was described as very functional, very efficient, very compatible, very usable, very reliable, very secure, very maintainable and very portable.

Table 24

Summary of Evaluation of the Smart Inventory Management System for SUCs using QR Code Technology

Software Product Quality Categories	Weighted Mean	Verbal Description
1. Functional Suitability	3.80	Very Functional
2. Performance Efficiency	3.60	Very Efficient
3. Compatibility	3.80	Very Compatible
4. Usability	3.50	Very Usable
5. Reliability	3.33	Very Reliable
6. Security	3.33	Very Secure
7. Maintainability	3.80	Very Maintainable
8. Portability	3.73	Very Portable
Average Weighted Mean	**3.61**	

4.2 Property Custodian, Supply Officer, Department Heads, faculty and staff Evaluation of the Smarty Inventory Management System for SUCs using QR Code Technology (SIMS) based on the ISO 25010 Criteria

The evaluations made by the Property Custodian, Supply Officer, Department Heads, faculty and staff pointed that the SIMS highly exceeded the criteria set by the ISO 25010 Software Product Quality Standards on the functional characteristics of the system. The Property Custodian, Supply Officer, Department Heads, faculty and staff consistently scored the system with the general rating of 3.55 having constantly high ratings on each criterion.

From the data collected and analyzed, SIMS was described as very functional, very efficient and very usable.

Table 28

Summary of Evaluation of the SIMS by the Property Custodian, Supply Officer, Department Heads, faculty and staff

Software Product Quality Categories	Weighted Mean	Verbal Description
1. Functional Suitability	3.49	Very Functional
2. Performance Efficiency	3.33	Very Efficient
3. Usability	3.84	Very Usable
Average Weighted Mean	**3.55**	**Very Functional, Very Efficient and Very Usable**

4.3 Evaluation on the Level of Effectiveness of the Smart Inventory Management System for SUCs using QR Code Technology (SIMS)

The evaluations of the Property Custodian, Supply Office, Department Heads, faculty and staff specified that the SIMS is Very Effective. The end-users had unanimously given an overall rating of 3.56. The results show that the end-users all approved that the SIMS is very effective.

Table 29

Summary of Evaluation on the Level of Effectiveness of the SIMS

	Weighted Mean	Verbal Description
1. It searches, updates, archives and retrieves records efficiently.	3.52	Very Effective
2. It records tools and equipment details.	3.48	Very Effective
3. It monitors and tracks tools and equipment.	3.71	Very Effective
4. It generates ICS number or property code.	3.76	Very Effective
5. It generates QR Code.	3.62	Very Effective
6. It generates report.	3.43	Very Effective
7. It approves and disapproves transfer of tools and equipment.	3.43	Very Effective
Average Weighted Mean	**3.56**	**Very Effective**

Conclusions

Based on the findings, the following conclusions were drawn:
The Smart Inventory Management System for SUCs using QR Code Technology (SIMS) was successfully developed based on the different phases of the V-Model of the System Development Life Cycle (SDLC).

The Smart Inventory Management System for SUCs using QR Code Technology (SIMS) complied with the requirements specified in the ISO 25010 Software Product Quality Standards as evident by the ratings conforming to as Very Functional, Very Efficient, Very Compatible, Very Usable, Very Reliable, Very Secured, Very Maintainable and Very Portable given by the IT Experts.

The End-users are ready to accept and integrate the system in their process and workflow of transactions as proven by the qualitative rating of Very Functional, Very Efficient and Very Usable for the three selected categories of Functional Suitability, Performance Efficiency and Usability given by the End-users.

The Smart Inventory Management System for SUCs using QR Code Technology (SIMS) may be implemented in Nueva Ecija University of Science and Technology system based on the high level of acceptance received from the evaluators and because it features the technical functionalities and requirements that are needed for the effective monitoring of the supply inventory system of the University.

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Appendix A

Representation and Figures of Design Charts

Designs and conceptual framework necessary for the development of the graphical user interface, functionalities and database of the system were created.

The Figure 1 shows the functionality of the Smart Inventory Management System for SUCs using QR Code Technology. It is further explained here that the developed system administered by different users who are assigned with different levels of access and restriction, depending on their task related to the issuance process.
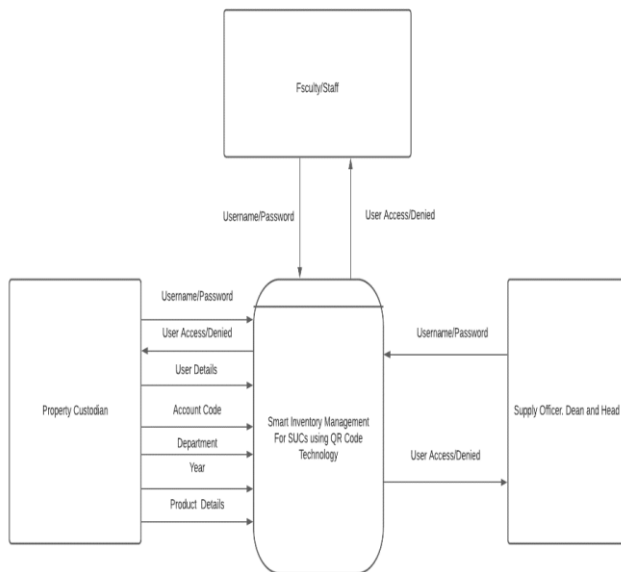
B. 2. Data Flow Diagram

Figure 2. **Data Flow Diagram Level 1 of Tools and Monitoring System for SUCs using QR Code Technology**

Figure 1. Context Diagram of Smart Inventory Management System for SUCs using QR Code Technology

Appendix B

Computer Programme

B. 1. Introduction

For the development phase, the researcher used several software to create and develop the system based on all the data gathered, policies and regulations, analyzed and designs conformed to in consideration of the end-users' requirement. The researcher used PHP scripting language for the actual coding of the system while Bootstrap, CSS and HTML were utilized in designing the system's graphical interface. Meanwhile, MySQL was utilized for establishing the database of the system.

The system was designed and created in a web-based environment in order to eliminate problems on software and hardware requirements since it can work on different devices and different platforms, provided a web browser had been installed on it.
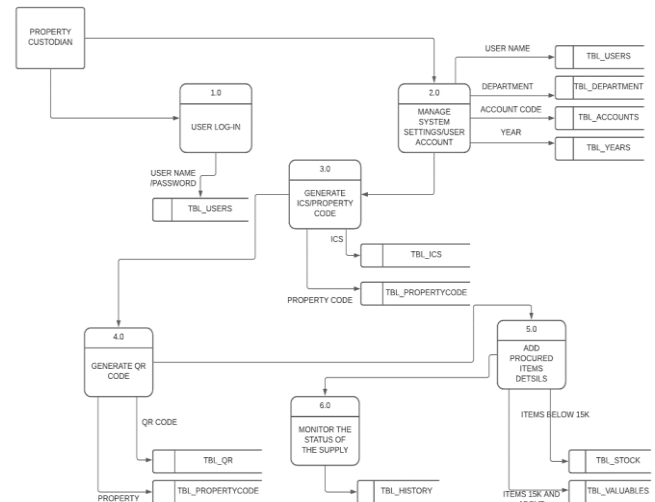
Study on Thermal Signature Detection using AMG 8833 Sensor for Low Visibility Rescue Operations

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Abstract

The AMG8833 Thermal Sensor is an affordable sensor that can be interfaced with a microcontroller to measure temperatures ranging from 0^0C to 80^0C. The Sensor, once connected to a microcontroller, can output an array of 64 temperature readings which is used to generate a thermal image. This study focuses on Thermal Signature Detection for Low Visibility Rescue Operations. A UAV drone prototype was designed to use the AMG8833 thermal Sensor for its field of vision when surveying a low visibility area. An Arduino Mega was used to interface the AMG8833, and an HC-05 Bluetooth module was used for wireless communication between the Arduino Mega and Laptop. The initial output of the AMG8833 Thermal only offers an 8x8 resolution which made it difficult to interpret the thermal image output. Bilinear interpolation using MATLAB was applied to resize the image into an 80x80 resolution to improve the thermal images. The processed thermal images were tested with varying distances and heat sources for its subject. The results were able to show that for ten trials, an average of 5.39 seconds processing time for the thermal images exists, and an improvement in thermal signature detection was found. The AMG 8833 Sensor can be used in Heat detection in low visibility environments but must be within 35-45cm from the Sensor. More complex image processing techniques may be applied further to enhance the image output of the low-resolution Sensor. It is recommended that a high-resolution thermal sensor be used for these applications for better results.

Keywords

AMG8833; Thermal Images; Image Processing

INTRODUCTION

Time, Environment, and Equipment are the factors that rescuers consider during rescue operations. There are cases during Search and Rescue (SAR) wherein the environment affects the duration of a rescue mission. This may be due to low visibility, wherein victims are challenging to locate. Having the right tools and equipment improves how fast victims can be rescued. A reconnaissance drone with thermal imaging capability can help find victims in low visibility areas. For this study, the AMG 8833 Thermal sensor is used to develop a UAV drone that aims to detect heat signatures in an area of interest.

Performing reconnaissance surveys allows determining the number of people in each area, what obstructions and the situation ahead, and what equipment to use to help people effectively. The rescuers need to do reconnaissance surveys to know the problem they will encounter and what they should do once they are there. The rescuers need gadgets to help them do reconnaissance surveys in the area that will not involve the study. Various Research papers support using thermal sensors in rescue operations. Perdana et al. [1] noted that a thermal sensor is needed to identify victims from the complex background, and it is much better if it is in aerial view. The thermal sensors will detect heat signatures that can easily distinguish through heavy intensity colors. Thus, helping the rescuers to visualize the surroundings within the rescue operation if there is a victim.

The researchers observed different studies to improve the existing research when creating a reconnaissance system. In flooded areas, the rescuers mostly use boats as their equipment for rescuing people. Consequently, limited vision while traversing the flooded area [2]. Considering the need for a wide view that would easily spot the people who need help, developers should create a system that could widen the search area and easily spot the victim. Navigation is critical when traversing a disaster site; thus, developing a navigation system for the UAV is a must [3]. Considering that a navigation system was implemented, there are still obstructions that could affect the flying of the UAV. However, there is a lack of papers and journals that use UAVs as a reconnaissance system in a low visibility environment. In a low visibility environment, rescue operations will be on halt due to having no visuals, which affects the response time of the rescuers. Also, they may encounter obstacles while traversing the flooded area that could lead to injuries. It further proves the need to use a technology that could give information while making a rescue operation in a low visibility environment.

This research aims to develop a remote-controlled reconnaissance system for rescue operations in low visibility environments to help locate victims. Specifically, the study

seeks to detect the presence of humans in low visibility environments like nighttime flooding in low to no lighting using thermal sensors.

The study is limited to using the AMG8833 Thermal Sensor for its field of vision in a low visibility area. An affordable UAV drone was used in this study and was piloted by the researchers during data gathering. The testing area is in an enclosed home environment to eliminate other external factors such as wind. The data range also depends on the HC-05 Bluetooth module, rated from 36 meters to 44 meters. The flight time of the UAV drone is also dependent on its battery.

I. Methodology

This chapter discusses the function and the development of the remote-controlled reconnaissance system. The methodology emphasizes the design of the Sensor, system flowchart, and data gathering methods.
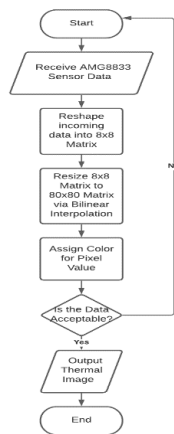
Figure 2.1. System Process Flow chart

In figure 2.1 shows the system process flow chart. This shows the process involved in enhancing the output of the AMG8833 Thermal Sensor. The process starts by receiving the data from the Sensor; the Sensor's output is only an array of eight temperature values. The values were designed to be reshaped into an 8x8 grid representing the image. This 8x8 image is considerably a low-resolution output, which is seen in further parts of this study labelled as unprocessed images. The 8x8 output is processed using MATLAB to make the image much clearer. The 8x8 output was resized to an 80x80 output using the image toolbox library. The process involved bilinear interpolation in approximating the values in between known variables. Once the output was interpolated, colors were assigned depending on its temperature value. A higher resolution thermal image was generated based form the initial 8x8 array data.
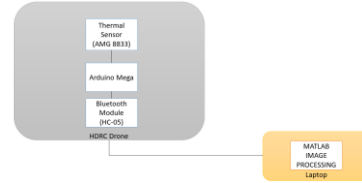
Figure 2.2. Block Diagram for Remote Controlled Reconnaissance System.

In figure 2.2, shows the block diagram for the prototype. Since the device is intended for reconnaissance in low visibility environments, this study uses a UAV drone wherein the AMG8833 and the microcontroller is placed. To have a wireless transmission of data from the microcontroller to the laptop, an HC-05 Bluetooth module was used for data communication. The image processing application installed in the computer is the one that will interpret and generate heat signatures based on the output from the AMG8833 Thermal Sensor.


Figure 2.3. Thermal Sensor Location

In figure 2.3, it was shown that the AMG8833 could detect heat signatures which helps determine the presence of humans in the area. The heat radiated from the body of people will appear as hot spots in the thermal sensor output. To further enhance the output of the AMG8833 Sensor, image processing techniques are based on this paper [4].

RESULTS AND DISCUSSION

This chapter discusses the Results of Heat signature Detection with the Image processing application. The results also compare the unprocessed 8x8 resolution output and the processed 80x80 resolution output.
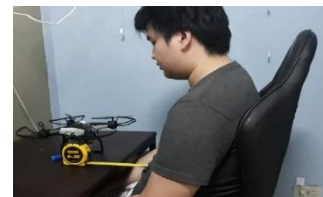
Figure 3. Set Up for Single Heat Source (Human)

In figure 3, it shows the initial setup with a Single Person as a Heat Source. This test will compare the results of the unprocessed image and the processed image while also considering the distance of the Heat Source from the AMG 8833 Sensor.

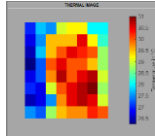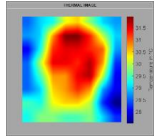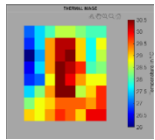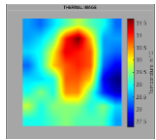**Table 3.1. Single Heat Source**
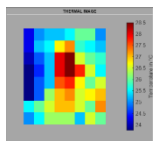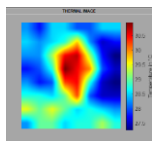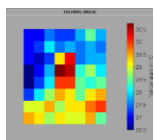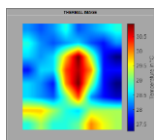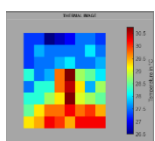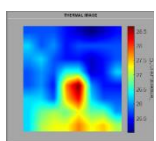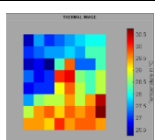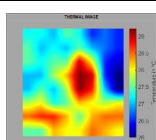
SINGLE PERSON HEAT SOURCE		
Distance to Sensor	Unprocessed Image	Processed Image
15cm		
25cm		
35cm		
40cm		
45cm		
50cm		

Table 3.1 shows the unprocessed and processed image of a single heat source. In the unprocessed image, the shape and the heat signatures are scattered as the single heat source moves away from the thermal Sensor. It does not give a clear picture of whether it is a human or not. In the processed image, the shape and the heat signatures are clearly defined, wherein it can detect the heat source that emits high temperature and low temperature. As the source moves away, the hotness of the single heat source dissipates, as can be seen on the image's shape in 50cm.

Figure 3.2. Set up for Single Heat Source (Artificial Heat Source)

Figure 4.1 shows the initial setup with a lamp or an artificial source of heat as a Heat Source. This test will compare the results of the unprocessed image and the processed image while also considering the distance of the Heat Source from the AMG 8833 Sensor.

Table 3.2. Artificial Heat Source
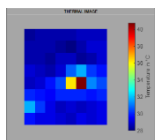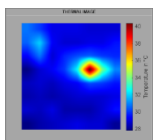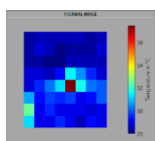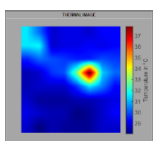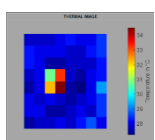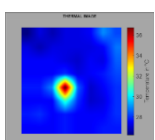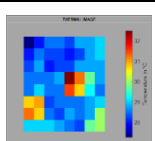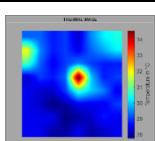
ARTIFICIAL HEAT SOURCE (LAMP)		
Distance to Sensor	Unprocessed Image	Processed Image
15cm		
25cm		
35cm		
40cm		
45cm		
50cm		

Table 3.2 shows the unprocessed and processed image of an alternative heat source, which is the lamp. In the unprocessed image, the artificial heat source is not defined, and the element in the array is not exact. As the artificial heat source moves away, it becomes fuzzy, and the artificial heat source cannot be seen clearly. The processed image is defined and clear where the heat is coming from. As it moves away, the artificial heat source becomes a small circle.
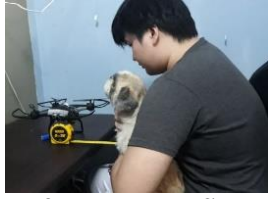
Figure 3.3. Set up for Two Heat Sources (Human and Dog)

Figure 3.3 shows the initial setup with two Heat Sources, which used a Human and a dog as Heat Source. This test will compare the results of the unprocessed image and the processed image while also considering the distance of the Heat Source from the AMG 8833 Sensor.

Table 3.3. Human and Dog

2 HEAT SOURCES (HUMAN AND DOG)		
Distance to Sensor	Unprocessed Image	Processed Image
15cm		
25cm		
35cm		
40cm		
45cm		
50cm		

Table 3.3 shows the unprocessed and processed image of a human and dog. In the unprocessed image, the shape and heat signatures are scattered and cannot identify human and dog. As it moves away, the heat source in the image is scattered even the shape is unidentifiable. The dog cannot be clearly identified in the processed image because of its fur. The

thermal Sensor clearly detects the high temperature the human gives off. It was known that animals give off a higher temperature than humans, but the thermal Sensor cannot detect their hotness and shape because of their fur.

Figure 3.4. Set Up for Two Heat Sources (Human and Human)

Figure 3.4 shows the initial setup with Two Heat Sources with Two Humans as Heat Sources. This test will compare the results of the unprocessed image and the processed image while also considering the distance of the Heat Source from the AMG 8833 Sensor.
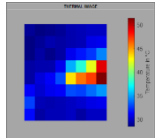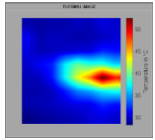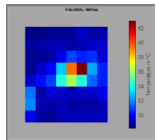
Table 3.4. Human and Human

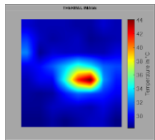| 2 HEAT SOURCES (HUMAN AND HUMAN)		
Distance to Sensor	Unprocessed Image	Processed Image
15cm		
25cm		
35cm		
40cm		
45cm		
50cm		
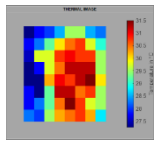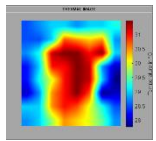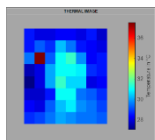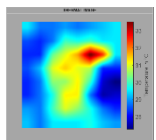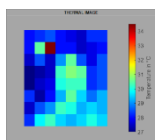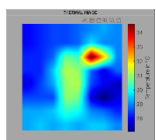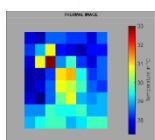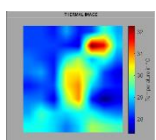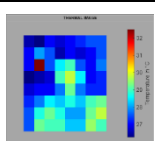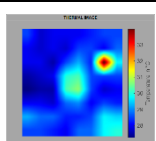
Table 3.4 shows the unprocessed and processed image of two humans. In the unprocessed image, two heat sources can be seen easily and as it moves far away one heat source is not clearly defined in the thermal image. In the processed image, the shape and heat signature are clearly detected. It gives off the same heat signature seen in the temperature gradient. As it moves away, two human shapes are still clearly defined in the thermal image.
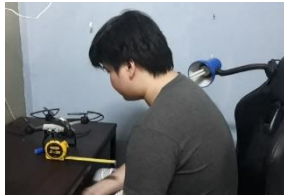
Figure 3.5. Set up for Two Heat sources (Human and Artificial Heat Source)

Figure 3.5 shows the initial setup with Two Heat Sources. A Human and a lamp served as Heat Sources. This test will compare the results of the unprocessed image and the processed image while also considering the distance of the Heat Source from the AMG 8833 Sensor.

Table 3.5. Human and Artificial Heat Source

2 HEAT SOURCES (HUMAN AND ARTIFICIAL)		
Distance to Sensor	Unprocessed Image	Processed Image
15cm		
25cm		
35cm		
40cm		
45cm		
50cm		
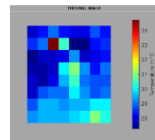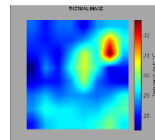
Table 3.5 shows the unprocessed and processed image of a human and an artificial heat source. In the unprocessed image, it is not clear which is the human and the artificial heat source. As it moves away, the heat source is not detected, and a blue temperature gradient can be seen. In the processed image, the human and the artificial heat source cannot be identified while they are both near the Sensor, but the high temperature is clearly defined. As it moves away, the human is not detected, and the artificial heat source was shown. The thermal Sensor detects the highest temperature and makes it clear in the image.

Table 3.6. Processing Time of Thermal Image

Trial	Processing Time (sec)
1	5
2	4.99
3	5.12
4	5.25
5	5.32
6	5.77
7	5.45
8	5.51
9	5.58
10	5.91
Average	**5.39**

Table 3.36 shows the processing time of the thermal image from Bluetooth to the laptop. Ten trials were conducted, and the processing time averaged 5.39 seconds. This shows that a delay of approximately 5 seconds exists in data transmission and image processing time.

H_O: *Detection of other heat sources in low visibility environments is not improved due to added sensors.*

H_A: *Detection of other heat sources in low visibility environments is improved due to added sensors.*

Table 3.7. Testing Heat Detection

TESTING HEAT DETECTION		
Trial	Number of Heat detected using Sensor	Number of Heat detected without Sensor
1	4	0
2	3	0
3	3	0

4	4	0
5	4	0
Average	$x_1 = 3.6$	$x_2 = 0$
Standard Deviation	$s_1 = 0.5477$	$s_2 = 0$

Table 3.8. Images of Testing Heat Detection
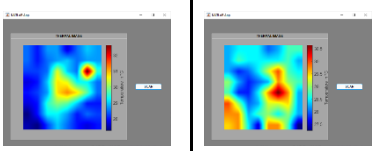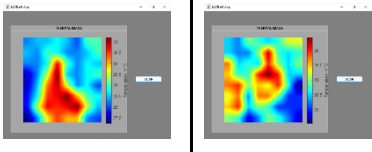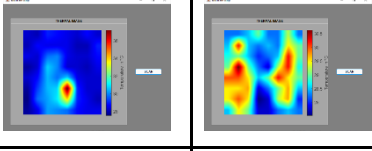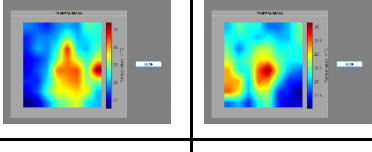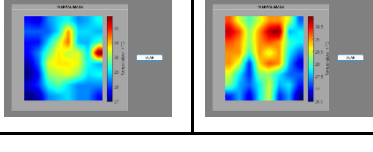
IMAGES OF TESTING HEAT DETECTION		
Trial	Thermal Image	Number of Heat Sources Detected
1		4
2		3
3		3
4		4
5		4

Table 3.8 shows the thermal images captured during the five trials for Heat detection.

Having five samples for each parameter, the degree of freedom for the t-test is 8. Considering the set p-value is 0.05, the critical value used in the t-test is 2.132. The resulting value must be higher than 2.132 to reject the given null hypothesis.

Conducting the statistical analysis on the testing of heat detection on numbers of heat detected with and without sensors showed t-value of 14.70. This means the null hypothesis of detecting other sources of heat in low visibility environments is not improved due to added sensors will be rejected. Thus, detection of other sources of heat in low visibility environments has improved due to added sensors.

II. Conclusion and recommendations

The researchers were able to design a Remote-Controlled Reconnaissance System for low visibility Rescue Operations using AMG8833 Thermal Sensor. This was achieved by installing Arduino Microcontrollers to the Drone. The Arduino receives and interprets data from its Sensor.

The objective of this study was to detect the presence of humans in low visibility environments such as in low to no lighting using thermal sensors. This was achieved by using the AMG8833 Thermal Sensor. However, this Sensor outputs a low-resolution 8x8 image. To meet the objective using this Sensor, image processing techniques were used. Using MATLAB, image processing such as bilinear interpolation allowed the researchers to expand the 8x8 image into an 80x80 resolution. The processed output thermal image showed an improvement and was able to approximate the shape or figure of the heat source.

Based on the results of this study, low-resolution outputs can only be processed to a certain degree of clarity. It may not accurately represent the temperature and figure of the heat source. For the case of this Sensor, the best heat signature representation can be generated when the distance of the Sensor to the target is between 35cm to 50cm. The Sensor can better detect when there is a single heat source. In cases wherein there were multiple heat sources, if the temperature difference of the heat sources was high, the Sensor outputs the higher temperature. It is recommended to have a thermal sensor with a high frame rate and resolution to easily detect and distinguish a human and other source of heat.

The study was able to show that AMG8833 thermal imaging for low visibility rescue operations can be used only for close-range applications such as a distance of 35cm to 50cm from the subject. This also shows that long-range application using the AMG8833 is not recommended due to its low resolution and frame rate. It is suggested to use other thermal Sensors with higher resolution for similar applications.

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The use of academic platforms and simulators in the pandemic era

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Abstract

The social distancing policies generated by the pandemic have forced a large majority of universities to modify or rethink the pedagogical models used in the classroom. The development of educational platforms, the use of simulators, virtual labs, and the creation of serious games have been instrumental in achieving this goal. At our university, professors in the logistics area have been working since before the pandemic on the creation of an educational platform (GOAL Project), and on the creation of a serious game called Logistic Simulator (or LOST, for short). The conditions of isolation have forced us to modify the pedagogical design of the course to promote activities that foster the research and self-learning capacity of our students. This work discusses the use of educational platforms and simulators to face disruptive conditions when it is not possible to use face-to-face models.

Keywords

Higher Education, Educational Innovation, Supply Chain Education, Logistics Education.

INTRODUCTION

Social distancing measures drastically affected social, labor, and economic dynamics on all continents. For most education systems, this has represented significant changes in the way knowledge is transmitted. Within higher education, most universities chose to incorporate new information and communication technologies (ICT) such as Zoom, Google Meet or Microsoft Teams to offer courses and maintain communication with their students. Despite the conveniences offered by these platforms, new difficulties have arisen in terms of disinterest on the part of students, absence of personal contact, absence of visual interactions, poor distance assessment methods and other technological problems such as the poor capacity of the network system.

For the professors at our university, which is in Mexico City, remote models using these communication platforms began three years earlier when the 2017 Mexico City's earthquake occurred. The earthquake forced us to experiment with different pedagogical models of distance education, and the logistics professors at our university have worked on the creation of different educational platforms, new forms of distance assessment, simulators, serious games, educational videos, etc. On this occasion, the remote models were only applied for one semester, and we returned to the face-to-face model in January 2018.

The incorporation of ICT has led us to create innovative strategies and has changed the paradigms that favored repetition and has prioritized the development of new skills such as information search, critical thinking, problem solving and self-regulated learning. The changes that are generated when we move from a face-to-face model to a remote model have important implications in the design of learning activities, since the transmission of knowledge is only part of the objective, since it is also desirable to promote meaningful learning and to develop competencies that will be useful for students in this new millennium.

While within the field of logistics, traditional teaching is the dominant form of knowledge transfer, during this new millennium new techniques have been incorporated that favor practical activities with a more active approach with the intention of involving students in their own learning. Some of these activities are for example, problem-based learning [1, 2], case method [3] and professional practices [4, 5]. In addition, in the last decade, the inclusion of technology in educational processes has supported didactic techniques such as the flipped classroom, augmented reality, virtual reality, and game-based learning [6, 7, 8].

The objective of this article is to show the changes that have been made in a pedagogical design for the implementation of a remote teaching-learning model using an educational platform dedicated to the teaching of logistics. The platform contains several strategies to promote active learning, develop meaningful content, modify traditional assessment, and promote game-based learning using a logistic simulator. The use of this simulator has facilitated the acquisition of theoretical knowledge, has increased the motivation of the participants, has provoked significant learning, and has developed the capacity for self-regulated learning.

GOAL Project and Logistic Simulator

GOAL Project is an educational platform designed with the aim of transmitting and integrating logistics concepts (see Fig. 1). The construction of this platform has led us to develop useful and meaningful materials for students, including videos, quizzes, and notes. These elements are linked to a game called Logistic Simulator (or LOST, for short).

Fig. 1 GOAL Project platform (https://goalproject.co)

LOST is a video game in which students apply logistics concepts and understand the interfaces of a supply chain. The intention of the game is that students can experiment, create strategies, manage interfaces, understand the constraints of a logistics system, and finally, motivate them to understand the different concepts that make up this area.

The game shows students the consequences of each decision and how a decision in a company's department affects the performance of the system. Using the simulator, students forecast demands, create a production plan, select raw materials, choose suppliers, and determine the size of orders. This game allows participants to observe the effects that decisions have in relation to the profits of the company.

The simulator includes multiple concepts (demand planning, production planning, inventories, optimization, and transportation decisions). One of the advantages of this simulator is that it contains different degrees of difficulty and can be used for different purposes. For instance, the simulator can be used with students who have begun to take subjects about logistics, or with students who have already seen some content in this area. In the latter case, the simulator allows students to apply previous knowledge in new scenarios (see Fig. 2).
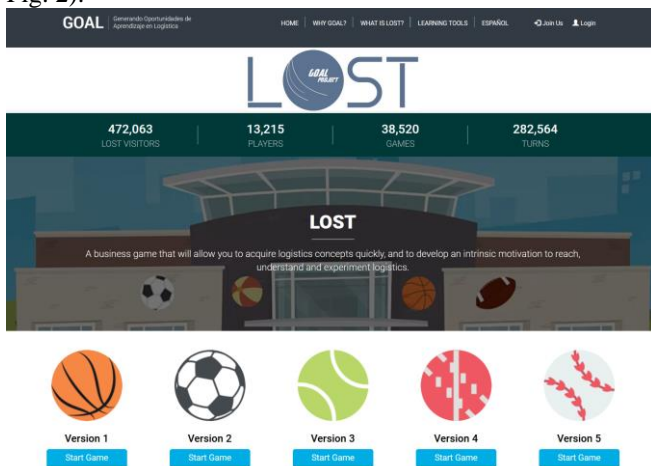
**Fig. 2 Logistic Simulator LOST
(https://goalproject.co/lost)**

The aim of GOAL goes far beyond the use of this logistic simulator. The platform offers students support tools on different topics that relate to the decision-making process in the logistics area. To ensure that students achieve this goal,

we have created a set of supporting materials that we placed on the platform. We also created a YouTube channel containing more than 200 educational videos (Fig. 3).
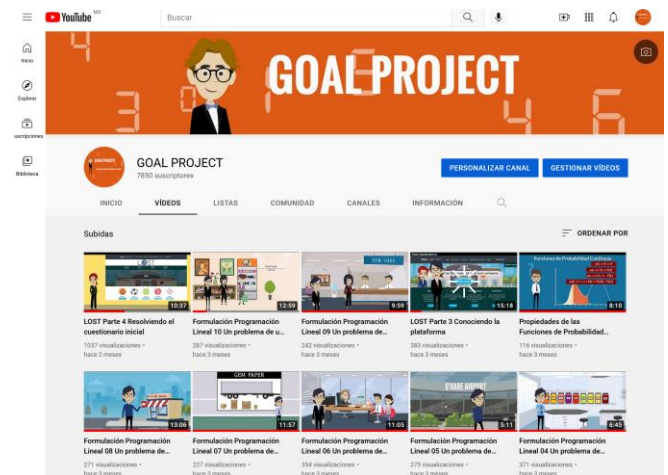
Fig. 3. YouTube channel of the GOAL Project

To motivate students to consult the existing materials on the platform, GOAL has been fully gamified, so that students can receive different rewards within the game when they respond adequately to the questionnaires that appear within the platform. These in-game benefits allow students to acquire certain privileges, such as increasing their warehouse space, having greater production efficiency, and raising demand, among others.

INSTRUCTIONAL DESIGN FOR A FACE-TO-FACE MODEL

From the second semester of 2017, we began to work on a pedagogical model based on the GOAL project platform to create courses in logistics that increase student learning, improve motivation, and develop skills in students for their learning self-regulation.

Including videos on the platform allowed us to experiment with different methodologies, such as flipped classroom, active learning, and the use of LOST led us to conduct game-based learning (GBL). These modifications of the original course led us to the pedagogical design shown in Fig. 4.
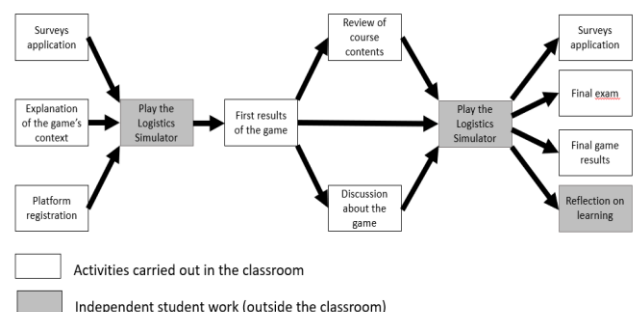
This pedagogical design was used from the semester August - December 2017 to the semester August - December 2019. The main academic results obtained in this period compared

to those obtained in traditional teaching for the previous semesters are presented in Table I.

TABLE I
Main Academic Indicators

	Feb-Jun 2014 Feb-Jun 2017	Aug-Dec 2017 Aug-Dec 2019
Number of students	194	103
Percentage of dropouts (%)	7.7	2.8
Average of partial exams	72.4	82.1
Final exam Average	75.3	83.4
Pass rate (%)	76.8	88.6

This pedagogical design was used from the semester August - December 2017 to the semester August - December 2019. The main academic results obtained in this period compared to those obtained in traditional teaching for the previous semesters are presented in Table I.

On the other hand, at the beginning and at the end of the course we applied three types of surveys:

1. The first survey measured the motivation of the student during the course and was based on the classical literature of the area [9]. This survey measures lack of motivation (amotivation), extrinsic motivation and intrinsic motivation.
2. The second survey is based on the student's self-perception of self-regulated learning [10].
3. The third survey was designed to measure the relevance of the selection of strategies that students follow in the game.

From the results of the motivation survey, we can conclude that demotivation is reduced, while intrinsic and extrinsic motivation increase significantly. A summary of the results of these surveys can be found in Table II.

The perception survey conducted to know the opinion of students about the importance of self-regulated learning contains 52 questions and we have a database of 418 answers from students who have used the platform and the simulator. With these data we performed a factor analysis concluding that seven factors explain 62.15% of the total variance. These factors are the following:

• Self-management skills
• Openness to accept new ideas.
• Critical thinking.
• Self-direction and skills in information acquisition
• Enjoy learning.
• Awareness of your limitations
• High expectations

After obtaining the factors, we performed a t-test to determine if there were significant changes in the importance that students attached to the factors. The results show that in five of these areas students improve their assessment of the importance of self-regulated learning. The results of this comparison can be seen in Table III.

Finally, in terms of the strategies that the students follow during the game, we found significant differences between the first and the second time they play. The results studied show significant differences in topics such as forecasting, production planning, and inventory management.

INSTRUCTIONAL DESIGN FOR A REMOTE MODEL

The beginning of the COVID 19 pandemic resulted in the need to discuss the strategies that can change under this new scheme of remote work. The following decisions were made:

- *Increase the number of videos and notes that will be placed on the platform.*
- *Increase the number of activities that students will perform independently.*
- *Increase flexibility in the submission of assignments and projects in the course.*
- *Institute a greater number of personalized counselling.*
- *Promote team discussions about the various strategies students followed.*

The pedagogical design used during this stage is shown in Figure 5.

The academic results are quite like those obtained in the last two years, the percentage of dropouts was 0%, the average of the partial exams was 80.7, the average grade in the final exam was 82.7, and the pass rate was 90.47%.
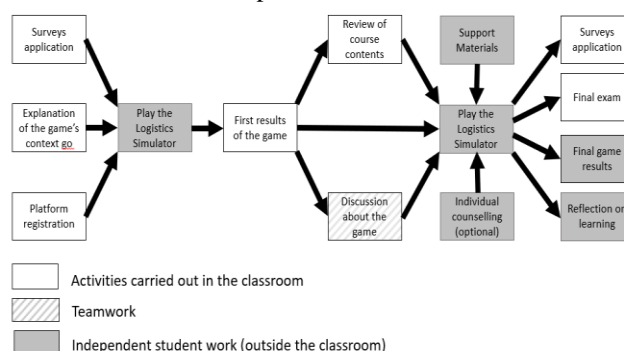
Fig. 5. Pedagogical design for a remote model

Table II shows a summary of the results of the motivation survey in the face-to-face model (2017 – 2019), and those of the remote model, (2020 – 2021). As can be seen, both in the face-to-face model and in the remote model, the lack of motivation decreases, while intrinsic and extrinsic motivation increases throughout the course. In the case of intrinsic motivation, it can be observed that in the remote model the

second survey is also significantly different from that of the face-to-face model. This means, apparently, that the pedagogical design used in the remote model increases intrinsic motivation in the students.

TABLA II
Results of the motivation survey

	N	First Survey			Second Survey		
		Amotivation	Extrinsic Motivation	Intrinsic Motivation	Amotivation	Extrinsic Motivation	Intrinsic Motivation
Remote	72	2.25	4.63	4.96	1.49	5.21	6.33
Face to face	103	2.19	4.51	5.10	1.51	5.17	5.83

In relation to the development of competencies of the self-regulated learning survey among students, the results are presented in Table III. In this case, the results are quite similar, however, there is a significant difference in favor of remote mode with the sub competence called "SelfDirection".

TABLE III
Self-Regulated Learning Survey Results

	Face to face Model		Remote Model	
Sub competencies	First Survey	Second Survey	First Survey	Second Survey
Self-management	27.95	29.52	27.56	29.44
Openness to accept new ideas	70.17	72.87	69.71	73.07
Critical thinking	32.15	32.17	31.87	32.46
Self-Direction on acquiring information	27.73	26.13	28.19	29.84
Enjoy Learning	31.30	33.19	30.63	34.05
Awareness of their limitations	52.18	53.22	51.16	52.93
High expectations	41.13	42.76	41.02	43.00

Finally, in terms of the relevance of the game's decision-making and the scores obtained by the students in the simulator, in both learning modes they were similar. The Pre-Test and Post-Test results are evaluated on a scale of 0 - 100 (where 0 is the lowest score, and 100 is the highest score). The game score is the result that the students obtain at the end of the game, regularly the scores of the 5800 participants who have played this game range between 0 and 1'000,000 (consider that the median of the scores is 680,000). The average of the scores obtained in the post-test in face-to-face mode were higher than those of the remote mode, however, the score obtained in-game is better in the remote mode than the average score in face-to-face mode. The results can be seen in Table IV.

TABLE IV
Results Pre-Test, Post-Test and Game Score

		Pre-Test	Post-test	Score
Remote Model	N = 75	63.81	82.31	817 324
Face to face Model	N = 109	60.18	84.17	796 439

DISCUSSION

With the use of the GOAL Project academic platform, significant improvements had been obtained in the most important academic indicators, and in addition, it had allowed us to experience the didactic technique of the flipped classroom, which we consider fundamental for students to develop sub competencies contained in self-regulated learning.

On the other hand, the use of the logistic simulator had generated greater motivation in the students before the pandemic. The game contains a leaderboard that allows students to identify their position with respect to the other participants. Most participants have played more times than requested, due to their desire to see their names appear at the top of the leaderboard.

In our classes we have observed that when a new topic is taught, students relate the contents with some of the decisions or data of the game, which increases their motivation to learn. In addition, the topics become meaningful for the students. Along with the increase in student motivation, we consider this to be the greatest contribution of the game in the course, to provide significance of the contents in the classes.

At the beginning of 2020, one of the projects in mind was to experiment with the platform with a smaller number of teacher-led sessions and with a more active participation of students in learning activities. The pandemic accelerated our plans, and in March 2020 changes were made in the programming of the simulator to allow the generation of new scenarios, the creation of more support videos for students and the generation of a greater number of activities outside the classroom. The original plan was to experiment with these changes in the August-December 2020 semester;

however, the isolation policies that began in March 2020 accelerated the implementation plan.

Comparing the scenario face-to-face and the remote mode, there was a very significant increase in intrinsic motivation in the remote mode. This could be explained by the availability of new scenarios in the LOST game.

At another angle, six of the seven sub-competencies related to self-regulated learning were superior in remote mode. We would like to underline that the sub-competence "self-direction in information acquisition" was significantly higher in students under this new format. This could be explained by the new activities planned for the course.

The post-test shows a difference in favor of the face-to-face methodology. This fact may be expected since the students have a smaller number of theoretical elements to explain their decisions in the game, that is, the verbalization of the strategies is better expressed by the students who have had a greater number of theory classes. However, the score achieved by students in the simulator is higher in students in remote mode. These two results indicate that an area of opportunity in the case of students in remote mode is a greater theoretical content that allows them to better explain the concepts applied in the simulator.

The main academic indicators seem to be better in the remote model compared to those obtained in the face-to-face modality, however, we did not make a comparison between them since certain percentages of the course evaluation were modified, and according to the pandemic conditions, the students should have more flexibility in exams and tasks submissions.

Regardless of this change in evaluation policies, we prioritize in our pedagogical design the student's commitment to their learning, the development of self-regulated learning competence and the proper application of this logistical strategy, so the comparison of these elements is slightly favored by the methodology designed for distance learning more than in the face-to-face mode.

CONCLUSION

Social distancing policies implemented by governments have impacted work at universities, who have experimented with different models of distance learning. Among the strategies for this new teaching modality are the use of academic platforms and the use of simulators. The implementation of these tools involves the modification of existing pedagogical designs, promoting greater responsibility for students over their learning, and considering schemes that provide greater flexibility for the execution of activities, review of materials and the modification of evaluation models.

On the other hand, an essential feature in these models is to corroborate that learning is significant, and that it can promote changes in students' behaviors, which must be observed with tangible results.

GOAL Project as an online learning platform had been a successful alternative when it was applied in the face-to-face model. The platform improves the teaching of logistics decisions making use of gamification, the flipped classroom and self-regulated learning. The disruptive conditions created by the pandemic allowed to test GOAL Project's value in new circumstances and it was necessary to adapt the contents, generate new learning scenarios in the game and give greater freedom to students in the search for information. This new instructional design allowed to increase the motivation and commitment of the students with their learning, significantly increased the development of the capacity of self-regulated learning and allowed the students to internalize the content of the game through meaningful learning, which can be related to the increase in the score obtained in the game.

This experiment, forced in part by the pandemic, leads us to conclude that LOST is a simulator that promotes remote and self-regulated learning. This work contributes to the enrichment of LOST as a learning space in which students can use different technological resources and collaborate remotely. In addition, the supports included in the platform provide the right flexibility for students to manage their own learning.

Future work is required to continue the enhancement of value of the GOAL Project platform and the LOST logistics simulator under the post-pandemic reality. It is necessary to generate new learning scenarios, to increase the variety of active learning resources, and to promote the intensive use of the platform.

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Water Billing System with Business Intelligence and Data Analytics

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Abstract

Water resource management involves the day to day operations such as computing water consumptions and collecting payments of water consumers. It also includes the activity of planning, developing, distributing, and managing the optimum use of water resources. Two of the major problems in water resource management are the lack of an automated system for collection and the distribution of water facilities. This study is about the development of a Water Billing System with Business Intelligence and Data Analytics for Water Resource Management using Linear Regression a web-based application that implements business intelligence and linear regression. In the development, the researchers used the agile model to systematically create the system. The system is evaluated by IT- Experts to meet the software Industry standards. The developed system can generate a dashboard through the implementation of business intelligence particularly data aggregation that can produce different graphs in terms of water consumption, consumer distribution, revenue collections, and collectibles. The developed system can generate data analytics through the implementation of a Linear Regression Algorithm that can also produce forecasts and patterns in terms of water consumption, revenue collections, and collectibles based on previous data trends. As a result, there is a significant increase in collections based on the last four months' implementation of the system. Using the ISO-9126 as an evaluation instrument the system has passed the industry standard because the evaluation results show only two verbal interpretations; "Highly" and "Very Acceptable".

Keywords
Business Intelligence, Water Resource Management, Linear Regression, Water System, Information System

INTRODUCTION

The water system is one of the necessities of every community. It is better not to have electricity than not having water. People can live without food for three days but losing water will mean death. That is how important water is.

Meanwhile, the water system has been a major problem for everyone. The effect of climate change and the excessive use of humans are the two major reasons for water shortage. If global temperatures continue to rise, rainfall will increasingly become a beast of extremes: long dry spells, dangerous floods there, and in some places, intense water shortages. As early as 2025, the World Health Organization estimates that half of the world's population will be living in water-stressed areas [1].

Part of the water system is the people who use and consumes water including the management who implements guidelines in the distribution process of water facilities. In some way, the inability to find the right location to build water facilities for water distribution creates problems. This problem is part of water management's responsibilities. Water management is the activity of planning, developing, distributing, and managing the optimum use of water resources [2].

Today, technology like a prediction system is being utilized to craft an adequate solution to the setback of society. A prediction System is the estimation of some variable of interest at some specified future date. Usually, it is based on statistical and time series forecasting methods [3].

On the other hand, new techniques in data analytics are also introduced like business intelligence. Business intelligence (BI) is a technology-driven process for analyzing data and presenting actionable information that helps executives, managers and other corporate end-users make informed business decisions. BI encompasses a wide variety of tools, applications, and methodologies that enable organizations to collect data from internal systems and external sources, prepare it for analysis, develop and run queries against that data and create reports, dashboards, and data visualizations to make the analytical results available to corporate decision-makers, as well as operational workers. The field of business analytics has improved significantly over the past few years, giving business users better insights, particularly from operational data stored in transactional systems. An example is e-commerce data analysis, which has recently come to be viewed as a killer app for the field of data mining [4].

Meanwhile, the analysis of data in prediction is simplified through linear regression. Linear regression is used for finding a linear relationship between the target and one or more predictors [5].

In the province of Laguna, water is said to be rich since its landmark is surrounded by water because of Laguna De Bay. But water shortage has been a big challenge to the entire province. [6] Based on the Philippine Water Districts Directory majority of the municipal water district in Laguna are still using a manual procedure in managing their day-to-day business transactions that lead to mismanagement. At present, water system automation is not well established in the province of Laguna. Different concessionaires are operating per municipality most of them are privately operated. One of the reasons why a water problem arises is the lack of an automated system that can be used for water operation. Many of the Local Government Unit (LGU) relies heavily on a manual billing system which resulted in some human errors and manipulation (Philippine Water Districts Directory).

This study developed a water billing system that capable of providing prediction with the application of business intelligence using linear regression. This will help the municipalities in the province of Laguna to identify places that need more water system installation based on water consumption, provide automation on day-to-day transactions, and will result in better water management.

The objective of the study

The general objective of the study is to develop a "Water Billing System with Business Intelligence and Data Analytics in Laguna" Specifically, it aims to:

1. Create a web-based system that can automate, and improved the process of collecting payments, and generating reports in the municipalities in Laguna;
2. Create a web-system that utilizes linear regression that produces predictions on the consumption of water in the municipalities of Laguna.
3. Create a web-based system that offers business analytics to provide dashboards that generate graphs based on the collection, consumptions, and collectibles from the different barangays and other related categories;

Methodology

This research study focused on the development of a Water Billing System with Business Intelligence and Data Analytics using the Linear Regression Algorithm. Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable.

Linear Regression Formula

Figure 1. Linear Regression Formula

Figure 1 shows the formula applied in the system that is used for prediction.
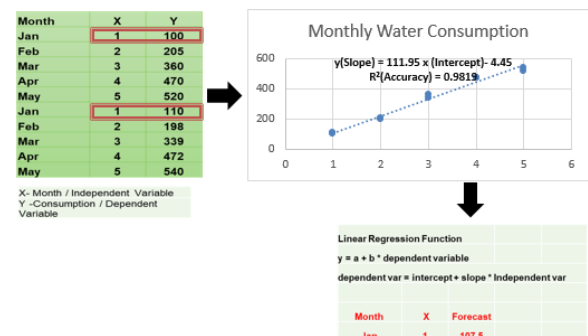
Figure 2. Liner Regression sample implementation

Figure 2 shows the sample illustration of how the Linear Regression Model was implemented in the system.
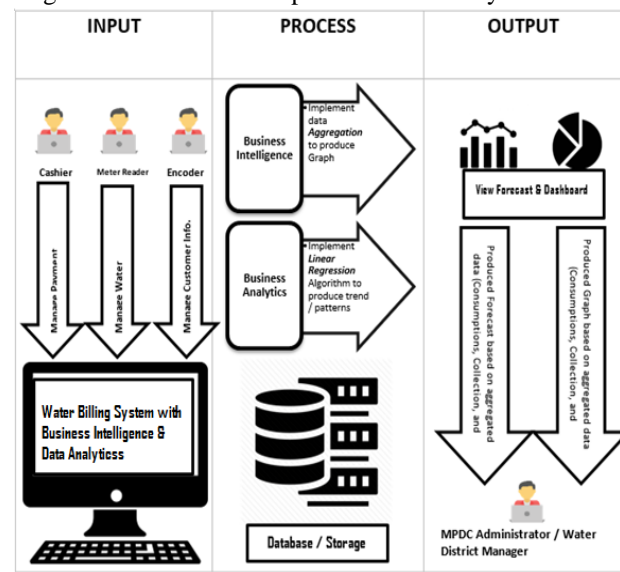
Figure 3. Conceptual Framework

Figure 3 shows the Conceptual Framework of the Study which shows how the water billing system will work with the application of data and business analytics and with the implementation of linear regression. The system will be the center of the entire transactions of water management in the municipalities of Laguna.

All the transactions are saved to the centralized database, particularly consumers' water consumption encoded by the municipal waterworks encoder, and consumers' payment transactions encoded by the municipal waterworks cashier.

The system utilizes data aggregation (One of the parameters of business intelligence) to produce a dashboard that consists of graphs and charts.

Moreover, the system will also implement a linear regression algorithm that utilizes the aggregated data and finding the correlation between consumers' monthly water consumption to produce predictions based on the data trend in a graphical view.

Results and Discussion

The system is designed to improve and automate water resource management day-to-day business transactions in the municipality of Laguna, also the system offers a dashboard to track and monitor water management transactions such as collection, collectibles, and water consumption with the application of business intelligence and analytics.
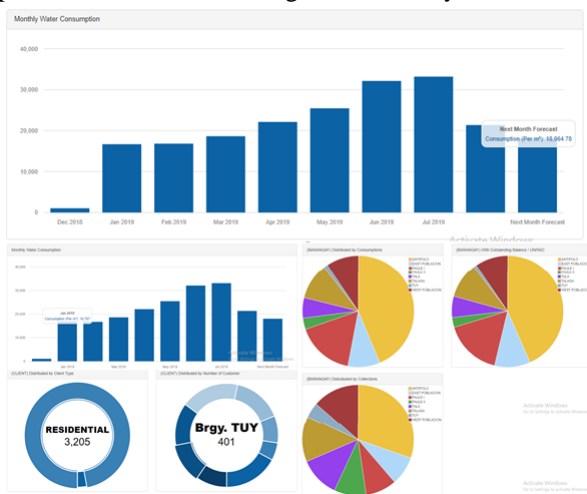
Figure 4. System's Screenshots

Figure 4 shows the system main features, with the implementation of "Business Intelligence" in the study, the Local Government Unit can view better insights into water management through the visual representation of water consumption trends. Also, the chart or graphs shows the number of water consumers distributed per barangay. Moreover, the collection and collectibles were also visually represented through graphs or charts.

Meanwhile, the used of "Linear Regression" as a model to predict water consumption, collections, and collectibles for the next succeeding usage based on past trends are completely related to the implementation of "Business Intelligence" The same results have been formulated by the study.

Overall Evaluation Summary based on ISO 9126 evaluation instrument

Criteria	Sub - criteria	Overall Mean	Interpretation
Functionality	• Accuracy • Compliance • Interoperability • Security • Suitable	4.19	Very Acceptable
Reliability	• Fault Tolerance • Maturity • Recoverability	4.17	Very Acceptable
Usability	• Learnability • Operability • Understandability	4.5	Highly Acceptable
Efficiency	• Resource Behavior • Time Behavior	4.19	Very Acceptable
Maintainability	• Analyzability • Changeability • Stability • Testability	4.25	Very Acceptable
Portability	• Adaptability • Conformance • Installability • Replaceability	3.88	Very Acceptable

Based on the evaluation as shown in table 1, the three types of respondents, IT Experts, Water Consumer, and Water District Staff, usability and functionality got the highest verbal evaluation score, this served as evidence that the developed system meets the required functions, and user-friendliness based on the summary of the evaluation. However, portability got the lowest score which the developed system is a web-based system that requires an internet connection.
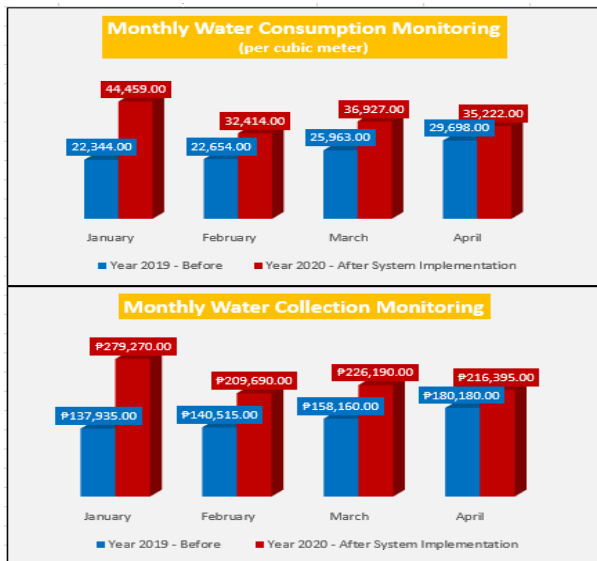
Figure 5. Month Water Consumption and Collection Monitoring

During the implementation of the system in Rizal, one of the municipalities in Laguna the developed system helped them a lot in the collection aspect. There is a significant increase in the collection and that is based on the last four months of implementation as shown in figure 5.

Figure 5 also shows the difference between using the manual operation of water resource management versus the implementation of the developed system.

Conclusions

Based on the conducted evaluation by the researchers the following conclusions were derived;

1. The study is a helpful tool in managing water resource in the municipality of Laguna for their day to day operations;

2. The developed system in this study can perform business intelligence which is a helpful tool in visualizing water management-related data;

3. The study can perform prediction through the implementation of the linear regression technique;

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Practical Analysis of Learning English in Higher Schools of Kazakhstan

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Abstract

English is taught at the early stage of education in Kazakhstan and focuses on developing reading, writing, listening and speaking skills. The objectives of higher schools are not compatible with the students' purposes for learning English. Students are not taught to the rules and techniques to pass international exams on English or enter to universities to get master or doctorate degree. This paper presents the practical analysis of learning English in higher schools of Kazakhstan. The analysis was developed by scaling techniques for measuring data gathered from respondents (Likert, the constant comparative, one-way variant analysis). The validity and the confidence of the measuring is based upon the data obtained from 218 first-year students of L.N. Gumilyov Eurasian National University. The aim of the article is to determine the main problems of students to learn English in higher schools and present teachers' recommendations for improving English.

Keywords

agreement, English, frequency, importance, problems, quality, recommendations

INTRODUCTION

Within a historically short period after gaining independence in 1991, Kazakhstan has managed to take a strong position on the international scene. Kazakhstan became a member state of the United Nations and other international organizations. Since then, Kazakhstan has been actively involved in the activities of many UN organizations, such as UNESCO, UNICEF, ECOSOC, UNHCR, to name but a few. Kazakhstan also began to collaborate with a number of major international organizations, as the International Monetary Fund (IMF), the International Bank for Reconstruction and Development (IBRD), the Organization for Security and Co-operation in Europe (OSCE). It was an initiator of the convening of the Conference on Interaction and Confidence-Building Measures in Asia (CICA), the Asian analog of the OSCE. And it is actively involved in the integration processes within the framework of the Economic Cooperation Organization (ECO), the Collective Security Treaty Organization, the Central Asian Economic Union (CAPS), and the Shanghai Cooperation Organization (SCO). Kazakhstan became the first Asian country to chair the OSCE. English proficiency is considered as a way to enter into the world community and upward economic mobility in Kazakhstan. There is enormous amount of foreign companies in Kazakhstan which motivate youth to be employed in jobs with high levels of proficiency in English (Chevron, Exxon Mobil, General Electric, Halliburton, etc.).

Kazakhstani higher educational institutions cooperates with foreign establishments launching new scientific projects and participating in international events conferences, seminars, workshops). There are 10 national (L.N. Gumilyov Eurasian national university, T.K. Zhurgenov Kazakh national academy of arts, Abai K. Kazakh national pedagogical university, Al-Farabi Kazakh national university), 4 international (A. Yassavi International Kazakh-Turkish university, International university of Information technology, Nazarbayev university, Kazakhstan-Germany university), 30 state (S. Toraigyrov Pavlodar state university, Korkyt-Ata Kyzylorda state university, A. Buketov Karaganda state university, Atyrau institute of oil and gas), 15 national securities (Military institute of the national guard, national defense university, Military institute of the land forces, Military institute of the air defense, Military engineering institute of radio electronics and communications), 15 incorporated (Kazakhstan University of Peoples' friendship, S.Seifullin Kazakh agriculture university, Kazakh academy of sport and tourism, A.Myrzakhmetov Kokshetau university), 75 private (University Turan-Astana, S.Demirel University, "Bolashak" University, Kazakh-Chinese university), 6 affiliate higher schools (Moscow state University, Russian economical university, Moscow financial-industrial university) in Kazakhstan.

L.N. Gumilyov Eurasian National University is the only young university from Kazakhstan entered the OS Top 50 under 50. This university is a member of the Eurasian Association of Universities, Association of Asian Universities, STARNET, Turkic Universities Union, Network University of CIS countries, University of Shanghai Organization, ICRA-Net. Moreover, in 1999 L.N. Gumilyov Eurasian National University adapted and actively promotes the Bologna principles of academic mobility among faculty and students. This open policy of integration into the world

educational arena has enabled ENU to send its students abroad for study at leading universities and to host students from **Europe, Asia, and North America.**

The education policy of the University is directed for training specialists, development of knowledge and skills, including skills of self-education, necessary for production of new knowledge and technologies in the competitive world market of work. This university has a major emphasis on the teaching foreign languages and trains a significant number of English teachers on the philological faculty. The main function of the philological faculty is to train qualified specialists, bachelors and masters with knowledge of English with deep theoretical and practical training, strong professional knowledge, skills and techniques corresponding to the state educational standards of the Republic of Kazakhstan and the Bologna Convention.

TEACHING AND LEARNING IN HIGHER SCHOOLS OF KAZAKHSTAN

The national program "The 100 concrete steps to implement the five institutional reforms" set by N.A. Nazarbayev became the hit to learn English in all spheres of life. This program determined the importance of knowing English in order to study abroad and attract students and teachers from foreign countries to work in Kazakhstan. In 2010, in the framework of realization of the objectives set by the President of the Republic of Kazakhstan on the development of the system of the national education, Kazakhstan joined the Bologna Process [1].

The need to improve the methods of teaching the English language, to renew the content of education, find out new forms and techniques making it possible to implement modern concepts of education and development is evident in light of the rising status of the English language and the change of educational priorities. In fact, all-round human development depends on quality and efficiency of educational system. Education is considered to be a leading factor of social and economic progress.

The scaffold of education system in Kazakhstan is the Law on Education (1999), the State Program on Education (2002), the national project "Trinity of Languages" (2007), the State Program Development of Education for 2020-2025 (2019). The State Program of Education Development in the Republic of Kazakhstan for 2011 – 2020 is an organizational basis for implementation learning English. Since 2005, the Republic of Kazakhstan has adopted several official documents in education sphere. These are namely the State Program of Education Development for 2005-2010, the State Program of Technical and Vocational Education Development for 2008-2012, "Children of Kazakhstan" Program for 2007 – 2011 and "Balapan" Preschool Education Program for 2010-2014, "Bolashak" International Scholarship Program. Owing to these programs, the number of English speaking teachers preparing for secondary, technical and vocational education, and higher education is increasing. More than 20,000 Kazakhstani citizens are studying abroad to date. Around 3000 recipients of the Bolashak International Scholarship of the President of the Republic of Kazakhstan are studying in 27 countries of the world (State Education Development Program 2011).

The aim of learning English in higher school is to prepare students to use it in their future profession. The students' competence in skills development is measured by their ability to understand and produce written and spoken language in an educational context, to perform the following academic tasks:

- to read and understand written academic language;
- to write assignments in an appropriate style for university study;
- to listen and comprehend spoken language in both lecture format as well as formal and informal conversational style;
- to speaking to colleagues and lecturers on general and given topics in formal and informal situations.
- to broaden and expand the students' proficiency and knowledge in English;
- to provide material for the students to revise, consolidate and extend their command of English grammar and vocabulary;
- to develop the students' reading skills to enable them to skim the text for the main idea, to scan the text for specific information, to interpret the text for inferences, attitudes and styles, to deduce meanings from the context;
- to develop the students' writing skills to enable them to respond to input applying information to a specified task, to elicit, to select, to summarize information in a range of writing activities, such as essays, articles, reports;
- to develop the students' speaking skills to enable them to use general, social and professional language, to negotiate, report, explain, summarize and develop a discussion;
- to develop the students' general capacity to a level that enables them to use English in their professional and academic environment granted that they are provided with the specific notions and vocabulary of economics, mathematics, statistics, banking and finance in the course of their studies;
- to develop the students' ability to apply knowledge of the language system, to develop their social competence skills, to form their behavioral stereotypes and professional skills necessary for successive social adaptation of graduates [2].

Furthermore, Kunanbayeva developed a concept of foreign language education in the Republic of Kazakhstan which defines the new methodological approaches in accordance with the requirements of the educational standard: the study of the English language is recognized as socially significant, as a guarantee of ensuring the practical and professional life of a person in modern multilingual globalized world; the place of the English language as the language of International communication was determined on a pair with the Kazakh language; conceptually significant concept such as language

for specific purposes (LSP) and language for academic purposes (LAP) were clarified [3].

Fundamental transformations in the methodological content and technological basis of education necessitated the creation of a unified national system of foreign language education. The level of English acquisition meets modern requirements. These requirements are based on the (CEFR) Common European framework of Reference for languages [4].

RESEARCH STUDY

English is taught at the early stage of education in Kazakhstan and focuses on developing reading, writing, listening and speaking skills. The objectives of higher schools are not compatible with the students' purposes for learning English. Students are not taught to the rules and techniques to pass international exams on English or enter to universities to get master or doctorate degree. Today, English has long been highly regarded among undergraduates and postgraduates of Kazakhstani society. Except for university studies, students attend private educational centers to be proficient in English, to prepare for passing international exams IELTS, TOEFL, Cambridge English examinations.

This research centers on determination *the main problems to learn English* (students) and *presentation of recommendations for improving English* (teachers).

Data collection was conducted at L.N. Gumilyov Eurasian National University. This university has a major emphasis on English teaching and trains future English teachers at the philological faculty. There are 13 departments which trains future teachers on languages. Department of foreign philology implements educational programs of different levels in the following areas: 5B021000 – "Foreign philology (English)", 5B011923 - "Foreign language: two foreign languages (German, French)", 6M021000 – "Foreign philology", 6D021000 – "Foreign philology", 8D01719 – "Foreign language: two foreign languages". The Foreign Languages Theory and Practice department provides teaching of linguodidactic and linguistic disciplines and gives students the opportunity to acquire practical skills of teaching English in schools and universities for their high competitiveness in the Kazakhstani labor market in the implementation of their professional activities: teaching, educational, research, etc. in two educational programs: 5B011900 "Foreign language: two foreign languages (main English)", 6M011900 "Foreign language: two foreign languages (main English)".

The main problems to learn English

The research is based on a written questionnaire or survey in order to measure and analyze students and English teachers' views. Survey technique is a research approach that aims to describe a real situation of the researching and a tool to gather data [5]. The survey consists of ten questions and includes comments of students to analyze the problems. These comments are the main sources for teachers to provide recommendations to overcome problems. The questionnaire was passed on Likert scale which is used to analyze

participants' agreements (agree, disagree, can't decide, strongly agree, strongly disagree); frequency (always, often, rarely, sometimes, never); importance (important, very important, moderate important, slightly important, unimportant); quality (excellent, good, fair, poor, very poor). Moreover, participants were asked to rate their own English language proficiency in listening, reading, speaking and writing skills using the Common European framework of reference for languages (Picture 1).

The A Levels: Basic User	
A 1 Beginners	**A 2 Elementary**
– Can **understand and use very basic expressions to satisfy concrete needs.** – Can introduce themselves and others, ask and answer questions about personal details such as where he/she lives, people they know and things they have. – Can interact simply as long as the other person speaks slowly and clearly.	– Can **understand sentences and frequently used expressions** related to areas of most intermediate areas, such as shopping, family, employment, etc. – Can communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters. – Can describe in simple terms aspects of their background, immediate environment, and matters in areas of immediate need.
• **The B Levels: Independent User**	
B 1 Intermediate	**B 2 Upper-Intermediate**
– Can **understand the main points of clear standard input on familiar matters** regularly encountered in work, school or leisure-related topics. – Can deal with most situations likely to arise while traveling in an area where the language is spoken. – Can produce simple connected texts on topics that are familiar or of personal interest. – Can describe experiences and events, dreams, hopes, and ambitions, as well as opinions or plans in brief.	– Can **understand the main ideas of a complex text** on both concrete and abstract topics, including technical discussions in their field of specialization. – Can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party. – Can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options.
• **The C Levels: Proficient User**	
C 1 Advanced	**C 2 Proficiency**
– Can **understand a wide range of demanding, longer clauses,** and recognize implicit meaning. – Can express ideas fluently and spontaneously without	– Can **understand with ease virtually everything heard or read.** – Can summarize information from different spoken and written sources,

much obvious searching for expressions. – Can use language flexibly and effectively for social, academic and professional purposes. – Can produce clear, well-structured, detailed text on complex subjects, showing controlled use of organizational patterns, connectors, and cohesive devices.	reconstructing arguments and accounts in a coherent presentation. – Can express themselves spontaneously, very fluently and precisely, differentiating finer shades of meaning even in the most complex situations.

Picture 1 - Common European framework of reference for languages

During the research teachers and students self-rated their reading, writing, listening and writing skills in English.

CEFR levels help to measure the participants' ability in language. Each of these levels describe the ability of four language competencies (language skills). Using this grid in this research means to self-rate and analyze the level of participants in this study. The interview was organized on the base of constant comparative method where each question is compared with existing findings as it emerges from the data analysis. The constant comparative research consists of four elements *agreement, frequency, important, quality* (AFIQ). Each element in this method provides continuous development to the following stage [6].

Table 1 shows the number of students participated in this research from different faculties. There are 218 students (25.5% students studying English for specific purposes (LSP) and 74.5% students studying English for academic purposes (LAP)).

Table 1 - Students' background information

№	Faculties	Number of participants	% of participants
1	Natural sciences	37	16.9
2	Information technology	17	7.8
3	Economics	20	9.2
4	Philology	10	4.5
5	Law	14	6.4
6	Mechanics and mathematics	14	6.4
7	Transport and energy	27	12.4
8	Architecture and construction	44	20.2
9	Physics and technical sciences	35	16.1

In carrying out the survey, the participants are required to give response to 20 questions which were divided into four AFIQ elements. Moreover, participants were asked to rate their own English language proficiency in listening, reading, speaking and writing skills using the Common European framework of reference for languages (Table 2).

Table 2 – Participants' English language proficiency (%)

Levels	A1	A2	**B1**	B2	C1	C2
%	6,9%	30,7%	**49,5%**	9,6%	2,8%	0,5%

This analysis demonstrates that 49.5% of participants have intermediate level. These students can **understand the main points of clear standard input on familiar matters** regularly encountered in work, school or leisure-related topics; deal with most situations likely to arise while traveling in an area where the language is spoken; produce simple connected texts on topics that are familiar or of personal interest; describe experiences and events, dreams,

hopes, and ambitions, as well as opinions or plans in brief. There were no any problems to answer the survey questions and express their ideas about learning English and indicate the problems they face. Although 62.4% studied English at school in urban areas, and 37.6% of students were from rural areas.

The stages of the constant comparative research define the existing problems to learn English in higher schools to allow teachers to present recommendations for improving English AFIQ elements were evaluated by one-way variant analysis with the following ranges: 4.20 - 5.00 (strongly agree, always, very important, excellent - 5); 3.40 – 4.19 (agree, often, important, good - 4); 2.60 – 3.39 (can't decide, sometimes, moderate important, fair - 3); 1.80 -2.59 (disagree, rarely, slightly important, poor - 2); 1.00-1.79 (strongly disagree, never, unimportant, very poor - 1). One-way variant analysis was applied to determine whether there was a meaningful difference between AFIQ elements (Table 3).

Table 3 – The results of the AFIQ elements (agreement, frequency, importance, quality)

Questions	strongly agree - 5	agree - 4	can't decide - 3	disagree - 2	strongly disagree - 1	X	result
Agreement							
1 Studying English is	86	121	8	3	-	4.3	

very important in your life	(39.4%)	(55.5%)	(3.6%)	(1.3%)	(0%)		SA
2 All English teaching materials during the lesson are understandable	33 (15.1%)	158 (72.4%)	3 (1.3%)	21 (9.6%)	3 (1.3%)	3.91	A
3 Studying grammar is more important than practicing conversation skills	120 (55%)	11 (5.04%)	6 (2.75%)	70 (32.1%)	11 (5.04%)	3.8	A
4 You feel afraid of making mistakes while speaking	109 (50%)	67 (30.7%)	4 (1.83%)	67 (30.7%)	12 (5.5%)	4.5	A
5 It is difficult for you to learn and use the new material (vocabulary, grammar) in learning or home assignments	101 (46.03%)	10 (4.58%)	12 (5.5%)	83 (38%)	12 (5.5%)	3.4	A
Frequency							
Questions	always - 5	often - 4	sometimes - 3	rarely - 2	never - 1	X	result
6 How often do you revise the new materials on English at home?	40 (18.3%)	53 (24.3%)	101 (46.3%)	18 (8.3%)	6 (2.8%)	3.7	O
7 How often do you do reading, listening, writing and speaking activities during the lesson?	86 (39.4%)	77 (35.3%)	43 (19.7%)	11 (5%)	1 (0.5%)	4.08	O
8 How often do you read English news, magazines, journals, newspapers?	15 (6.9%)	33 (15.1%)	77 (35.3%)	66 (30.3%)	27 (12.4%)	2.7	S
9 How often do you speak English during the lesson?	65 (29.8%)	75 (34.4%)	59 (27.1%)	14 (6.4%)	5 (2.3%)	3.8	S
10 How often do you look the syllabus of the course?	47 (21.5%)	43 (19.7%)	60 (27.5%)	20 (9.17%)	48 (22%)	3.9	S
Importance							
Questions	very important -5	important -4	moderate important - 3	slightly important - 2	unimportant - 1	X	result
11 Is it important to have an environment that makes you familiar with the original language?	71 (32.6%)	104 (47.7%)	25 (11.5%)	16 (7.3%)	2 (0.9%)	4.03	I
12 Is it important for you to be assessed during the lesson?	170 (77.9%)	48 (22.01%)	-	-	-	4.8	VI
13 Is it important for you to make note during the lesson?	65 (29.8%)	91 (41.7%)	34 (15.5%)	7 (3.2%)	21 (9.63%)	3.6	MI
14 Writing all grammar exercises in your copybook	71 (32.5%)	58 (26.6%)	25 (11.4%)	22 (10.09%)	42 (19.2%)	3.4	I

15 Reading paper books in English and make analysis	24 (11.09%)	34 (15.5%)	43 (19.7%)	26 (11.9%)	91 (41.7%)	2.5	SI
Quality							
Questions	excellent - 5	good - 4	fair - 3	poor - 2	very poor - 1	X	result
16 How would you appreciate the quality of teaching methods that the English teacher applied during this course?	139 (63.8%)	70 (32.1%)	6 (2.8%)	3 (1.4%)	- (0%)	4.6	E
17 How would you appreciate your overall learning results at the end of this course?	57 (26.1%)	133 (61%)	22 (10.1%)	4 (1.8%)	2 (0.9%)	4.9	E
18 How well were the assessment scores of the course correlated?	113 (51.8%)	82 (37.6%)	23 (10.5%)	-	-	4.4	E
19 What scores did you take after each test or written assignment during the lesson?	93 (42.6%)	63 (28.8%)	45 (20.6%)	17 (8.25%)	-	4.6	E
20 How do you appreciate your working to pass individual assignments online?	96 (44%)	109 (50%)	13 (5.96%)	-	-	4.3	E

This analysis determines the main problems of students in learning English. AFIQ elements shows the importance of learning English and students do not have any problems in understanding the lexical and grammatical materials during the lesson. 55% of students *strongly agree* with statement that learning English grammar more important than practicing conversational skills. Grammar is associated with the sounds, structure, sentences, tenses, forms and system of language. Moreover, grammar is the structural foundation to express ideas and communicate [7]. In 2018-2019, professor Debra Myhill (Exeter University, England) held a seminar in L.N. Gumilyov Eurasian University on teaching grammar for students of non-languages specialties. She noted about the importance of grammar in learning languages in order to speak and use the language correctly. Myhill determines the place of grammar in learning and teaching English [8]. There no progress in communication without grammar whether it is a native language or a foreign language. People should know the essential grammatical rules and principles in order to speak and communicate orally and in written form. The problems students face in learning English is the lack of practice and barriers to speak. 50% of students are afraid of making mistakes while speaking and have troubles in using learned materials in their home assignments (Figure 1). These problems were ascertained in the frequency element of this research. Only 18.3% of students attempt to revise the learning materials at home and 12.4% never read additional materials in English (Figure 2).
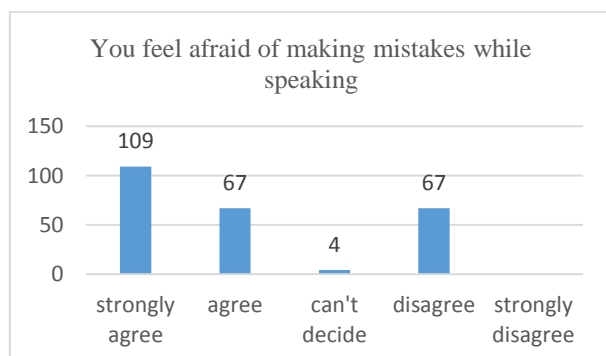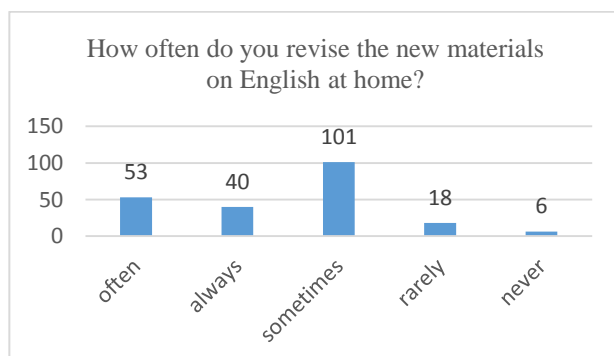

Figure   1

Figure   2

Moreover, students do not follow the educational programs and syllabus. 27.5% work with the syllabus of the English discipline and 22% never look at it. This analysis shows the weak sides of students in learning English. The result and an indicator of importance element denotes that students are only interested in their scores and teacher's assessment (Figure 3). 77.9% of students are interested to be assessed
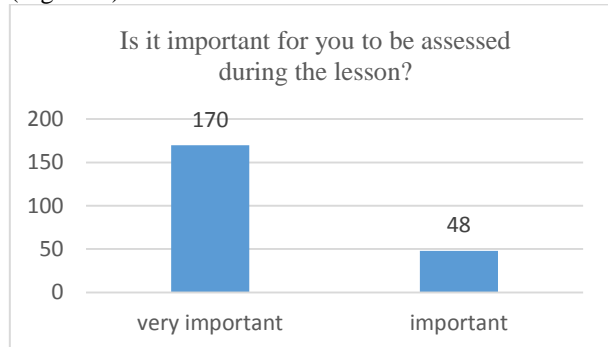
during the lesson and 51.8% satisfy with the correlation of their assessment scores. Furthermore, 50% of students like to do and pass individual assignments online and 42.6% have high scores at the end of the English course (Figure 4). The middle average of AFIQ elements equals to equivalent 4.40 out of 5.00.

Figure 3

Figure 4

The questionnaire on the base of Likert scale, the constant comparative research of AFIQ elements, one-way variant analysis (Anova) defined the main problems to learn English in higher schools: *a fear of mistakes while speaking; failure to use using learned materials in assignments; absence of motivation to repeat the learned materials*.

Thirty-six teachers of the department of foreign languages were invited to discuss these problems and give recommendations. The majority of teachers (83%) graduated from higher schools in Kazakhstan. 70% of teachers had opportunities to visit English speaking countries to develop their language proficiency. The USA and UK were the most popular destinations. Teachers have an average of 15 years of teaching experience and were teaching at higher schools and universities in Kazakhstan.

Teachers discussed the views of students regarding the problems during the academic year on English course. Students wrote their problems in written form: "I didn't have any problems"; "a lot of information, sometimes I do not have time to master all the material"; "It was difficult to speak English"; "It's was so hard for me to learn English"; "spelt is difficult to overcome yourself when talking in English. I'm getting lost"; "If you are absent, there is no explanation and no understanding"; "I got a lot of information"; "I have a weak level of English, because of this it is very difficult to learn the language at the level of other students"; "It would be better if groups were made by level of English skills. The biggest problem is the difference between students, who doesn't have choice and just have to learn terms they've already known or doesn't even ready to know about"; "I have some difficulty on listening and speaking tasks"; "Listening was difficult for me, but after many practices it is easier for me now"; "I am very ashamed that I can't understand the language in class, I'm ashamed to ask where I can't understand"; "Afraid to ask questions so as not
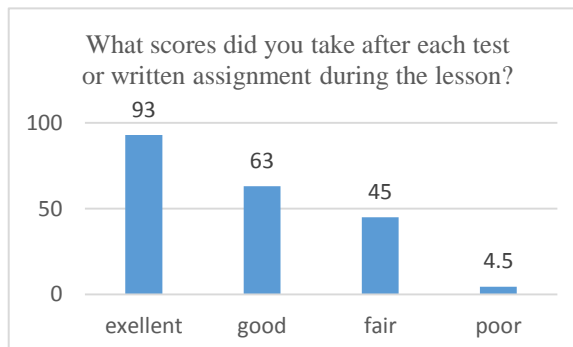
to look stupid and ask for preparation material"; "no motivation from my side".

The most common suggestion of teachers to decide these problems focused on the student-initiated learning strategies. Student-initiated learning enables students to explore their interests and learn within and beyond the curriculum. As teachers note students should be in charge of their own learning and catch opportunities to improve their English. The first problem of students was a fear to speak. Roy H. Williams said "a smart man makes a mistake, learns from it, and never makes that mistake again" [9]. The teachers' recommendations how to conquer your fear of doing mistakes during speaking and communication:

- to change your mindset because it plays a significant role to see mistakes and react on them;
- try to speak English with your friends, relatives, groupmates;
- practice your spoken English with yourself;
- remember that making mistakes is normal, learning from mistakes is an essential skill to move forward;
- don't avoid the conversation and simply jump into it.

The problem of failure to use using learned materials in assignments means to practice at home and using writing as a learning tool. As learning tool, writing and oral assignments develop critical thinking and critical writing skills. These skills convert students from passive to active learners. Teachers should give students different interesting tasks each lesson. These tasks shouldn't be repeated each lesson. The main goal of writing assignments is to clarify thinking, explore ideas, ask questions, reflect on learning, and search for connections between theory and practice.

It is known, that lack of interest limits the progress in acquiring the language. In this research students note the

absence of motivation to repeat the learned materials as the existing problem in learning English. There are different types of motivation as integrative, instrumental, intrinsic, and extrinsic. Integrative motivation refers to language learning for personal growth in order to work and live in language society. Instrumental motivation concentrates on the aim of learning (learning the themes, passing exams and take final rewards) and follow the requirements [10]. Using each type of motivation depends on situations and assignments. Intrinsic motivation leads to engage students in activities during the lesson. Extrinsic motivation provides for doing actions [11]. These types of motivation have close relationship between each other [12]. Despite of the different type of motivation, learners are intrinsically motivated to develop four skills of activities through their knowledge and achievement. In order to motivate students, teachers should select materials arranged to students' level (elementary, intermediate or advanced), indicate goals in their classroom activities, present new and interesting materials. Intrinsic motivation needs a class to be communicative. As teachers encourage students to communicate more in class (1), they will be motivated more. Teachers should try to use real materials (2) and sources to motivate students to learn English. At last, teachers should give feedback (3) for students' work. These types of motivation set students up for success as in and out of class.

CONCLUSION

This study aims to determine the main problems to learn English (students) and present recommendations for improving English (teachers). Based on the theoretical and practical analysis of this research, it is concluded that the 1-year students have faced with the problems during learning English in higher schools. The result of the research has provided teachers' recommendations. Teachers should take account students' interest before preparing classroom activities and conducting the lesson. Using scaling techniques as the Likert scale, the constant comparative research of AFIQ elements, one-way variant analysis (Anova) help to measure the internal and external attitude of students objectively. Likert scale is useful and effective to measure qualitative responses of students of four elements (AFIQ). These elements are the main instruments to determine the students' agreement with the educational process, frequency part of using learning materials in classes, importance element expresses the importance of learning English, quality element defines the evaluation of students and teachers work. The total summing of AFIQ scores highlight the problems that students face. Likert scale only enables the attitude between researched elements, not the difference between them. The attitude between these elements were done with the help of constant comparative research and one-way variant analysis.

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Utilization of Waste Materials (Sugarcane Bagasse Ash and Recycled Coarse Aggregate) in Concrete: A Review

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Abstract

This paper summarizes the ongoing research on use of waste materials like Sugarcane Bagasse Ash (SCBA) and Recycled Coarse Aggregate (RCA) in Concrete manufacture. The usage of waste substances in concrete manufacture, presents an exceptional approach to a number of the environmental agonize and issues associated with waste management. The main focus of this paper is to study the various works carried out by the researchers on the effects of Sugarcane Bagasse Ash (SBCA) as partial replacement of cement in concrete and also the effect of replacing Natural Coarse Aggregate (NCA) with Recycled Coarse Aggregate (RCA) in Concrete. The key results obtained by the previous research studies are listed and the issues are highlighted that are not yet well understood and need further investigation.

Keywords

Natural Coarse Aggregate (NCA), Recycled Coarse Aggregate (RCA) in Concrete Sugarcane Bagasse Ash (SBCA), and Waste Materials.

I. INTRODUCTION

Waste reuse and recycling are among present day society's environmental prime concern and thus domains to which sizeable effort are being devoted now a days**.** Ordinary Portland cement is one of the major construction materials used far and wide. Now a day's cement is replaced by waste from industries, such as waste from steel industries-blast furnace slag, waste from thermal power plants-fly ash and waste from silicon and ferrosilicon industry-silica fume, as a supplementary material. Furthermore, agricultural wastes which include wheat straw ash, rice husk ash and sugarcane bagasse ash which possesses pozzolanic properties hence are also being used as cement replacement material. Pozzolanic materials contains silica (SiO_2) and when these pozzolanas are added to cement chemical reactions occur. During the process of hydration, the released free lime reacts with the silica available in the pozzolanic material and forms additional calcium silicate hydrate (CSH), which is a new hydration product [12]. Subsequently, ameliorating the mechanical properties of concrete.

Fig 1: Sugarcane Bagasse

India produces 300 million tons of sugarcane per year [13] and hence large quantity of sugarcane bagasse is available from sugar mills. Sugarcane bagasse is burnt and partly used as fuel at the sugar industries. Generally, bagasse ash is abandoned in landfills and is now hampering the environment.

Sugarcane Bagasse → Sugarcane Bagasse Ash → Finer Sugarcane Bagasse Ash

Reusing of waste concrete is advantageous and important from the perspective of ecological conservation and successful use of assets. For the effective utilization of concrete waste from the demolished structures, the aggregates from this concrete can be reused in fresh concrete. Utilizing recycled aggregate is undeniably a foremost step in regard to sustainable development in the concrete industry and governance of construction waste. Recycled aggregate (RA) is a feasible alternative to natural aggregate, which helps in safeguarding the environment. Irregularity of the aggregate properties is one of the critical parameters that affect the use of recycled aggregate.

II. LITERATURE REVIEW

Numerous studies have been carried out on the use of sugarcane Bagasse ash in creating modified concrete. It is now widely accepted that there is a remarkable prospective for demolish debris recycling and using the recycled aggregates for development of concrete to optimize economic and environmental gain. These studies fortify the view of usage of huge cumbersome waste in the construction. The profuse findings in this field are as mentioned below: -

K. Ganesan, K. Rajagopal, K. Thangavel (14) investigated the effects on physical and mechanical properties of indurated concrete by partial replacement of cement with bagasse ash. Investigations included water absorption, compressive strength, permeability characteristics, splitting tensile strength, resistance to chloride ion penetration and water chloride diffusion. They found that up to 20% ordinary Portland cement can be ideally replaced with well burnt bagasse ash without any disadvantageous effect on the expedient properties of concrete. Specific advantages of such replacement are high early strength development, reduced water permeability and considerable chloride permeation resistance and diffusion.

Nuntachai Chusilp, Chai Jaturapitakkul, Kraiwood Kiattikomol (15) investigated the physical properties including heat evolution, compressive strength and water permeability of concrete with ground bagasse ash. In their study a ball mill was used to ground the bagasse ash. Grounded bagasse ash was sieved by IS sieve No 325untill less than 5% by weight particles were retained. This sieved bagasse ash was replaced by Type I Portland cement at 10%, 20%, and 30 % by weight of binder. Findings revealed that lower heat evolution, reduced water permeability and an acceptable strength with respect to the standard concrete can be achieved by using ground bagasse ash as a pozzolanic material in concrete.

Sumrerng Rukzon, Prinya Chindaprasirt (16) partially replaced Portland cement type I with bagasse ash finely grounded. Chloride diffusion, Coefficient of water Absorption, Compressive strength, Porosity and the rapid chloride penetration of concretes were obtained by partially replacing the cement by weight in concrete mixtures with 10%, 20% and 30% of bagasse ash respectively. Tests outcomes indicated that adding bagasse ash up to 30% replacement level escalates the resistance to penetration of chloride and is produces high strength concrete.

Khaldoun N. Rahal and Abdul (17) made plain concrete with recycled coarse aggregate and studied its effects. Considered parameters included Poisson ratio, longitudinal modulus of deformation, compressive strength, workability, density, depth of water penetration under pressure and the stress–strain diagram. The findings of the study revealed that this modified concrete needed more water than the conventional concrete to gain the same workability. In concrete made with 100% recycled aggregate the Density declines by around 7%, with rising replacement rates.

Jianzhuang Xiao, Jiabin Li, Ch. Zhang (18) conducted experiments to analyze the stress–strain curve and the compressive strength of concrete with recycled aggregate for various percentage replacement of recycled coarse aggregates. Recycled coarse aggregates were replaced for various percentages of replacements viz., 0%, 30%, 50%, 70% and 100%, respectively and these concrete specimens were tested under Uniaxial compression loading. Failure behavior and the influences of the recycled coarse aggregate contents on the elastic modulus, the compressive strength, the peak and the ultimate strains of recycled coarse aggregate is given special attention.

Sherif Yehia, Kareem Helal, Anaam Abusharkh, Amani Zaher, and Hiba Istaitiyeh (19) discussed the appropriateness of manufacturing concrete with 100% recycled aggregates to match durability and strength requirements for various applications. Some of the physical and mechanical properties which contribute to the durability and strength of concrete are absorption, shape, texture, specific gravity, gradation and aggregate strength. The experimentation emphasizes on the analysis of mechanical and physical characteristics of the recycled aggregate. Based on the experimental analysis, it was concluded that concrete with sustainable durability and strength could be manufactured if high packing density is attained.

Sepani Senaratne, Gregory Lambrousis, Olivia Mirza, Vivian W. Y. Tam, Won-Hee Kang (20) analyzed distinct methods of enhancing the strength of recycled aggregates, in order that it could be broadly used in the industry. Findings of the study revealed that use of Recycled Aggregate in concrete impart and acceptable substitute to Natural Aggregate, and showed successful results in structural applications by several researchers. Although, insufficient utilization of Recycled Aggregate as a structural material was noticed. This resulted in carrying out qualitative discussions with industry professionals in search of hurdles and supporters affect the use of RA in structural applications. This research suggested that further areas which require research such as life cycle cost analysis and experiments, using pre-cast constructions

and also revealed several allowing and obstruction factors in using the RA as a structural material.

Noor-Ul Amin (21) explored the effects of bagasse ash when partially replaced in cement on mechanical and physical properties of hardened concrete such as splitting tensile strength, compressive strength, chloride diffusion and resistance to chloride ion penetration. Based on the test conducted it was concluded that bagasse ash can be optimally replaced by 20% weight of cement and also is an effective pozzolan and a mineral admixture. Reduction by more than 50% in chloride diffusion is observed without any disadvantageous effects on other properties of hardened concrete.

Eduardo M.R. Fairbairn, Branca B. Americano, Guilherme C. Cordeiro, Thiago P. Paula, Romildo D. Toledo Filho, Marcos M. Silvoso (22) prepared a model to evaluate the reduction in emission of CO_2 and the possibility to provide certified emission reduction credits. The model was evolved within the structure of methodology set by the United Nations Framework Convention on Climate Change for the Clean Development Mechanism. It was concluded in this study that partially replacing sugarcane bagasse ash reduces CO_2 emission into the atmosphere and is a pozzolan which partially replaces clinker in production of cement, thus qualifying as a product for CDM projects.

Gritsada Sua-iam, Natt Makul (23) investigated the impact of mixing limestone powder with self-compacting concrete mixtures wherein fine aggregate was replaced with bagasse ash. Fine aggregate was replaced by volume of bagasse ash and limestone powder with variable percentage (10%,20%,40%,60%,80% and 100%). This volumetric percentage replacement effectively enhanced the hardened properties and workability of self-compacting concrete.

A.Bahurudeen, Deepak Kanraj, V. Gokul Dev, Manu Santhanam (24) studied the manufactruring of sugarcane bagasse ash based blended cements with various levels of replacement of sugarcane bagasse ash and also the behavior of concrete with such cements in concern with the heat of hydration, compressive strength, drying shrinkage and durability. Findings revealed that concrete with sugarcane bagasse ash remarkably improve its performance. Also, additional strength gains due to pozzolanic reaction, low heat of hydration, notable reduction in permeability were observed for bagasse ash blended concrete compared to control concrete.

R.Srinivasan, K.Sathiya (25) this study characterizes partial replacement of cement by weight with bagasse ash in different percentage as 0%, 5%, 15% and 25%. Several fresh concrete tests hardened concrete tests were conducted. They found that as the percentage of bagasse ash is increased the strength of concrete also increases.

Francisco Agrela, Auxi Barbudo, Antonio Ramirez, Jesus Ayuso, María Dolores Carvajal, Jose Ramon Jimenez (26) investigated the source of waste from construction and demolition which are used in recycled aggregate, the processing plant for recycled aggregate production that manufactures the material which are treated with cement and the genuine use of recycled aggregate in a construction project. Investigations concluded that using these aggregates in roads is utterly acceptable from point of view of economy and environment, the mixed recycled aggregates are a good substitute to natural materials.

Fabiana da Conceicao Leite, Rosangela dos Santos Motta, Kamilla L. Vasconcelos, Liedi Bernucci (27) conducted and experimental program to analyze the practicality of using aggregate from recycled waste from construction and demolition of structures in pavement applications. The results show that recycled waste from construction and demolition may be utilized as aggregates in base and subbase layers for roads with low volume.

Javier Tavira, Jose Ramon Jimenez, Jesus Ayuso, Maria Jose Sierra, Enrique Fernandez Ledesma (28) evaluated the mechanical properties in lab and in situ of mixed recycled aggregates obtained from wastes of construction and demolition which is used as unbound materials for base and subbase. An experimental study specifying the properties of recycled aggregates also long-term behavior of these materials under actual traffic and weather conditions was carried out. Studies found that substandard mixed recycled aggregates can be utilized as alternatives for natural aggregates. The surface roughness values attained from the experimental road shows sustainable behavior.

Surender Singh, G.D. Ransinchung R.N, Solomon Debbarma, Praveen Kumar (29) considered waste from road section (Reclaimed Asphalt Pavement) and agricultural industry (Sugarcane Bagasse Ash) for manufacturing of concrete mixes for investigation.5 mixes were developed by partially replacing natural aggregates with coarse reclaimed asphalt pavement and fine reclaimed asphalt pavement in the percentage of 50%and 100 %. 3 mixes were developed containing 100% reclaimed asphalt pavement aggregates mixed with 10% and 15% of bagasse ash partly relaced in cement. They found that, blending 10% bagasse ash remarkably enhanced the durability and mechanical properties of 100% reclaimed asphalt pavement concrete. Also, amalgamations of reclaimed asphalt pavement aggregates mixed with bagasse ash reduces total cost of concrete per cubic meter by more than 40% when compared to controlled concrete. It was suggested to replace 10% by weight of cement with bagasse ash in reclaimed asphalt pavement concrete as it provides strength to the pavement also beneficial economically and environmentally.

Mary Vancura, Lev Khazanovich, and Derek Tompkins (30) proposed to reconsider the utilization of recycled aggregate in slabs of rigid pavements. Details of using recycled aggregates as a structural component in pavement were mentioned. They found that using recycled aggregate in concrete in an acceptable way can expand beyond by just using it as filling material in base layer of pavement. Using recycled aggregates in concrete in the lift of lower PCC of a composite pavement permits several opportunities as economical and sustainable for reusing recovered materials, also advantageous for environmental incentives for road construction.

V.Ayan, S. M. N. Azadani, J. R. Omer, M.C. Limbachiya (31) evaluated the sturdiness behavior of recycled aggregates mixed with natural aggregates in concrete. Three main

factors such as amount of traffic, moisture content in highway pavements and the temperature conditions were involved in performance assessment. Based on the evaluation it was found that the materials were suitable for loose subbases for moderate amount of traffic non-frosty condition from the point of view of sturdiness. Also, they are acceptable for low amount of traffic with less moisture and freezing weather.

Mrs.U.R.Kawade, Mr.V.R.Rathi, Miss Vaishali D. Girge (32) in this study sugarcane bagasse ash is physically and chemically distinguished and replaced partially by 0%,10%,15%,20%,25% and 30% by weight of cement in concrete. The properties of fresh concrete and hardened concrete are tested and compared. It is found that the strength of concrete increases by up to 15% when replaced with sugarcane bagasse ash.

Er Aman Joon, Irfan Ahmad Najar, Heemant Gulati (33) studied with a vision to produce and create greener methods of construction to reduce the pollution from cement and other materials used in construction. In manufacturing of paver blocks for low traffic loading bagasse ash is used which may develop the pavements for city roads., village roads or other district roads. It was found that using bagasse ash in paver block production resulted in less environmental problems as compared to control concrete. Which further reduces global warming and pollution. Economy is achieved in construction and maintenance cost when cement is replaced with bagasse ash to produce paver block.

Togay Ozbakkaloglu, Aliakbar Gholampour and Tianyu Xie (34) performed tests to get the different strength parameters also elastic modulus, workability, drying, shrinkage and water absorption. Test specification include the replacement percentage of recycled aggregate, coarse aggregate size and methods of mixing used in concrete development. It was found that characteristics of various recycled aggregates concrete mixes with similar compressive strength are influenced by the size and content of coarse aggregate. With less contents of recycled aggregate, it is feasible to manufacture recycled aggregate concrete with properties similar to those of natural aggregate concrete.

Abrahams Mwasha, M. ASCE, and Rakesh Ramnath (35) proposed a technique based on particle packing optimization for preparing high strength concrete with recycled aggregates and pre-soaking of recycled aggregates. The study showed that high compressive strengths concrete with lower slump develops by drying the recycled aggregates before concrete production.

Eva Remisova, Martin Decky, Milan Mikolas, Matej Hajek, Lubos Kovalcik, Martin Mecar (36) comparative study of the mechanical properties of the structural layers of road pavements constructed with recycled and natural aggregate. It also highlights associated functions of results achieved from in situ and in laboratory by CBR measuring method used to find bearing capacity of stated layers.

III. CONCLUSION

This paper focuses on two different aspects of material replacement in standard concrete. Firstly, partially replacing cement with Sugarcane Bagasse Ash and Secondly partially replacing natural aggregate with Recycled Coarse Aggregate. In the above discussion, most of the authors studied replacement of Portland cement with well burnt Bagasse ash and its effects on the aspired characteristics of concrete. Benifits of such replacement are the attainment of high early strength, diffusion, reduction in water permeability, and appreciable resistance to chloride permeation.

Also, authors have studied the feasibility of partially replacing Recycled coarse Aggregate with natural Coarse Aggregates in concrete. These studies suggested that it is possible to manufacture Recycled Aggregate Concrete with durability and mechanical properties which are similar to those of natural aggregate concretes having the same compressive strength.

Studies have been carried out on the possibilities of using these recycled materials (Sugarcane Bagasse Ash and Recycled Coarse aggregate) in concrete individually, but there are some studies based on actual uses of Recycled Aggregates from construction and demolition waste and Sugarcane Bagasse Ash from Sugarcane Industries, hence needs further exploration.

The review of the work done by the researchers show that a considerable progress has been made in terms of utilization of bagasse ash as partial replacement to cement and natural aggregates being replaced partially by recycled coarse aggregates in concrete. But, availability of laboratory research and experimental data on the use of bagasse ash as partial replacement to cement with natural aggregates being 100% replaced by recycled coarse aggregates in concrete is still lacking. Also, use of such recycled concrete for various application such as use in pavements, structural members etc needs to be further explored.

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A Full-Scale Emergency Exercise Scenario for Aircraft Accident in the Airport

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Abstract

According to international and national aviation regulations, one of the essential requirements for airport and airline certification is the emplaced emergency plan. This emergency plan should include different types of emergency exercises, e.g. Full-scale, partial-scale, and table-top emergency exercises that may be encountered by the aircraft either at an airport or up in the air. International Civil Aviation Organization (ICAO)'s regulation respected by the national Civil Aviation Authorities (CAAs) mandates airports to conduct full-scale emergency exercises every 2 years at most. The main purpose of the exercise served different purposes including staff training and testing their readiness to handle various emergency situations, it also allows the participants to check the efficiency and effectiveness of the material and equipment's at the airport to ensure the readiness for handling the crisis cases.

This case study illustrates -as a model- one of the most common scenarios and depicts -in detail- the situation of "engine fire during an aircraft approaching the airport. The case study includes the time planning and operational and safety procedures from the side of airport operations perspective including air traffic control units, airport rescue, and firefighting unit, medical division, and other stakeholders as airline and ground handler.

Keywords

Airline, Airport, Crisis management, Emergency, Full-scale exercise, response plan.

INTRODUCTION

Airport Emergency Planning (AEP) is the process of preparing an airport to cope with an emergency occurring at the aerodrome or in its vicinity International Civil Aviation Organization (ICAO), it is compulsory for every airport to have updated effective AEP. The main objective of AEP is to minimize the effects of an emergency and to save lives and maintain aircraft operations. The plan is prepared according to ICAO requirements and approved by the national civil aviation authority. The plan contains a set of instructions and procedures to ensure effective response of the responsible parties including the airport authority, Air Traffic Control (ATC), rescue and firefighting, law enforcement, police/security, medical services, and other agencies on and off the airport. The purpose of the AEP is to ensure that all the concerned personnel performance is competent, ensure they are well trained, and prepared for any airport irregular operations and qualified personnel adequate to meet all unusual conditions.

According to ICAO there are three methods of testing the effectiveness of airport emergency plans and it included:

a. Full-scale exercises and should be conducted at least once every two years.

b. Partial exercises; and should be conducted at least once each year that a full-scale exercise is not held or as required to maintain proficiency.

c. Tabletop exercises. and should be conducted at least once each six months, except during that six-month period when a full-scale exercise is held.

This case study is focusing on full-scale exercises during an emergency.

Aircraft emergencies background

According to ICAO, airport emergencies are divided into three types.

- **Emergencies involving aircrafts:**
    1. Aircraft accident on-airport,
    2. Aircraft accident off-airport (land or water),
    3. Aircraft incident in flight (turbulence, decompression and structural failure),
    4. Aircraft incident on ground,
    5. Aircraft incident (sabotage/bomb threats),
    6. Aircraft incident (unlawful seizure),
- **Emergencies not involving aircraft**
    1. Structural fire,

2. Sabotage/bomb threat,
3. Natural disaster,
4. Dangerous goods,
5. Medical emergencies/pandemics,

- **Compound emergencies**
  1. Aircraft /structures,
  2. Aircraft /fueling facilities,
  3. Aircraft/aircraft,

Coordination is very critical during the planning, training and implementation of different exercises, examples of agencies located:

- On aerodromes: Air Traffic Control, firefighting, airport management, health, aircraft operator, airport security,

- Off aerodromes: firefighting department, police, medical, ambulance, hospital, military, harbor patrol.

Full-scale exercise objective:

The main target of a full-scale exercise is to validate the coordination among airport divisions and stakeholders: rescue and firefighting team, medical department, mutual aid, and security & safety departments.

Preparation for full-scale exercise

The preparation for a full-scale exercise at the airport required the operation/safety coordinator to plan for the schedule at least 120 days prior to the exercise. Table 1 shows the suggested timeline for preparing the full-scale exercise.

Table 1: A suggested time schedule for full-scale exercise

:

D–120 days	Supervisory personnel of participating agencies to outline aims, set a scenario, assign and select emergency plan coordinator.
D–90 days	First progress report
D-70 days	First meeting with all participating agencies representatives.
D-60 days	Complete arrangements for the site and the written scenario approved and completed.
D-50 days	Training for medical services and volunteers, second meeting of emergency committee representatives. Individuals training for each agency involved in drill.
D-40 days	Arrangements for transportation, dual training between agencies and volunteer works completed.
D-30 days	Third meeting of emergency committee representatives, communication exercise. Evaluate training schedules and result.
D-21 days	Fourth meeting of emergency committee representatives. Make-up for members who missed previous team training. Check arrangements for volunteer causalities and mutual aids agreements
D–14 days	Final meeting of emergency committee representatives, including critique
D-7 days	Final rehearsal and final review to the assignments.
Date of the exercise	
D +(1 –7) days	A critique following the exercises so that all participants may hear the observers report
D + 30 days	Supervisory personnel meet to review written critiques submitted by observers and by the participants to revise and correct mistakes listed in the report.

In additions to the time schedule, the operation/safety coordinator needs to prepare an airport grip map.

A Grid map is a map of an area overlaid with a grid system of rectangular coordinates that are used to identify ground locations where no other landmarks exist (ICAO), the updated grid map (figure 1) was prepared by the airport operations division and provided to all the stakeholder working at the airport especially within the airside. In addition, all vehicles (including the rescue and firefighting vehicles) operating in the airside should be also given an updated copy of the grid map.

Figure 1: Grid map

The preparation of the rescue units is also an important component in the full-scale exercise. These included the preparation of the equipment based on the number of passengers. (e.g. the number of buses, minibuses for passenger transport), and adequate medical equipment by estimating the causalities of different levels of severities (e.g.: deaths, injured, uninjured). The causalities rates are estimated based on historical review according to ICAO. Table 2 is showing the estimated number of casualties of an aircraft accident at an airport.
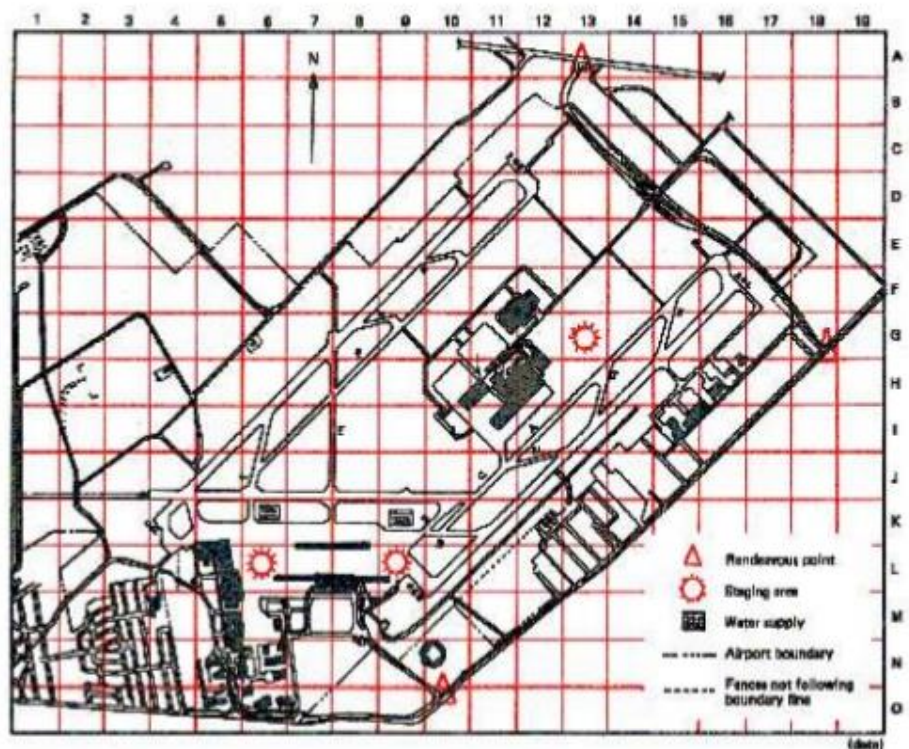
Table 2: Estimated maximum number of casualties at an aircraft accident at an airport

Aircraft occupants	Number of casualties (75%)	Casualties Immediate care (Priority I) (20%)	Casualties Delayed care (Priority II) (30%)	Casualties Minor care (Priority III) (50%)
500	375	75	113	189
450	338	67.5	101	169
400	300	60	90	150
350	263	52.5	79	131
300	225	45	68	113
250	188	37.5	56	94
200	150	30	45	75
150	113	22.5	34	56
100	75	15	23	38
50	38	7.5	11	19

(Source: ICAO)

Full-scale exercise layout

In preparation to stage for a full-scale exercise, an area on the apron is needed to be identified for coordinating and controlling the flow of the injured. This area is selected based on accurate relevant criteria e.g. the stopping point of the aircraft, wind speed, and direction,…, etc, and this wide area should be subdivided into different zones to serve its purposes e.g. Collection area, Triage area, Care area, and

Transportation area. Figure 2 is showing an example of the   organization, triage, and medical care setup.

Figure 2: Organization, Triage and Medical care

1. Collection area (150 m^2)
2. Triage area and tagging
3. Care area priority I
4. Care area priority II
5. Care area priority III
6. Transportation to staging area for evacuation
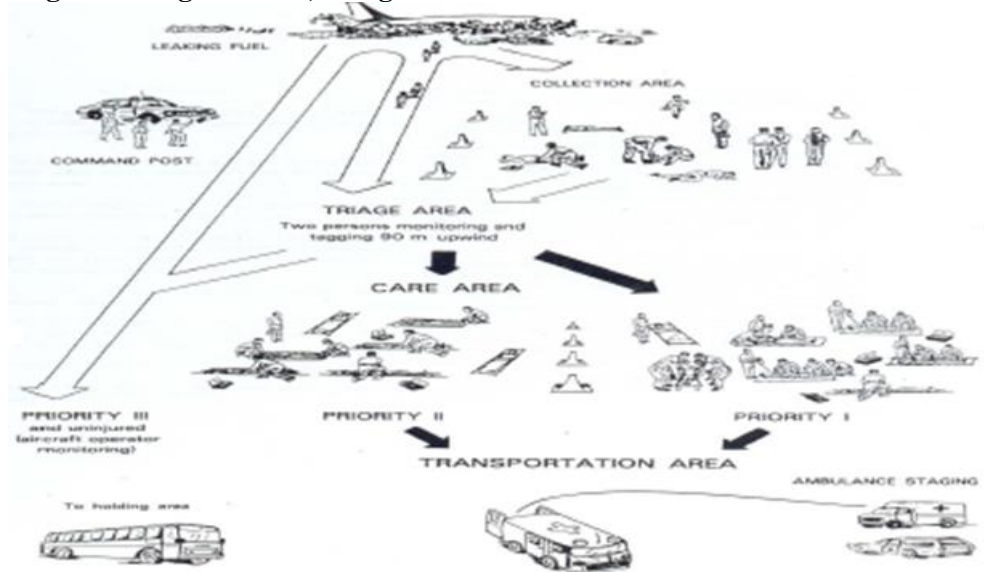
(Source: ICAO)

After the aircraft landed, the procedures in the airport emergency plan (AEP) must be followed accordingly. The injured passengers and/or crews are medically classified in different priority/colors based on their condition.

Figure 3 illustrates the medical care priority levels.

Figure 3: Medical Care Priority

Priority	Color	Meaning
0	Black	Dead
I	Red	Immediate
II	Yellow	medical care
III	Green	Delayed medical care Minor medical care
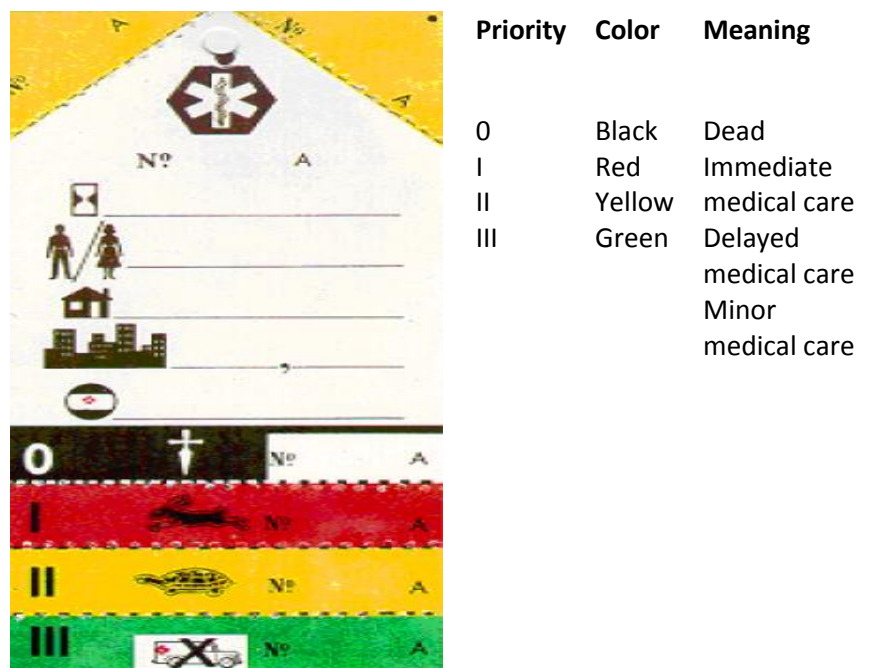
(Source: ICAO)

Figure 4: full-scale Chronology

Alert transmitted from tower → Start the drill • 10:45 pm → End of operations • 03.00 p.m
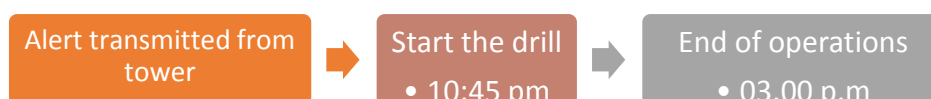
Conclusion

The main objective of this case study is to guide the students/participants to plan a full-scale exercise drill, this drill is an essential requirement for the airport management to evaluate the competency of the staff and the lack of resources needed to handle the emergency situation, as this drill is mandated by ICAO and Civil Aviation Authority (CAA) at most every two years, many airports exercising the drill once a year to maintain the safety level of the airport as high as mentioned in both Airport Emergency Plan (AEP) and Safety management system (SMS).

Further Reading

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Digitized Scoreboard: Its Use in the Implementation of Conditional Cash Transfer Program in One Province in the Philippines

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Abstract

Conditional Cash Transfer Program is an effective way of the government to eradicate poverty. Philippines is one of the many developing countries implementing it since 2007 and named it as Pantawid Pamilyang Pilipino Program or 4Ps. The Department of Social Welfare and Development is the implementing and facilitating unit of the government which monitors the program. Recording, updating and managing the household beneficiaries and their activities were conducted by staff implementers on each municipality then data will be collected for consolidation in the provincial level. Everything was encoded manually in a spreadsheet application and carried out every month for reporting. With the increasing number of beneficiaries, challenges such as difficulty in monitoring beneficiaries' performance and consolidation of reports were repeatedly observed by the unit. This study focuses on the development of a digitized scoreboard for recording, updating and monitoring household beneficiaries. Consolidation of reports from municipal level up to provincial level is featured significantly. For the methodology, the researcher used the agile model to systematically design and develop the system. Then, training was conducted to assess the knowledge of target end-users with regards to managing and accessing the system. In addition, usability testing was administered to determine the usefulness, ease of use and learnability of the developed digitized scoreboard. Both the training and testing procedure were participated by 107 staff implementers in the province of Laguna and officers from regional office. The training evaluation result yield an overall mean of 3.84 which is interpreted as "Best". This means that the target end-users of the digitized scoreboard were pleased and appreciative on the content, methodologies, management team and presentation aid used during the training. Clearly, staff implementers were able to learn how to access, manage and manipulate the developed digitized scoreboard. Furthermore, testing results revealed that with the design and structure of the developed digitized scoreboard, staff implementers were able to record and update the information and conditionalities, monitor status, consolidate reports of household beneficiaries of Pantawid Program with ease of use, effectively, satisfactorily and with minimal supervision from technical experts. Thus, the developed digitized scoreboard is a useful system for the implementing unit of the government and an innovative way to do the tasks of each staff implementers in managing and monitoring the conditional cash transfer program household beneficiaries.

Keywords

Conditional cash transfer program, Department of Social Welfare and Development Staff Implementers, Digitized Scoreboard, Pantawid Pamilyang Pilipino Program

INTRODUCTION

Conditional Cash Transfer (CCT) Program is considered to be as one of the effective programs of the government in terms of poverty reduction and social protection strategies. It is one of the many ways of improving the way of life of people through cash grants. Every country implementing this type of program claimed that it lifted the lives of millions of people [1].

The Philippines is one of the countries implementing the CCT program since 2007. Under the Republic Act No. 11310 [2], the program was named as Pantawid Pamilyang Pilipino Program or 4Ps. It is a national poverty reduction strategy and a human capital investment program that provides conditional cash transfer to poor households for a maximum period of seven years, to improve the health, nutrition and education aspect of their lives. Eligible beneficiaries are farmers, fisher-folks, homeless families, and indigenous people, those in the informal sector, those in geographically isolated areas and those in areas with no electricity. The conditional cash transfer will be given under the following scheme: P300 per month for a child in kindergarten and elementary school for a maximum of ten months per year; P500 per month for ten months for a child enrolled in junior high; P700 per month for ten months for every child enrolled in senior high school and a health and nutrition grant of P750.00 per month for 12 months per year. Pantawid Pamilyang Pilipino Program is facilitated by the Department of Social Welfare and Development (DSWD) office and considered as the Philippine government's poverty reduction and social protection strategy [3] [4].

Secretary of DSWD-Rolando Jose Bautista reported that since 2007, the Philippine government expanded the CCT program and as of November 2019 the program already reached a total of 20 million Filipinos belonging to 4 million households [5].

The implementation of CCT program follows several phases. Registration and verification of beneficiaries are the initial phases. Staff implementers are the ones who go to the field and meet the verified beneficiaries of each barangay or municipality face to face. All the beneficiaries are obligated to attend and participate in the conditionalities set by the program [6]. It comprises of monitoring the health of each beneficiary including pre and post-natal services for pregnant, 85% attendance to school for 3 to 18 years old and attendance in family development session (FDS) [7]. Aside from all the types of grants received by the beneficiaries, the mode and period of payment, complaints such as payment-related issues and reduced grants are also monitored. Failure to comply with the conditionalities would be the bases of adjustment or even suspension of the cash grants. Each beneficiary together with his / her family members who are part of the program, their activities and performance are checked by the staff implementers using the designed worksheet and saving it is the way to record and monitor the status of each household beneficiary. The provincial office will then collect all reports obtained from each municipality called scoreboard consolidation [8].

The national government has this good intention and initiative towards the poverty alleviation through the 4Ps. However, because of the expansion and rapid pace of the program, there are various challenges and concerns when it comes to the process of recording and monitoring the household beneficiaries' activities. In the Province of Laguna, as of June 9, 2021 [9] there were 44, 642 active 4Ps beneficiaries within the 5 cities and 25 municipalities supported and monitored by the program, nonidentification of supposed beneficiaries, lack of data updating, tracking mechanism, storage and security were just several issues that need improvement for public integrity and managing resources [10]. Also, staff implementers from the said province mentioned that augmenting the way they do the process is advantageous and not only beneficial to them and even more to DSWD. Furthermore, adopting to a more augmented way to facilitate the process would not be difficult since most of the implementers are in competent age and knowledgeable in computer operations as assessed by the researcher in 2018 [11].

This research focuses on the development of digitized scoreboard for Philippines' Conditional Cash Transfer Program with the aim to manage and monitor record of all the household beneficiaries' information, conditionalities, activities and their performance. Consolidation of the scoreboard through dashboard, statistics and pertinent reports are essentially incorporated in the system. In this context, using a digitized scoreboard would give the facilitating body of the program a more effective and efficient ways to monitor all the beneficiaries.

MATERIALS AND METHODS

The researcher based its design and development approaches using the agile methodology specifically the iterative and incremental development model. The agile model is a combination of both iterative and incremental model by breaking a product into components where on each cycle or iteration, a working model of a component is delivered. The model produces ongoing releases (iterative), each time adding small changes to the previous release (iterative). During each iteration, as the product is being built, it is also tested to ensure that at the end of the iteration the product is shippable. The Agile model emphasizes collaboration, as the customers, developers and testers work together throughout the project [12].

Bhavz Kakarla (2019) stated that there are several phases in the system design and development process [13] as shown in the Fig. 1
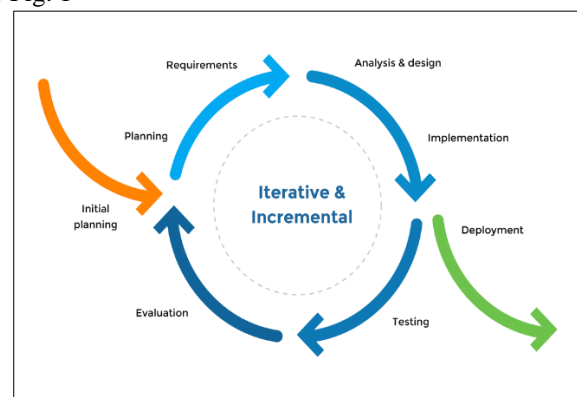
Fig.1 Agile Methodology

As shown in the Fig. 1, the first phase is the requirements phase. During this phase, the researcher was able to assess the process on how the conditional cash transfer program for household beneficiaries are being carried out, strengths and opportunities such as the level of knowledge of staff implementers in computer operations and resources available. Assessment result can be illustrated in the Input-Process-Output (IPO) Model in Fig. 2.
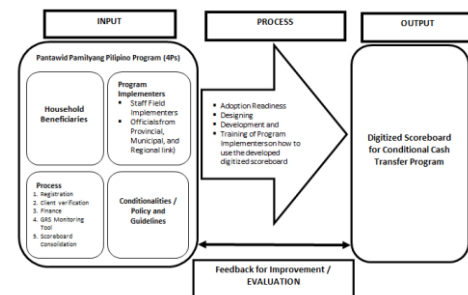
Fig. 2. IPO Model

The result of the assessment was the basis for the structure, design, requirements and resource specification and scope of the digitized scoreboard.

After all the requirements were identified, planning and designing the structure as to how the development were executed. Development tools such as Hypertext Preprocessor (PHP) to build web-based system and for managing content,

WAMP Server to create database and tables, Sublime Text to write codes, Hypertext Mark-up Language (HTML) and Cascading Style Sheet to construct presentable webpages and MySQL to structurally manage the searching technique were all used to create the entire digitized scoreboard.

As the development of the scoreboard progresses, training on internet technology, database, web development and web-based system management was conducted. This is to prepare them in using the system.

Then, participants were assisted on how to manage and access the system. The scope of the digitized scoreboard was presented and demonstrated to the target end-users who are the staff implementers, then remote access was facilitated as well. Immediately after, they were asked to perform their usual task but this time using the system. The researcher observed the behavior, and noted their feedback while facilitating the training.

Using the LSPU Extension and Training Services Evaluation Form [14], the training regarding the management and how to use the system was evaluated by the participants. Moreover, usability type of testing focusing on the criteria such as usefulness, ease of use, ease of learning and user satisfaction was administered. Both the training evaluation and usability testing were participated by 107 mostly are staff implementers from the province and few from regional office Lastly, consultative meetings were arranged to synthesize the outcome of the development, testing and evaluation.

RESULTS AND DISCUSSION

The research project is a significant initiative in implementing the CCT program. The developed digitized scoreboard would be beneficial to the implementing department of the program – Department of Social Welfare and Development and to all the staff implementers in improving the services of the program when it comes to tracking and monitoring the scoreboard of each household beneficiary.
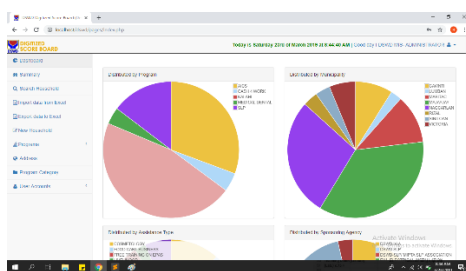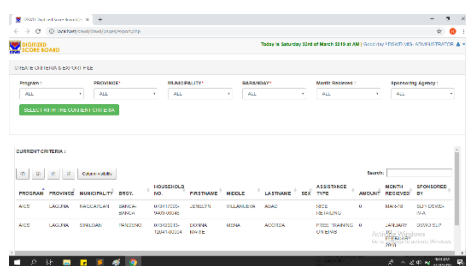

Fig. 3 Scoreboard Dashboard

Fig. 4 Select Criteria and Export File Interface
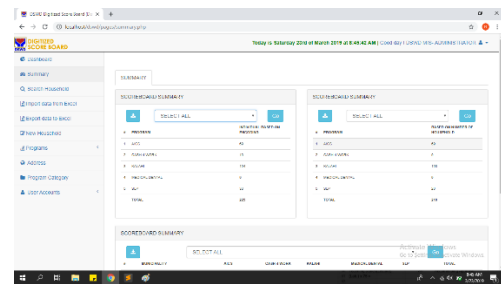
Fig. 5 Record Summary Interface

Fig. 3, 4 and 5 show the system main features of the developed system. Using the system, staff implementers who are main users in the municipal level can record all the household beneficiaries' information and their conditionalities and in the provincial level, consolidation of data is generated through dashboard or in matrix form and can only be accessed by the provincial link officer.

Furthermore, the development of digitized scoreboard made the staff implementers monitor household beneficiaries' activities and their performances in programs in which they participated. This would greatly help the implementers identify who among the beneficiaries are obediently following the conditionalities and can be evaluated as "can now independent sustain their needs on their own" and can be graduated from the program.

Table 1 shows the result of the training evaluation. Based on the evaluation, instructional or presentation aid got the highest rating which is 3.93 while meeting of expectations, training content, training management team, facilities and services acquired comparable rating of 3.84. While training contents and methodologies used gained 3.74. All the particulars in the training program acquired an interpretation of "Best" and gained an overall mean of 3.84. This only shows that staff implementers who attended the training learned to use the digitized scoreboard purposefully.

Table 1. Training Evaluation Result

Particulars	Mean	Interpretation
a) Meeting of expectations	3.84	Best
b) Attainment of objectives	3.81	Best
c) The training/workshop content	3.84	Best
d) The activities included	3.79	Best
e) Methodologies used	3.79	Best
f) Instructional/Presentation Aids	3.93	Best
g) Resource Persons	3.84	Best
h) Training Management Team	3.84	Best
i) Training Facilities and Services	3.84	Best
Overall Mean	**3.84**	**Best**

Table 2. Testing Result

Criteria	Mean	Interpretation
Usefulness	4.69	Strongly Agree
Ease of Use	4.52	Strongly Agree
Ease of Learning	4.52	Strongly Agree
Satisfaction	4.52	Strongly Agree
Overall Mean	**4.56**	**Strongly Agree**

Testing was administered to 107 staff implementers of the Pantawid in the province and regional office. This is to examine the usability and ask the target users if they agree on the performance of the digitized scoreboard focusing on the usefulness, ease of use, ease of learning and user satisfaction. As a result, Table 2 displays that among the four criteria, usefulness got the highest rating which is 4.69. This shows that the using the digitized scoreboard, staff implementers can accomplish their task conveniently and with more outputs.

On the other hand, the ease of use, learning and user satisfaction gained the same results which is 4.52. Evidently, with the design and structure of the new scoreboard, all the staff implementers strongly agreed that they can now record and monitor all the beneficiaries' information, activities and status easily and with very minimal supervision.

Finally, the developed system yields an overall rating of 4.56. This only means that handling records of Pantawid beneficiaries, monitoring and tracking the conditionalities, updating and consolidating data from all municipalities can now be easily handled and managed. The assigned task to staff implementers can be accomplish effectively, efficiently and satisfactorily. And pertinent reports and scores of household beneficiaries can be generated digitally.

CONCLUSION AND RECOMMENDATION

Based on the assessment, developed system, and conducted training evaluation and usability testing, the following conclusion and recommendation are derived:

1. The developed digitized scoreboard is a community-based project which is useful to the staff implementers of the Conditional Cash Transfer Program in one province in the Philippines. It is an innovative way to facilitate the process of monitoring household beneficiaries in a manner that is efficient [15];

2. Staff implementers who are the main users were able to manage and access the developed system easily and smoothly. They can accomplish their tasks efficiently [16];

3. Using the developed digitized scoreboard, staff implementers from the province and regional office can record, monitor, consolidate data of household beneficiaries conveniently and effortlessly; and

4. Using the developed digitized scoreboard, updating and managing pertinent records would be prioritized

with confidentiality thus promote integrity and security [17].

By adopting by way of deployment and installing in all the municipalities of the province of the Department of Social Welfare and Development is recommended to fully assessed the performance of the developed digitized scoreboard. And even if there is a feature in the developed system where staff implementers can filter and summarize the performance and activities of each beneficiary, case management and all the components under the social welfare and development indicator can be added to systematically identify who among the beneficiaries are survival, subsistence and self-sufficient.

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Solution of Linear Partial Differential Equation with Variable Coefficient by HPM

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Abstract

In the current research work, Homotopy Perturbation method will be used to solve systems of linear partial with variable coefficient differential equations. We will be solving few problems of Linear PDE with Homotopy Perturbation method. The resultant error will be compared in the exact solutions. Based upon the perturbation and decomposition theories, these methods proved to be highly accurate and useful in the current times. To further show the utilization of these methods we will be presenting few examples of variable coefficient with different boundary conditions.

Keywords

Variable coefficient, PDE, Solution, HPM

INTRODUCTION

In theory, the Homotopy perturbation method shown by *Ji-Huan* [1,2,3,4] is studied to determine the linear partial differential equation with variable coefficient. The numerical outcomes perceived are definite explanation of the formula.

To understand various physical developments and problems associated with PD equation having variable coefficients in mathematical physics, along with more range of science and engineering, we inspect the correct explanation. Upon further examination we find out that this formula gives us the correct explanation of linear partial differential equation having variable coefficient.

Partial Differential Equation (PDE) with variable coefficient

The application of PDE is widely used in applied mathematics and science. A differential equation which involves two or more independent variable is called PDE.

It is called linear if the dependent variable and its partial derivatives are only in the first degree and do not multiply together.

A PDE with variable coefficient is introduced when a linear PDE gets multiplied with a variable[7,8]. Like in this equation u is a dependent variable and $x,\ t$ are independent variable.

Homotopy Perturbation Formula:

Suppose

$$B(u) - g(s)=0, \quad s\in\xi \qquad (1.1)$$

along the initial condition of

$$C(u,\frac{\partial u}{\partial n})=0, \quad s\in \lambda, \qquad (1.2)$$

where point B is a general operative, $g(s)$ is an accepted analytic action, C is an initial operative, and λ is the boundary of the domain ξ. The operative B may be generally divided further into two operative, K and M, where point K is a linear and M a nonlinear operative.

$$K(u) + M(u) - g(s) = 0 \qquad (1.3)$$

To prove the homotopy formula, we have created a homotopy v(s, p): $\xi \times [0, 1] \to$S,

$$H(v, p) = (1 - p)[K(v) - K(u_0)] + p[B(v) - g(s)] = 0, \qquad (1.4)$$

Or

$$H(v, p) = K(v) - K(u_0) + p\ K(u_0) + p\ K(u_0) + p[M(v) - g(s)] = 0 \qquad (1.5)$$

point $p\in[0, 1]$ is called homotopy limitation (5,6,9) and u_0 is an original proximate as the explanation about (1.1), and that produce the initial condition. certainly, about (1.4) or (1.5), we get

$$H(v, 1) = K(v) - K(u_0) = 0 \qquad (1.6)$$

$$H(v, 1) = B(v) - g(s) = 0 \qquad (1.7)$$

Along with altering action like p from zero to unity is just that of $H(v, p)$ from $K(v) - K(u_0)$ to $B(v) - g(s)$.

In topology, here is called deformative $K(v) - K(u_0)$ and $B(v) - g(s)$ are called homotopy

We proposed that the explanation (1.4) or (1.5) can be written as a series in p as pursue:

$$V = v_0 + pv_1 + p^2 v_2 + p^3 v_3 +\dots \qquad (1.8)$$

Putting $p =1$ result in the proximate explanation as (1.9)

$$U = \lim_{p\to 1} v = v_0 + v_1 + v_2 + v_3 +\dots$$

To check the method's efficiency, we have given different examples of linear PDE with variable coefficient.

EXAMPLE 1: Let us consider a linear differential equation with variable coefficient.

$$\frac{\partial^2 u}{\partial t^2} = \frac{x^2}{2}\frac{\partial^2 u}{\partial x^2} \qquad 0 < x < 1, \quad t > 0 \qquad (1.1)$$

With original situation

$$u(x, 0) = x^4; \quad u_t(x, 0) = 0 \qquad (1.2)$$

Let us consider the following homotopy.

$$\frac{\partial^2 u}{\partial t^2} = p[\frac{\partial^2 u}{\partial t^2} + \frac{x^2}{2}\frac{\partial^2 u}{\partial x^2} - D^2{}_t\ u] \qquad (1.3)$$

Now by using Homotopy Perturbation formula we get.

$$u = u_0 + pu_1 + p^2 u_2 + p^3 u_3 + p^4 u_4 +\dots \qquad (1.4)$$

Using the equation (1.3) in equation (1.4) and correlating the coefficient various power of p we get.

$p^0 = \frac{\partial^2 u_0}{\partial t^2} = 0; \quad \frac{\partial u_0}{\partial t} = 0; \quad u(x,0) = u_0 = x^4.$

$p^1 = \frac{\partial^2 u_1}{\partial t^2} = \frac{x^4}{2}(u_0)_{xx}$

$= \frac{x^2}{2}(12x^2); \quad \frac{\partial u_1}{\partial t} = 6x^4 t; \quad u_1 = x^{2z}\frac{t^2}{2!}$

$p^2 = \frac{\partial^2 u_2}{\partial t^2} = \frac{x^2}{2}(u_1)_{xx} = x^2\frac{t^2}{2!}$

$p^2 = u_2 = x^2\frac{t^4}{4!}$

$p^3 = u_3 = x^2\frac{t^6}{6!}$

:
:

Solving above differential equation under the condition $u_t(x,0) = 0$

$u_0 = x^2$

$u_1 = x^2\frac{t^2}{2!}$

$u_2 = x^2\frac{t^4}{4!}$

$u_3 = x^2\frac{t^6}{6!}$

:
:

$u = u_0 + u_1 + u_2 + u_3 + u_4 + \ldots$

$u = x^2 + x^2\frac{t^2}{2!} + x^2\frac{t^4}{4!} + x^2\frac{t^6}{6!} + \ldots$

$= x^2 \cos ht$

Which is correct explanation.

Example 2: Let us resolve the Partial Differential equation with variable coefficient.

$u_{tt} = \frac{x^2}{12}u_{xx} \quad 0 < x < 1, t > o \quad\quad (2.1)$

With fundamental case

$u(x,0) = 0; \quad u_t(x,0) = x^6 \quad\quad (2.2)$

present to the HPF.

Let us consider the following homotopy.

$\frac{\partial^2 u}{\partial t^2} = p[\frac{\partial^2 u}{\partial t^2} + \frac{x^2}{12}\frac{\partial^2 u}{\partial x^2} - D^2{}_t u] \quad\quad (2.3)$

Now by Homotopy Perturbation formula we get.

$u = u_0 + pu_1 + p^2u_2 + p^3u_3 + p^4u_4 + \ldots \quad\quad (2.4)$

Using the equation (2.4) in equation (2.3) and comparing the coefficient of various power of p we get,

$p^0 = \frac{\partial^2 u_0}{\partial t^2} = 0; \quad \frac{\partial u_0}{\partial t} = x^6; \quad u(x,0) = u_0 = tx^6.$

$p^1 = \frac{\partial^2 u_1}{\partial t^2} = \frac{x^2}{12}(u_0)_{xx}$

$= \frac{x^2}{12}(30x^4 t); \quad \frac{\partial u_1}{\partial t} = \frac{5}{2}x^6\frac{t^2}{2}; \quad u_1 = \frac{5}{2}x^6\frac{t^3}{3!}$

$p^2 = \frac{\partial^2 u_2}{\partial t^2} = \frac{x^2}{12}(u_1)_{xx}$

$= \frac{25}{4}x^6\frac{t^3}{3!}$

$p^2 = u_2 = \frac{25}{4}x^6\frac{t^5}{5!}$

$p^3 = x^4\frac{t^7}{7!}$

:
:

Solving above differential equation under the condition $u_t(x,0) = x^4$

$u_0 = x^6 t$

$u_1 = \frac{5}{2}x^6\frac{t^3}{3!}$

$u_2 = \frac{25}{4}x^6\frac{t^5}{5!}$

:
:

$u = u_0 + u_1 + u_2 + u_3 + u_4 + \ldots$

$u = tx^6 + \frac{5}{2}x^6\frac{t^3}{3!} + \frac{25}{4}x^6\frac{t^5}{5!} + \ldots + \ldots = x^6 (5/2)^n \sinh t$

Which is correct explanation.

In this PDE when we applied HPM we get exact solution.

Example 3: Let us proposed partial differential equation with variable coefficient.

$u_{tt} = \frac{x^2}{6}u_{xx} \quad 0 < x < 1, \quad t > o \quad\quad (3.1)$

With fundamental situation

$u(x,0) = x^3; \quad u_t(x,0) = 0$

Present to the HPF let us consider the following homotopy.

$\frac{\partial^2 u}{\partial t^2} = p[\frac{\partial^2 u}{\partial t^2} + \frac{x^2}{2}\frac{\partial^2 u}{\partial x^2} - D^2{}_t u] \quad\quad (3.2)$

Now by homotopy perturbation formula we get.

$u = u_0 + pu_1 + p^2u_2 + p^3u_3 + p^4u_4 + \ldots \quad\quad (3.3)$

Using the equation (3.3) in equation (3.2) along with correlate the coefficient of various power of p we get.

$p^0 = \frac{\partial^2 u_0}{\partial t^2} = 0; \quad \frac{\partial u_0}{\partial t} = 0; \quad u(x,0) = u_0 = x^3.$

$p^1 = \frac{\partial^2 u_1}{\partial t^2} = \frac{x^2}{6}(u_0)_{xx} = \frac{x^2}{6}(6x); \quad \frac{\partial u_1}{\partial t} = x^3 t; \quad u_1 = x^3\frac{t^2}{2!}$

$p^2 = \frac{\partial^2 u_2}{\partial t^2} = \frac{x^2}{6}(u_1)_{xx} = x^3\frac{t^2}{2!}$

$p^2 = u_2 = x^3\frac{t^4}{4!}$

$p^3 = u_3 = x^3\frac{t^6}{6!}$

:
:

Solving above differential equation under the condition $u_t(x,0) = 0$

$u_0 = x^3$

$u_1 = x^3\frac{t^2}{2!}$

$u_2 = x^3\frac{t^4}{4!}$

$u_3 = x^3\frac{t^6}{6!}$

:
:

$u = u_0 + u_1 + u_2 + u_3 + u_4 + \ldots$

$u = x^3 + x^3\frac{t^2}{2!} + x^3\frac{t^4}{4!} + x^3\frac{t^6}{6!} + \ldots = x^3 \cos ht$

Which is correct explanation.

CONCLUSION

In this paper we have solved three problems of Linear PDE using HPM. We can see that obtained solution is same as exact solution. The final results tell us that the proposed method is efficient and easier to handle when compared with the exact solutions or Adomian Decomposition Method (ADM).

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Risk assessment roadmap for a non-complied taxiway slope in an airport

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Abstract

As mandated by International Civil Aviation Organization (ICAO) and the national Civil Aviation Authorities (CAAs), for every international airport to be certified, and to comply with the international and national aviation regulation, and as having Safety Management System (SMS) is an essential requirement for service provider certification, the SMS focuses on managing safety risks and safety performance, one of the main parts of this SMS is the "gap analysis" to identify the non-compliant elements in the airside.

Due to varying constraints, some airports may not be able to fully comply with the requirements, and in such cases, ICAO recommended for the airport safety and operations management to conduct a "Risk Assessment Study (RAS)" and take the necessary actions to mitigate this risk to an acceptable level.

In this case study, we apply the standard methodology for risk assessment where the slope between a parallel taxiway and the runway is not complied with neither ICAO nor national standards, and this causing aircraft movements to/from the affected runway very risky, especially during the winter season where heavy rain, slippery ground and windy weather become highly probable. This case study will introduce a risk management process for this problem and propose a methodology for managing this risk and recommend the mitigation procedures to minimize this risk to an acceptable level

Keywords

Airport, risk assessment, runway, taxiway, deviation, hazards, consequences, airline, mitigation.

INTRODUCTION

Safe air operations require continuous monitoring and assessment of possible hazards, such as building, constructions, equipment, procedures, organization structure,..,etc., ICAO provided a systematic assessment approach to be followed, to demonstrate that safety is not compromised. such assessment -also known as "aeronautical study"- is one of the core competencies that keep the aviation industry safe all the time.

One of the objectives of this case study is to demonstrate the ways and means to prepare and implement a Risk Management Study and conclude operational and/or technical solutions that meet the needs of airport operators, airspace users, and project developers, and share experience and best practices in this field.

Risk management process framework

For any aviation service provider e.g. airport, Air Navigation Service Provider (ANSP), airline, and as described by ICAO document 9859: Safety Management Manual, figure 1 provides an overview of the hazard identification and Safety Risk Management (SRM) process, hazards may be the result of systems that are deficient in their design, technical function, human interface or interactions with other processes and systems, The SRM process systematically identifies hazards that exist within the context of the delivery of its products or services.

Figure 1 depicts the hazard identification and risk management process the decision aid, while figure 2 explains the safety risk management, the different ways of risk mitigation, and actions that often result in changes to operating procedures, equipment or infrastructure.

Figure 1: Hazard identification and risk management process
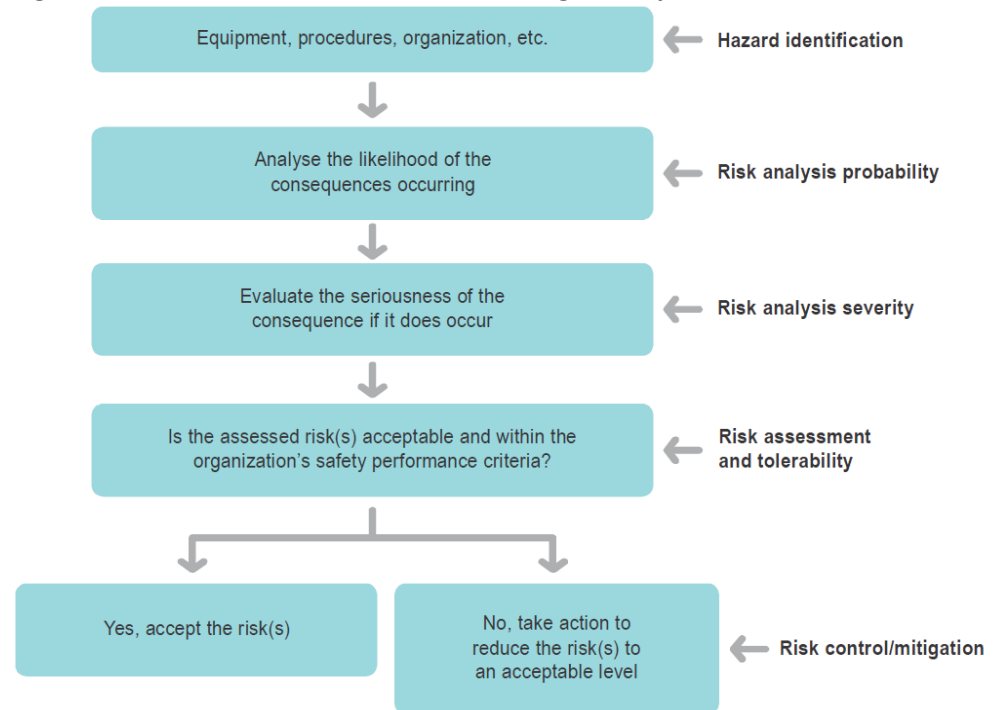
(Source: ICAO)

According to ICAO, safety risk mitigation strategies may be classified into three categories:

a) **Avoidance:** The operation or activity is cancelled or avoided because the safety risk exceeds the benefits of continuing the activity, thereby eliminating the safety risk entirely.

b) **Reduction:** The frequency of the operation or activity is reduced, or action is taken to reduce the magnitude of the consequences of the safety risk.

c) **Segregation:** Action is taken to isolate the effects of the consequences of the safety risk or build in redundancy to protect against them.

The safety risk index is a combination of the probability and severity scores, this risk index is expressed in alphanumeric designation table 1. The safety risk assessment matrix is expressed in three levels to be used to determine safety risk tolerability, these three levels are Intolerable, Acceptable, and Tolerable.

Figure 2: Safety risk management decision aid
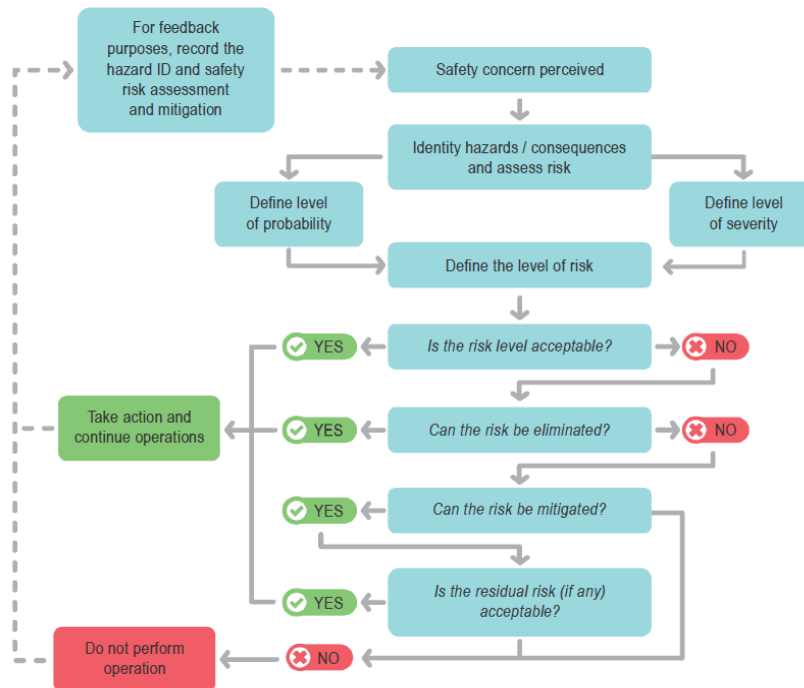
(Source: ICAO)

Table 1 Example safety risk matrix

Safety Risk		Severity				
Probability		Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

(Source: ICAO)

Based on concluded final Risk Index (RI) -and applying the safety mitigation measures- the safety committee will determine the consequences according to the tolerability levels:

1. **Intolerable (Red)**: Take immediate action to mitigate the risk or stop the activity.
2. **Acceptable (Orange):** Can be tolerated based on the safety risk mitigation. It may require management's decision to accept the risk.
3. **Tolerable (Green):** Acceptable as is, so no further safety risk mitigation is required.

Case study background

As shown in the Airport Layout Plan (ALP) in Figure 3, airport ABCD is a virtual international airport, with two parallel runways: 07L/25R and 07R/25L. There is also a taxiway "D" parallel to runway 07R/23L, and three Rapid Exit (RE) taxiways D1, D2, and D3 connecting the parallel taxiway D and the referred runway. The traffic density for the past 5 years (excluding 2020 as traffic was impacted by the Covid-19 pandemic) is in table 2.

Rapid Exit taxiways D1 and D2 are used by flights landing on the 25R threshold to vacate the runway, while Rapid Exit taxiway D3 is used by flights landing on 07R threshold.

These three Rapid Exits also could be used for departing flights, especially for narrow-body aircraft.

The airport is located in a four seasons area with a heavy rainy winter and strong prevailing wind.

The main goal of this case study is to illustrate how to conduct a "Risk Assessment" to review the impact of the longitudinal slope of taxiway "D" and the Rapid Exit "D3" to identify the existing risk/s and to propose mitigation measures to minimize the effects of non-compliance on the aircraft movements either in-bound or out-bound.

Figure 3: Airport Layout Plan (ALP)
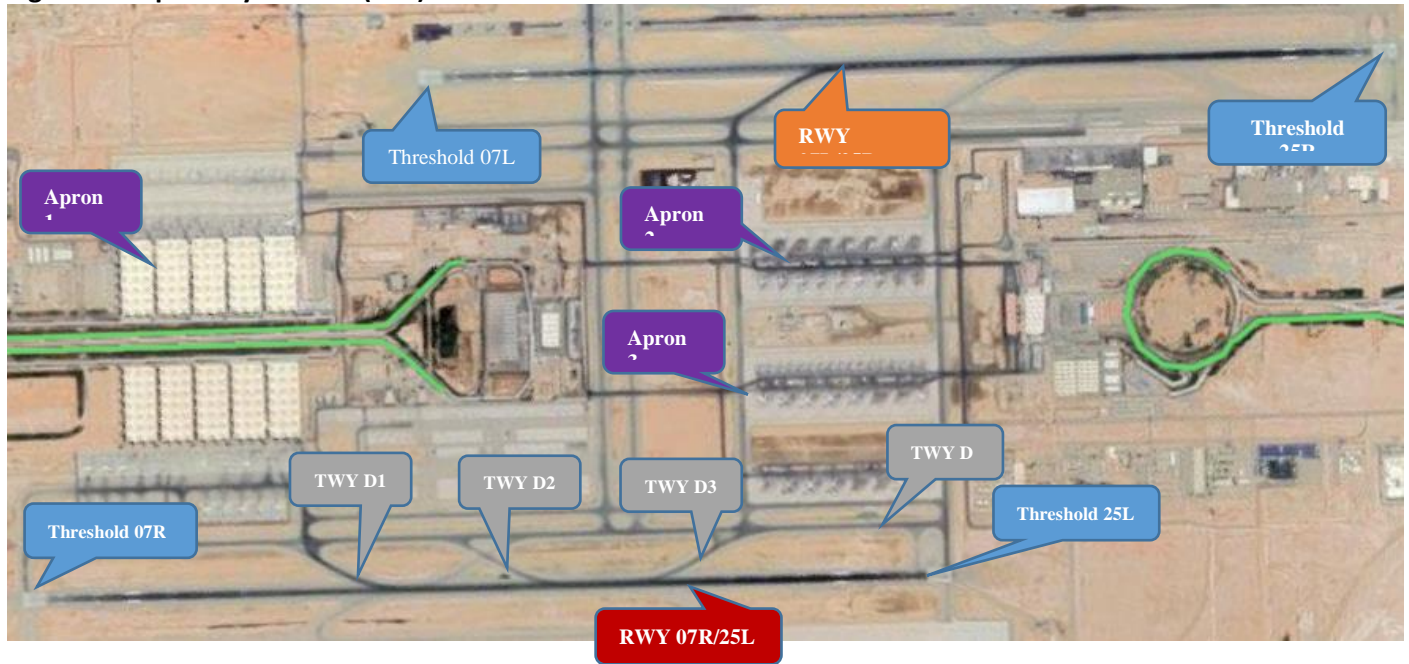
Aeronautical remarks:

- Runway 07R/25L dimensions are 4000m length and 45 m width, (Reference Code is 4E),
- The separation distance between the centerlines of runway 07R/25L and runway 07L/25R is 2100 m,

Year	Aircraft Movement per year	Passenger movement per year
2015	140,251	12,256,721
2016	143,901	13,335,032
2017	144,340	14,223,481
2018	147,332	14,356,590
2019	155,283	15,982,276

- Runway 07R/25L is dedicated for Landing & Takeoff (mixed operations),
- There had been many complaints from the pilots using both taxiways "D" and "D3" that they need to apply brakes to slow down the taxi speed while taxing to the intersection for the takeoff on runway threshold 25L or after vacating the runway to join taxiway "D" respectively,

Table 2: Air traffic movements for the past 5

- Runway 07R/25L and the accompanied taxiways are planned for renovation and upgrading works and is targeted to re-open during the period March: Dec., 2022,
- All taxiways' pavement is asphalt and code "E" (width 23m).
- The approach light systems for runway threshold 07R is equipped for Cat. II, while normal ILS approach is used for threshold 25L,
- Taxiways D3 is Rapid Exit Taxiway (RET) for runway threshold 07R, located in 3000 m from the threshold,
- The traffic densities for thresholds 07R & 25L are 35% and 65% respectively,
- The distances between runway threshold 25L and rapid exit taxiways D1 & D2 are 3100 m and 2650 m, respectively.
- Rapid Exit Taxiway "D3" usability in both dry and wet surface cases are shown in table 3,

Table 3: RET "D3" usability

	Large aircraft	Heavy aircraft
Dry surface	80%	20%
Wet surface	70%	30%

- The pilots are complaining about the need to apply hard brake to avoid runway incursion (when taxiing towards the runway) or taxiway incursion (when vacating the runway).

Existing hazard:
Based on the frequent complaints of the pilots using taxiway "D" and RET "D3", thus violating longitudinal slope on taxiway "D" act as a hazard for the aircraft movements to and from the runway.

ICAO recommendation:
ICAO recommendation for taxiway longitudinal slope: The longitudinal slope of a taxiway should not exceed 1.5 percent where the code letter is C, D, E or F (Annex 14 V.1, 3.9.8).

Preparation for risk assessment study
A Risk Assessment Team (RAT) was established comprising of members listed in Table 4. They did regular brainstorming sessions to prepare an "aeronautical study", and to review and resolve all the findings concerning "the deviation of the longitudinal slopes".

Table 4: Recommended risk assessment team

No.	Entity	Title			
1.	Airports	Safety manager (coordinator)	2	Airline	Safety manager (pilot)
3.		Operations manager	4		Operations manager (flight dispatcher)
5.		Head of civil engineer	6	Air Traffic control	Safety manager
7.		Head of electrical engineer	8		Operations manager (aerodrome controller)
9.	Ground handlers	Operations Manager	1	Airside firefighting unit	Head of airside firefighting unit
11.	Metrological authority	Metrology specialist			

RAT team remarks and recommendation
The team estimated the consequences could be as follows:
- **For taxing aircraft on taxiway "D":**
  - In the case of outbound flights, aircraft taxing towards the runway threshold 25L, the pilots may need to apply brake to slowdown the aircraft movements especially when they come closer to 25L Runway Holding Position (RHP) to overcome the downward slope,
  - Also, for outbound flights, and for the holding aircraft waiting on the 25L's RHP for the takeoff permission, there is possibility for this aircraft to go beyond the RHP marking and causing a runway incursion especially when the surface is wet.
  - In the case of inbound flights using runway threshold 07R, for the aircraft taxing on taxiway D the pilots may need to apply more fuel for more power to manage the upward slope.

- **For Rapid Exit Taxiway "D3":**
  - In the case of flights vacating the runway, the pilot needs to apply brake to control the speed of aircraft especially because RET "D3" is short, and also to avoid colliding onto aircraft taxiing along taxiway "D",
  - In the case of outbound narrowbody flights via D3, there is a possibility for this aircraft to slide back causing taxiway incursion and becomes a hazard for aircraft taxiing along taxiway "D", especially when the surface is wet and the takeoff permission need long time.

The team evaluated the severity and probability for every above-mentioned hazard separately, and luckily all of them are either 2B or 3C, which are acceptable with the following mitigation measures according to table 1:

1. **The mitigation measures for the airport management:**
   - To publish these deviations on the national Aeronautical Information publication (AIP),
   - To set priority to resolve these deviations when the upgrade this area (the management advised that this will take place next year),
   - To advise their operational staff to pay more attention to these areas and increase the frequency of inspection to them (should be reflected on the Airport Operations Manual (AMO)).

2. **The mitigation measures for the Air Traffic Controller (ATC):**
   - To be very cautious when clearing landing aircraft to vacate the runway via RET "D3" if there are aircraft taxiing along taxiway "D",
   - Not to give permission for flights vacating runway via RET "D3" if they need to hold position on it,
   - To keep an eye for the outbound flights via runway threshold 25L and ask them to slow down their speed, if needed, especially when they approach the RHP.

3. **The mitigation measures for both inbound and outbound flights' pilots are as follows:**
   - To make sure they are already aware about the airport layout deviations,
   - To provide clear ATC instructions especially in terms of taxing speed and taxing instructions, when either vacating the runway via RET "D3" or when taxiing towards the RHP of runway threshold 25L,

The detailed aeronautical study to be sent to the national Civil Aviation Authority (CAA) for approval and deviation publication in the AIP.

Conclusion

To maintain the safety level of the aviation industry to the acceptable level of safety (ALoS), International Civil Aviation Organization (ICAO) mandate every service provider to conduct Risk Assessment Study for any non-compliance element within the airside, through a proactive identification of hazards and apply Safety Risk Management (SRM).

In this case study we have two taxiways slope that are non-compliance with both international and national regulation. Those two taxiways are directly connected to the runway 07R/25L, which may affect both inbound and outbound operations.

To overcome this non-compliance, a Risk Management Study (RMS) had been conducted to explore the possible solution and to mitigate the consequences to the acceptable risk level.

Further Reading

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Applications of Fiber Reinforced Polymer (FRP) in Structural Strengthening: A review

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Abstract

This paper summarizes the ongoing research on use of Fiber Reinforced Polymer (FRP) in structural strengthening. Strengthening is required when the structural members are damaged under excessive external loading or when there is change of Structural use of the Structure. Since Fiber Reinforced Polymer (FRP) have been the source of an increasing interest in the field of rehabilitation, the main focus of this paper is to study the work done by various researchers on the application of Fiber Reinforced Polymer (FRP) in rehabilitation of Structures. The main findings obtained in the previous studies are mentioned and the issues that are not yet well understood and require further investigations are pointed out.

Keywords

Fiber Reinforced Polymer (FRP), Reinforced Concrete Members and Structural Strengthening

I. INTRODUCTION

In civil engineering applications the maintenance, rehabilitation and upgrading of structural members, is one of the most crucial problems. Furthermore, numerous systems designed using the previous design codes in different countries of the world are structurally unsafe according to present design codes. Thus, the restoration of civil engineering systems is therefore becoming more necessary because of the need to maintain and enhance the huge structural surroundings inherited from the past. Since replacing these defective elements of systems requires a tremendous amount of citizens money and time, rehabilitation has become an appropriate way to improve their capacity to carry load and prolong their service lives. Deterioration of infrastructure caused by premature decay of structures has led to the review of several systems for the purposes of repair or rehabilitation. One of the difficulties in Reinforced Concrete Structures is the selection of a retrofitting system that will improve the structure's strength, durability and life while resolving constraints such as constructability, building operations and budget.

In the past 20 years, Fiber Reinforced Polymers (FRP) material have appeared to be most promising material for construction activities. Originally the Fiber Reinforced Polymers (FRP) material originated for Aerospace industries and had applications in the automobile industries also. But over the period of time shifted to civil engineering applications because of its superior qualities over other materials.
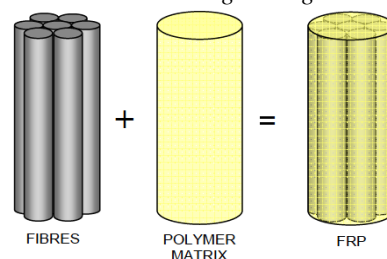

Fig.1: Materials combined to create an FRP composite.

II. LITERATURE REVIEW

Researchers over the years have carried out a various study on use of Fiber Reinforce Polymer (FRP) in construction industry for maintenance, rehabilitation, and up-gradation of structural members. These studies focused on different aspects of FRP such as applications systems, locations of application and different types of FRP (Glass Fiber, Carbon Fiber and Aramid Fiber). Some of the earlier studies and their findings are mentioned below.

Sangeeta Gadve et al. [1] studied the effect on concrete cylinders implanted with steel bars and submerged in salt water. Then an anodic current was passed through the embedded steel bars to instigate cracking in the concrete cylinders. This cracking was the result of accelerated corrosion of steel. This progression of steel corrosion in concrete was studied after adhesively bonding the cylinder with Glass and Carbon FRP sheets. The finding of this study revealed that the rate of corrosion was dramatically decreased after wrapping. Moreover, the decrease corrosion in samples wrapped with Glass FRP was more than that of Carbon FRP. If should be noted that in the field application during the

experimentation process the thickness of Glass FRP used was more than Carbon FRP.

A.H. Al-Saidy et al. [2] conducted an experimental program in which specimens of RC beams (rectangular) were subjected to accelerated corrosion. The rate of corrosion was varied from 5% to 15%. Due to which in the tension side of the beam the cross-sectional area of the steel reinforcement was reduced. To compensate the strength loss caused due to corrosion the tension side of the beam specimen that were corroded were repaired by CFRP bonding. It was found that, corrosion had an impactful effect on the bond between the reinforcement and the surrounding concrete. The ultimate strength of the repaired beams is increased with respect to the corroded beams. The structural integrity is maintained when CFRP sheets are used to strengthen the RC corroded beams.

Scott T et al. [3] conducted sequence of tests on concrete slabs which were simply supported and one way. These slabs were strengthened using FRP composites in flexure with tension face bonded and anchored with distinctive arrangements of FRP anchors. Behaviors of the specimens including the failure modes and selected strain results are investigated. Additionally, responses of the load deflection are plotted for all the slabs. The outcome of the study recommended that robustness can be build in to the member when anchored with Fiber Reinforced Polymer strengthening plate. The rate of de-bonding crack propagation was reduced when the anchors were closely spaced. Whereas, gains in deflection capacity but with limited gain in strength when the anchors spaced far apart.

Yasmeen Taleb Obaidat et al. [4] experimentally explored the performance of full-scale RC beams which were damaged structurally and later retrofitted in shear or in flexure using Carbon Fiber Reinforced Polymer laminates. The main variables observed were and the length of Carbon Fiber Reinforced Polymer, position of retrofitting and Internal reinforcement ratio. Findings of this study revealed that, when retrofitted in shear there was increase in maximum load and reached values about 23% for the retrofitted specimen. Similarly, when retrofitted in flexure there was increase in maximum load and reached values between 7% and 33%. Furthermore, it was observed that the mode of failure shifted to brittle. In flexural retrofitting when the CFRP plate length is increased it can make Carbon Fiber Reinforced Polymer more impactful for strengthening and concrete repair. To produce the intended strengthening effect the strengthening lengths should be sufficient enough.

Yousef A. Al-Salloum et al. [5] conducted experimentation on concrete cylinders subjected to high temperature and assessed the bond strength between concrete substrate and Fiber Reinforced Polymer. The experimentation was designed for both CFRP and GFRP wrapping. In all 42 standard concrete cylinder specimens of size 100mm x 200mm were casted. These 42 standard concrete cylinder specimens were distinguished into 3 groups of 14 unwrapped specimens,14 GFRP sheet wrapped specimens and 14 CFRP sheet wrapped specimens respectively. For both, GFRP and CFRP sheets wrapped specimens only single layer wrapping was adopted. It was found in this study, that peculiarly for CFRP wrapped specimens at a temperature of 200°C a notable deterioration occurred in the bond strength. Also, in FRP confines specimens rate of loss of compressive strength was observed at elevated temperature. Thus, attempts must be made to control the temperature within few hours to prevent very high loss of strength.

C.G. Bailey et al. [6] tested 8 circular columns which were shear critically reinforced, had a span to depth ration of 2.5 and were under a combined constant axial and cyclic lateral displacement history and simulating earthquake loading. These specimens were evaluated in 3 groups namely post-heated, post-heated plus restored with either CFRP or GFRP and unheated. A significant increase was observed in the energy dissipation, ductility and shear capacity of the post-heated damaged columns specimens jacketed with CFRP and GFRP. It was noticed that, the failure mechanism was shifted from column shear failure to flexural failure and there was a considerable degradation in the FRP properties at high temperature.

H.W. Zhang et al. [7] performed tests on 41 Fiber Reinforced Polymer to concrete joints which were anchored with single as well as multiple FRP anchors in addition to two unanchored control joints. Investigation is done on the location of the anchors and method of anchor installation. Results of the tests performed suggested that in comparison with unanchored control joints the multiple anchors increased the strain utilization of the Fiber Reinforced Polymer plate more efficiently. Moreover, when the anchors were optimally arranged it increases the strength of anchor joints 3 times more than the unanchored control joint average. It must be duly noted that joints anchored with rigid anchors were found to be stronger than joints anchored with flexible anchors.

Renata Kotynia [8] used externally bonded (EB) and near surface mounted (NSM) FRP strengthened RC beams to evaluate the bond behavior between concrete and Carbon Fiber Reinforced Polymer materials. Six parameters such as compressive concrete strength, CFRP bond length, beam's span and depth, type of the CFRP strips/ sheets and longitudinal steel reinforcement were considered to investigate the bond mechanism with the help of Modified RILEM beam bond test. It was found in this study that on the strengthened beams the concrete strength has an insignificant influence on the ultimate load when strengthened with both NSM and EB methods. Tests confirmed that internal steel bars play a crucial role in concrete to FRP bond and failure modes.

G. Promis et al. [9] suggested the usage of a performance index, based on a damage index, to evaluate the three experimental investigations and suggested effectiveness of external FRP reinforcement retrofitting with the help of 3

experimental investigations. Determination of the presence of FRP bars and FRP reinforcement on the performance index of the columns, the shape of the reinforced short column and the influence of axial compressive loading is done. The study concluded that for non-reinforced circular columns increases in the axial compressive load improves the performance. Under a heavy compressive load, the dissipated energy is lower for the same ultimate displacement. When the rectangular cross-section columns were analyzed, it suggested that anchoring FRP bars and using FRP jacketing for the strengthening of columns increases its performance. For the anchored FRP column and the FRP confined column the slope of the performance index is very high.

Rajeh Z. Al-Zaid et al. [10] studied reinforced concrete beams analytically which were strengthened for flexure with FRP reinforcement externally bonded. Development of numerical models was done considering the parameters such as equilibrium conditions, cross-sectional analysis and satisfying strain compatibility. These models also produced load– deflection relationship of the beam with respect to its preloading conditions, loading system and configuration. The comparison of the analytical results with the available experimental data suggested for the FRP strengthened beams the model which are developed can precisely produce the load – deflection response. In addition, for a Reinforced Concrete beam with the preload condition, specified dimensions, FRP cross-sectional area and internal steel reinforcement this model can be helpful in generating the moment–curvature relationship and subsequently the moment–deflection relationship. Moreover, the model developed in this study is very simple and easily implemented through a computer program.

Davood Mostofinejad et al. [11] experimentally tested 16 square reinforced concrete columns with cross section 133x133 mm cross section and 500 mm height under uni-axial compression. In this study a new method was developed by using FRP battens at sides and FRP strips at corners for the confinement of square concrete columns. The number of confining layers, the volume of fibers used and continuity or discontinuity of corner strips along height of column were the test parameters focused on. This research discovered that confining battens is the new technique of corner strip–batten which are uniformly stretched under the tension stresses of confinement. Hence, more uniform distribution of confining pressure on section occurs and the stress concentration at corners is eliminated. As compared to confinement using conventional FRP wraps a better performance was observed and the compressive behavior of the strengthened column was significantly improved by this proposed method.

J.H. Gonzalez-Libreros et al.'s [12] studied two different composites viz. Fiber Reinforced Polymer (FRP) and Fiber Reinforced Cementitious Matrix (FRCM) composites by experimentally investigating the behavior of reinforced concrete beams strengthened in shear with externally bonded composites. The parameters investigated included the variables such as the use of anchors, type of fiber and internal shear reinforcement ratio. This study revealed that with the increase axial stiffness of the composite the shear strength of strengthened beams increases. The anchors used changes the failure mode, the concrete crack pattern and mid-span displacement but did not affect the shear strength of the beams.

Jikai Zhou et al. [13] experimentally investigated concrete circular specimens of different sizes which were Carbon Fiber Reinforced Polymer confined. This investigation included studying the size effect on mechanical properties of Carbon Fiber Reinforced Polymer confined concrete circular specimens. The different sizes of CFRP confined concrete cylinders tested under uniaxial compressive were 70 mm, 100 mm, 150 mm, 190 mm and 310 mm. Further, different confinements layers CFRP were used namely, one layer, two layers and three layers. The four parameters obtained were peak strain, interception strength, strain of turning point and interception strength. The study revealed that mechanical properties of concrete have significant size effect and the uniaxial compressive strength of unconfined concrete cylinders has apparent size effect. Thus, size effect on large scale specimens confined with FRP should be investigated.

Anh Duc Mai et al. [14] studied 12 specimens of reenforced concrete columns of size 150 mm x 150 mm cross-section and 800 mm height which were tested under four-point bending, eccentric axial loads and concentric axial load. This study was carried out to explore the behavior fully and partially wrapped square reinforced concrete (RC) columns. It was learned that in both fully and partially wrapped RC column specimens the strength and ductility increased. The strength and ductility of fully wrapped square RC columns specimens was higher than partially wrapped square RC column specimens for all the loading conditions. Better performance of fully and partially CFRP wrapped square RC specimens as compared to non-wrapped square RC specimens revealed by axial load-bending moment interaction diagrams

Haytham F. Isleem et al. [15] developed a stress-strain model for CFRP confined rectangular RC columns and and subjected to cyclic axial compression. This model is based upon the experimentation carried out on 24 large-size CFRP-confined rectangular reinforced and unreinforced concrete columns under cyclic and monotonic axial compression. It was discovered that available strength and strain models peculiarly based on results of small size FRP-confined plain concrete specimens were inaccurate when assessed for FRP-confined large-size rectangular RC columns. As the cross-sectional size increases effectiveness of the confinement provided by FRP is decreased.

Alireza Rahai et al. [16] performed an experimental study on 8 large-scale rectangular RC columns under biaxial bending moment and axial load which were retrofitted with CFRP composites. These columns which had a regular cross section were casted and examined under bi-eccentric compressive loading up to failure. The various parameters

taken into consideration were eccentricities, fiber orientation and CFRP thickness. The outcomes of these experiments and numerical research showed great development on the strength and ductility of RC column confined with CFRP.

J.J. Zeng et al. [17] experimented on 9 large-scale rectangular RC columns. Out of these 9 nine large-scale rectangular RC columns 1 was a controlled specimen without FRP jacketing and 8 were RC columns jacketed with FRP. The key test variables of this experimental program were the sectional corner radius and the FRP jacket thickness. The tests revealed that in the large-scale FRP-confined rectangular RC columns the stress-strain curves of FRP-confined concrete have a typical bilinear shape. The compressive strength of concrete of a standard concrete cylinder was more than that of concrete in a large-scale unconfined concrete column. The ratio between the two was found to be 0.94 for the columns tested.

Tara Sen et al. [18] performed experimentation on 14 beams specimens, in this experimental study the efficiency of jute textile reinforced polymer composite (JFRP) as compared to GFRP and CFRP for the flexural strengthening of reinforced concrete beams was investigated. This evaluation was done dividing the 14 beams specimens into 3 groups and by performing bending test on these beams. Observations were noted based on load deflection behavior, flexural strengthening effect on ultimate load, failure modes and s the deflection ductility study. It was seen that JFRP strengthening increased the flexural strength of the RC beams by 62.5%, GFRP increased the flexural strength of the RC beams by 125% and CFRP increased the flexural strength of the RC beams by 150% when full wrapping technique was applied. Similarly, when the strip wrapping technique was used JFRP strengthening increased the flexural strength of the RC beams by 25%, GFRP increased the flexural strength of the RC beams by 37.5% and CFRP increased the flexural strength of the RC beams by 50%.

H.R. Ronagh et al.'s [19] evaluated the use of Glass fibre reinforced polymers (GFRP) and Carbon fibre reinforced polymers (CFRP) in flexural strengthening of Reinforced Concrete structures. This strengthening was adopted to and aimed at increasing the lateral resistance of the structure. Findings revealed that by using both the composites' materials the lateral load carrying capacity remarkably increased. Is should be noted that CFRP strengthening improved the lateral resistance twice that of GFRP. However. GFRP provided higher ductility.

Guo Yongchang et al. [20] experimentally investigated 60 cylindrical specimens of dimension 150mm (diameter)x 300mm (height) under axial compression. The axial compressive behavior of Carbon FRP jacketed damaged concrete containing both High Strength Concrete (HSC) and Normal Strength Concrete (NSC) were studied. The test procedure comprised of 2 types of concrete, 2 levels of damage to the specimens and 3 amounts of CFRP wrapping.

The investigations revealed that most of the studies in the used of CFRP sheets only focused on the confinement of normal strength concrete (NSC) whereas the confinement of high strength concrete (HSC) with CFRP is still less explored. Furthermost, it was concluded that the axial strain and the ultimate strength of both damaged and sound specimens was appreciably enhanced by CFRP confinement. For smidgen Carbon FRP reinforcement, the pre-existing damage little effect on Carbon FRP-confined High Strength Concrete. But, a significant effect on the compressive performance of CFRP-confined Normal Strength Concrete

Nawal Kishor Banjara et al.'s [21] study is centered at the experimental exploration and nonlinear finite element simulations of shear deficient and GFRP retrofitted bolstered concrete beams.14beams specimens were casted and their test results were compared with the controlled specimen. The main aim of this research was to study the load carrying capacity of beams strengthened with corrugated laminates and plain sheets. Development of mathematical models was incorporated for the prediction of load carrying capacity of pre-cracked strengthened beams. In the GFRP retrofitted beams the mode of failure changed from shear to flexural failure. There was a remarkable improvement observed **in** the ductile behavior too. Study concluded that application of GFRP to strengthen RC beams is one of the impressive rehabilitation techniques.

III. CONCLUSION

This paper presents a concise review of the study by various researchers on application of Fiber Reinforced Polymer (FRP) in strengthening of structural members. In the above discussion, most of the researchers studied the use of FRP laminates to repair/retrofit concrete specimens which were deteriorated but the grade of concrete was not taken into consideration. These studies were conducted either analytically or experimentally. Thus, Comparison of analytical and experimental results are lacking. Also, the researchers have studied the bonding effect of FRP and concrete. These studies suggested that the FRP has good a bonding with concrete. Studies have been carried out on possibilities of using Glass fibre reinforced polymers, Carbon fibre reinforced polymers and Aramid fibre reinforced polymers to repair and strengthen the concrete specimens. But there are few studies bases on use of Carbon FRP for structural strengthening, hence needs further exploration. The review of the work done by the researchers in last two decades show that a considerable progress has been made in terms of availability of laboratory research and experimental data on the use of Fiber Reinforced Polymer (FRP) in structural repair. But, information of FRP wrapped models that are exposed long term to the atmosphere are still lagging. The effects of FRP retrofitting on large scale specimens should be explored further because there is gap in the knowledge. Most of the models developed and investigated experimentally are established on test results columns and beams which are small-scale so their relevancy to large scale FRP retrofitted rectangular RC columns and beams are still to

be properly authenticate. Cost comparison models for traditional retrofitting using steel jacketing and use of FRP composite for structural repair are still lacking.

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Tough and Biocompatible PVA/Chitosan Modified Fumed Silica Based Nanocomposite Hydrogels for chemotherapeutic delivery in Vitro

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Abstract

Biocompatible nanocomposite hydrogels (NCHs) find a pivotal role in various biomedical applications, especially in regenerative medicine, tissue engineering and drug delivery. Here we report the formulations of biocompatible nanocomposite hydrogels using chitosan (CH), polyvinyl alcohol (PVA), Oleo polyol and fumed silica (SiO_2) via ex-situ free radical polymerization method for drug delivery. The structural, morphological and mechanical analysis were performed by FT-IR spectroscopy, SEM and Rheological techniques. The effect of fumed silica concentration on mechanical strength, swelling ratios, and morphological behavior of hydrogels were studied. The incorporation of SiO_2 nanoparticles significantly improved these properties of nanocomposite hydrogels. The *in-vitro* equilibrium swelling behavior of nanocomposite hydrogelsat pH 4, 7.4 and in physiological solutions was further investigated. The biocompatibility, cytotoxicity and cell viability tests were also conducted by MTT assay of human embryonic kidney (HEK-293) cell line for 48h, which confirmed the non-toxic and biocompatible nature of nanocomposite hydrogels. The sustained released of cisplatin at pH-4 and pH-7.4 was investigated using UV/Vis spectrophotometer, showing highest % release rate for PCB-3 (84.44%) than those of PCBSF-3 (77.30%) and PCBSF-6 (72.86%), at pH -4, after 48h. These studies suggest that these biocompatible nanocomposite hydrogels, have potential scope for their application in drug delivery based anticancer therapy.

Muscle regenerative effects of polydeoxyribonucleotide and microcurrent therapy on muscle atrophy in rabbit model

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Abstract

Background: To investigate the synergic effects of polydeoxyribonucleotide (PDRN) combined with microcurrent therapy (MT) on an atrophied calf muscle in a cast-immobilized rabbit model

Methods: Thirty-two male rabbits at 12 weeks of age were allocated into 4 groups. After 2 weeks cast-immobilization, 4 types of procedures [weekly two injections normal saline 0.2ml injection group 1 (G1-NS); weekly two injections 0.2ml PDRN injection group 2 (G2-PDRN); MT group 3 (G3-MT); and 0.2ml PDRN injection with MT group 4 (G4-PDRN+MT)] were performed at atrophied calf muscle. MT (alternating current, 25µA, 8 Hz, rectangular pulse) was applied 60 minutes daily for 2 weeks (Fig. 1). Calf Circumference (CC), Compound Muscle Action Potential (CMAP) of tibial nerve, and Thickness of Gastrocnemius muscle (TGCM) using ultrasound were evaluated before and after 2 weeks of treatment (Fig. 2). Cross Sectional Area (CSA) of GCM fibers (type I, II and total), Proliferating Cell Nuclear Antigen (PCNA), vascular endothelial growth factor, and Platelet Endothelial Cell Adhesion Molecule-1 (PECAM-1) were measured (Fig. 3).

Results: G4-PDRN+MT (18.3 ± 1.3, 20.0 ± 1.6, $14.3\pm0.5/14.1\pm0.6$) showed significantly lower in the mean atrophic changes of right CC, CMAP, TGCM (medial/lateral) than those in the G1-NS (23.0 ± 1.6, 23.2 ± 1.7, $16.3\pm0.8/15.9\pm0.6$), G2-PDRN (19.3 ± 1.4, 21.9 ± 1.7, $14.8\pm0.9/14.6\pm0.7$) and G3-MT (19.9 ± 1.5, 21.5 ± 1.8, $15.1\pm0.1/14.8\pm0.6$), respectively ($P < 0.05$, Table 1). In addition, the mean CSAs (type I, II & total) of medial and lateral GCM muscle fibers in G4-PDRN+MT (863.73 ± 225.0 µm2, $1,306.06\pm393.5$ µm2, $1,192.61\pm406.6$ µm2/844.94 ± 282.8 µm2, $1,210.06\pm305.5$ µm2, $1,140.79\pm333.5$ µm2) were the larger than those in the G1-NS (287.63 ± 92.6 µm2, 443.09 ± 121.2 µm2, 399.03 ± 133.7 µm2/286.20 ± 159.7 µm2, 420.09 ± 155.6 µm2, 400.73 ± 163.1 µm2), G2-PDRN (633.59 ± 123.2 µm2, 955.08 ± 350.1 µm2, 888.29 ± 342.4 µm2/538.71 ± 162.5 µm2, $1,063.01\pm322.2$ µm2, 973.86 ± 359.8 µm2), G3-MT (505.21 ± 155.4 µm2, 817.67 ± 231.2 µm2, 752.99 ± 251.8 µm2/479.24 ± 107.8 µm2, 784.57 ± 228.7 µm2, 744.19 ± 240.0 µm2), respectively ($P < 0.05$, Table 2).

G4-PDRN+MT (0.386 ± 0.105, 0.489 ± 0.105, $0.493\pm0.075/0.374\pm0.094$, 0.479 ± 0.113, 0.488 ± 0.133) was significantly higher than G1-NS (0.076 ± 0.027, 0.161 ± 0.075, $0.059\pm0.032/0.063\pm0.016$, 0.146 ± 0.055, 0.061 ± 0.039), G2-PDRN (0.217 ± 0.068, 0.282 ± 0.106, $0.280\pm0.073/0.204 \pm 0.039$, 0.301 ± 0.091, 0.293 ± 0.053) and G3-MT (0.179 ± 0.039, 0.264 ± 0.108, $0.265\pm0.089/0.181\pm0.046.$, 0.271 ± 0.062, 0.279 ± 0.066), respectively ($P < 0.05$) in terms of the PCNA, VEGF, and PECAM-1 positive cells ratio of medial and lateral GCM muscle fibers. In G3-MT and G2-PDRN, CC, TG, CMAP, and CSA (type I, II and total) and the ratios of PCNA, VEGF, and PECAM-1 positive cells were significantly greater than those in G1- NS ($p<0.05$, Table 3).

Conclusions: The PDRN injection combined with MT was more effective than PDRN injection, MT, and normal saline injection separately on atrophied calf muscle of the rabbit model.

Keywords : Microcurrent, polydeoxyribonucleotide, atrophy, muscle, cast

Artificial Intelligence Remote Sensing for Open-pit Mining Detection in the Tropical Environment of Indonesia

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Abstract

The purpose of this study is to build an Artificial Intelligence Remote Sensing model for Open-pit Mining Detection in the Tropical Environment of Indonesia. This is done based on the characteristics of the climate and environmental conditions in Indonesia which are humid or tropical and have vegetation. There are various challenges and variations of surface objects in the field that are similar to mining objects, as well as following the development of satellite image classification methods that are currently being developed. In this study, the classification process for Open-pit Mining Detection is carried out by applying the Random Forest (RF) algorithm. The result of accuracy assessment based on the reference availability of SPOT 6/7 data which consists of Procedure Accuracy (PA), User Accuracy (UA), and Overall Accuracy (OA) are 90.41%; 84.21%, and 72.03% respectively.

Keywords : Artificial Intelligence, Remote Sensing, Mining, Tropocal Environment, Indonesia

I. INTRODUCTION

Remote sensing has an important role for the mining sector that has spectral, spatial and temporal capabilities. This can be used to monitor mining activities and changes periodically in large areas, and areas that are difficult to access, so that their utilization can be controlled and measured. Research for detection of mining areas using remote sensing data has been carried out using optical satellite data of medium spatial resolution, especially from hyperspectral sensors such as hyperion and multispectral, namely Landsat-8, ASTER and Sentinel-2 [1,2]. The presence of silicates, carbonates, clay, hydroroxyl and iron oxides minerals can be detected from Visible-Near Infrared (VNIR), Shortwave Infrared (SWIR) and Themal Infrared (TIR) spectral which are the key spectrals for mineral identification from remote sensing satellites [3–6]. Spectrally, VNIR (0.4-1.0 μm) was used to sharpen the presence of iron oxide minerals [5]. Meanwhile, SWIR (1-3 μm) is intended for the detection of AL-OH, Mg-OH, CO3, NH4 and SO4 minerals [5,7], and TIR (7-14 μm) can be used to detect silicates and carbonates [3,5]. The mining area detection method developed from analysis with visual interpretation techniques, namely using the Red Green Blue (RGB) composite satellite imagery with an understanding of the geological structure [8]. The visual interpretation method provides good accuracy, but this method is very subjective depending on the level of interpreter expertise, difficult to standardize, and is not effective for rapid mapping on a large scale. Digital techniques have also been implemented for mining mapping, including the band ratio technique to separate exposed rocks [2,9]. Mixture Tuned Matched Filtering (MTMF) for sub-pixel classification and analysis

focus on target objects [2], Independent Component Analysis (ICA) for transformation separates objects [2,5], and Principal Component Analysis (PCA) to minimize and sharpen target information, especially for the case of mixed pixels, covered with vegetation and there is noise/interference [6,10]. Digital techniques generally require a threshold value for mapping which is a weakness due to differences in location and environment, which will have different threshold values. These weaknesses can be overcome by the Artificial Intelligence method which can integrate several parameters from multi data, multi sensors from satellite imagery quickly and efficiently without complicated formulations. Satellite data can provide good mapping for mining and geological exploration in arid or semi-arid climates where exposed rocks are visible on the surface, but it is still a challenge for humid or tropical climates where mineral deposits are covered by thick vegetation and soil [2]. An alternative way to detect mines in a tropical environment is to pay attention to areas with sparse vegetation with the assumption that if there is a high concentration of metal in the area, vegetation growth will be disrupted. This is the beginning of the key to separating locations that have the potential to contain mining and non-mining minerals. The purpose of this study is to build an Artificial Intelligence Remote Sensing model for Open-pit Mining Detection in the Tropical Environment of Indonesia. This is done based on the characteristics of the climate and environmental conditions in Indonesia which are humid or tropical and have vegetation. There are various challenges and variations of surface objects in the field that are similar to mining objects, as well as following the development of satellite image classification methods that are currently being

developed. This method has never been carried out in previous studies and is an attempt to address the challenges and difficulties in detecting mining areas in tropical humid and vegetated areas. This is a new breakthrough in the remote sensing application community for mining.

II. RESEARCH METHODOLOGY

A. Study area

Study areas for the development of the Artificial Intelligence Remote Sensing model for Open-pit Mining Detection are throughout the Tropical Environment of Indonesia (Fig 1). The development is carried out by creating a learning model for sample set training that can provide machine learning in recognizing patterns, as well as input parameters in detecting various variations of the characteristics of open-pit mining objects in the study area. Furthermore, a running model was conducted for several test case locations that could represent conditions in Sumatra,

Kalimantan, Sulawesi, Java, Bali, NTB and NTT. This area is very suitable for mine mapping case studies, so this location was chosen as a test case location for the implementation of the model.

The annual Sentinel-2 mosaic data in 2021 has been used as the main data in this study by considering its spatial characteristics to be able to detect community mining areas which are generally carried out in small areas (Artisanal and Small-Scale Mining). Several things that can be taken into consideration using Sentinel-2 data are that it has spectral characteristics capable of detecting gold, tin, iron, copper, manganese and nickel in bands 3, 4, 6, 8 and 11, and also 4/8 band ratio for malachite detection [2]. Meanwhile, SPOT 6/7 high resolution data has been used as reference data for visual interpretation in determining learning for sample set training and also for reference in determining accuracy assessment in this study. The data that has been used in this study can be seen in Table 1.

Fig 1. Study area in the tropical environment of Indonesia

B. Data availability

Table 1. The data that have been used in this study

No	Data Type	Description	Data source
1	Multispectral Annual Sentinel-2 optical data in 2021	Multitemporal Free-cloud Level-2 SR	ESA
2	SPOT-6/7 high resolution satellite image data in 2020 - 2021	Reference data for visual interpretation in determining learning for sample set training and reference in determining accuracy assessment	LAPAN

C. arch stages

There are 5 stages of the method in this study (Fig 2) which will be carried out to achieve the research objectives. These stages are used to build an Artificial Intelligence

Remote Sensing model for Open-pit Mining Detection in the Tropical Environment of Indonesia.

Stage-1 teacher learning for sample set training

In the first stage, teacher learning is determined for the sample set of training data. This determination is carried out thoroughly for the Indonesian tropic environment, which can provide machine learning in recognizing patterns, as well as input parameters in detecting various variations of the characteristics of open-pit mining objects. The training set sample for the open-pit mining class was determined randomly, according to the availability of various mining objects in the tropical environment of Indonesia. Meanwhile, the training sample set for the non-open-pit mining class is determined based on the Grid Feature Index (GIF). The GIF with a size of 20 km x 20 km was used to systematically frame samples.

Stage-2 process machine learning classification

In the second stage, a machine learning classification process is carried out based on the input data that was created in the first stage (input layer stacking parameter bands on the Sentinel-2 satellite image and the results of teacher learning sample set training). At this stage, the classification process is carried out by applying the Random Forest (RF) algorithm. It is a digitally supervised classification approach, consisting of a combination of tree classifiers. Each classifier is created using a random vector sampled independently of the input vector. Furthermore, each tree cast will provide calculations on the most dominant class unit to classify certain classes corresponding to the input vector. In detail, the RF classifier formulation is presented in Equation (1).

$$\{h(x, \theta k), k = 1, 2, \dots\}, \tag{1}$$

where h is the result of the random forest classification; x is the input sample; and θk is the random vector sample as a class in the random forest classification [11-13].

Stage-3 post classification

In the third stage, a post classification process is carried out using a Majority Segment-based Filtering (MaSegFil) approach [14]. The process at this stage is carried out to eliminate pixel noise (paper and salt effect) resulting from the classification in the second stage. Thus, the processing results from the post-classification stage that have been carried out can be obtained post-land use land cover classification data.

Stage-4 Re-classification attribute

In the fourth stage, the attribute reclassification process as a result of post land use land cover classification processing is carried out in the third stage. This process is carried out to obtain open-pit mining and non-open-pit mining classes.

Stage-5 Accuracy assessment

The fifth stage is the last stage in determining the results of the open-pit mining classification based on the results of the re-classification in the previous stage. Accuracy assessment is carried out based on available reference data. The available SPOT 6/7 high resolution data having the same recording year were used as reference data. Furthermore, calculations are carried out to get the percentage value of Procedure Accuracy (PA), User Accuracy (UA), and Overall Accuracy (OA).
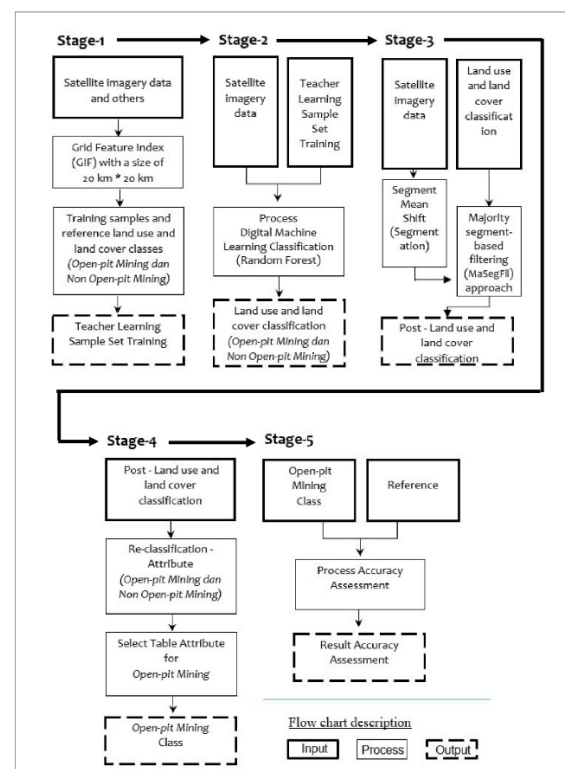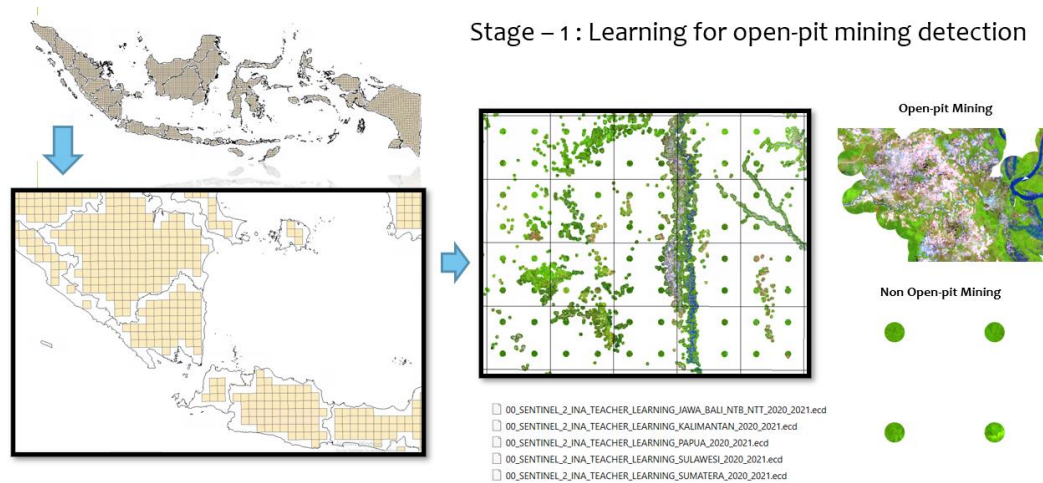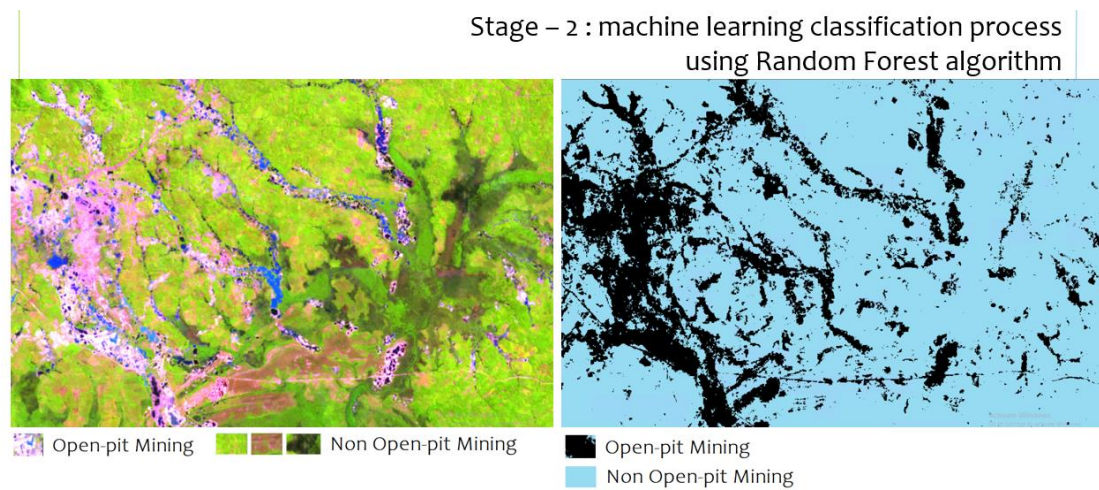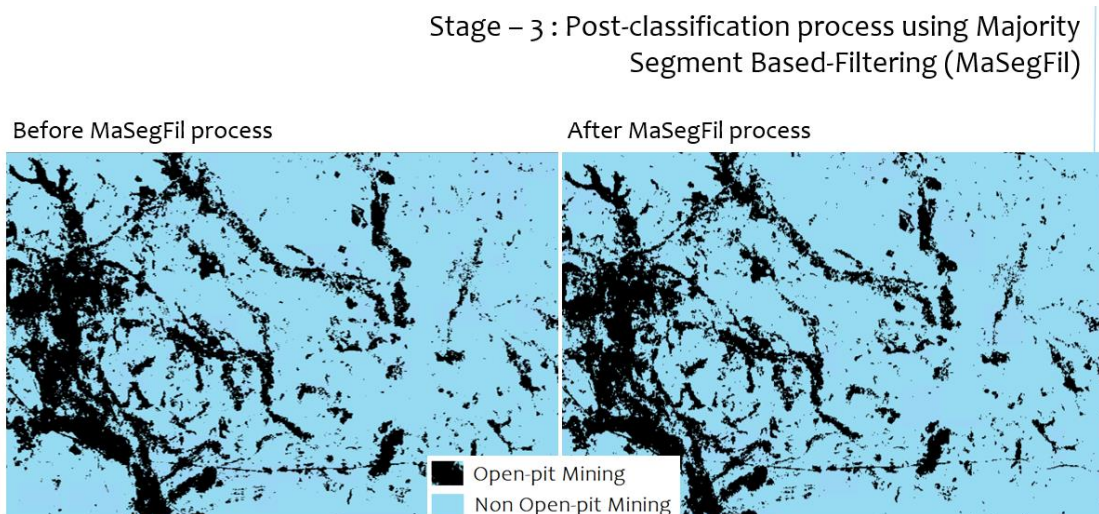

Fig 2. The stages of the method in this study

Fig 3. The result of stage-1 teacher learning for sample set training open-pit mining in the tropical environment of Indonesia

Fig 4. The result of stage-2 machine learning classification process using Random Forest algorithm for detection of open-pit mining and non open-pit mining

Fig 5 The result of stage 3 post-classification using Majority Segment Based-Filtering (MaSegFil)
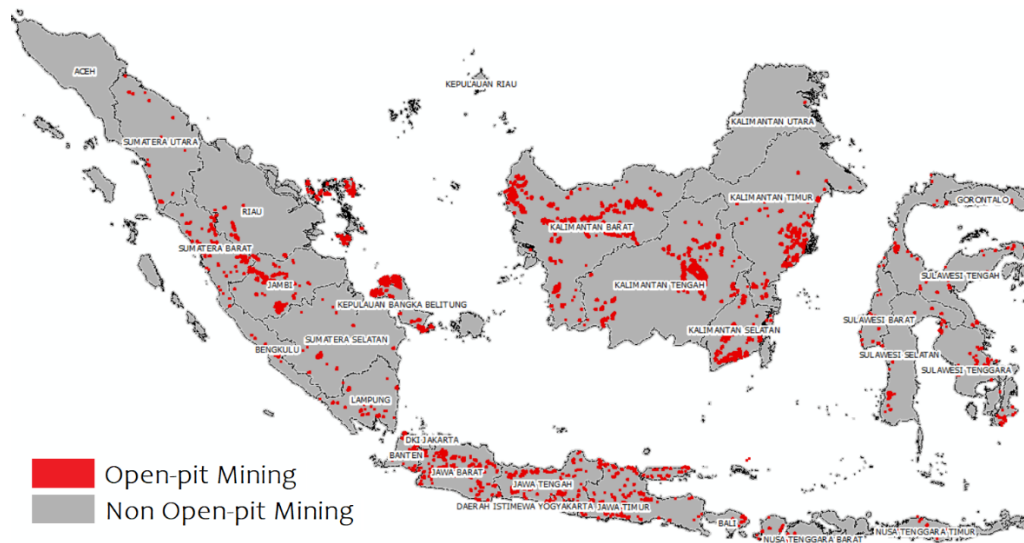
Fig 6 The results of running model was conducted for several test case locations that could represent conditions in Sumatra, Kalimantan, Sulawesi, Java, Bali, NTB and NTT

III. CONCLUSION

The result of training set sample for the open-pit mining class was determined randomly, and the training sample set for the non-open-pit mining class is determined based on the Grid Feature Index (GIF) to systematically frame samples can be presented in Fig 3. The result of machine learning classification process using Random Forest algorithm for detection of open-pit mining and non open-pit mining can be presented in Fig 4. The result of post-classification using Majority Segment Based-Filtering process to eliminate pixel noise resulting from the classification can be presented in Fig 5. The result of running model was conducted for several test case locations that could represent conditions in Sumatra, Kalimantan, Sulawesi, Java, Bali, NTB and NTT can be presented in Fig 6.

The result of accuracy assessment based on the reference availability of SPOT 6/7 data which consists of Procedure Accuracy (PA), User Accuracy (UA), and Overall Accuracy (OA) are 90.41%; 84.21%, and 72.03% respectively. There are limitations to the model in this study, which is used to detect open-pit mining areas based on Sentinel-2 optical remote sensing satellite imagery data. The smallest size of an open-pit mining object that can be detected is 0.1 Ha. This is because the image data used as input is a pixel size of 10 m x 10 m. The use of optical data also has the limitation of not being able to penetrate the cloud. In the condition of an area that is always covered by clouds when recording by satellite, of course it affects the results of the information being non-existent or incomplete.

IV. CONCLUSION

In this research, the Artificial Intelligence Remote Sensing model for Open-pit Mining Detection in the Tropical Environment of Indonesia has been developed. This is done based on the characteristics of the climate and environmental conditions in Indonesia which are humid or tropical and have vegetation. Based on the model created using the Random Forest algorithm, a test case study location has been carried out for the regions of Sumatra, Kalimantan, Java, Bali, NTB and NTT. The results showed that accuracy assessment based on the reference availability of SPOT 6/7 data which consists of Procedure Accuracy (PA), User Accuracy (UA), and Overall Accuracy (OA) are 90.41%; 84.21%, and 72.03% respectively. In future research, it can be done by combining multi-sensors from various optical satellite images, such as Landsat-8, ASTER which can be used as input for the Artificial Intelligence Remote Sensing model for open-pit mining detection. So that the limitations of the research carried out can be resolved, with better assessment accuracy.

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Indian Vehicle Number Plate Detection and Recognition using Deep Learning

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Abstract

The increase in the number of vehicles in the last few years has made it challenging to manually note the number plate text of the vehicle. Hence, in order to reduce the manual work, there is a need to propose a methodology that can detect the number plate region from the input image and recognize the characters of the number plate. Systems have been built for the same using Image Processing techniques, but this technique fails to provide accurate results occasionally in the case of real data. Modern technology such as Deep Learning overcomes this problem. Hence, a deep learning-based methodology is proposed to detect the number plate region from the input image and recognize its characters. Using the Region-based Convolutional Neural Networks (RCNN), the number plate region is detected and using Convolutional Neural Networks (CNN), the characters are recognized from the detected plate region. Once the characters of the number plate are obtained, the system derives the name of the state to which the vehicle belongs, and using the Vahan-info website, the complete details of the vehicle are obtained. The system also stores the number plate text with its state name into the database to maintain a record of number plates detected. The proposed system provides promising results, resulting in an accuracy of 98.46% for RCNN model and an accuracy of 95.98% for CNN model.

Keywords : Deep Learning, RCNN, CNN

I. INTRODUCTION

In recent years, the population of vehicles has been increased drastically which has made it difficult for the authorities to identify the vehicles in case of any violation. The manual approach to identify the vehicles would be arduous and exigent whereas modern technology can resolve it in a convenient manner. The Number Plate Recognition System has turned up to be one of the useful and convenient approaches for vehicle management and surveillance. The Number Plate Recognition System uses the number plate of the vehicle to identify the vehicle and can be used in various domains like traffic monitoring, challan management, detection of stolen vehicles, electronic payment of tolls on highways or bridges, parking lots access control. Addressing the above mentioned subject, a system is built that proposes a number plate detection and recognition system that identifies the vehicle by its number plate. The proposed system would facilitate the authorities to easily manage the vehicles. The proposed system is built using deep learning methodology that detects the number plate of the vehicle using RCNN and the characters of the number plate are recognized using a CNN model that is trained for all 36 characters. Once the number plate characters are obtained, the system derives the name of the state to which the vehicle belongs and provides complete information about the vehicle. The system also stores the number plate text and its state into the database to maintain records of detected number plates.

II. PROPOSED METHODOLOGY

Number Plate Detection and Recognition is carried out with three main aspects; Number Plate Detection, Character Segmentation, and Character Recognition. Figure 1 depicts the flow of solution for the proposed methodology at the simplest level.

Figure 2 depicts the architectural framework for Number Plate Detection and Recognition. It consists of five phases -

Phase 1: Building RCNN Model to Detect Number Plate Phase 2: Number Plate Detection

Phase 3: Character Segmentation

Phase 4: Character Recognition
Phase 5: Save to the database

Building RCNN Model to Detect Number Plate- During phase-1, a Regional based Convolutional Neural Network (RCNN) model is built by applying a Selective search algorithm on each image of the dataset. This algorithm divides the image into 2000 regions, and for each region based on IoU computed, the region is classified into plate or not plate and in this way, a new dataset called use data is generated. Using this newly generated data, the RCNN model is trained. Figure 3 shows the architecture of the RCNN Model.
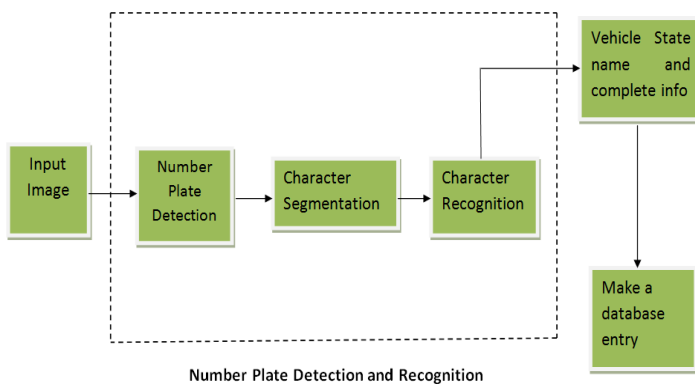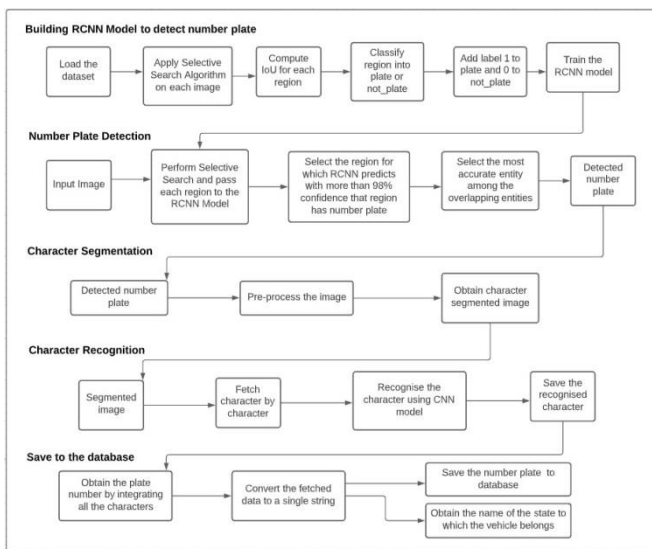
Figure 1: Block Diagram
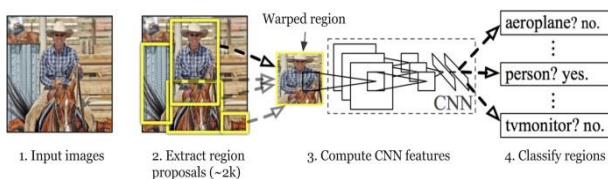

Figure 2: Architectural Framework

Figure 3: Architecture of the RCNN model to detect the number plate

Number Plate Detection- In phase 2, the number plate is detected for the given image. This is done by performing a Selective search algorithm on the image and pass each region to the RCNN model. The model gives a confidence value to each region and all the regions for which the model predicts with more than 98% confidence are selected. Among all the selected regions, the most accurate region is selected by using the non max suppression fast function. And that region is considered as the detected number plate region. Figure 4 gives pictorial

representation of working of the non_max_suppression_function

Figure 4: Working of non_max_suppression_fast_function

Character Segmentation- Character segmentation is an operation that seeks to decompose an image of a sequence of characters into sub-images of individual characters. In phase-3, from the number plate region detected, character segmentation is performed.

Character Recognition- In phase-4, each character from the segmented image is individually served as input to the CNN model. After all the characters are recognized, the number plate text is obtained. Figure 5 shows the architecture of the CNN Model.
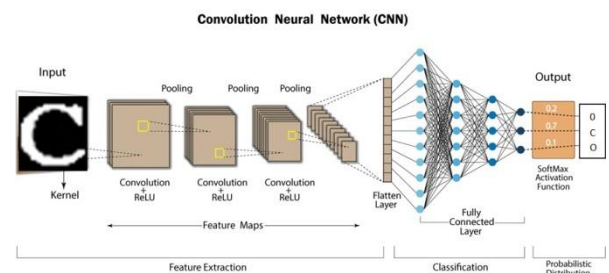

Figure 5: Architecture of the CNN model to recognize characters of number plate

Save to the database- In phase-5, the number plate text is converted to string format, and using the first 2 characters recognized by the CNN model, the state to which the vehicle belongs is obtained. Then the number plate text and the state of the vehicle are stored in the database. In addition, using the number plate text - the detailed information of the vehicle can be obtained via Vahan-Info site.

III. IMPLEMENTATION

The proposed methodology is implemented in a modularized manner, which means that each module is built separately and then combined together.

Building a RCNN model- To build the RCNN model, the newly generated data - use data (described in section II) is used. Every image from use data is labeled as 1 for plate and 0 for not plate. The data is split into two categories - train and test (7:3), using train test split, a function in the Sklearn model. Then a model is built with 6 Convolutional Layers followed by Max Pooling. This model is compiled

with Adam optimizer and binary cross entropy loss function. Then, the model is trained on the training data for 12 epochs.

Number Plate Detection- For the given input image, the selective search algorithm is performed and 2000 region proposals are generated. The number plate is detected by passing each region to the RCNN model. The model predicts the class and gives a confidence value to each region and all the regions for which the model predict as plate region with more than 98% confidence are selected. Among all the selected regions, the most accurate region is selected by using the non max suppression fast function. And that region is considered as the detected number plate region.

Character Segmentation- In this module, on the detected number plate region, character segmentation is performed. To do so, several image processing techniques such as image grayscaling, thresholding, eroding the boundaries, increasing the white region is applied to the image. Then the contours are drawn on each character within the cropped region of the number plate using the findContour function of OpenCV.

Character Recognition- Taking each character of the number plate as an input, character recognition is performed. To do so, a CNN model is built with 4 convolutional layers followed by MaxPooling layers. The model is then compiled with loss function categorical crossentropy and adam optimizer. The model is trained on training data for 25 epochs. Each segmented character is passed to the model and the model predicts the character. All the characters are then combined and the final result is obtained.

Save to the database In this module, using the first two characters of number plate text, the state to which the vehicle belongs is obtained. For this, we have a dataset (the dataset is as per 2021) in CSV for- mat which includes names of all Indian states and union territories along with their abbreviation. Then the number plate text and the state, both are stored in the respective fields of table vehicle number plates created in SQLite3 database. To do so, firstly connect to the the SQLite3 database using the command - *sqlite3.connect('database.db')* and the record is inserted using the insert command *INSERT INTO vehicle plate numbers (plate number, vehicle state) VAL- UES (number plate text, state of the vehicle)* . Further using the Vahan-Info website, giving the plate number as input - detailed information of the vehicle can be obtained. The website is free to use and available in the web.

IV. RESULTS AND ANALYSIS

This section discusses the outcomes of the proposed methodology.

Results obtained for RCNN Model- RCNN Model is built for Number Plate Detection. Following results were obtained by the model.

1) The model achieved an accuracy of 98.46% for 12 epochs.
2) The RCNN model performs well for most of the input images.
3) It also works better when an image has multiple vehicles in it. Figure 6 depicts the same scenario.
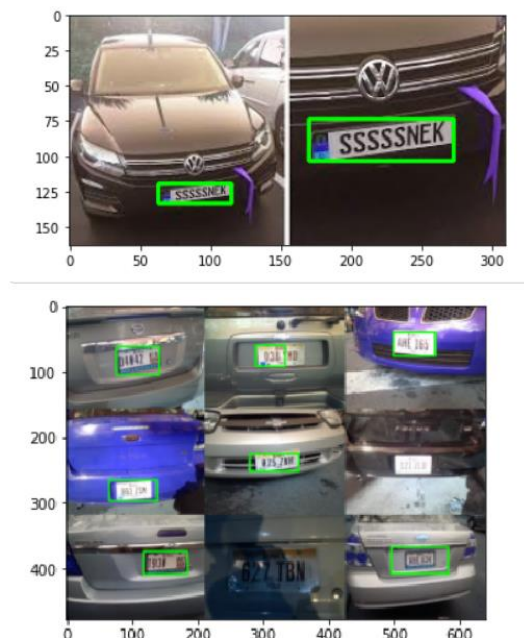
Figure 6: Number Plate Detection for multiple vehicles in same image

Results obtained for CNN Model- CNN Model is built for Recognizing characters of number plate. Following results were obtained by the model.

1) The model achieved an accuracy of 95.98% for 25 epochs.
2) The CNN model performs well for similar charac- ters like 'Z' and '2' and others. Figure 7 depicts the same scenario.

```
In [40]: img = cv2.imread('./dataset2/val/class_Z/class_Z_28.jpg')

         dic = {}
         characters = '0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ'
         for i,c in enumerate(characters):
             dic[i] = c

         img = img.reshape(1,28,28,3) #preparing image for the model
         y_ = our_model.predict_classes(img)[0] #predicting the class
         character = dic[y_]
         print('The character is : ' + character)

         The character is : Z
```

```
In [45]: img = cv2.imread('./dataset2/val/2/class_2_6.jpg')

         dic = {}
         characters = '0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ'
         for i,c in enumerate(characters):
             dic[i] = c

         img = img.reshape(1,28,28,3) #preparing image for the model
         y_ = our_model.predict_classes(img)[0] #predicting the class
         character = dic[y_]
         print('The character is : ' + character)

         The character is : 2
```

Figure 7: Model Performance for similar characters - 'Z' and '2'

Results obtained for a Sample Image The proposed methodology produces the following results for a sample image provided as input.

1) Input Image
   Following figure is a sample input image.

Figure 8: Input image

2) Number Plate Detection
   Applying a selective search algorithm to the input image generates 2000 region proposals for the image. Each region proposal is passed to the RCNN model built. The model classifies whether the region is number plate or not. For the input image provided, the following figure is the output of the RCNN model.

```
In [32]: name='./images/6.jpg'
         number = 6
         extract(name, number)

         Number Plate Detected successfully
```


Figure 9: Number Plate Detection

3) Character Segmentation and Recognition
   Once the region of interest is obtained, charac- ter segmentation is performed. The segmentation seeks to decompose the number plate characters into sub-images of individual characters. Then each character is passed to the CNN model built and the following figure is the **output obtained.**

Number Plate : CH01AN0001
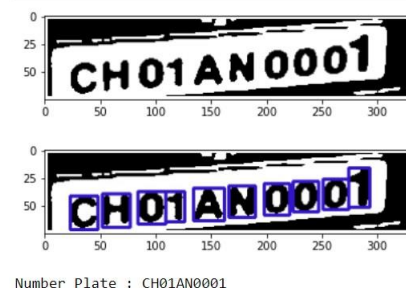
	plate_number	vehicle_state
	Filter	Filter
1	0L8CAF5030	None
2	CH01AN0001	Chandigarh

Figure 10: Character Segmentation and Recognition

4) Obtaining the state of vehicle
   Using the first 2 characters of number plate text, the state of vehicle is obtained.

Figure 11: Finding the state of the vehicle

5) Storing the number plate data and state of the vehicle in database
   To keep a record of vehicles captured, we store the number plate text of the vehicle and its state into the database.

```
a = find_state(text)
vehicle_state.append(a)

CH01AN0001
Chandigarh
```

Figure 12: Store into the database

6) Obtaining detailed information of the vehicle from Vahan info website
   Using the Vahan-info website, the complete details of the vehicle (owner name, fuel type, engine num- ber, and others) can be obtained. The following figure is the snapshot of the same.

Vehicle owner Details of Registration Number		
Registration Number	:	CH01AN0001
Registration Authority	:	
Registration Date	:	
Chassis Number	:	null
Engine Number	:	JF50E78127989
Fuel Type	:	PETROL
Engine Capacity	:	
Model/Model Name	:	
Color	:	
Owner Name	:	HARGOLD CONSULTANCY PVT LTD
Ownership Type	:	
Financer	:	null
Vehicle Class	:	class
Fitness/Regn Upto	:	null
Insurance expiry	:	Invalid date
Vehicle Age	:	null
RTO Code	:	CH01
Vehicle RTO	:	CHANDIGARH

Figure 13: Snapshot from Vahan-Info

V. CONCLUSION

A Novel Method for Indian Vehicle Registration Number Plate Detection and Recognition was carried out using Image Processing Techniques'. In this article, there was a gap that Deep Learning-based approaches provide reliable results on actual data when compared to Image Processing techniques. Upcoming this gap, we proposed a Deep-Learning-based methodology for Number Plate Detection and Recognition. We used Region- based Convolutional Neural Networks for Number Plate Detection and Convolutional Neural Networks for Character Recognition. After recognizing the number plate text, the state and the detailed information of the vehicle are obtained. The record of vehicles detected is also maintained by storing the number plate text of the vehicle and its respective state name into the database. The proposed methodology for Number Plate Detection and Recognition using deep-learning, landed up with an accuracy of 98.46% for the RCNN model and an accuracy of 95.98% for the CNN model, resulting in trustworthy findings. As a result, the proposed methodology finds a solution to the identified gap.

Our methodology includes the dataset having only Indian vehicle images with white background number plates and simplest font style; as a part of our future scope, we can carry out the same methodology/approach for the dataset including the different varieties of the number plate in terms of their font style, background color, and number plate text split into 2 lines (usually seen in two-wheelers).

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