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Kandungan

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Assalamualaikum WBT dan Salam Sejahtera

Salam Bijak Laksana Tuah, Berani Laksana Jebat
dan
Salam Malaysia Madani.

Alhamdulillah, syukur ke hadrat Allah SWT kerana dengan limpah kurnia-Nya, inisiatif penerbitan ini dapat dijayakan. Terlebih dahulu, saya ingin mengucapkan syabas dan tahniah kepada Unit Penyelidikan, Inovasi dan Komersial (UPIK) Politeknik Merlimau (PMM) dan seluruh ahli jawatankuasa yang bertungkus lumus dalam menjayakan penerbitan e-Digest Perkaya Inovasi PMM Edisi 3: Isu 1 ini.

e-Digest Perkaya Inovasi PMM ini merupakan salah satu wadah kepada para pensyarah politeknik bagi memperluas dan memperkembangkan ilmu melalui perkongsian hasil penyelidikan dan inovasi mereka. Budaya penyelidikan dan inovasi ini dapat memberi impak positif daripada pelbagai aspek seterusnya membantu ke arah pemantapan kualiti pendidikan di Politeknik dalam mentransformasi Pendidikan Tinggi Negara.

Tahniah juga diucapkan kepada para pensyarah politeknik yang telah menyumbang idea penulisan sekali gus menjadi *platform* kepada mereka untuk berinteraksi dan berkongsi pengalaman kajian meliputi bidang kejuruteraan, pelancongan dan hospitaliti, perdagangan serta sains sosial. Saya berkeyakinan usaha murni untuk menjayakan penerbitan e-Digest Perkaya Inovasi PMM Edisi 3:Isu 1 akan membantu kita lebih berjaya dan berdaya saing pada masa akan datang.

Akhir sekali saya berharap melalui e-Digest Perkaya Inovasi PMM Edisi 3: Isu 1 ini perkongsian ilmu penyelidikan dan inovasi dapat dimanfaatkan oleh semua pihak ke arah melahirkan komuniti yang berilmu dan bermaklumat.

Sekian, terima kasih.

Lt Kol Norizam bin Sekak
Pengarah
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Assalamualaikum WBT dan Salam Sejahtera

Salam Bijak Laksana Tuah, Berani Laksana Jebat
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Salam Malaysia Madani.

Syukur dengan izinNya, kompilasi penulisan penyelidikan penyelia projek akhir pelajar berjaya diterbitkan dalam e-Digest Perkaya Inovasi Politeknik Merlimau Edisi 3: Isu 1 terbaru bagi tahun 2024. Penerbitan e-Digest Perkaya ini merupakan Edisi ke 3 di mana penerbitan bagi isu 3 ini telah berjaya mengumpulkan sebanyak 15 kertas penyelidikan daripada lima jabatan utama di PMM iaitu Jabatan Kejuruteraan Elektrik, Jabatan Kejuruteraan Awam, Jabatan Kejuruteraan Mekanikal, Jabatan Perdagangan dan Jabatan Pelancongan dan Hospitaliti.

Penerbitan kertas penyelidikan ini adalah berdasarkan kepada pembangunan produk inovasi pelajar semester akhir di jabatan masing-masing yang telah dipertandingkan semasa PERKAYAInovasi Sesi 1 2023/2024. Terima kasih dan tahniah saya ucapkan kepada semua jawatankuasa penerbitan serta penyumbang artikel atas kerjasama yang dijalankan sehingga ia naskah ini berjaya direalisasikan.

Pelan Pembangunan Pendidikan Tinggi mempunyai matlamat untuk meningkatkan kualiti penyelidikan, dan menggalakkan penyelidikan dan inovasi dalam bidang-bidang strategik. Oleh yang demikian, aktiviti pembangunan projek inovasi seterusnya penerbitan kertas penyelidikan merupakan aktiviti penting dalam usaha untuk merealisasikan matlamat Pelan Pembangunan Pendidikan Tinggi ini. Selaras dengan keperluan tersebut, e-Digest PERKAYA INOVASI Politeknik Merlimau ini mensasarkan penerbitannya setiap tahun agar aktiviti penyelidikan, penulisan dan penerbitan menjadi budaya di kalangan warga Politeknik Merlimau khususnya dan warga Jabatan Pendidikan Politeknik dan Kolej Komuniti (JPPKK) amnya.

Melalui penerbitan ini, pembaca akan menemui pelbagai topik penyelidikan dan inovasi yang terdiri daripada penyelidikan sains sosial dan pelbagai cabang ilmu dalam penyelidikan sains fizikal. Setiap artikel mewakili perjalanan penerokaan idea, fasa pembangunan seterusnya pengujian bagi melengkapkan prosedur penyelidikan dan inovasi masing-masing.

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Dr. Aspalilla binti Main

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TRACK 1: INNOVATION PRODUCT DEVELOPMENT

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Design and Development of Smart Mini Portable Ice Cream Machine

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Abstract. This smart mini portable ice cream machine also known as MiMas that is smart and portable mini ice cream machine tailored for Malaysian markets. MiMas emerges as a compact, lightweight, and efficient solution to common challenges in ice cream production. Designed to prevent contamination, increase hygiene practice and streamline the manufacturing process, MiMas incorporates protective features that safeguard ice cream from outdoor air exposure, ensuring cleanliness and hygiene. Moreover, its innovative functionality accelerates ice cream production, boasting a mere 15-minute preparation time. Therefore, the MiMas is the best solution of mini portable ice-cream machine with latest and simple technology for Malaysia ice cream entrepreneur.

Kata Kunci: Portable, Ice cream, mini machine, hygiene, entrepreneur.

1.0 INTRODUCTION

Ice cream is a frozen dessert typically made from dairy products such as cream and milk, combined with sweeteners, flavorings, and often other ingredients such as fruits, nuts, chocolate, or cookies as discussed by Kilara and Chandan (2015). It is churned while freezing to incorporate air and create a smooth and creamy texture. In book written by Arbuckle (2013) say that the basic ingredients in traditional ice cream include cream, milk, sweeteners, flavorings, emulsifiers, stabilizers, and air to increase the ice cream volume, creating a light and airy texture. The mixture is churned in an ice cream maker or machine while slowly freezing. Arslaner and Salik (2020) scientifically described this process helps evenly distribute the air and prevent the formation of large ice crystals, resulting in a creamy texture. Once the desired consistency is achieved, the ice cream is typically transferred to a freezer to harden further before serving. Ice cream comes in a wide variety of flavors and forms, including scoops, bars, sandwiches, and sundaes, making it a popular dessert enjoyed worldwide. Goff et al. (2013) mentioned that the definition of ice creamvaries globally due to differing regulations and traditions of composition, resulting in many formulation variations of ice cream. In previous studies, Dizon (2019) discovered that the impactof ice cream as a marker of social identity, a commodity stemming from the sugar business, and asubject of contention among food enthusiasts has significantly contributed to the dessert's significance in American history.

In Malaysia, one of the most beloved traditional ice creams is known as Malaysian ice cream, which remains a favorite choice among many even today. While modern children may show less interest in this classic treat compared to other commercial ice cream brands available in the market, there are still enthusiasts who appreciate its nostalgic taste. The process of making

Malaysian ice cream typically involves combining ingredients and pouring the mixture into plastic bags, which are then manually tied. However, this manual method raises concerns regarding food hygiene, as it lacks guaranteed sanitation. Additionally, it is time-consuming compared to more automated manufacturing processes. Despite these challenges, the enduring popularity of Malaysian ice cream reflects its enduring cultural significance and unique flavor profile (kitchen flavours, 2011).

Emphasizing cleanliness in food manufacturing processes is paramount to ensure consumer safety and well-being. It is imperative for traders to uphold stringent cleanliness standards to mitigate the risk of foodborne illnesses and other adverse outcomes. In response to this imperative, the 'Mini Malaysia Ice Cream Machine Maker'S' (MiMAS) project was conceived. This innovative machine is equipped with protective measures to safeguard ice cream from external contamination, thereby ensuring heightened cleanliness standards. Furthermore, the MiMAS machine streamlines the process of making Malaysian ice cream, boasting a remarkably quick turnaround time of just 15 minutes. Designed to cater to both small-scale traders and households, this project aims to promote food safety and operational efficiency in the ice cream industry. Rooted in a commitment to industry-leading innovation, the MiMAS project endeavors to collaborate with top minds worldwide, empowering businesses of all sizes to thrive in their respective markets while providing opportunities for sustainable livelihoods for families and small shop owners.

In summary, this machine offers a compact and portable design, ensuring ease of transportation and maneuverability. Its utilization of stainless steel for body parts enhances durability and hygiene. With a powerful 240-volt blender, it efficiently mixes ingredients to create high-quality ice cream. Moreover, its enclosed structure prioritizes hygiene, safeguarding the integrity of the ice cream by preventing contamination. Overall, this machine provides a convenient and reliable solution for ice cream production, catering to both commercial and domestic needs with its practical design and focus on cleanliness.

2.0 LITERATURE REVIEW

Byrd and Dunn (2020) reviewed about the Ice cream's history spans millennia, originating with ancient civilizations like the Chinese and Persians who concocted frozen treats using snow or ice mixed with flavorings. It evolved through the Middle Ages with Arab traders introducing frozen milk desserts to Europe, further refined by Italian and French chefs in the Renaissance. By the 18th century, ice cream reached the American colonies, initially enjoyed by the elite. The 19th century saw industrialization and widespread accessibility with the invention of ice cream churns and refrigeration. Commercialization burgeoned with ice cream parlors and innovations like cones. Today, ice cream continues to thrive globally with a vast array of flavors and variations, reflecting its enduring appeal and cultural significance. The history of ice cream is full of myths and stories, which have little real evidence to support them as mentioned by Clarke (2015). There are some epic debates regarding the evolution of ice cream, but this review will focus even more on how the frozen dessert transformed from a food for the highborn into the widely consumed mass-market product it has become today (Weiss, 2012). Ice cream comes in various types, each offering unique flavors, textures, and ingredients to cater to different tastes and dietary preferences. Traditional ice cream, gelato, sorbet, sherbet, frozen yogurt, soft serve, low-fat options, and artisanal varieties are among the most common types. While traditional ice cream boasts a creamy texture and rich flavor, gelato offers a denser consistency and intense flavors. Sorbet and sherbet provide refreshing fruit-based options, while frozen yogurt appeals to those seeking a tangy, lower-fat alternative. Soft serve is known for its light and fluffy texture, while

low-fat options cater to health-conscious consumers. Artisanal ice cream, crafted in small batches with premium ingredients, offers unique and creative flavor combinations for discerning palates. With such diversity, ice cream continues to delight consumers worldwide, evolving from a luxury treat for the elite into a widely accessible and beloved dessert enjoyed by people of all ages (Whetzel, 2012).

There are several ways to make an ice cream such as traditional method until the modern technique by using the making device or machine. Quinzio (2009) in his book had mentioned that the new freezing technique made it possible for cooks and confectioners to begin experimenting with making ices and ice creams. Vaino et al. (2018), in their findings reveal that the crucial aspects for design success were the students' understanding of the scientific phenomena, the operational principles behind the ice cream making device, and the understanding of the design criteria. Corradi et al. (2018) in their report about a real-world use case composed of more than 12,000 ice cream machines connected worldwide, show how, by anticipating the state of the art, the underlying design of the ICT platform presents many interesting similarities with RAMI 4.0, notably the reference architecture model for Industry 4.0, typically focusing on smart factory environments.

Based on author knowledge, ice cream machines come in various types, ranging from batch freezers suitable for small-scale artisanal production to continuous freezers designed for large-scale industrial manufacturing. Soft serve machines specialize in producing smooth and creamy soft-serve ice cream, while gelato machines are optimized for crafting dense and flavorful Italian-style gelato. Frozen yogurt machines cater to the growing demand for healthier frozen treats, while popsicle machines are ideal for mass-producing ice pops. Each type of machine offers unique features and capabilities to meet the diverse needs of the ice cream industry, from small businesses and restaurants to large-scale production facilities, providing options for creating a wide range of frozen desserts to satisfy consumer preferences worldwide. When comparing types of ice cream machines, there are a few key factors to consider. Firstly, consider the capacity of the machine in terms of how much ice cream it can produce at once. Secondly, assess the power consumption of the machine to understand its energy efficiency.

This literature review findings affirmed that each product possesses unique characteristics and usage methods. The imperative for product improvement lies in enhancing hygiene standards beyond current levels. However, it's acknowledged that every product harbor inherent weakness requiring rectification and enhancement. Furthermore, meticulous selection of components based on quality and attributes significantly contributes to the creation of superior products. The integration of appropriate components is crucial in fostering innovation, particularly beneficial for Polytechnic students. Existing components necessitate refinement to ensure compatibility and optimal functionality of the product."

3.0 METHODOLOGY

Design and development of MiMas unfolds in four distinct stages. Initially, it begins with issuing a query to identify user needs and existing constraints, establishing the primary objectives of the study. This step lays the foundation for concentrated design efforts. The second stage involves thorough research, gathering relevant information from various sources such as previous studies, catalogues, journals, and surveys among individuals with diverse backgrounds and expertise. This comprehensive data collection serves as a reference and benchmark for the design process.

The third stage focuses on shadowing the prototype, fostering brainstorming sessions to generate

multiple solutions based on the accumulated information. All ideas are welcomed without judgment, encouraging creativity and innovation. Lastly, in the fourth stage, meticulous planning ensues as requirements and constraints are reviewed and compared against the best ideas. A solution is selected, and a detailed plan is crafted for implementing the chosen product design effectively. This structured approach ensures that each stage builds upon the preceding one, ultimately leading to the successful development of the MiMas.

MiMas fabrication need careful selection of materials/ components and equipment is crucial, particularly emphasizing the choiceof high-quality materials. The component of fabrication as follows:

i. Stainless Steel - Durability and resistance to corrosion, making it ideal for both the wall and body parts of the machine, ensuring longevity.
ii. Rotating Motor - Enhance the machine's performance at freezing part.
iii. Plug and Play Regulator – Control the voltage of spin motor speeding.
iv. Stainless Steel Pot – Hold the ice cream mold while the freezing process.
v. Zip lock plastic - Convenient storage of Malaysian ice cream.
vi. Salt – lower the freezing point/melting point of the ice -shorten the freeze timing.
vii. Ice Cube – to freeze the ice cream.
viii. Ice Cream Mould – to hold the ice cream while the freezing process.

All these mechanical components are joined by welding technique for good strength as shown in Figure 1.

Figure 1: The MiMas after mechanical joined.

Ice cream moulds are an essential tool for creating delicious and visually appealing homemade ice creams. These moulds come in various shapes and sizes, allowing user to create a wide rangeof frozen treats that can be enjoyed people of all ages. This MiMas use ice cream mould as shown in Figure 2.

Figure 2: MiMas ice cream mould.

The completed MiMas machine then run for serial test in order to review and upgraded overall performance to be maximum performance with good efficiency. The designing of MiMas also considered friendly user handling of one the important factor.

4.0 RESULT AND ANALYSIS

Figure 3 show the final MiMas successfully development. The MiMas also running with function at high efficiency. This MiMas components are made from stainless steel with food grade for foodsafety and hygiene purpose. In one-time MiMas can produced 20 ice creams stick in 15 minutes, thus this is very good for ice cream entrepreneur to gain big profit.

Figure 3: The final MiMas Machine

Figure 4 show the survey results from 102 respondents, it is evident that more than 60% of themstrongly agreed and expressed great interest in the machine. This data is crucial as it confirms the success of the design. Furthermore, considering the machine's affordable price point, estimated to be below RM300.00, MiMAS has also captured the attention of over 90% of the respondents, indicating a high potential for market commercialization.

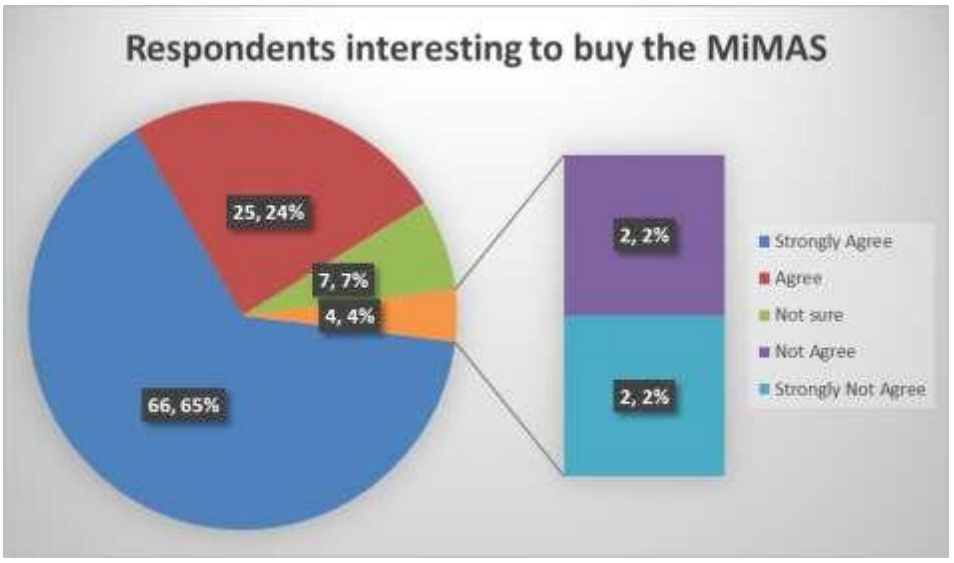

Figure 4: Demand survey of MiMas machine.

5.0 CONCLUSION

As conclusion it can be confidently confirmed that the Smart Mini Portable Ice Cream Machine (MiMas) has been successfully develop and fully function as expected. The MiMAS demonstrated excellent functionality, boasting dual capabilities that enable operation either with electric power or manually, offering versatility without reliance on an electric source. This innovative design hasgarnered significant interest among respondents, indicating a strong potential for commercialization. Further enhancements are necessary to optimize the good looking (aesthetic)and fabrication quality of the MiMAS.

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Bookad Innovation Guide: Empowering Self-Learning for Creative Problem-Solving Using Interactive Flashcards

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Abstract. This study explores the development and implementation of educational tools designed to foster self-learning and enhance creative problem-solving skills. Specifically, it focuses on the creation of interactive guided cards as a medium that supports independent and active learning styles. These cards are integrated with a guidebook, incorporating interactive elements such as QR links, book references, and open-ended questions to stimulate critical thinking, encourage innovation, and facilitate the application of theoretical knowledge to practical scenarios. To evaluate the effectiveness of this prototype, a quasi-experiment was conducted with 66 participants which have been divided into eight groups, utilizing pre- and post-tests as data collection methods. A comprehensive analysis of user feedback and performance metrics demonstrates that the interactive guided cards effectively foster self-learning with a mean increase of 16.52%, further supports the effectiveness of the intervention. The findings indicate significant improvements in participants' creative problem-solving abilities and self-directed learning capabilities. This paper contributes to the growing knowledge on educational innovation, offering practical recommendations for leveraging interactive tools to enhance learning outcomes in creative disciplines.

Keywords: self-learning, flashcard, problem-solving

1.0 INTRODUCTION

In an increasingly digital age, the ability to solve problems creatively is an essential skill that transcends multiple disciplines. These skills need to be cultivated not only for adults, but also for students. For that, education is continuously developed in order to improve problem-solving abilities to find solutions to a problem (Angelica & Novitasari, 2020). As traditional teaching and learning methods struggle to keep pace with the demands of the digital world, there is a growing need to develop innovative approaches that foster self-directed learning and creative thinking. Therefore, the need to diversify learning materials according to student needs is critical (Ishartiwi et al., 2022). Consequently, teachers must have the understanding to design learning materials and deliver lessons with strategies so that students can understand and then achieve the learning objectives.

Material-based learning activities are productive endeavors that require the development of learning materials to support active teaching and learning sessions. Traditionally, educational institutions have relied on textbooks and PowerPoint presentations as teaching aids to implement this strategy. While effective in some contexts, research has shown that PowerPoint presentations often fail to encourage active student engagement (Alizadeh et al., 2021), thus variety of effective educational materials and teaching aids to facilitate and enhance student learning sessions are

needed. There are various learning materials that have been used by educators in learning sessions in addition to textbooks and slide presentations. Simulation models, experimental materials, interactive web platform and flashcards among them. According to Susilaningsih et al., (2019), learning sessions supported with various teaching materials improve student understanding.

The use of flashcards as a teaching aid has been extensively studied by researchers (Khan & Sindi, 2012; Teng & He, 2015; Angelica & Novitasari, 2020; Alizadeh et al., 2021; Zung et al., 2022; Wahyuningtyas et al., 2023). These flashcards are effective tools for self-testing, leveraging active recall and spaced repetition principles to enhance memory retention and learning capabilities. Traditional paper-based flashcards, typically consisting of index cards with information on each side, serve as prompts to aid in recalling summarized information.

Nevertheless, the advent of digital technology has led to the development of interactive flashcards with advanced functionalities, such as multimedia integration and adaptive learning features, which significantly enhance educational outcomes. As a result, the creation of interactive flashcards is increasing in the digital era, surpassing traditional flashcards in usage. These digital flashcards, particularly useful in subjects involving calculations where handwritten input is required, enhance student autonomy for independent learning. The use of flashcards supports the principles of hypertext education and autonomous learning, encouraging students to engage actively with the material, create their own learning resources, and assess their understanding through interactive tests. Incorporating active elements in learning methods, combining physical, verbal, and visual interactions, enhances users' skill levels and reinforces the effectiveness of interactive tools in promoting self-directed learning. Researchers have also adapted flashcards into various forms, including thinking tools cards (Takase et al., 2020), work cards (Sumaryati etal., 2022) and project activity cards (Wahyuningtyas et al., 2023).

Therefore, this research paper aims to examine the effectiveness of traditional interactive flashcards as a self-learning medium for improving problem-solving skills in order to come out with creative solution, despite the recent introduction of digital interactive cards.

This research paper is organised as follows: Section 2 presents published related works, section 3 presents the methodology, while the results and analysis are presented in section4 and finally, section 5 details the conclusion and future work.

2.0 RELATED WORKS

The literature highlights the existing research on the efficacy of traditional and digital interactive flashcards in improving problem-solving skills, focusing on their impact on student engagement and learning outcomes.

Sumaryati et al., (2022) developed flashcards that function as work card through the application of the Creative Problem Solving (CPS) learning model. This work card serves as a tool for teachers to present cases that students must solve. In order to enhance the problem-solving skill towards the student, the work card is designed according to the creative problem-solving process of which includes problem clarification, idea generation, evaluation and selection, and implementation. Furthermore, the work card is designed attractively to engage students and enhance their participation in learning. CPS significantly improves the problem-solving skills of accounting class students, especially in the topic of giro savings. This conclusion is drawn from the observed

improvement in problem-solving abilities across different indicators: understanding problems, planning solutions, executing plans, and reviewing the results of their work.

Takase et al., (2020) improved teaching methods for analyzing situations and defining ideals through the development of a set of 10 cards. These cards have proven effective in enhancing creative problem-solving (CPS) skills in programming education by helping students analyze problems and bridge the gap between ideals and reality, thereby improving their focus on ideals. The research emphasizes the importance of clarifying ideals in CPS learning and suggests the need for tools specifically designed to clarify reality. Additionally, the study highlights the significance of incorporating new ideas and procedures in programming education, advocating for designs that support discussions and goal-setting to boost problem-solving and creative thinking skills among students. This system is expected to provide long-term guidance.

Wahyuningtyas et al., (2023) utilized the implementation of flashcards as the tools for project-based learning in plane figure material. This study contributes by exploring the effectiveness of project-based learning assisted by flashcard media in improving problem-solving abilities among primary school students as its positive effects on students. It involves students selecting and creating a picture from a flashcard using folded paper shapes. They plan and schedule the steps with the teacher's guidance, complete the project with teacher support, present their work to the class, and then have their projects evaluated by the teacher for accuracy and adherence to instructions. This approach facilitates a better understanding of material concepts, increases students' interest in learning, and encourages active participation in answering questions, thereby improving problem-solving skills.

Nursiami & Soeprodjo (2016) highlighted the importance of learning material in conveying the information to the students. Ineffective communication can make it difficult for students to understand the teacher's message, whereas effective and efficient communication can help achieve more learning goals. Media plays a crucial role in this process, and the interactive flash learning model can serve as an effective medium for communication. Therefore, the researchers implemented the Creative Problem Solving (CPS) learning model with interactive flashcards in educational settings. They focused on developing interactive flashcards that give users full control, fostering an interactive relationship between the user and the program content. The study found that interactive tools can engage students more effectively, making the learning process more dynamic and interactive. The study demonstrated that utilizing this model with the aid of interactive flashcard can enhance problem-solving skills and creativity among students.

Sage et al., (2016) focus on how self-control over learning pace helps students effectively extract information from flashcard learning aids. Past research indicates that too much control can be overwhelming, while too little can be ineffective. In the popular self-testing domain of flashcards, they compared learning outcomes between paper and digital flashcards. Their findings show that both traditional (paper) and digital flashcards are effective in facilitating learning. This suggests that both mediums have their merits and can be chosen by students based on individual preferences and needs.

These research studies emphasis how interactive flashcards can help improve problem-solving abilities while also promoting self-learning. The Creative Problem Solving (CPS) paradigm (Sumaryati et al., 2022) uses flashcards to help students solve problems in an organised way while enhancing their comprehension and self-management skills. Takase et al., (2020) have developed tools in programming education that allow students bridge the gap between theory and practical application on their own, thereby supporting self-learning. In project-based learning, the use of

flashcards (Wahyuningtyas et al., 2023) encourages students to develop, carry out, and present projects with little to no direct supervision, which promotes self-learning. Interactive flashcards that provide effective communication improve self-learning by making the learning process more dynamic and engaging (Nursiami & Soeprodjo, 2016). Furthermore, according to Sage et al., (2016), flashcards—which may be used digitally or on paper—offer adaptable learning tools that let students set their own pace for learning, meet their own needs, and encourage independent study. Taken together, these studies highlight how flashcards help students take control of their education.

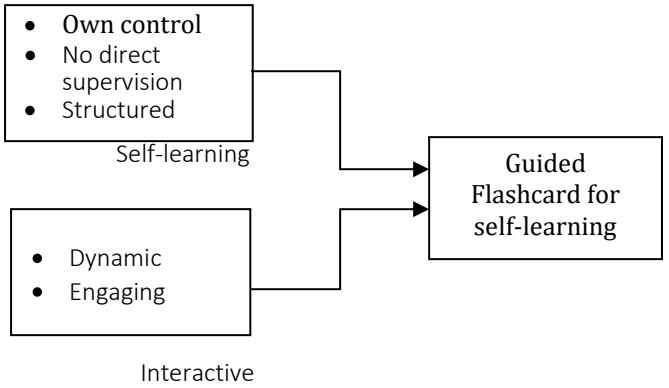

Figure 1: Guided Flashcard Conceptual Framework for Enhancing Problem-Solving Skills and Self-Learning

3.0 MATERIAL AND METHOD

This research employs a quantitative approach with an experimental method. In experimental research, the researcher can manipulate conditions by providing a treatment or creating a condition or stimulus for the subjects being studied. The aim of this study is to determine whether self-learning with the aid of guided flashcard media affects the creative problem-solving abilities among innovation workshop participants. A quasi-experimental design is used, wherein participants receive treatment in the form of self-enrichment learning with guided flashcards in developing the creative solution for a problem that has been identified. Before and after the treatment, participants are given tests consisting of multiple-choice questions at two levels.

3.1 Flashcard Design

The flashcard design for this study meets the principles of effective learning materials and innovative pedagogical approaches highlighted in the literature. Based on the literature on interactive flashcards and their potential to enhance self-directed learning and problem-solving skills, this design aims to create an engaging and informative learning aid for individuals who wish to learn structured problem-solving. According to the conceptual framework in Figure 1.0, the Bookad Innovation Guide is designed as follows:

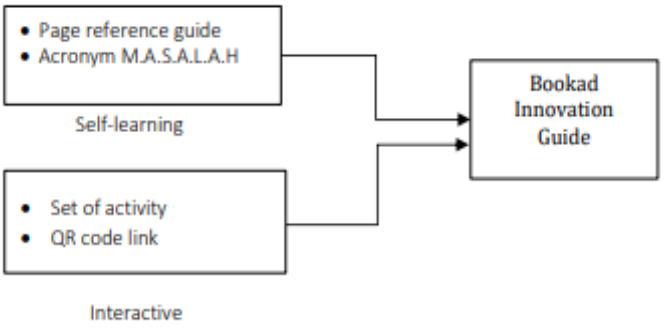

Figure 2: Bookad Innovation Guide Design

The flashcard design for this study is structured to support both self-learning and interactivity, adhering to the principles of effective educational tools. As depicted in the figure, the Bookad Innovation Guide integrates two main components: self-learning elements and interactive features. For the self-learning components, each flashcard includes a page reference guide to help students navigate through the learning material systematically, ensuring easy access and connection to related information for better comprehension and retention. Additionally, the acronym M.A.S.A.L.A.H is employed as a mnemonic device to aid in the structured problem-solving process, with each letter representing a step or concept in problem-solving to facilitate recall and application.

The interactive features of the flashcards are designed to engage readers actively. Each card includes a set of activities tailored to reinforce problem-solving concepts and encourage practical application, thereby enhancing readers' understanding and skills. Furthermore, each flashcard incorporates a QR code link that directs students to additional resources, interactive content, or supplementary exercises, providing a more dynamic and enriched learning experience. This combination of self-learning and interactive elements aims to create a comprehensive educational tool, leveraging contemporary pedagogical approaches to foster creative problem-solving skills and self-directed learning, ultimately enhancing the overall educational experience for students.

3.2 Research Design

This research employs a quantitative experimental approach to investigate the impact of flashcard media as a self-learning tool on problem-solving abilities. Adapting the action research method, this study follows five steps: planning, action, observation, and reflection, as outlined bySumaryati et al. (2022). Based on the principle of action research, the sample size can be selected based on the targeted sample that needs to be subjected to action, ie tervention. Therefore, the sample consists of 66 participants from an Innovation Workshop, selected to assess the effect of the intervention. During the intervention, participants will apply problem-solving steps to find creative solutions using flashcards. Observations will be conducted throughout the process to monitor and evaluate the effectiveness of the flashcard medium.

Participants were subjected to pre- and post-tests to measure the changes in their problem-solving skills before and after the intervention. The tests consisted of 2 tier-choice questions designed to assess the participants' problem-solving abilities. The comparison of pre- and post-test results aimed to identify any significant improvements in the experimental group after the

intervention, thereby evaluating the effectiveness of the flashcard as the medium in enhancing problem-solving skills among Innovation Workshop participants.

4.0 RESULT AND ANALYSIS

The following section presents the results and analysis of the study, focusing on the impact of flashcard media on the creative problem-solving abilities of Innovation Workshop participants. During intervention, the experimental group, which received the flashcard- treatment were compared their test result to evaluate any significant differences in their problem-solving skills. In addition, the group was observed whether they succeeded in producing a creative solution based on the problem that had been identified during the problem-solving process.

This section provides a detailed examination of the data collected, including statistical analyses to determine the effectiveness of the flashcard.

4.1 Bookad Innovation Guide Prototype as a Self-Learning Medium

The structural concept on the card shows step-by-step problem solving using the acronym MASALAH as shown in Figure 3. The design process prioritized clarity, simplicity, and visual appeal to ensure the effectiveness of flashcards as a learning aid. Each card displays a clear picture of the problem-solving process so that the process of creatively generating problem-solving ideas is accompanied by concise and comprehensive information.

Figure 3: Acronym M.A.S.A.L.A.H shows step-by-step problem-solving process

Figure 4: Page reference guide in the right corner of each card

In addition, the flashcards are structured to help readers systematically navigate the learning material by including a page reference guide in the right corner of each card, as shown in Figure 4. This guide ensures easy access to related information, enhancing comprehension and retention. It encourages readers to control their learning pace and promotes autonomy for self-exploration, thereby supporting self-directed learning.

Interactive elements such as Figure 5 shows the reflection questions designed to reinforce problem-solving concepts and encourage practical application, thereby enhancing readers' understanding and skills, while QR links have been strategically integrated into the design to encourage individual engagement during the learning process.

Figure 5: Reflection question to encourage practical application

Figure 6: QR links to encourage individual engagement

Overall, the flashcard design for this study is in line with the theoretical framework of interactive learning tools and aims to provide an effective and engaging platform for readers to improve their understanding of problem-solving skills in an interactive and self-directed manner.

4.2 Empowering Self-Learning for Creative Problem-Solving

The study aimed to assess the impact of flashcard as a self-learning media on problem-solving abilities among Innovation Workshop participants. The analyses were presented in Table 1.

Table 1 : Pre-test and post-test analyses

Statistic	Pre-Test(%)	Post-Test (%)	Difference (%)
Count	66	66	66
Mean (%)	59.09	75.61	16.52
Standard Deviation (%)	9.07	11.11	10.88

The results indicate a significant improvement in problem-solving abilities following the intervention with flashcard-assisted project-based learning. The mean post-test score (75.61%) is notably higher than the mean pre-test score (59.09%), suggesting that the use of flashcards effectively enhanced the participants' problem-solving skills. The difference in scores, with a mean increase of 16.52%, further supports the effectiveness of the intervention.

The standard deviation of the post-test scores (11.11%) is higher than that of the pre-test scores (9.07%), indicating a wider range of performance outcomes post-intervention. This variability could be due to differences in how individuals interacted with and benefited from the flashcard-based learning. In addition, based on the observations that have been made, eight groups consisting of 66 participants managed to produce eight creative solutions for the problems that have been identified.

Overall, the findings demonstrate that the flashcard media positively influences problem-solving abilities, as evidenced by the substantial improvement in test scores and the output of creative solutions. The interactive and self-directed nature of the flashcards likely contributed to this enhanced learning outcome, aligning with the principles of effective educational tools highlighted in the literature.

The study underscores the effectiveness of flashcards, particularly interactive ones, in bolstering problem-solving skills and fostering self-directed learning, aligning with prior research. Sumaryati et al. (2022) and Takase et al. (2020) demonstrated how structured flashcards, tailored for Creative Problem Solving (CPS), significantly enhanced students' problem-solving abilities. These findings were echoed in the current study, which noted substantial improvements in participants' problem-solving skills in an innovation workshop setting. Moreover, Wahyuningtyas et al. (2023) and Nursiami & Soeprodjo (2016) highlighted the value of flashcards in project-based learning and effective communication, respectively, further supporting the efficacy of interactive flashcards in facilitating comprehension and engagement. The study's use of traditional flashcards, as advocated by Sage et al. (2016), reaffirms their enduring relevance and effectiveness in the digital age, offering flexibility and personalized learning experiences.

In conclusion, the study reinforces the utility of interactive flashcards as a versatile educational tool for enhancing problem-solving skills and promoting self-learning. Its findings, consistent with existing literature, validate the effectiveness of flashcards across diverse educational settings, emphasizing their role in fostering student engagement and improving learning outcomes. This reaffirms the enduring value of flashcards as a dynamic means of facilitating comprehension, retention, and application of problem-solving processes.

5.0 CONCLUSION

In conclusion, our study underscores the enduring effectiveness of interactive flashcards as a versatile educational tool for enhancing problem-solving skills and promoting self-directed learning. Our research contributes to the growing body of evidence supporting the efficacy of flashcards in enhancing problem-solving abilities. By incorporating interactive elements, clear instructions, and visual appeal, flashcards serve as dynamic aids that cater to individual learning needs and preferences. Moreover, our study reaffirms the enduring relevance of traditional flashcards in the digital age, emphasizing their flexibility and adaptability in diverse learning environments.

Overall, the results of our study underline the importance of integrating interactive flashcards into educational practices to foster active engagement and facilitate deeper learning experiences. As educators continue to seek innovative approaches to enhance student learning, interactive flashcards emerge as a valuable tool for promoting critical thinking, creativity, and self-directed learning skills essential for success in the modern world.

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The Study of Used Facemask and Dried Leaves InBricks Manufacturing

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Abstract. Since the outbreak of the covid-19 epidemic, every country has made it mandatory for everyone to wear a face mask in open and closed areas frequented by a large number of people. This is causing it tohappen, the disposal of face masks is increasing and has even become a problem in landfills. So, there is a solution that can alleviate the problem, which is to use the face mask as an additional material in brick making. Not only that, but it can help to reduce the impact of bulk face mask dispose at landfill. This project has collaborate on the creation of bricks using additional materials such as used face mask and dried leaves. Dried leaves is a garden waste that can be found anywhere at our surrounding. So, this study would innovated on reducing waste of face masks and dried leaves while also minimize landfill costing. This study has focused to apply the used face mask and dried leaves into brick making. Several tests to test the strength and integrity of the brick, namely the compressive test using a brick ratio of 1:6, which one is cement or also known as fine aggregate and six is sand. It have been conducted to test the effectiveness inbrick manufacturing. Dried leaves additional material percentage are 5%, 10%, and 15% while used face masks are 3%, 6% and 9%. Both tests will be performed when the brick reaches 7 days, 14 days, and 28 days of age. As a result, this new project innovation will ensure that this brick will give goods fulfil development criteria and that it can also be a green building index that is environmentally beneficial. Thebrick with 6% used face mask and 10% dried leaves has a remarkable compressive strength result and performed in good performance in others test.

Keywords: face mask, dried leaves, brick, waste material, landfill, compressive strength test and water absorption test.

1.0 INTRODUCTION

1.1 Bricks Manufacturing

One of the most important materials in the construction industry is brick. The traditional methodof producing bricks has unmistakable flaws (V.Anandabaskaran and Dr.G.Vijayakumar, 2016). Concrete block construction has grown in popularity and is now a viable alternative to fired clay bricks. Cement, aggregate (sand and gravel), and water are the three basic components of concrete. Concrete blocks come in a wide range of shapes and sizes. They can be made manually or with the assistance of machines (Skat, Vadianstrasse, 2017). Brick is a building material that isused to create walls, pavements, and other masonry elements (Mebrahtom Teklehaimanot, 2021).

1.2 Used Face mask

The knowledge that the use of face masks delays the SARS-CoV-2 transmission is rapidly gaining popularity in the general population (Christiane Matuschek, 2020). The increase in production

and consumption of face mask across the world has given rise to a new environmental challenge, adding to the vast plastic and plastic particle waste in the environment. Some of these materials are getting into waterways from where they reach the freshwater and marine environment adding to the presence of plastics in the aquatic medium (Mar Pollut Bull. 2020). Plastics are not biodegradable in the natural world. As a result, the disposal of plastics causes issues for both the environment and human life. Plastic waste is being researched for use as an additive in Civil Engineering applications such as roads. Reengineered or recycled plastics are used to solve solid waste management issues. This research was primarily concerned with the effective use of waste plastics in the manufacture of bricks in order to avoid the ecological and environmental problems that they cause (M Jayaram et. al., 2021).

1.3 Dried Leaves

The manufacturing of bricks using dried leaves is an eco-friendly and sustainable alternative to traditional brick production methods that use non-renewable resources such as clay and fossil fuels. This method involves using dried leaves mixed with soil and water to create a composite material that can be molded into bricks and then dried in the sun. According to a study published in the Journal of Cleaner Production, the use of dried leaves in brick production can reduce the environmental impact of the manufacturing process by up to 50% compared to traditional methods (Ghavami et al., 2018).
This study looks into ways to reduce the disposal of used face masks in landfills as additional material in brick. Because of an epidemic known as the coronavirus, which can cause pollution to our environment, the disposal of used face masks has increased. In this study, used face masks were collected from Polytechnic Sultan Idris Shah students, while dried leaves was obtained from backyard from Polytechnic Sultan Idris Shah. These two materials will be used in the manufacture of bricks. The ability of facemask and dried leaves in brick manufacturing can provide us with additional benefits, such as the ability to save our environment. Hence, the objectives of this study are:

i. To study used face mask and dried leaves as a brick manufacturing.
ii. To identify that dried leaves may also can be used for other things, so that we can avoid the burning of dried leaves.

2.0 PREVIOUS RESEARCH

In order to fight waste disposal issues, an increasing number of communities have adopted resource reduction, trash recycling, or waste resource recovery (Barbieri et al, 2000). Many studies have been conducted recently to identify environmentally appropriate alternatives to solid waste as a cheap resource for construction (Alaa . A Shakir et al, 2013). Brick's employment in architectural applications is favoured in addition to its technical benefits due to the material's aesthetic charms (Ed Edwards,). There are many types of bricks out there but as we want to recycle and recovery of our waste, now have many ways to do that such as reuse the waste into new thing or innovation. This research turn masses of plastic waste that would have otherwise gone to landfills into bricks that are stronger, more affordable, and lighter than concrete while still being environmentally benign. This bricks which comes from used face mask and dried leaf combined with sand and heated to a high temperature, creating sludge that is subsequently moulded into blocks. This eco brick or better known as hybrid brick is a building bricks made from used face mask for use in building and construction. It was an outcome to recycle all used face mask because process recycle all plastic is technically complicated which makes the cost for collecting separated plastic and recycling high (for most countries too high).

This study significance is comply to the reoason of: for each brick helps rid the world of discarded plastic and is cheaper and more fuel efficient to manufacture than conventional bricks. It's also less energy intensive than recycling the used face mask into other forms. In present circumstances, the concentration on sustainable development in every sector of our daily life. Only an innovative and creative approach can fulfil this mission. Many research studies have believed that an increase in pollution growth can only be controlled by reusing and recycling waste efficiently and effectively. So, here comes the idea of using waste materials for making "Eco-friendly Bricks", which is one of the most primary materials for building construction.

Furthermore, Table 1 presents the previous study on used face mask and bottom ash that contribute to this project.

Table 1: Previous Study on Used Face Mask and Bottom Ash

Author	Parential citation	Narative excerpt
Mar Pollut Bull	Polymers used to make disposable face masks (single use face masks) include polypropylene, polyurethane, polyacrylonitrile, polystyrene, polycarbonate, polyethylene, and polyester. They are made up of three layers: an inner (soft fiber) layer, a middle (melt-blown filter), and an outer layer (nonwoven fibers, which are water-resistant and usually colored). The melt-blown filter is the primary filtering layer of the mask produced by conventional micro- and nanofiber fabrication, in which melted polymer is extruded through tiny nozzles with high-speed blowing gas.	Mar Pollut Bull (Oct 2020), Surgical face mask as a potential sources for microplastic pollution in the COVID-19 scenario. National Library of Medicine, National Center for Biotechnology Information
Navjit Gaurav	The release of black Carbon as an outcome of burning dry leaves according to ICIMOD's research can have a direct effect on health (Nazareth, 2015). This black carbon infuses in the atmospheric air as ultrafine particles smaller than 2.5 micrometers called PM 2.5 and this can enter deep into people's lungs and has profound effects on the lungs. The world health organization has recently reorganized black carbon as a carcinogen. why do we leave ourselves open to smoke and the burning of leaves and garbage? What is needed is to spread awareness to make citizen more responsible and participating towards reusing and recycling the dry leaves. There is always a sustainable method to get rid of leaves and burning them is definitely not one of them (Nazareth, 2015).	Navjit Gaurav,(October 2018), Environmental Pollution and Recycling of Dry Leaves.
Sahu and behera	The compressive strength and water absorption properties of the dried leaf bricks were comparable to those of	Sahu, P. K., & Behera, A. K. (2016). Performance evaluation of fired clay

	traditional bricks. Another study published in the International Journal of Engineering Research and General Science found that dried leaf bricks had a higher thermal insulation capacity than traditional bricks, which could lead to significant energy savings in buildings constructed with this material	bricks with partial replacement of clay using waste materials. International Journal of Engineering Research and General Science, 4(1), 268-275.
Dr. Subramanian Narayanan	If you specify 1:3:6, the volume is followed. Note that M10 is defined as having a 10MPa strength for a 28-day period. Concrete volume mixtures up to M20 are acceptable, while mixes over M20 must be weight-based. In the past, only physical strength was valued. Then people understood the need of endurance in addition to strength. As a result, different surroundings now have specific intensities and mixtures. M10, on the other hand, is not structural concrete, therefore any volume or weight ratio is highlighted. Additionally, nominal mixtures like 1:3:6, 1:2:4, and others can always be used to achieve higher strength.	Dr. Subramanian Naranayan, Former Chief Executive at Computer Design Consultants (1982–2008), Is the ratio 1:3:6 for m10 grade concrete by volume or by weight.
Elvis Genbo Xu and Zhiyong Jason Ren	It is critical to identify this possible environmental concern and stop it from becoming the next plastic issue in light of the growing reports of improper mask disposal. The fact that the masks are made entirely of microsized plastic fibres with a thickness of between one and ten micrometres is a more recent and serious worry. The mask may break down in the environment more quickly and easily than bulk plastics like plastic bags, releasing more micro-sized plastics. A new generation of masks called nanomasks, which directly use nano-sized plastic fibres with a diameter less than 1 micrometre and add a new source of nanoplastic pollution, have the potential to make such effects worse.	Elvis Genbo Xu, Zhiyong Jason Ren (March 2021)Frontiers of Environmental Science & Engineering, Preventing masks from becoming the next plastic problem.
Tim Chan	N95 and KN95 masks are both made of multiple layers of synthetic material (typically a polypropylene plastic polymer) and are worn over the mouth and nose. Both masks must filter out and capture 95 percent of the airborne particles as small as 0.3 microns.	Tim Chan (July 2022), N95 Masks vs. KN95 Masks: Which Work Best to Protect Against Covid?. Editor's Lifestyle and Market.

3.0 METHODOLOGY

A work process of the brick-making procedure is discussed in this section. Each phase of the brick-making process is described in this section. Furthermore, certain approaches for obtaining comparative results of the level of water absorption on brick samples are being investigated. Another method

investigated was the comparison of the original brick's durability level with three types of brick samples created accordingto a number of various ratios. Sustainable practices, such as the effective use of energy and resources, recycling and reuse of waste materials, and minimizing environmental impact, are becoming increasinglyimportant throughout the brick manufacturing process.

3.1 Collect Material

Alternative materials such as used face masks and dried leaves are selected as additional materials in brick making. The collection of used face masks is done at the Sultan Idris Shah Polytechnic by providing plastic for the collection of used face masks in each block. While at the Civil Engineering Department office, a box has been prepared in front of the office door, and a used face mask collection box has also been prepared in front of the Environmental Engineering Laboratory (DAS). These used face masks have been collecting every weekend. In addition, the collection of dry leaves is done at Sultan Idris Shah Polytechnic by taking dry leaves from polytechnic areas.

3.2 Prepare The Sample

The primary materials utilised, such as facemasks, require particular preparation, which includes pre-treatment with bleach and ethanol. This pre-treatment is used to eliminate chemicals and toxic waste from each layer of the facemask. While the dried leaves have been burned using a muffle furnace, the leaves are burned for 5 minutes at a temperature of 215 °C. The objective of burning leaves is to speed up the process of crumpling them into smaller pieces so it's easy to put into mixture of bricks.

a. Prepare sample of brick

Blank sample have been made and will be compared to the sample that used the face mask and bottom ash. Furthermore, use a 1:6 ratio to set the brick grade standard, which is grade m10 (1 cement and 6 aggregate and water). Gred m10 brick dimensions are 215mm x 100mm x 65mm. Each sample contains adifferent percentages of used face mask are 3%, 6% and 95 and dried leaves 5%, 10% and 15%, which is replaced in the ratio aggregates.

b. Test Sample: Water Absorption

After the bricks have dried, the reading of the weight of the brick before and after 24 hours of soaking brick samples must be recorded in this test method. If there is still lingering water on top, the drying process begins after 24 hours and it must be wiped. Prior to reading the weight of the brick sample once it has been recorded. Heavy reading of the brick sample before recording as M1, and weight reading of the brick sample after recording as M2. The equation of % water absorption is shown in equation 1:

$$\%\ of\ water\ absorption = \frac{(M2-M1)}{M1} \times 100 \qquad (1)$$

c. Compressive Strength

This test is performed following the brick drying process, which comprises three phases: 7 days, 14 days,

Example: 1) 123.44KN x 1000 = 123 440 N

$$\frac{N}{A} = \frac{123\,440}{215\,000} = 0.574\ N/mm^2$$

2)133.90KN X 1000 = 133 900 N

$$\frac{N}{A} = \frac{133\,900}{215\,000} = 0.623\ N/mm^2$$

and 28 days. A compressive strength machine is used to perform the compressive strength test. The goal of this test is to determine the strength of the brick sample under pressure. The example of compressive strangth is shown as in the following:

4.0 RESULTS AND DISCUSSION

Results and observations from the water absorption test and the compressive strength test has been reviewed. The results will then be compared to the M10 brick standard as a consequence of the tests that have been performed. According to the results, the best brick ratio has been established based on the tests that have been performed. Various ratio values twill be discovered in this research. The goal is to determine which ratio is the best and how successful it is when additional materials such as face masks and dry leaves are added to the brick-making process. To facilitate comprehension, results and observations are presented in the form of graphs and explanations.

4.1 Water Absorption Test Result

The first test was carried out on water absorption test. The strength of brick depends on its water capacity. The water absorption is used for the presence of voids in the bricks. If the brick has more voids, it will absorb more water and reduce the load carrying capacity. As for this study, used facemasks and dried leaves were used in brick manufacturing. Hence, the bricks were tested to determine their water absorption capacity before using it for construction. The results indicate about water absorption over 3 type ratio of used facemask and dried leaves into brick manufacturing. The results are observed for 7 days, 14 days and 28 days. From this result, it shows how much moisture of a specific type of tile is likely to absorb on an ongoing basis. Some types of tiles may crack if the moisture penetration is too high. It is because of the surface of dried leaves and facemask that absorb water made brick of ratio 3% of used facemask and 5% of dried leaves have a little amount of water absorption. As for days, the more day that brick has taken for dry, made it more percentage of water absorption. Which is for 7 days, it absorbs 10.6%, for 14 days absorbs 11.3% and for 28 days absorbs 11.1%.

Table 2: Data for Water Absorption

Water Absorption Test	Control Mix(%)	3% of UFM and5% of Dried Leaves (%)	6% of UFM and 10% of Dried Leaves (%)	9% of UFM and 15% of Dried Leaves (%)
7 days	12.1	10.6	10.2	9.4
14 days	11.7	11.3	10.8	9.2
28 days	12.6	11.1	10.3	8.9

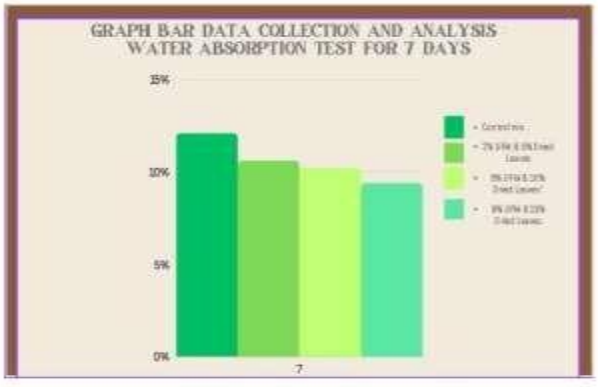

Figure 1: Data Collection and Analysis Water absorption Test for 7 Days

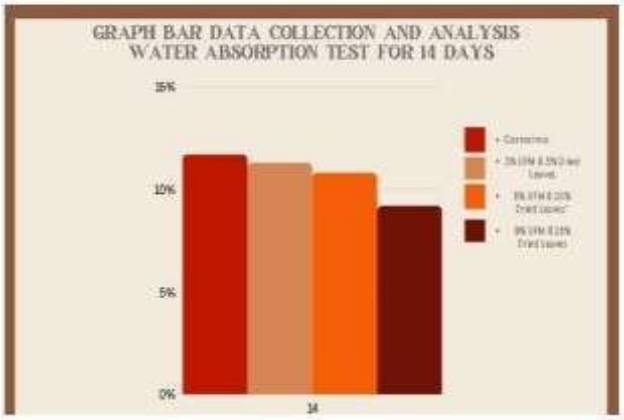

Figure 2: Data Collection and Analysis Water Absorption Test for 14 Days

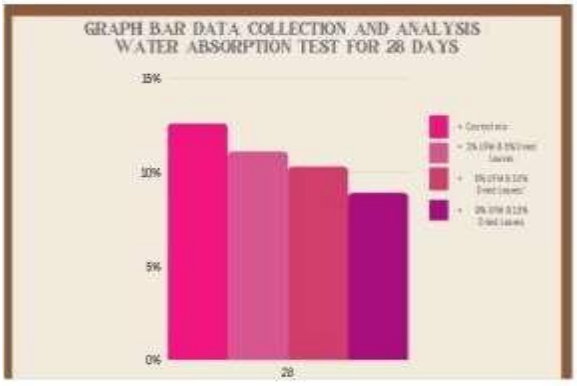

Figure 3: Data Collection and Analysis Water Absorption Test for 28 Days

4.2 Compressive Strenght Test Result

Different brick will have a different number of density. The density of a brick is depends on its mass and volume. The higher the mass, the higher the density. Otherwise, the higher the volume of the brick, the lower its density. The mass of brick is directly proportional to the density of brick while the volume of brick is inversely proportional to the density of brick. The compressive strength test on the brick was successful. Since the brick's surface is even, an average load will cause it to crack due to an even distribution of compressive force. The brick's compressive strength is directly proportional to the amount of maximum load it can withstand. Keep distance from the compressive machine when it was in use to prevent damage from flying debris. In order to ensure that it won't interfere with subsequent tests, the plate surface in the compressive strength machine needs to be thoroughly cleaned after testing. The maximum amount of brick is on 28 days which is 9%of used face mask and 15% of dried leaves because from the data, it show that the more mass of used face mask and dried leaves the more it can stand with heavy load of compressive strength. While the minimum is on 3% of used face mask and 5% of dried leaves because as the both additional of material in brick decrease, it show that amount of compressive strength that it can stand also decrease. This happen because when the both material is less, it make amount of water is more than others material and make it brick that have more 10% of water absorption.

Table 3. Data for Compressive Strength Test Result

Compressive Strength Test	Control Mix (Pa)	3% of UFM and 5% of Dried Leaves (Pa)	6% of UFM and 10% of Dried Leaves (Pa)	9% of UFM and 15% of Dried Leaves (Pa)
7 days	0.405	0.457	0.545	0.607
14 days	0.475	0.482	0.624	0.682
28 days	0.574	0.623	0.692	0.718

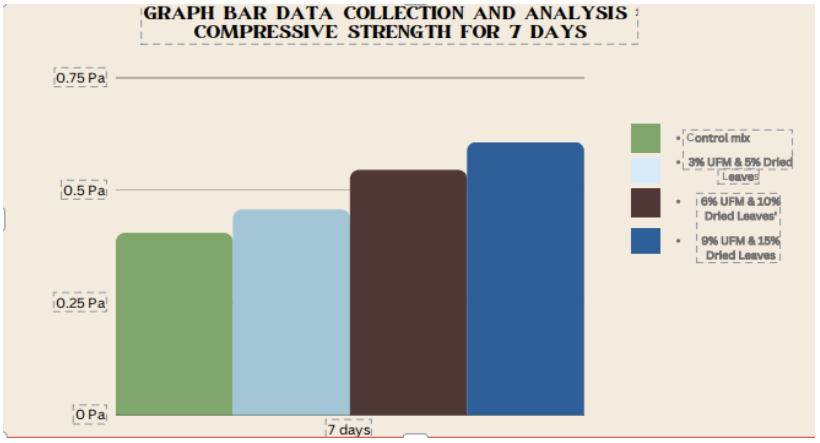

Figure 4: Data for Compressive Strength Test for 7 Days

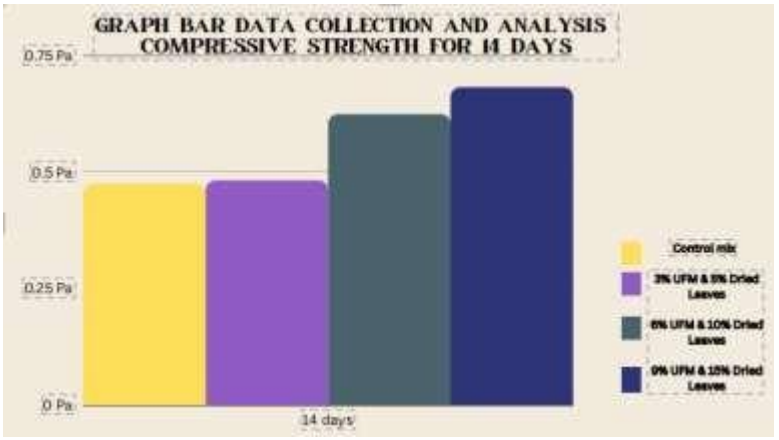

Figure 5: Data for Compressive Strength Test for 14 Days

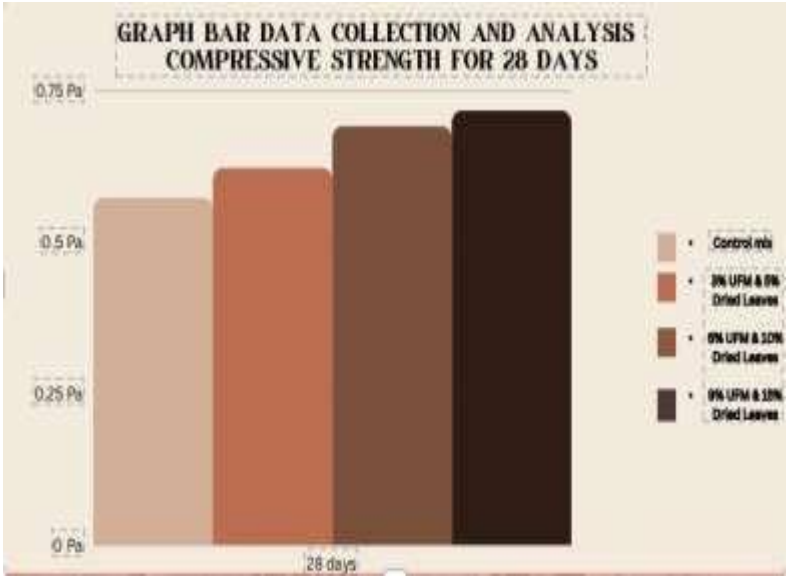

Figure 6: Data for Compressive Strength Test for 28 Days

5.0 CONCLUSION

Since 2020, the entire world has been experiencing a COVID-19 outbreak. If people do not protect their health by using face masks, the sickness spreads quickly. To prevent the spread of this disease, most people around the world are required to wear face masks. As a result, the problem of dumping used face masks is becoming more prevalent. Used face masks are frequently discovered in public places such as parks, shopping malls, and recreational locations. Face masks, as we all know, contain micro plastics that are difficult to dispose of. Used face masks have been used as an ingredient in brick making to prevent waste disposal of used face masks. Leaves are a type of green substance found in the environment.

Dry fallen leaves can wreak havoc on the soil, causing it to deteriorate. Soil degradation has an impact on its quality.Leaves are utilize as an addition in bricks to reduce open-burning activities that are common in the neighbourhood. The current market favors objects or materials that have been altered by the addition of natural and plastic ingredients. Based on the brick outcomes, the bricks created by this study have an interesting and distinct design. This brick sample achieved the desired objective level after undergoing many tests, including the water absorption test and the compressive strength test. If this brick sample becomes available for purchase, it will be one of the more interesting attractions and can be utilize for outdoor purposes such as the construction of playgrounds, bus stations, stadiums, and other structures. One of the benefits of this product is that it has an appealing appearance that does not require painting. Because it contains components that are harmful to human health, this product cannot be used in enclosed spaces such as houses or offices.

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TRACK 2: COMMERCE

Laman Web Dan Strategi Pemasaran Digital: NormaBaharu di *Redtma Recreation Sport Centre*

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Abstrak. Perkembangan teknologi pemakin perkembangan industri rekreasi terutama dalam bidang pemasaran. Redtma Recreation Sport Centre (RSC) salah satu agensi yang menawarkan perkhidmatan ,*outdoor,* latihan, rekreasi terletak di Melaka tidak terkecuali dengan perkembangan teknologi digital . Berdasarkan temubual dan soal selidik awal menunjukkan syarikat ini mengalami penurunan jualan sebanyak 70% dari tahun 2020-2023. Strategi semasa pemasaran firma adalah secara tradisional. Ini memberi kesan kepada jumlah permintaan keseluruhan terhadap perkhidmatan syarikat. Maka kajian ini adalah untuk mengenalpasti tahap situasi semasa syarikat dalam pemasaran menggunakan laman sesawang dan menganalisis faktor pemilihan pengguna dalam melayari laman sesawang. Seramai 170 respondan telah memberi maklumbalas soal selidik yang diedarkan secara rawak. Data dianalisis menggunakan *Statistical Package Social Science* versi 29. Dapatan menunjukkan tahap aplikasi laman sesawang dalam pemasaran semasa adalah rendah. Manakala skor min faktor kandungan , *appearance* dan *userbility* adalah pada tahap tinggi. Ini memberikan satu peluang penambahbaikan dalam meningkatkan pelanggan Redtma Recreation Sport Centre seterusnya meningkatkan jualan. Kajian lanjut berkenaan keberkesanan pemasaran digital ini boleh dilaksanakan pada masa akan datang

Kata Kunci: Aplikasi Pemasaran digital, laman web, digital, rekreasi

1.0 PENGENALAN

Pelancongan rekreasi adalah salah satu industri yang sedang berkembang serta mempunyai potensi yangtinggi untuk menyumbang kepada kemajuan dan sumber ekonomi negara. Pelancongan rekreasi ini boleh dipromosikan melalui laman web dan media sosial seperti Tiktok, Instagram dan Facebook dengan memuat naik gambar-gambar yang cantik supaya dapat menarik minat pelancong atau masyarakat. Menurut (Aznie & Abdullah, 2012) ekopelancongan adalah salah satu medium penjelajahan sesuatu kawasan yang spesifik seperti penghayatan dalam menikmati persekitaran flora dan fauna yang pelbagai spesies.

Menurut (Nur Faeza, 2015) laman web korporat, laman web perniagaan, e-mel, Google dan Instagram merupakan medium pemasaran elektronik yang mempunyai signifikan kepada peniaga untuk menarik perhatian pelanggan. Ini kerana perkembangan semasa internet , 4IR dan laman web dewasa ini memberruang yang sangat luas untuk penyampaian maklumat berkaitan perkhidmatan yang ditawar, produk serta kelebihan tanpa perlu melibatkan kos ruang dan masa. Menurut Faradillah (2020) kemajuan teknologi internet terkini merupakan satu platform digital terbaik dalam melakukan aktiviti pemasaran dengan lebih optimum untuk membantu pencapaian objektif organisasi melalui pengoptimuman impak media digital sebagai agen saluran maklumat yang pantas dan meluas melepasi sempadan masa dan ruang. Industri rekreasi yang melibatkan sukan telah menjana RM 4 billion pada tahun 2018 selain mewujudkan 600 000 peluang pekerjaan (Prof Dr Md Amin, 2020). Terdapat peluang dan ruang yang besar untuk syarikat-syaraikat yang menawarkan perkhidmatan rekreasi menjana keuntungan. Namun tidak dinafikan pandemik covid 19 memberi kesan yang besar kepada industri ini.

1.1 Pernyataan Masalah

Redma Recreation Sport Centre tidak terkecuali terkesan dengan faktor ekonomi luar jangka yang berlaku ini. Ini telah menyebabkan syarikat mengalami penurunan jualan sebanyak 70% berbanding sebelum Covid 19. Keadaan yang berlaku juga mendorong syarikat menukar lokasi operasi utama ke Pantai Siring,Melimau Melaka dari di Jalan tasik, Hang Tuah Jaya, Ayer Keroh. Ini bersesuaian dengan potensi dan kemudahan serta fenomena alam semulajadi yang wujud di Pantai Siring. Namun tinjauan awal menunjukkan majoriti orang ramai tidak mengetahui perubahan lokasi syarikat ini. Pencarian melalui internet juga menunjukkan maklumat Syarikat yang boleh diakses melalui tekonologi digital adalah sangat terhad dan tidak kemaskini. Capaian maklumat syarikat sangat terhad. Ini berikutan tidak ada medium informasi atau laman web rasmi syarikat di gunakan secara efektif dan meluas. Laman web pada kebiasaan merupakan rujukan orang ramai untuk mendapatkan informasi sesebuah syarikat. Ini memberi kesan terhadap peluang pemasaran syarikat tersebut dan kesan kepada jumlah jualan. Sehubungan dengan itu objektif utama kajian ini ialah untuk mengetahui tahap situasi semasa syarikat dalam pemasaran menggunakan laman sesawang dan menganalisis faktor-faktor pemilihan pengguna dalam melayari sesebuah laman sesawang syarikat .

1.2 Kepentingan kajian

Kajian ini mempunyai siginfikan yang tersendiri kepada syarikat, mahupun komuniti. Hasil dapatan dapat membantu syarikat mengambil langkah proaktif mengenalpasti strategi pemasaran berkesan dengan perkembangan teknologi yang berlaku untuk meningkatkan jualan dan meluaskan peluang pasaran hingga peringkat antarabangsa. Ini boleh dilakukan melalui interaksi digital dalam tempahan dan menyebaran maklumat tentang pakej perkhidmatan. Selain itu pihak komuniti lebih berminat dan yakin dengan perkhidmatan yang ditawarkan apabila terdapat satu platform sesebuah syarikat yang diyakini serta sentiasa dikemaskini untuk menunjukkan kewujudan syarikat tersebut. Oleh yang demikian masalah yang dikenalpasti berdasarkan tinjauan dan pemerhatian menunjukkan satu kajian menyeluruh perlu dilakukan untuk membantu meningkatkan pelanggan syarikat seterusnya meningkatkan potensi penjanaanhasil jualan dan keuntungan.

2.0 SOROTAN KAJIAN

2.1 Pemasaran digital dan laman web

Pemasaran digital merupakan satu bentuk pemasaran norma baharu kesan kepesatan perkembangan teknologi telekomunikasi dan internet secara global. Pemasaran sedemikian mengaplikasikan sepenuhnya penggunaan teknoologi internet berfokuskan atas talian sebagai platform untuk menyebarluaskan maklumat produk atau perkhidmatan yang ditawarkan oleh sesebuah syarikat (A. Lavaya, 2021). Selain itu ia lebih bersifat dinamik, lebih pantas dan merentas sempadan masa dan ruang selain menjimatkan kos. Pemasaran melalui media sosial dewasa ini signifikan dalam pemasaran digital . Website atau laman web boleh juga diertikan sebagai kumpulan laman yang memaparkan maklumat datateks, data gambar diam atau gerak, data animasi, suara, video dan atau gabungan dari semuanya, baik yang bersifat statik dan dinamik (Norusuriani, 2019). Pemilihan saluran yang baik akan memberikan pulanganpelaburan yang maksimum (S.N. Singh, 2016). Kekangan waktu memberi peluang pelanggan lebih cenderung untuk membuat pembelian produk atau perkhidmatan melalui website tanpa perlu ke lokasi fizikal.

2.2 Faktor -faktor pemilihan laman web

Kandungan adalah penting dalam membangunkan laman web, khususnya, persepsi subjektif terhadap kandungan diketahui mempengaruhi pelbagai penilaian pengguna, dengan itu mengubah sikap dan hasil tingkah laku. Penyampaian kandungan yang berkesan merupakan kekuatan yang boleh meyakinkan pelanggan (C.H.Li, 2022). Selain itu kebolehgunaan(*userbility*) memainkan peranan

penting, untuk menentukan kaedah interaksi di antara pengguna dengan sistem yang akan dibangunkan. Hal ini dapat memudahkan pengguna untuk mengakses sesuatu laman sesawang. Faktor kebolehgunaan yang dikenalpasti adalah sifat membantulaman web yang mudah diakses akan mempunyai tahap kemanfaatan yang tinggi dan ia juga akan memenuhi keperluanpengguna. Pengalaman pengguna menggunakan laman web memberikan indikasi penting menentukan keberkesanan laman sesawang (Sharma, 2023). Ini juga akan membantu syarikat memaksimumkan pemasaran secara digital.

Menurut John Mueller dalam Southern (2023) , paparan visual yang menarik akan memberikan satu eleman baru yang akan memberi kesan kepada persepsi pengunjung laman web. Dalam pada itu Penampilan reka bentuk laman web yang berkesan membantu firma/organisasi mencapai matlamat mereka. Berdasarkan kajian yang dilakuakan oleh Nicols Wilson bahawa di Asia, Australia dan Eropah, kualiti perkhidmatan memainkan peranan yang lebih penting dalam mempengaruhi niat pembelian semula, manakala kualiti reka bentuk laman web memainkan peranan yang lebih penting dalam mempengaruhi niat pembelian semula di Amerika Utara danAmerika Selatan (Nicholas Wilson, 2019). Sehubungan dengan itu pemasaran digital merupakan satu signal penting dan signifikan dalam membantu menyebarluaskan maklumat produk dan perkhidmata. Selain penggunaan pemasaran menggunapakai teknologi dan internet mampu menarik perhatian pengguna selain membantu meningkatkan permintaan hasil kecekapan dan keberkesanan penggunaan laman web dengan kandungan yang menarik, kebolehcapaian yang mudah selain paparan yang menarik.

3.0 METODOLOGI KAJIAN

Metodologi kajian merupakan suatu proses bagi melaksanakan suatu penyelidikan dan pemerolehan maklumat bagi mencapai objektif ditetapkan dalam kajian tersebut (Nirwana, 2016).

3.1 Kaedah Pengumpulan Data

Data merupakan sumber utama kajian ini terbahagi kepada dua jenis iaitu data primer yang merupakan data yang diperolehi dan dikumpulkan dan dianalisis menggunakan perisian untuk menghasilkan keputusan. Data primer ini adalah maklumat yang diperolehi secara langsung melalui temubual bersama wakil syarikat , pemerhatian selain tinjauan melalui soal selidik . Ujian rintis dilakukan sebelum instrumen utama data iaitu borang soal selidik diedarkan kepada responden bagi menentukan kebolehpercayaan dan keesahan item-item soalan dalam kajian. Dapatan kajian akan diterjemahkan untuk menerangkan suatu keadaan yang berlaku bagi mencapai objektif atau membangunkan hipotesis (Ang K. H., 2016) .

Data sekunder dalam kajian ini diperolehi daripada individu selain bahan bercetak selain audio visual bahan kajian (Ang K. H., 2016). Contohnya artikel, jurnal serta sumber daripada internet adalah data-data yang dikumpulkan di dalam kaedah data sekunder. Data ini sangat sesuai digunakan bagi menyokong proses mengumpul maklumat dari data asal.

3.2 Rekabentuk Kajian

Rekabentuk uang digunapakai dalam kajian ini adalah secara kuantitatif dengan menggunakan kaedah deskriptif atau tinjauan (survey research) yang mengimplementasikan data-data yang diperolehi dan diterjemah kepada huraian untuk menerangkan keadaan atau fenomena yang berlaku. Populasi bagi kajian ini terdiri daripada pelajar Politeknik Merlimau seramai 3975 orang. Ini terdiri dari pelajar sepenuh masa.
Kajian ini menggunakan persampelan daripada populasi secara rawak mudah seramai 354 pelajar (Krejcie, 1970). Pemilihan sampel yang tepat akan memastikan soal selidik yang dijalankan adalah berseuaian dan menepati sasaran . Berdasarkan soal selidik yang telah diedarkan kepada sampel , seramai 170 orang telah memberikan maklum balas dalam kajian ini.

3.3 Instrumen kajian dan Analisis data

Instrumen kajian merupakan alat kajian untuk menjawab objektif penyelidikan . Cara pengumpulan data yang digunakan di dalam projek ini melalui borang soal selidik dan mempunyai dua bahagian iaitu bahagian a dan b. Soal selidik disebarkan melalui Google Form serta dijawab oleh populasi secara rawak. Data yang diperolehi ditadbir dan diproses menggunakan Statistical Package for Social Science (SPSS) versi 29.0 . Ujian Cronbach Alpha terhadap kesahihan soalan-soalan di dalam borang soal selidik telah dijalankan untuk mengukur darjah kebolehpercayaan item soal selidik yang di buat. Jumlah responden adalah sebanyak 30 . Nilai Alpha Croncabch yang diperolehi adalah 0.907 untuk content,0.867 untuk appearance dan 0.938 untuk userbility. Ini menunjukkan tahap kesesuaian item- item di dalam borang soal selidik ini adalah baik.. Kaedah in dipilih kerana ianya mudah, murah, dan perwakilan yang tepat bagi pelanggan yang lebih besar.

Skor yang diperolehi dipersembahkan melalui bentuk deskriptif iaitu berdasarkan kepada taburan peratusan, kekerapan dan min . Nilai min yang tinggi menunjukkan persetujuan yang tinggi terhadap aspek yang dikemukakan. Analisis deskriptif ini juga digunakan untuk memenuhi objektif yang telah ditetapkan berdasarkan tafsiran statistik min yang digunakan diubahsuai daripada Wiersma (1995) seperti dalam Jadual 1.

Jadual 1 : Interpretasi Skor Purata

Skor purata	Interpretasi
1.0 hingga 2.00	Rendah
2.01 hingga 3.00	Sederhana rendah
3.01 hingga 4.00	Sederhana tinggi
4.01 hingga 5.00	Tinggi

4.0 KEPUTUSAN KAJIAN DAN ANALISIS

Bahagian ini akan membincangkan tentang hasil data yang diperolehi melalui soal selidik yang telah diedarkan kepada responden yang telah dipilih secara rawak. Sebanyak 380 borang soal selidik telah diedarkan kepada pelajar dan penduduk di sekitar Merlimau sebagai sampel kajian berdasarkan Jadual Krejcie and Morgan. Bilangan sampel ini meliputi pelajar – pelajarPoliteknik Merlimau dan penduduk di Merlimau. Daripada 380 borang yang telah diedarkan namun hanya 170 responden yang telah melengkapkan maklumat dalam soal selidik tersebut dan sempurna untuk diproses menggunakan SPSS.

4.1 Latar belakang Responden

Borang soal selidik yang telah diedarkan mengandungi dua bahagian iaitu bahagian A mengandungi maklumat demografi dan Bahagian B mengandungi 18 item menrujuk kepada faktor yang mempengaruhi pemilihan laman web .

4.2 Jantina

Jadual 2 menunjukkan responden perempuan yang paling ramai iaitu seramai 96 orang pelajar atau 57 peratus manakala responden lelaki hanya 73 orang pelajar atau 43 peratus dari keseluruhan 170 orang.

Jadual 2 : Jantina Responden

Jantina	Kekerapan	Peratus
Lelaki	73	43%
Perempuan	96	57%

4.3 Umur

Jadual 3 menunjukkan majoriti responden kajian berumur antara 18 hinnga 24 tahun seramai 47.6%. Ini kebanyakkan responden adalah dalamkalangan pelajar Politeknik Merlimau. Manakala responden berumur 25 hingga 35 tahun seramai 22.4 % dan hanya 11.2% responden berumur lebih 47 tahun. Ini kebanyakan adalah terdiri dari penduduk sekitar Merlimau yang dapat memberikan maklumbalas kajian.

Jadual 3 : Umur Responden

Umur	Kekerapan	Peratus
18 – 24 Tahun	81	47.6%
25 – 35 Tahun	38	22.4%
36 – 45 Tahun	32	18.8%
> 47 Tahun	19	11.2%
Jumlah	170	100

4.4 Analisis untuk tafsiran dan pembolehubah

4.4.1 Kandungan (*Content*)- Perspektif pengguna terhadap cadangan kandungan laman web syarikat Redtma

Jadual 4 menujukkan perspektif responden terhadap kandungan yang perlu diletak dalam laman web Syarikat Redtma. Secara purata 4.49 responden sangat setuju jika laman web mempunyai kandungan yang menarik. Secara keseluruhan skor purata adalah pada tahap tinggi . Skor terendah dalam kajian ini ialah Soalan lazim " FAQ" memulakan saya mendapatkan maklumat lebih pantas namun masih pada tahap tinggi.

Jadual 4: Perspektif Pengguna Terhadap Cadangan Kandungan Statistik

No	Item	Purata	Interprestasi
1	Halaman hubungi perlu dinyatakan di dalam laman web supaya memudahkan pihak pengguna membuat panggilan kepada Redtma Recreation Sport Centre.	4.49	**Tinggi**
2	Maklumat perkhidmatan yang disediakan perlu dinyatakan di dalam laman web untuk menarik perhatian pelanggan	4.51	**Tinggi**
3	Halaman " about us " perlu dinyatakan didalam laman web untuk memudahkan pengguna mendapatkan maklumat tentang servis yang ditawarkan di Retma Recreation Sport Centre	4.49	**Tinggi**
4	Soalan lazim " FAQ" memulakan saya mendapatkan maklumat lebih pantas.	4.43	**Tinggi**

5	Pautan media sosial perlu dinyatakan di dalam laman web boleh memudahkan pengguna mendapatkan maklumat lanjut tentang Redtma Recreation Sport Centre.	4.53	**Tinggi**
6	Borang tempahan secara atas talian yang disediakan akan memudahkan bakal pelanggan membuat tempahan di laman web	4.48	**Tinggi**
7	Pakej yang ditawarkan perlu dinyatakan di dalam laman web bagi memudahkan pengguna membuat pilihan	4.51	**Tinggi**
	Skor Purata Min	**4.49**	**Tinggi**

4.4.2 *Appearance* (Persepektif pengguna terhadap cadangan appearance laman web syarikatRedtma

Jadual 5 menujukkan persepktif responden terhdap *appearance* yang perlu diletak dalam laman web Syarikat Redtma. Skor min tertinggi adalah bagi item *Button kembali ke halaman sebelumnya di dalam laman web* perlu diletakkan di website bagi memudahkan pengguna.iaitu 4.47 pada tahap tinggi. Secara keseluruhan skor min bagi item -item adalah pada tahap tinggi iaitu 4.41.

Jadual 5: Perspektif Pengguna *Appearance*

No	Item	Purata	Interprestasi
1	Susun atur di dalam laman web perlu menarik perhatianpelanggan untuk membuat tempahan	4.39	Tinggi
2	Warna yang digunakan perlulah berpadanan dengan identity Redtma Recreation Sport Centre.	4.39	Tinggi
3	Pelbagai gambar yang menarik perlu diletakkan di dalamlaman web untuk menarik perhatian pengguna	4.43	Tinggi
4	Video gambar di dalam laman web boleh menarik perhatian bakal pelanggan gambar di dalam laman web boleh menarik perhatian bakal pelanggan	4.42	Tinggi
5	Galeri gambar di dalam laman web boleh menarik perhatian bakal pelanggan	4.41	Tinggi
6	Interaktif visual seperti animasi yang menarik bolehmemberi kepuasan kepada pengguna	4.41	Tinggi
7	Button kembali ke halaman sebelumnya di dalam laman web perlu diletakkan di website bagi memudahkan pengguna.	4.47	Tinggi
	Skor Purata Min	**4.41**	**Tinggi**

4.4.3 *Userbility (*Persektif pengguna terhadap *userbility* laman web syarikat Redtma RecreationSport Centre)

Jadual 6 menujukkan perspektif responden terhadap *userbility* dalam laman web Syarikat Redtma. Secara purata 4.45 responden sangat setuju jika laman web mempunyai *userbility* yang mudah diakses oleh semua orang. Berdasarkan jadual diatas purata 4.49 merupakan purata yang paling tinggi, dimana laman web yang menarik mestilah mudah diakses melalui pelbagai jenis alat elektronik.

Jadual 6 : Perspektif Pengguna Terhadap *Usebility*

No	Soalan	Purata	**Interprestasi**
1	Laman web yang menarik mestilah mudah diakses melalui pelbagai jenis alat elektronik.	4.49	Tinggi
2	Melalui laman web boleh menarik perhatian pelanggan untuk berinteraksi secara interaksi dengan pihak syarikat Redtma Recreation Sport Centre	4.46	Tinggi
3	Maklumat yang dipaparkan mudah difahami oleh setiap pengguna	4.43	Tinggi
4	Capaian yang pantas boleh menarik perhatian pengguna dan meningkatkan kepuasan pengguna.	4.42	Tinggi
	Skor purata min	**4.45**	**Tingi**

Daripada maklumat yang diperolehi , data yang diperolehi melalui soal selidik tersebut menunjukkan faktor-faktor kandungan, appearance dan userbility mempunyai signifikan yang tersediri dalam mempengaruhi kecenderungan pengguna untuk melayari laman web sesuatu perniagaan . Ini menunjukkan kesan positif aplikasi teknologi digital mempunyai kesan kepada pemasaran syarikat.

5.0 KESIMPULAN

5.1 Analisis dapatan bagi objektif 1 : Mengenalpasti tahap situasi yang berlaku di syarikat Redtma Recreation Sport Centre dalam menggunakan laman sesawang.

Berdasarkan dapatan kajian yang telah dilaksanakan dan hasil interpretasi data menunjukkan bahawa tahap situasi atau fenomena semasa yang berlaku di syarikat Redtma Recreation Sport Centre dalam penggunaan laman sesawang sebagai medium pemasaran digital masih berada pada tahap rendah. Ini dibuktikan berdasarkan pemerhatian dan tinjauan melalui carian menggunakan aplikasi digital . Ini dibuktikan juga dengan kajian awal menunjukkan bahawa 76.5% daripada responden tidak mengetahui tentang perpindahan lokasi syarikat yang baharu dan sebanyak 81.4% tidak pernah melayari laman sesawang Redtma Recreation Sport Centre.

Selain ini dibuktikan berdasarkan temubual melalui wakil syarikat pada kebiasaannya promosi mahupun sebaran maklumat masih menggunakan flyers. Syarikat tidak menggunakan laman sesawang rasmi sebagai salah satu cara untuk tujuan pemasaran. Ini selaras dengan dapatan (Ankita Puri, 2020) bahawa penggunaan digital akan membolehkan sasaran pasaran ke seluruh dunia.

5.2 Analisis dapatan bagi objektif 2: Menganalisis faktor-faktor yang mempengaruhi pemilihan pengguna dalam melayari laman sesawang Redtma Recreation Sport Centre sebagai medium pemasaran.

Dapatan menunjukkan bahawa semua pemboleh dalam kajian ini mempunyai sinifikan yang mempengaruhi pemlihan pengguna dalam melayari laman web sesawang syarikat tersebut. Faktor kandungan memberikan skor purata min paling tinggi iaitu 4.49. Ini menunjukkan responden yakin dan percaya kandungan bahan yang bersesuaian adalah penting untuk pembangunan laman web yang sebagai satu tarikan pemasaran digital . Ini kerana informasi yang menarik dan bernilai adakan mendorong pengguna atau pelanggan untuk mengakses dengan lebih kerap dan mampu memberi kesan positif terhadap perubahan tingkahlaku pengguna (Joel Jarvinen, 2015). Faktor kandungan adalah yang paling dominan mendorong individu melayari laman sesawang.

Appearance salah satu faktor yang juga mempunyai kesan terhadap kecenderungan pengguna atau

pelanggan untuk mengakses laman sesawang sesebuah syarikat. Ini dibuktikan melalui dapatan skor purata min ialah 4.1 iaitu pada tahap tinggi. Kajian Eline Jongmans (2022). visual yang dipapar melalui laman web akan memberikan nilai estetika dan pengalaman yang baik dalam strategi pemasaran. Faktor ini menjadi tarikan dalam menggalakkan pelanggan untuk mendapatkan pengalaman sebenar seperi maklumat yang dipaparkan.

Dalam pada itu laman web yang interaktif dan menarik dapat menarik perhatian pengguna seterusnya dapat menyampaikan maklumat. Pengguna menjadikan laman web sebagai platform untuk mengenalpasti dan membuat penilaian perkhidmatan atau produk ditawarkan sesebuah syarikat dengan lebih mudah tanpa ke lokasi fizikal syarikat tersebut. Secara tidak langsung laman web dengan paparan dan maklumat yang menarik dan interaktif memudahkan syarikat mendapatkan potensi pelanggan dan sasaran pelanggan syarikat (Norusuriani, 2019).

Faktor skor purata min *userbility* ialah 4.45 , ini menunjukkan bahawa reponden bersetuju keboleh capaian dengan mudah dalam mengakses laman web turut mempengaruhi pelanggan untuk terus memberikan perhatian dalam laman web tersebut. Laman web yang mudah diakses memberikan kelebihan kepada pengguna untuk mengeksplorasi lebih banyak maklumat syarikat tersebut. Ini menjadikan faktor ini signifikan dalam mempengaruhi sesebuah syarikat termasuk Redma memberikan lebih banyak peluang pemasaran dengan meluas dan berterusan. Menurut Rasyiqah (2017) kebolehgunaan laman web yang mudah akan menjadikan interaksi manusia dan teknologi semakin tinggi akan mewujudkan pengalaman pelanggan dalam elemen keselesaan, kecekapan dan menyeronokanBerdasarkan kepada hasil dapatan kajian perlu memanfaatkan peluang perkembangan teknologi ini dengan mengaplikasi pemasaran digital melalui laman web. Syarikat perlu memastikan promosi yang bersesuaian dan kepelbagaian yang dapat memberikan tarikan kepada pelanggan untuk menggunakan perkhidmatan yang ditawarkanoleh Redtma Recreation Sport Centre. Selain itu laman web juga boleh meyakinkan pelanggan untuk menggunakan perkhidmatan Redtma Recreation Sport Centre apabila pengguna dapat membaca maklum balas tentang perkhidmatan yang telah digunakan. Ini juga memberi kemudahan kepada bakal pengguna untuk membuat pilihan aktiviti melalui aktiviti- aktiviti yang dipamerkan di dalam laman web.

PENGHARGAAN

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TRACK 3: TOURISM AND HOSPITALITY

Creating Abstract Shibori Batik Textile PatternsInspired by Waterfall

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Abstract. This study delves into the fusion of inspiration drawn from the enchanting beauty of waterfalls into the realm of batik textiles, achieved through the amalgamation of batik and Shibori techniques. By conducting a literature analysis of traditional batik and Shibori methodologies, the investigation seeks to craft novel abstract patterns that capture the distinctive essence of nature. The research methodology entails a comprehensive literature review to draw upon existing knowledge of batik and Shibori techniques, followed by laboratory experiments aimed at generating innovative textile patterns. The findings of the study reveal success in amalgamating batik and Shibori techniques to craft patterns that vividly depict the fluid movement of water and the distinctive visual allure of waterfalls. These patterns emerge through experimental iterations involving variations in wax application, dye selection, and binding techniques. The ensuing discussion accentuates the uniqueness and commercial viability of these patterns, while the research implications delve into their contributions to the advancement of textile art techniques and the creative industry at large. In conclusion, the study underscores the potential of integrating batik and Shibori techniques to produce innovative batik textile in abstract patterns inspired by the splendour of natural elements, particularly waterfalls. Consequently, this research significantly contributes ideas and inspiration to batik entrepreneurs, offering a fresh design approach infused with the captivating essence of waterfalls and the natural world.

Keywords. Design Inspiration, Abstract Pattern Design, Batik, Shibori, Textile Design.

1.0 INTRODUCTION

Batik textile art stands as a revered cultural legacy, characterized by its intricate patterns and traditional techniques (Poon, 2020). Inspired by the allure of the natural world, particularly the splendor of Malaysia's preserved landscapes, batik designers have long drawn upon motifs rootedin nature's beauty (Dinata & Fan, 2019). Among these motifs, floral patterns reign supreme, captivating batik enthusiasts with their uniqueness and charm (Hussin, 2006). Hussin's seminal study in 2006, as documented in his book "Motif Alam dalam Batik dan Songket Melayu," meticulously cataloged 167 plant categories utilized in batik motifs and 148 in songket. This research delved into the typology of motifs, exploring their historical underpinnings from a cultural perspective. The abundance of fresh, distinct, and readily accessible natural motifs serves as a wellspring of inspiration for designers and researchers, enabling them to showcase Malaysia's natural bounty to a global audience. This study, in particular, integrates batik and Shibori techniques to explore and craft innovative textile patterns. Building upon Malaysia's richartistic heritage, deeply rooted in local traditions and culture (Ramlan, 2019), this research draws inspiration exclusively from waterfalls. Renowned for their symbolic significance and breathtaking beauty, waterfalls serve as the focal point for this endeavor. The fusion of time- honored batik techniques with captivating Shibori elements lays the groundwork for creating patterns that not only encapsulate the magnificence of waterfalls but also incorporate unexpected
and inventive elements (Che Ya, 2019). The primary objective of this research is to ascertain the efficacy

of utilizing combined batik and Shibori techniques in producing abstract patterns reflective of waterfall-inspired designs. Through an exhaustive analysis of batik and Shibori pattern literature, coupled with laboratory experiments, this study endeavours to unearth new abstract patterns pertinent to textile art and the creative industry. This endeavour is expected tofoster the advancement of textile art and the safeguarding of local cultural heritage in the realm of contemporary art. By harnessing the captivating allure of waterfalls as its central muse, this study opens pathways for further exploration in crafting textile patterns that seamlessly blend tradition with innovative elements.

2.0 LITERATURE REVIEW

2.1 Batik Textile Art

Batik textile art stands as a unique and integral aspect of Malaysian cultural heritage (Wahida et al., 2022). The intricate process involved in batik creation encompasses several steps, including the utilization of tools such as canting, blocking, and brushes for the application of wax (Sapian et al., 2022). As depicted inFigure 1, canting tools are commonly employed for the batik wax technique. The batik-making process commences with the creation of motifs or patterns on the fabric using wax (Hartono et al., 2022). Wax serves as a protective barrier for specific areas of the fabric during the subsequent dyeing process. Following the application of multiple layers of wax, the fabric undergoes immersion in dye. Various dye application techniques, such as brushing, spraying, or soaking, are employed, resulting in the creation of intricate and multi-layered colors (Kusumawati et al., 2021).

Figure 1: Utilizing canting tools for the batik wax technique.(Source: Rahayu et al., 2020)

Malaysian batik textiles are renowned for their distinctive patterns, often drawing inspiration from nature and cultural heritage (Wahed et al., 2022). Iconic floral motifs such as jasmine and frangipani are frequently featured in Malaysian batik designs (Setyowati & Na'am, 2020). These traditional patterns carry profound symbolic meanings rooted in beliefs, customs, and folklore. Crafting batik entails meticulous handiwork and demands the skills of a skilled artisan. The process of creating motifs with wax and applying colors necessitates a high degree of patience and precision (Sukadari & Huda, 2021). Despite its traditional roots, batik textile art embraces innovation, with researchers often exploring new techniques to produce modern and distinctive patterns. Batik finds widespread application in traditional attire such as baju kurung and sarong (Ya et al., 2022), as well as household decorations like table covers, curtains, and wall hangings. Artworks featuring batik patterns are frequently showcased in art galleries, serving asa testament to the beauty and uniqueness of these designs. Batik textile art not only serves as a medium for artistic expression but also embodies cultural identity, replete with values and aesthetic allure (Syed Shaharuddin et al., 2021). Through the enduring legacy of this tradition, batik textile art continues to evolve and garners recognition as a distinct form of artistic expression on a global scale.

2.2 Shibori Technique in Contemporary Art and Fashion

Shibori, a traditional Japanese method, involves a variety of binding and fabric manipulation techniques to create distinct patterns (Aishwariya & Sreedevi, 2023). This technique typically entails gathering fabric onto tools such as pipes and securing it with strings or threads to form specific patterns, as illustrated in Figure 2 (Hall, 2020). The density of the binding determines the size of the areas exposed to dye, resulting in intricate patterns. Prior to binding, the fabric is often folded or pleated to create repetitive patterns (Gaughan, 2022). The thickness of the folds and the methods of binding greatly influence the final outcome. Subsequently, the bound fabric is immersed in dye, resulting in captivating line patterns and distinctive textures. To achieve complex and multicolored results, the bound or shaped fabric may undergo several layers of dye. The Shibori technique provides researchers with creative freedom to innovate in its application (Kokko, 2021). The resultant patterns are frequently abstract and organic in nature (Aishwariya & Sreedevi, 2023). Shibori transcends being merely a dyeing technique; it embodies an expressive art form that showcases uniqueness with every application (Azidhak, 2020).

Figure 2: Illustrates a Shibori technique.(Source: Novak et al., 2015, p. 237)

The Shibori technique has garnered significant traction in contemporary art as a versatile medium for crafting innovative and textured artworks (Aishwariya & Sreedevi, 2023). Patterns resulting from Shibori applications find widespread use in fashion and decorative fabrics, offering intriguing textures and non-reproducible designs (Aishwariya & Sreedevi, 2023). This technique presents abundant creative opportunities for researchers and textile designers alike, enabling the creation of unique and inventive works. The allure of the patterns produced, coupled with the artistic liberty inherent in its application, has propelled the Shibori technique into increasing popularity within the realms of both art and fashion.

In contemporary art, Shibori has emerged as a significant medium of expression for many artists. The use of Shibori techniques enables artists to create works that blend tradition with modernism. For instance, textile artworks by artists like Hiroyuki Shindo integrate traditional Shibori techniques with contemporary art concepts to produce pieces that emphasize deep textures, patterns, and colors (MacQuarrie, 2017).

Study by Wada (2002) indicates that Shibori techniques can create dynamic visual effects and complex textures that are difficult to achieve with other dyeing methods. This makes Shibori a popular technique among contemporary textile artists who seek new ways to express their creativity. Shibori has also made substantial contributions to the contemporary fashion industry. Fashion designers such as Issey Miyake have employed Shibori techniques to create innovative and unique clothing designs. According to Wada (2002), Miyake uses Shibori to merge traditional Japanese elements with modern designs, resulting in garments that are not only beautiful but also practical and comfortable. A study by Aishwariya & Sreedevi (2023) states that Shibori techniques add value to fashion designs by creating unique textures and patterns that cannot be replicated industrially. Garments produced using Shibori techniques typically

possess high aesthetic value and are appreciated as exclusive textile art pieces.
Overall, Shibori techniques have made significant contributions to the development of contemporary art and fashion. From its application in textile art to its crucial role in the fashion industry, Shibori demonstrates that traditional techniques can remain relevant and innovative. Further research on this technique can unveil more opportunities to understand and expand the creative potential inherent in Shibori.

2.3 Natural Inspiration

Drawing inspiration from the natural environment is fundamental in creative artistry, encompassing textile arts such as batik and Shibori techniques (Che Ya, 2019 & 2021). Researchers often derive inspiration from the inherent beauty of the natural world. According to Plato, motif creation in design involves imitation or replication, and recreating artistic outcomes is an innate instinct for designers. The role of designers or researchers in interpreting motifs from the natural environment is pivotal in crafting high-quality, captivating designs suitable for broader audiences (Basiroen et al., 2023).

Waterfalls, for instance, with their serene or cascading water movements, vivid water hues, and surrounding landscapes, offer a plethora of inspirational elements (Goudie, 2020). Natural color palettes such as verdant leaves, azure skies, and earthy tones can inform the color selection for textile art (Pastoureau, 2023). Researchers can explore combinations of these natural hues to create harmonious patterns. Forms found in nature, like leaves, flowers, or stones, can be adapted and incorporated into textile patterns. The unique structures inherent in nature can lend intriguing dimensions to artworks. Drawing inspiration from waterfalls can infuse patterns with elements of movement and dynamism. Flowing lines, vortex formations, and shifts in water shapes can evoke dynamic movements in textile art.

The concept of dynamics and natural changes, such as seasonal transitions or celestial rotations, can be reflected in pattern compositions to visually express these phenomena. Natural objects often bear symbolic meanings in cultural and belief systems. Integrating these symbols into patterns can imbue artworks with depth and enrich their interpretation. Inspiration from the natural environment also enables researchers to explore emotions evoked by the natural surroundings. Combinations of color and form can be employed to convey sentiments associated with the splendor of nature (Goudie, 2020). Drawing inspiration from the natural environment unlocks opportunities to delve into the beauty and diversity of nature, conveying messages or emotions through the medium of textile art. By integrating natural elements into patterns, researchers can create textile artworks that are not only visually appealing but also carry profound meanings and forge a strong connection to the surrounding environment.

2.4 Integration of Batik and Shibori Techniques

The integration of batik and Shibori techniques represent a creative fusion aimed at generating textile abstract patterns that marry traditional batik motifs with the intricate texture and distinctive characteristics of Shibori techniques (Che Ya, 2019 & 2021; Ibrahim et al., 2023). At its core, this integration leverages the fundamental principles of batik, where fabric is adorned with patterns using tools such as canting, brushes, or blocks coated with wax prior to the dyeing process (Che Ya, 2019 & 2021). Concurrently, the Shibori binding process empowers researchers to selectively expose specific areas of the fabric to dye. This convergence of techniques grants researchers a high degree of creative latitude, enabling them to employ binding, folding, or fabric manipulation techniques according to their preferences, resulting in distinctive and structured patterns (Gaughan, 2022). Researchers adeptly blend traditional batik aesthetics with Shibori techniques to introduce additional texture and dimensionality. For instance, Shibori methods involving pleating fabric on pipes and securing it with thread can seamlessly merge with the traditional batik wax application. Such integration often involves the use of layered dye applications. The bound fabric, exposed to dyes, may undergo multiple dye layers to achieve intricate and multi-tonal outcomes. This amalgamation of techniques offers researchers the opportunity to amalgamate traditional batik dyeing techniques with experimental Shibori methods, such as gradual dyeing or resist techniques. By experimenting with traditional batik tools like canting and stamping alongside Shibori

techniques, researchers produce visually captivating effects. The resulting integration yields artworks imbued with rich texture and depth. Dynamic patterns emerge, marrying the nuanced elegance of batik with the tactile, textured effects characteristic of Shibori techniques. The collective effect engenders a range of innovative textile artworks, showcasing the ingenuity of researchers in harnessing the distinctive qualities of both techniques. This amalgamation opens avenues for researchers to craft textile patterns that seamlessly blend traditional elements with experimental and innovative approaches. This process necessitates a profound understanding of both techniques and grants artists the artistic freedom to amalgamate disparate elements into cohesive artworks that harmoniously unite the distinctive strengths of each technique.

4 METHODOLOGY

This research work adopts a structured methodology, comprising a thorough literature review and laboratory experiments. The literature review is conducted to explore relevant literature on batik textile art, Shibori techniques, and the artistic influence of waterfalls. It serves as a foundational resource for understanding traditional batik patterns, pertinent Shibori techniques, and the conceptual underpinnings of drawing inspiration from natural landscapes, particularly waterfalls, in artistic expression. Initially, a literature analysis is undertaken to ascertain traditional batik motifs associated with waterfall themes, guiding the selection of pattern elements for experimentation. Similarly, a review of Shibori techniques is conducted to identify suitable methods that align with the concept of waterfall inspiration. These Shibori techniques, focusing on binding and folding, are then integrated with traditional batik principles. Following the literature review, laboratory experiments are carried out with a primary emphasis on textile design exploration, centered around batik and Shibori techniques inspired by waterfalls. Prior to commencing experimentation, essential materials such as cotton fabric, batik dyes, wax, and application tools like canting and stamps are procured. Emphasis is placed on utilizing high-quality materials to ensure optimal experimental outcomes. A combination of batik and Shibori techniques is then applied to the fabric through strategic binding, folding, and wax application, aimed at creating abstract patterns that evoke the movement and allure of waterfalls. The experimentation phase entails a meticulous dyeing process employing selected batik dyes, with careful consideration given to color combinations that mirror the captivating hues found in natural waterfalls. Upon completion of the dyeing and experimentation processes, the fabric undergoes drying and subsequent analysis to evaluate the efficacy of the combined techniques. Result analysis encompasses the assessment of aesthetic attributes, abstract pattern intricacy, and the fidelity in conveying the essence of natural elements embodied by waterfalls.

Figure 3: Experiments of designing pattern of Batik Shibori through wax application technique.

Figure 4: Experiments of designing pattern of Batik Shibori through wax application technique and colouring.

4.0 RESULT AND ANALYSIS

An analysis is undertaken to assess the efficacy of amalgamating batik and Shibori techniques in producing patterns that resonate with the inspiration drawn from waterfalls. Evaluation criteria encompass various facets including aesthetic appeal, intricacy of patterns, and fidelity in capturing the essence of natural elements. Additionally, the recognition and evaluation of the combined techniques and final products are conducted through participation in a series of exhibitions and competitions. The objective is to gauge the extent to which the outcomes of the experiments are acknowledged, validated, and aligned with the requirements of the Batik industry in Malaysia. The judging panel comprises a diverse array of stakeholders including academicians, industry practitioners, and professionals from the design industry, all possessing extensive expertise in the local textiles domain.

Overall, the research objectives have been effectively accomplished, with thorough addressing of the research questions. The integration of literature reviews and experimentation with diverse textile techniques, particularly their application in batik and Shibori, has yielded noteworthy results in the creation of batik-designed fabrics inspired by waterfalls and nature. The study has showcased significant outcomes, notably in the development of batik textile abstract patterns through the amalgamation of batik and Shibori techniques, drawing inspiration from the enchanting beauty of waterfalls. Through the experimental process, a range of distinctive and innovative batik in abstract patterns has been successfully generated.

The evaluation criteria for this study emphasize both aesthetic and technical dimensions. Aesthetic qualities are scrutinized based on texture, wax application, color selection, and the harmony of patterns generated through the combined batik and Shibori techniques. The assessment of texture involves examining the replication of intricate and varied surfaces characteristic of natural waterfalls. Wax application is analyzed to determine the precision and intricacy of the resist patterns created, while color selection is evaluated for its effectiveness in capturing the nuanced hues and gradients found in waterfall imagery. Harmony pertains to the cohesive integration of batik and Shibori elements within a single pattern, ensuring a visually appealing and unified design.

In addition to aesthetic considerations, the technical execution of the combined techniques is evaluated with respect to durability and consistency. Durability measures the fabric's resistance to wear and the longevity of the patterns under typical usage conditions. Consistency examines the reproducibility of the patterns, ensuring that similar aesthetic qualities can be achieved across multiple iterations. Data collection for this study involves an extensive visual analysis of the produced patterns, comparing them with the original waterfall inspirations to evaluate their fidelity and artistic interpretation.

Figure 5 illustrates the outcomes of pattern designs in Batik Shibori achieved through the wax application technique. These patterns are a reflection of the movement and beauty observed in natural waterfalls, creatively employing folding, and wax application principles. The fusion of batik and Shibori techniques yields abstract patterns with rich dimensions and textures. The utilization of batik wax strokes in

conjunction with Shibori techniques results in patterns that encompass subtle elements and maintain a balanced structure. Experimentation with color selection and layering of dyes produces harmonious and impactful color combinations, adding depth and richness to the patterns and contributing to a visually appealing multi-dimensional effect. Aesthetic analysis of these patterns indicates a successful fusion of traditional batik elements with textures obtained through Shibori techniques. Drawing inspiration from waterfalls introduces dynamic and attractive visual elements to the study. The created of abstract patterns distinctly capture the thematic inspiration drawn from waterfalls, providing access to the movement and beauty of natural elements through textile patterns and establishing a close connection with the inspirational source.

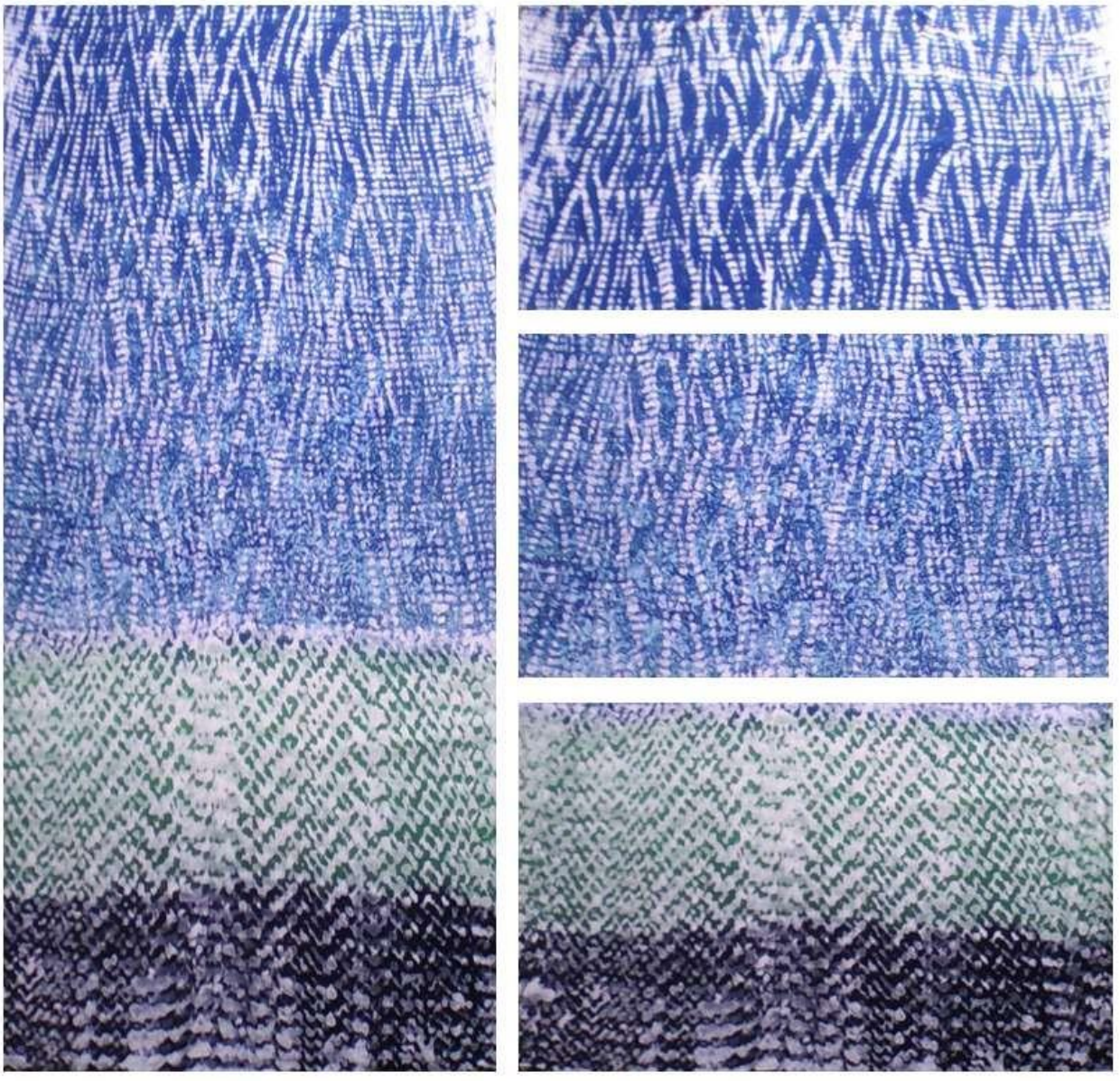

Figure 5: The results of abstract pattern designs of Batik Shibori through wax application technique.

This study has garnered recognition through various national competitions, including the Piala Seri Endon batik design competition organized by Yayasan Budi Penyayang Malaysia from 2003 to 2023. The competition is segmented into three categories: fashion, soft furnishings, and handicrafts. Contestants are challenged to showcase their creativity by producing high-quality batik designs that demonstrate research, technique, and commercial value. Figures 6 document the participation entries in the batik design competition of Piala Seri Endon 2015. The successful achievements and recognition garnered in this competition validate the acceptance and acknowledgment of this research study.

Figure 6: Artwork products and recognition from the batik design competition (fashion category) at the grand finals of Piala Seri Endon 2015- Consolation Prize.

Indeed, the combination of batik and Shibori techniques in this study has proven to be successful in creating textile in patterns that effectively reflect inspiration drawn from waterfalls. This achievement marks a significant contribution to the field of textile art, demonstrating the innovative potential of integrating traditional techniques with contemporary inspiration. The successful outcome of this study opens up avenues for further exploration and experimentation in textile design, encouraging researchers and artists to continue exploring the rich possibilities offered by combining different artistic approaches. Furthermore, expert feedback through this competition, providing qualitative insights into the aesthetic appeal and market viability of the patterns. This robust combination of aesthetic and technical evaluation criteria, underpins the assessment of the efficacy of integrating batik and Shibori techniques in creating waterfall-inspired designs. Overall, the success of this study underscores the creative synergy between traditional craftsmanship and modern artistic vision, paving the way for new directions in textile artistry.

5.0 CONCLUSION

As a conclusion, this study has successfully achieved its objectives by combining batik and Shibori techniques with inspiration drawn from waterfalls, resulting in captivating and meaningful abstract textile patterns. The integration of these techniques has led to remarkable success, striking a balance between traditional batik elements and experimental Shibori techniques to create unique and visually appealing aesthetic dimensions. The use of waterfalls as a source of inspiration has proven effective in imbuing the patterns with beauty, movement, and balance, adding profound natural elements to the textile artwork. This research significantly contributes to the development of textile art, not only within traditional contexts but also as a form of creative contemporary art.

The patterns generated have the potential to serve as sources of inspiration and exploration for researchers and textile designers alike. For future studies, researchers may consider exploring the application of different inspirational themes, such as local flora or fauna, to observe the effects and variations in the patterns produced. This could involve further experimentation with different techniques and inspirations, as well as an in-depth examination of how these patterns can be utilized within the textile and creative art industries. Additionally, continued research into batik and Shibori techniques could provide deeper insights into the potential variations and technical experiments that can be employed in textile art. In summary, this study has led to the creation of innovative textile patterns through the combination of batik and Shibori techniques inspired by waterfalls. This conclusion opens up opportunities for ongoing exploration and enhancement of artistic expression in textile art, paving the way for future advancements in the field.

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Exploring Resist Techniques for Repurposing Discarded Denim Fabrics

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Abstract. This study addresses the significant challenge of scalability in applying resist techniques to discarded denim fabrics for sustainable textile design. It presents a comprehensive examination of resist techniques employed in the treatment of discarded denim textiles. The primary aim of this research is to assess the feasibility of repurposing discarded denim materials through the exploration of various resist techniques, thereby facilitating the creation of distinctive and environmentally sustainable textile designs. The research methodology encompasses a thorough review of pertinent literature to identify key resist techniques, complemented by laboratory-based experiments involving the application of these techniques to samples of discarded denim fabrics. Experimental procedures include the acquisition of discarded denim fabric specimens from diverse sources and the application of specific resist methods, such as batik, shibori, and tie-dye, to these samples. Findings from the study reveal that the application of resist techniques to discarded denim fabrics yields aesthetically pleasing designs with significant artistic merit. Moreover, this process stands to make a constructive contribution to textile recycling initiatives and waste reduction endeavours. A detailed analysis of these findings entails an examination of the efficacy of different resist techniques and strategies for their optimization at a production scale. However, the scalability of these techniques remains a significant challenge, particularly in maintaining consistency and quality in mass production settings. Addressing this issue is crucial for the practical implementation of resist techniques in industrial contexts. The implications of this research suggest that the textile industry can harness the creative and sustainable potential of resist techniques in the treatment of discarded denim fabrics. This study serves as a foundational platform for further exploration into the development of environmentally conscious and innovative manufacturing processes. The study's conclusion emphasizes the imperative of adopting sustainable practices within the textile sector and posits that the exploration of resist techniques on discarded denim textiles represents a strategic stride toward fostering a more sustainable industry. Nevertheless, overcoming the scalability challenge is essential to fully realize the environmental and economic benefits of these techniques.

Keyword: Resist Techniques, Discarded Denim Fabrics, Denim, Sustainable, Textile Design.

1.0 INTRODUCTION

The contemporary textile industry grapples with significant challenges concerning environmental impact and waste management (Adamkiewicz et al., 2022). As sustainability gains increasing prominence, there is a pressing need for research to identify innovative solutions to address these pressing issues (Syed Shaharuddin et al., 2021).

In recent years, the textile industry has experienced considerable growth, resulting in heightened production levels and increased consumer demand (Rahman, 2023). Unfortunately, this surge in activity has been accompanied by a corresponding rise in textile waste, exacerbating challenges related to waste disposal (Jin et al., 2022). Denim fabrics, integral to the industry, emerge as significant contributors to the escalating textile waste crisis (Periyasamy, 2017). Despite efforts to implement textile recycling

initiatives, there remains a critical need for more imaginative and sustainable approaches to revitalize materials that have fallen out of use. While prior studies by Sandin & Peters (2018) and Juanga-Labayen et al. (2022) have predominantly concentrated on general textile recycling and waste minimization, there exists a noticeable gap in research specifically regarding the utilization of resist techniques on discarded denim fabrics. Hence, this study endeavors to address this gap by exploring the artistic and sustainable prospects associated with repurposing discarded denim textiles.

The principal aim of this research is to investigate the viability of employing resist techniques on discarded denim fabrics, with a focal point on sustainability and creative textile design. Through the identification of pertinent and efficacious resist techniques, this study aims to contribute towards shaping a novel paradigm in more eco-conscious textile manufacturing practices. With this context and objectives in consideration, the research seeks to address the following inquiries:

i. What resist techniques are suitable for application on discarded denim fabrics?
ii. How can the implementation of resist techniques on discarded denim fabrics enhance design aesthetics and sustainability aspects?

By tackling these research queries, the study endeavors to provide comprehensive insights into the potential benefits and challenges of integrating resist techniques into the treatment of discarded denim textiles, thus facilitating innovation within the textile industry. Consequently, this research holds critical significance in the context of devising sustainable and innovative approaches to mitigate textile waste concerns, while presenting a fresh outlook on the utilization of unused textile materials.

2.0 LITERATURE REVIEW

2.1 Resist technique in textiles

The literature review commences with an exploration of the fundamental concept of resist techniques within the realm of textiles. Resist techniques encompass methodologies whereby specific areas of fabric undergo treatment to impede or resist the absorption of dye (Che Ya & Shaharin, 2024). Among the commonly encountered resist techniques are those employing wax (commonly known as batik), binding (referred to as shibori), and a combination of binding and dyeing techniques (termed as tie-dye). Previous research has demonstrated that the application of these resist techniques yields distinctive patterns and textures on fabrics, thereby imbuing textile products with an artistic flair (Meng et al., 2023).

2.2 Application of resist techniques on denim

Despite the widespread utilization of resist techniques across various fabric types, a critical gap remains in fully understanding their application on denim. Denim, characterized by its distinct fiber properties and thickness, necessitates a tailored approach when employing resist techniques (Che Ya et al., 2019; Sanchez et al., 2021; Che Ya & Shaharin, 2024). While some previous studies have attempted to apply these techniques to denim, the inherent complexities of denim call for a more nuanced investigation. While previous endeavors have undoubtedly advanced our understanding of the process (Bhattacharjee et al., 2019), the existing body of research grapples with limitations, notably concerning the variability of techniques utilized and the selection of appropriate materials. These limitations represent crucial areas requiring further examination and exploration. A deeper analysis of the intricacies of resist techniques on denim is essential to unlock the material's full creative and sustainable potential within the domain of textile design.

2.3 Discarded denim fabrics and sustainability

As the awareness of sustainability continues to mount, the textile industry is increasingly focusing on implementing effective practices for managing textile waste. Notably, among the materials targeted for recycling and waste reduction initiatives, discarded denim fabrics emerge as a prominent concern (Rathinamoorthy, 2019). While some research has acknowledged the potential for repurposing discarded denim (Rodriguez, 2020; Eike et al., 2020), there remains a noticeable gap in exploring resist techniques applied to these specific materials. This study endeavors to address and bridge this knowledge gap by focusing on the application of resist techniques to discarded denim fabrics. While prior research has laid the groundwork for denim reuse, the specific utilization of resist techniques to enhance the creative and sustainable potential of discarded denim has received comparatively less attention. By venturing into this uncharted territory, the research aims to provide valuable insights and methodologies that can significantly propel the integration of resist techniques into the recycling and upcycling processes within the textile industry.

2.4 Relevance to sustainability and textile recycling

Research conducted by Riemens et al. (2021), Papadopoulou et al. (2022), and Zaman & Kusi-Sarpong (2023) extends beyond the immediate findings to examine their broader implications for overarching sustainability and textile recycling issues. Of central concern is how the application of resist techniques to discarded denim fabrics can align with ecological and economic sustainability principles. This inquiry is crucial given prior research emphasizing the need for innovative and sustainable approaches to address the urgent challenges associated with textile waste. As a result, this study is positioned to make a significant contribution to the development of more comprehensive and sustainable solutions.

At its culmination, the literature review identifies discernible gaps in the existing body of knowledge and establishes the rationale for the research endeavor. The notable absence of information regarding the application of resist techniques to discarded denim fabrics serves as a compelling catalyst for further investigation. By undertaking the exploration of resist techniques specifically on iconic materials like denim, this research aims to illuminate new synergies between innovation and sustainability within the textile industry. The integration of these elements not only promises to advance understanding of textile waste management but also to inspire fresh and holistic approaches to propel the industry towards a more sustainable trajectory.

3.0 METHODOLOGY

The research employs a comprehensive research design comprising a literature survey and laboratory experiments. The literature survey aims to identify the most relevant resist techniques, while laboratory experiments focus on exploring resist techniques specifically applicable to discarded denim fabrics. Adopting a laboratory experimental design enables precise control over the resist technique application process, facilitating systematic exploration and analysis of their impact on the characteristics of discarded denim fabrics. The study's samples consist of several discarded denim fabrics sourced from diverse outlets, including the textile industry and local textile recycling programs.

Sample selection criteria include considerations such as color variation, fabric durability, and other pertinent characteristics to ensure representativeness of the wide array of denim fabrics prevalent in the industry and society. Table 1 outlines the process of preparing treatment materials on the selected denim fabrics earmarked for exploration in this experiment.

Table 1: The process of preparing treatment materials.

Process	Method
Isolating 	Separating denim materials such as pants, jackets, skirts, and so on.
Soak and wash 	Denim materials are soaked in hot water and detergent powder to eliminate bacteria before being washed. After the soaking process, the denim material is washed.
Cutting 	Afterward, the selection of denim materials with potential is carried out through the process of patterning and cutting the required sections.
Fading and Washing 	The fading process is carried out on the relatively dark denim fabric to fade the original denim color, facilitating the application of resist techniques. Afterward, the fabric is immersed in vinegar to neutralize it, and then the fabric is washed with detergent and fabric softener.
Drying 	Drying is performed before the resist technique application process takes place.

Source: Che Ya & Shaharin, 2024, p. 5 & 6.

Table 2: Selected resist techniques for this experiment.

Technique	Procedure
Tie-dye 	Method of creating patterns by repeatedly dipping the fabric into dye several times. The patterns and color application designs are planned in advance. Wax or ties will protect the existing color from changing when dipped into the dye. The tying process is done on white fabric, and the dyeing process is repeated several times with different patterns to achieve a complete batik pattern.
Shibori 	Method of dyeing fabric with patterns by tying, stitching, folding, brushing, compressing, or covering. Arashi Shibori is also known as pole-wrapping Shibori. Fabric is wrapped around a pole, tightly bound with thread wrapping both above and below. Subsequently, the fabric is neatly tied to the pole.

Batik 	Method of patterning using batik canting. In batik technique, designers typically use canting to create patterns on fabric. Canting is used with wax to prevent color from entering specific patterned areas.

Source: Che Ya & Shaharin, 2024, p. 6 & 7.

The application of resist techniques involves several stages, starting with material preparation and the selection of suitable resist techniques. Table 2 shows some selected techniques explored in this experiment include batik, shibori, and tie-dye. Each technique is applied to the samples of discarded denim fabrics using methods detailed in the experiment protocol. Experiments are conducted in a controlled laboratory environment to ensure result consistency. Figure 2 shows the resist technique application process involves strict steps, including preparing treatment materials, resist technique application, coloring, drying stages, color fixing process and boiling fabric to remove wax and color fixative. Each stage is closely monitored and recorded to ensure that each sample receives uniform treatment.

Figure 1: Resist technique application process (Source: Che Ya & Shaharin, 2024, p. 7)

The collected data will undergo qualitative analysis tailored to the nature of the data obtained. Qualitative methods will be employed to elucidate the distinctive attributes of each resist technique. Throughout the experimental phase, an assessment of the sustainability implications associated with employing resist techniques on discarded denim fabrics will be conducted. This evaluation encompasses considerations such as chemical usage and the feasibility of repurposing denim fabrics within the framework of sustainable industry practices.

4.0 RESULTS AND ANALYSIS

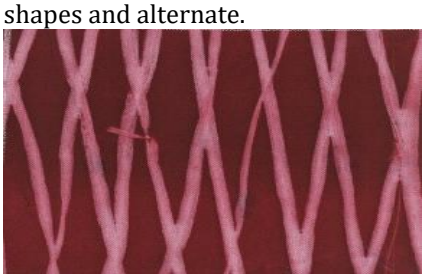
Prior to presenting the analysis results, it is imperative to provide a succinct overview of the discarded denim fabric samples utilized in this study. The sample set comprises 50 pieces of discarded denim fabric, exhibiting variations in colour, texture, and thickness levels. The selection process ensures the inclusion of diverse samples that mirror the spectrum of denim fabrics commonly encountered in industrial practices and textile recycling initiatives. Overall, both research objectives have been effectively achieved, with comprehensive addressing of the research questions.

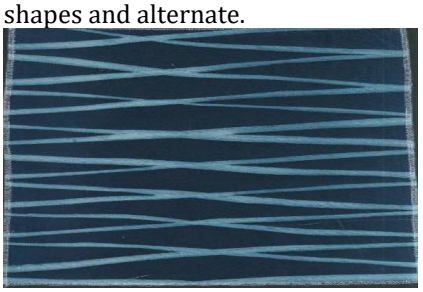
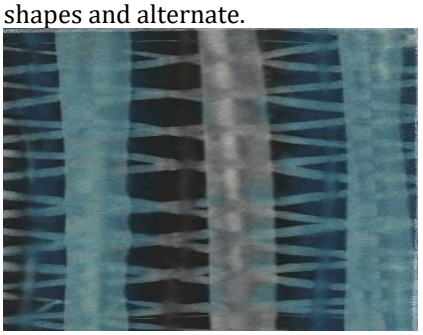
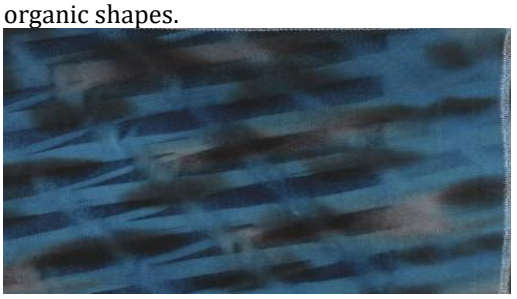
The exploration of resist techniques applied to the production of textile designs on various discarded denim fabrics has yielded positive outcomes. The successful application of resist techniques across different types of discarded denim fabrics signifies the realization of the research objectives. Furthermore, the study has not only met its primary goals but has also yielded valuable insights into the creative and sustainable utilization of resist techniques in textile design, particularly within the domain of discarded denim materials. These accomplishments underscore the research's significance in contributing to the existing body of knowledge and promoting innovative and sustainable practices within the textile industry.

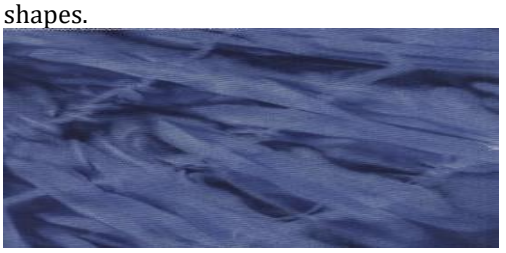
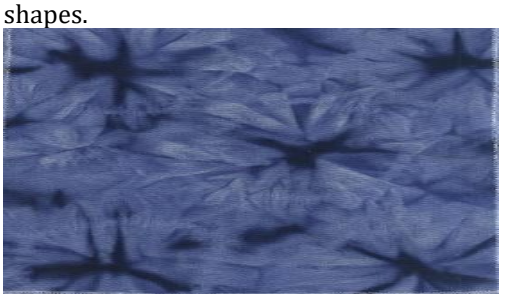
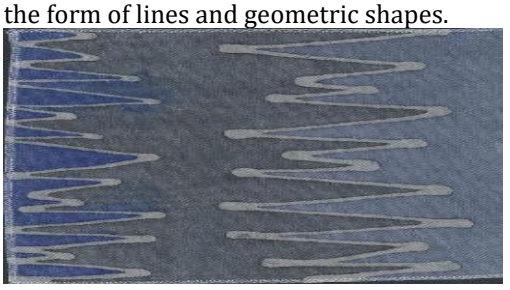
Table 3 presented the analysis of experiment results for 10 highlighted samples demonstrate the effectiveness of resist techniques, particularly batik (canting), shibori, and tie-dye, when applied to

discarded denim fabrics. These techniques yield variations in patterns and textures, resulting in visually appealing designs. Visual observations reveal that each resist technique imparts unique characteristics to the fabric, aligning with the application process. Qualitative analysis indicates that batik produces a smoother and neater resist effect, allowing for the formation of clearly defined lines and geometric patterns. Shibori, on the other hand, generates more organic and structured geometric patterns, imbuing the fabric with a unique handmade impression. Tie-dye, characterized by its organic and random features, adds an expressive and artistic dimension to denim fabrics. Statistical analysis of color intensity and pattern clarity measurement data confirms significant differences between these resist techniques. An evaluation of the sustainability of each resist technique during the experiments reveals that batik and shibori techniques are more efficient compared to tie-dye. Tie-dye involves a higher use of chemicals in the dyeing process, suggesting that batik and shibori may be considered more environmentally friendly when applied to discarded denim fabrics. These findings affirm the substantial potential of exploring resist techniques on discarded denim fabrics to create unique and sustainable textile products. The successful application of resist techniques also paves the way for the development of new designs applicable on a production scale. Ultimately, the conclusions drawn from this analysis reinforce the argument that repurposing discarded denim fabrics through resist techniques can positively contribute to textile recycling efforts and sustainable industry development.

Table 3: Analysis for the experimental results for 10 samples that have the potential to be highlighted.

No	Techniques and materials	Process	Outcome
01	Shibori Arashi Shibori (tie without restraining the fabric) Thick denim that has been melted.	Roll the fabric on a pipe at a diagonal angle. Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate to fix the color for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form geometric shapes and alternate. 
02	Shibori Arashi Shibori (tie without restraining the fabric) Thick denim that has been melted.	Roll the fabric on a pipe at a diagonal angle. Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate to fix the color for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form geometric shapes and alternate. 

03	Shibori Arashi Shibori (tie without restraining the fabric) Thick denim that has been melted.	Roll the fabric on a pipe at a diagonal angle. Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate to fix the color for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form geometric shapes and alternate. 
04	Shibori Wrapping Pleated Thick denim that has been bleached.	Roll the folded fabric onto a wooden dowel at a diagonal angle. Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate for color fixation for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form geometric shapes and alternate. 
05	Shibori Wrapping Pleated Thick denim that has been bleached.	Roll the fabric onto a vertical wooden dowel. Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate for color fixation for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form lines and organic shapes. 
06	Tie-dye Medium-weight denim that is not bleached.	Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate for color fixation for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form organic shapes. 

07	Tie-dye Medium-weight denim that is not bleached.	Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate for color fixation for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form organic shapes. 
08	Tie-dye Medium-weight denim that is not bleached.	Tie the fabric using raffia string as shown below. Ensure the ties are secured tightly. Color using reactive dye (remazol). Once the color is dry, untie the string and apply sodium silicate for color fixation for 8 hours. After that, immerse the fabric in hot water mixed with soda ash.	The color does not penetrate into the tied sections of the fabric. The resulting tied patterns form organic shapes. 
09	Batik (Canting) Medium-weight denim that is not bleached.	Canting (wax) Color with reactive dye (remazol). After the color is dry, apply sodium silicate for color fixation for 8 hours. Afterward, immerse the fabric in hot water mixed with soda ash.	Some areas where the wax has seeped out, allowing the color to emerge. The resulting canting produces patterns in the form of lines and geometric shapes. 
10	Batik (Canting) Medium-weight denim that is not bleached.	Canting (wax) Color with reactive dye (remazol). After the color is dry, apply sodium silicate for color fixation for 8 hours. Afterward, immerse the fabric in hot water mixed with soda ash.	Color does not seep out from the wax. The resulting canting produces geometric patterns. 

Source: Che Ya & Shaharin, 2024.

5.0 CONCLUSION

In conclusion, the synthesis of results and findings from the exploration of resist techniques on discarded denim fabrics underscores their effectiveness in creating unique and appealing designs. The experiment outcomes affirm that batik, shibori, and tie-dye techniques can be successfully applied to discarded denim, enriching its aesthetic and artistic potential. Each technique imparts distinct visual characteristics to the fabric, thereby contributing to the revitalization of unused materials. When compared with similar

studies, such as Che Ya & Shaharin (2024) who explored the application of resist techniques on various recycled denim, the findings align in demonstrating the artistic versatility and sustainability benefits of these methods. However, this study uniquely highlights the specific advantages of batik and shibori in terms of higher recycling potential with proper pattern arrangement on a discarded denim fabric, which were not extensively covered in previous research. This comparison not only validates the results but also provides a clearer understanding of the most effective techniques for sustainable textile production. This research significantly contributes to knowledge in textiles and sustainability by proposing a creative solution to textile waste issues and fostering opportunities for innovative design and sustainable production practices. By repurposing discarded denim fabrics through resist techniques, the study advances the concept of integrating art and sustainability in textile practices. Moreover, the sustainability implications of applying resist techniques to discarded denim fabrics are noteworthy. By considering factors such as chemical usage and recycling potential, the research suggests that certain resist techniques, such as batik and shibori, may offer more environmentally friendly alternatives compared to others. These insights are crucial for informing decision-making processes at both industry and sustainable textile-oriented manufacturer levels. Moving forward, recommendations for further action based on the research findings include scaling up the application of resist techniques, developing sustainable design-based products, and conducting more detailed environmental impact assessments. The comparative with prior studies suggests that focusing on optimizing batik and shibori methods could yield the best environmental outcomes and product quality. Additionally, the findings hold potential for creating a range of fashion, accessories, craft design products, interior decorative items, and textile artwork.

Lastly, reflecting on the research experience, it is important to acknowledge the challenges encountered, the lessons learned, and the anticipated impact of this study on guiding the future development of the textile industry. By addressing these aspects, the conclusion serves to encapsulate the significance of the research journey and its potential implications for advancing sustainable practices in the textile sector.

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TRACK 4: ELECTRICAL ENGINEERING

Optimizing Fertigation Efficiency: An IoT-EnabledApproach for Automated Water Sprinkler and Monitoring

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Abstract. Today's technological advancements have revolutionized daily living, particularly through the adoption of the Internet of Things (IoT). Traditional farming methods often lead to inefficiencies in fertilization, resulting in wasted time and resources. Therefore, the proposed solution addresses this challenge by introducing a monitoring and control system utilizing IoT technology. This paper explores the application of IoT in agriculture, specifically focusing on the innovative practice of IoT fertigation by the development of automated water sprinkler and monitoring system prototype. By integrating sensors for soil moisture, humidity, temperature, motion, and water sprinkler control, the system enables real-time monitoring and precise management of fertigation processes. Through Wi-Fi connectivity and a mobile application interface, farmers can remotely access and adjust parameters, ensuring optimal plant health and productivity. This paper presents a comprehensive overview of the proposed system's design and functionality, highlighting its potential to enhance efficiency and yield in modern agriculture.

Keywords: fertigation, IoT, farming, monitoring , fertilization

1.0 INTRODUCTION

The rapid development of information and communication technology (ICT) has created vast opportunities in the management of sustainable production and service operations, in which theInternet of Things (IoT) has played an important role. IoT has found widespread application across diverse fields to enhance production efficiency, particularly as ensuring food security becomes increasingly critical in light of the growing population. Technology adoption in agriculture becomes imperative, particularly in addressing various shortcomings, notably in manual fertilizer application (Deshpande, 2019). Traditionally, farmers who depend on traditional techniques run the risk of applying either too little or too much fertilizer. Excessive use can posture risks to both human health and soil quality, while insufficient application fails tomeet the plant's nutritional requirements.

In agriculture, IoT technology has been extensively employed to enhance farm operations, ushering in the era of "precision agriculture" aimed at making farms smarter and more interconnected (Jenal et al., 2021). Smart agriculture represents a cutting-edge approach to ensuring the production of safe and nutritious food. It involves the integration of new informationand communication technologies (ICT), particularly IoT technology into agricultural practices. In IoT-driven smart agriculture, a framework is developed that integrates diverse sensors and robots to oversee and manage various aspects including irrigation systems, fertilization, soil moisture, disease control, and more. This enables farmers to remotely monitor farm conditions and utilize sensors for efficient farming practices from any location. According to Zulhilmi et al., (2021), this application is being utilized to mitigate labor costs and time expenditure as water, fertilizers, labor, and energy stand as the primary inputs in agriculture, where their

efficiency of use and associated costs can either enhance or hinder the viability of agricultural operations (Ahmed et al., 2018).

In recent years, there have been various researches on Precision Agriculture (PA) that apply IoT technology. PA promotes efficient use of farm input resources, enables more sustainable production, prevents land degradation, and reduces production costs to increase agricultural yields. Although the research discovered that PA can be achieved by utilizing IoT, the widespreadadoption of IoT systems in farming encounters difficulties such as the substantial investment needed and farmers' limited computer literacy awareness. (Misra et al., 2022).

Therefore, to overcome these challenges, this paper is proposing a user-friendly monitoring system with an automated water sprinkler, powered by the Internet of Things (IoT), designed specifically for small-scale operations to optimize the fertigation efficiency. This system is intuitive and easy to use, even for farmers with limited computer experience where users enableto monitor and control their plants using mobile devices. By incorporating sensors to measure soil moisture, humidity, and temperature, as well as an automated water sprinkler for pesticide application, the system offers comprehensive control over essential parameters.

The rest of this research paper is organised as follows. Section 2 presents published related works, section 3 presents the development process of the prototype, the results and analysis arepresented in section 4 and finally, section 5 details the conclusion and future work.

2.0 RELATED WORKS

In this section, we present an overview of the previous studies available related to IoT applications in PA. Through a comprehensive examination of previous research, we analyze the dimensions explored, the methodology used and the findings obtained in leveraging IoT to improve production management and operations in agriculture. By analysing existing knowledge, this review aims to provide a basic understanding and identify important parameters for furtherresearch.

Zubair & Adebiyi (2022) in the study developed an IoT-based automatic fertigation system, whichinvolves deploying controlled nutrient delivery to crops using data from soil sensors. Positioned around the plant's root area, these sensors feed information to a microcontroller that monitors soil conditions and tailors' water and nutrient supply for each plant. Employing a drip irrigation setup, the system delivers water and nutrients efficiently, optimizing resource utilization for enhanced economic gains and reduced environmental footprint. This automated process enhances crop yield, minimizes human error and labor, and encourages sustainable agricultural practices by efficiently allocating resources according to crop requirements.

Ahmad et al., (2022) developed the IoT-based irrigation and fertilization system to effectively manage water and nutrient resources in agriculture. It tackles labor-intensive tasks by automating valve control and monitoring plant growth status. Harnessing IoT technology, the system optimizes water usage, delivering precise amounts tailored to each plant's needs. This conserves water while ensuring adequate irrigation. Moreover, the system considers the relationship between crop water stress and soil water deficit for optimal irrigation scheduling, enhancing resource efficiency. By integrating IoT features, this intelligent system fosters sustainability in agriculture, curbing water waste and enhancing overall water and nutrient resource management.

Md Zailani, M. Z., & Jumaat, S. A. (2021) proposed a soil moisture monitoring system for fertigationvia IoT application. This system integrates smart devices and IoT technology to assist farmers in efficiently managing their plantations. By utilizing IoT sensors embedded in the soil and leveraging the user-friendly Blynk application, farmers gain access to real-time soil moisture data. Particularly useful for outdoor crops impacted by sunlight exposure, this system enables continuous monitoring, allowing farmers to grasp their crops' water needs accurately. Informed irrigation decisions are made possible through the system's

analysis of sensor data, aiding in precise estimation of crop water stress and soil water deficit. Consequently, farmers can optimize irrigation schedules for improved plant growth and resource utilization.

Lin et al., (2020) proposed IoT-based fertigation management system for sustainable precision agriculture to monitor environmental conditions and crop growth in real-time, offering effective control over agricultural production. Leveraging IoT technology, the system continuously monitors environmental factors such as temperature, humidity, and light intensity, along with crop growth indicators like plant height and leaf color. This real-time data empowers farmers to make informed decisions on irrigation and fertigation. The system ensures precise nutrient delivery by accurately measuring fertigation solution concentration and pH levels, providing crops with tailored nutrients for optimal growth. Moreover, it optimizes water and fertilizer distribution across multiple crops throughout their growth stages, maximizing economic returns and environmental benefits. By merging IoT with precision agriculture techniques, this fertigation management system enhances resource efficiency, crop productivity, and environmental sustainability in agriculture.
Raut et al., (2018) developed the IoT-based soil monitoring, fertigation, and irrigation system for agricultural purposes to automate irrigation while monitoring key soil macronutrients - nitrogen (N), phosphorus (P), and potassium (K). Its goal is to streamline farming operations, saving farmers time, money, and energy by reducing manual intervention and optimizing resource usage. Soil sensors detect temperature and humidity changes, transmitting data to an ARM 7 Processor for analysis. Based on preset thresholds or algorithms, the processor triggers appropriate actions. Moreover, the system can send real-time updates via email through IoT, providing users with immediate soil condition and nutrient level information. This integrated system facilitates efficient irrigation, precise fertigation, and continuous soil parameter monitoring, equipping farmers with insights for effective crop management and resource allocation.

Based on the previous study, IoT technology optimizes the efficiency of fertigation in agriculture by enabling real-time monitoring of the crop environment. By integrating IoT sensors into the soil and around plant roots, the system can continuously collect data on soil moisture, temperature and other relevant parameters. This real-time information enables the precise supply of water and nutrients to be tailored to each plant, thereby ensuring that plants receive the resources they need for optimal growth. In addition, IoT technology facilitates accurate measurement of fertigation solution concentrations and pH levels, leading to appropriate nutrient flow for specificplant needs. Overall, IoT technology enhances fertigation efficiency within the agricultural sectorthrough the provision of real-time data facilitating precise resource allocation. This, in turn,
results in delicate crop productivity and promotes environmental sustainability. Figure 1 shows the framework of how IoT technology can optimize the fertigation efficiently.

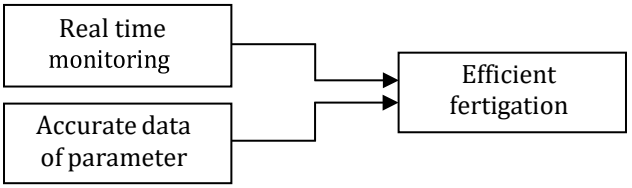

Figure 1: IoT framework for efficient fertigation optimization

3.0 MATERIAL AND METHOD

The integration of Internet of Things (IoT) technology into agricultural practices, especially through innovative approaches such as IoT fertigation, represents an important advance in modern agricultural methodology. This section outlines the methodological framework used to investigate IoT applications in agriculture, with particular emphasis on the design and functionality of the proposed IoT fertigation system.

3.1 Prototype Development

Figure 2 describes the block diagram of the project, defining the input, processing, and output stages. The subsequent output comprises a water pump, relay, and mobile devices, empowering users to monitor and regulate the dispensation of water and application of pesticides. This control is facilitated through the utilization of the Blynk application, leveraging data collected from the aforementioned sensors.

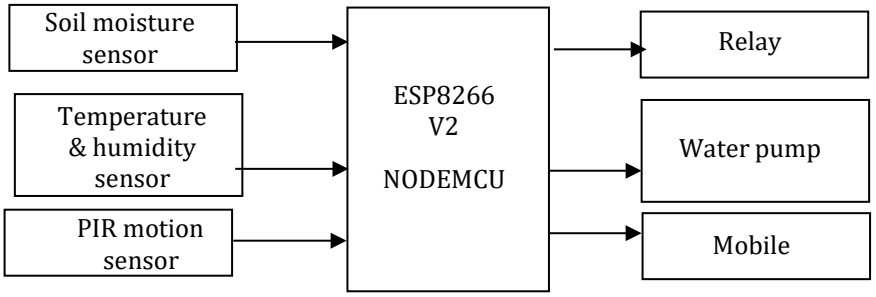

Figure 2: Block Diagram

Figure 3 shows the flowchart on how the automated water sprinkler is functioning. The water pump activates upon confirmation of connections between the soil moisture sensor and the DHT11 temperature and humidity sensor. Upon detection of sensor readings by the serial monitor, the data is stored; otherwise, the system undergoes an automatic restart. Subsequently, the system continuously monitors the soil moisture reading. If the reading falls below 50% of the threshold value, the water pump is automatically activated.

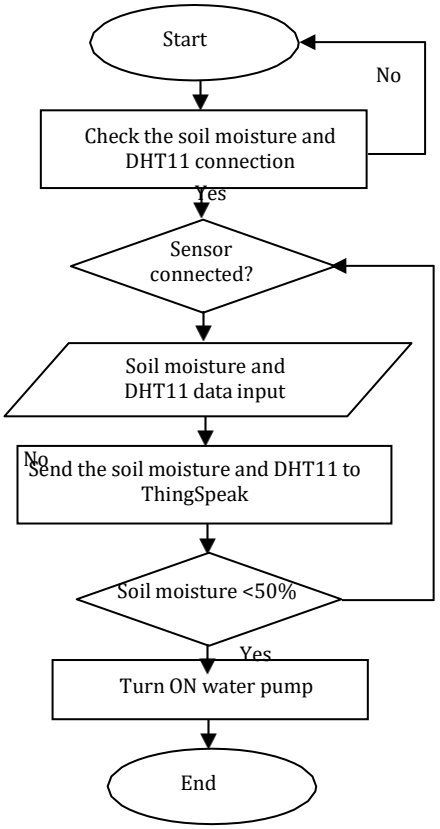

Figure 3: Automated Water Sprinkler Flowchart

3.3 Technical Resources (Hardware and Software)

The development of an IoT fertigation system prototype involves several key components. This includes an ESP8266 V2 NodeMCU CP2102 microcontroller for processing and connectivity, a capacitive soil moisture sensor to monitor soil moisture levels, a DHT11 temperature & humidity sensor to track ambient conditions, an HC-SR501 PIR motion sensor module to detect movement, a 2-channel 5V relay module to control external devices, 5V Arduino IIC 12C 1602 16x2 LCD for user interface, and R385 DC 12V pneumatic diaphragm water pump motor for water delivery. These components collectively enable the system to automate the irrigation process, optimize crop growth and increase agricultural productivity. Real-time monitoring data is crucial for providing accurate irrigation and nutrient recommendations within the fertigation system. Thus, the combination of Blynk and Arduino has been employed to fulfill this need. Blynk serves as an intuitive IoT platform, enabling users to create customized mobile applications for monitoring and controlling connected devices. With its user-friendly interface and cloud-based infrastructure, Blynk allows for real-time visualization of sensor data and remote device management from smartphones or tablets. Arduino, on the other hand, provides the hardware backbone for the system, offering computational power and interfacing capabilities for sensor data acquisition and actuator control. Together, Blynk and Arduino facilitate the creation of a versatile and efficient IoT fertigation system, capable of optimizing irrigation processes and enhancing agricultural productivity.

3.4 System Testing

The testing process focuses on validating the accurate control of fertigation, including the dosing mechanism and irrigation schedule, to maintain optimal soil moisture levels. Additionally, it involves verifying the system's IoT connectivity and communication capabilities to enable remote monitoring and control. Through rigorous testing and prototype iterations, the system can be fine-tuned for reliable and efficient operation, providing an effective solution for automating the fertigation process in plant cultivation. To gather insights into the outcomes generated by the prototype, data has been collected through observation. There are three observations been employed which are observation through soil moisture sensors, utilizing observation via temperature and humidity sensors, and employing observation using PIR motion sensors. The data has been collected by monitoring the soil moisture sensor, Blynk app, and water pump status. The observation process is carried out several times to ensure that the data is accurate, consistent, and properly timestamped.

Exploratory analysis has been employed for the data analysis involves visualizing and summarizing data to identify the patterns and relationships between parameters identified. The summarize data has been presented in table.

4.0 RESULT AND ANALYSIS

This research delves into the implementation and efficacy of an prototype approach aimed at optimizing water usage in agriculture. Specifically, it focuses on the utilization of a water pump control system facilitated by IoT technology to regulate soil moisture levels. The system's functionality hinges on the integration of a soil moisture sensor, a polybag housing a sapling, and a mobile application interface. In the subsequent sections, we present the results obtained from our approach. We analyze the impact of soil moisture regulation on water pump activation and sapling health.

4.1 Blynk application for facilitating the user-friendly monitoring system

Figure 4 shows the developed prototype and Table 1 presents the specifications of the prototype. Utilizing Blynk, a mobile application which designed with user-friendliness, particularly benefiting farmers with limited computer proficiency. It enables real-time monitoring of soil moisture, humidity, and temperature parameters. Furthermore, through the Blynk app, remote control over water and pesticide quantities is facilitated. Therefore, the monitoring of crops is more efficient.

Figure 4: Prototype from top and side view

Table 1: Prototype spesification

Descriptions	Details
Product function	Automated through the Blynk application, this system efficiently waters crops, monitors soil moisture post-watering, and tracks temperature during fertigation and pesticide spraying processes.
Targer user	Farmer

4.2 Optimizing Water Pump Performance Relative to Soil Moisture Levels

Table 2 illustrates how a water pump's condition and the effectiveness of soil moisture are impacted by activating the innovation prototype. This project involves placing a soil moisture sensor inside a polybag containing a plant. The Blynk app displays the soil moisture value obtained from this setup. Based on the sensor's readings, the water pump adjusts its status accordingly. If the soil moisture reading exceeds 50, the pump turns off. Conversely, if the readingfalls between 0 and 40, the water pump activates, as per the scheduled watering of three times a day.

Table 2: Soil moisture vs water pump condition

Soil Moisture Value	Results (Water Pump Condition)
Between 0 and 40	ON
Above 50	OFF

Result obtained from the observation which employed to assess the performance of water pumps in response to soil moisture levels. This monitoring process is facilitated using the Blynk application, accessible via mobile phones as shown in Figure 5.

Figure 5: Soil moisture value

4.3 Optimizing Water Pump Performance Relative to Temperature and Soil Humidity

Referring to Table 3, it depicts the status of the water pump and the temperature and humidity readings in the fertigation crop area when the prototype is activated. This setup involves placing temperature and humidity sensors in the crop area to monitor its conditions. Through the Blynk app, users can view real-time temperature and humidity values. Subsequently, the water pump adjusts its status based on these readings. For instance, if the temperature falls within the range of 20°C-25°C, indicative of rain, the pump turns off. Conversely, if the temperature ranges between 30°C-33°C or exceeds 33°C, the pump activates in accordance with the scheduled watering times, set at three times a day.

Table 3: Temperature and humidity readings vs water pump condition

Temperature and Humidity Value	Results (Water PumpCondition)
Between 20°C-25°C	OFF
Between 30°C-33°C	ON
Above 33°C	ON

4.4 Motion-Responsive Notification

Referring to Table 4, it illustrates the status of the PIR motion sensor. Upon detecting motion, the microcontroller initiates two types of notifications. Firstly, it sends an immediate alert to the Blynk mobile app through the Blynk IoT platform, utilizing a notification widget within the app. Additionally, it utilizes an email notification system to send alerts to a designated email address using protocols like SMTP. This dual notification system enables users to receive real-time updates on detected motion via both email and the Blynk app, thereby enhancing the monitoring capabilities of the PIR motion sensor setup. The notofications are shown in Figure 6.

Table 4: PIR motion sensor vs notification

Motion detection	Results (Water PumpCondition)
Object detected	Get notification
No object detected	Not getting notification

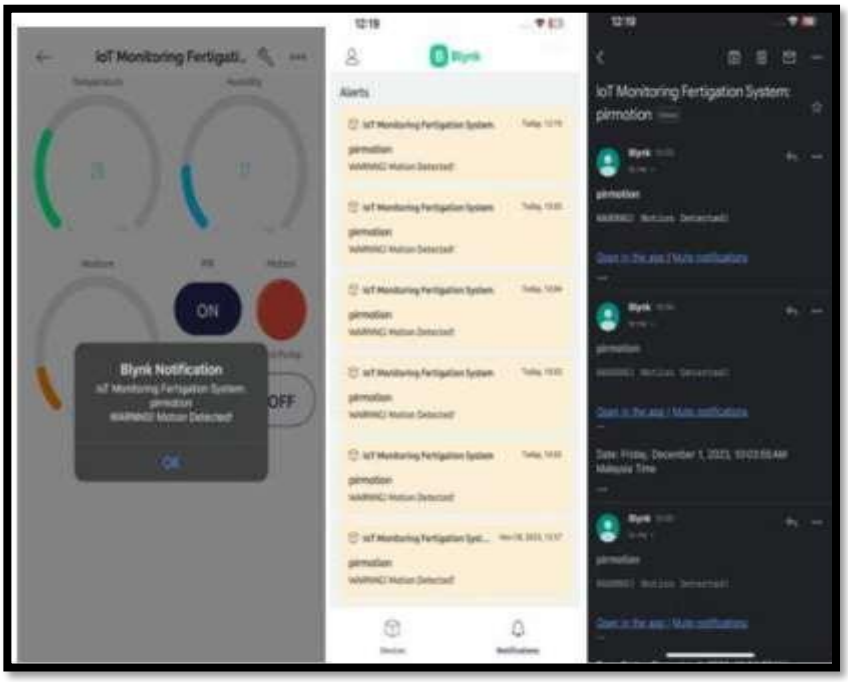

Figure 6: Notifications received via email and Blynk

The results of this prototype clearly demonstrate the successful attainment of its objectives. Based on the results, the integration of Internet of Things (IoT) technology has streamlined crop environment monitoring and control, accessible through mobile phones, thus benefiting farmers with limited computer literacy. Utilising the Blynk application has efficiently regulated water delivery relative to soil moisture, temperature, humidity. While, motion sensors have enhanced understanding of crop performance and any disturbance.

The findings underscore the substantial impact of IoT technology on enhancing crop management practices, particularly in improving monitoring and control efficiency. This conclusion is reinforced by the research conducted by Ahmad et al., (2022), which demonstrated that IoT technology effectively enhances fertigation efficiency by customizing irrigation and fertilization schedules according to plant-specific requirements, complemented by real-time soil moisture monitoring. Furthermore, Nyakuri et al., (2022) have validated the efficacy of fertigation through the development of a system integrating IoT and AI techniques. This system dynamically evaluates soil nutrients and moisture levels, resulting in a data-driven agricultural framework that optimizes water resource utilization. Thus, IoT emerges as a critical tool for maximizing fertigation efficiency. Additionally, studies by Zubair & Adebiyi, 2022), Zulhilmi et al., (2021), Linet al., (2020) and Raut et al., (2018) further verify the positive impact of IoT technology on fertigation efficiency in agriculture. These studies highlight how real-time data provided by IoT systems facilitates accurate resource allocation, leading to increased crop productivity and enhanced environmental sustainability.

Overall, this prototype presents a solution for implementation in fertigation systems. An IoT fertigation system offers farmers an efficient tool to enhance crop productivity while mitigating resource wastage. By leveraging sensors, real-time data, and remote monitoring capabilities, farmers can accurately assess soil moisture and nutrient levels, adjust fertilizer application rates accordingly, and prevent instances of over or under-fertilization. Moreover, integrating mobile connectivity enhances accessibility and usability, allowing farmers to manage their systems conveniently and access historical data and support services while on the move. Ultimately, an IoT fertigation system empowers farmers to make informed decisions, optimize resource utilization, and achieve higher crop yields, thus contributing to a more profitable and sustainable agricultural sector.

5.0 CONCLUSION

In conclusion, the amalgamation of IoT technology with agricultural practices presents promising avenues for efficiency and sustainability agriculture. Through the findings presented and supported by previous research, it is evident that IoT holds significant potential in optimizing fertigation processes by tailoring irrigation and fertilization practices to the specific needs of crops. By harnessing real-time data and automated control mechanisms, farmers can make informed decisions that maximize crop yield while minimizing resource wastage.

Moving forward, continued exploration and adoption of IoT solutions in agriculture are essential for addressing the challenges of food security and environmental sustainability in an increasingly dynamic and interconnected world. Exploring the integration of IoT and artificial intelligence (AI) technologies holds great potential. Embracing these advancements is poised to transform agricultural practices, ushering in a future characterized by enhanced resilience and productivity.

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Implementation Intelligent Letter Box using Blynk Applications

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Abstract. Intelligent letterbox using Blynk App is a system that sends reminders through a shortmessage system. This system was created to make it easier for high area housing residents to receive a short message via Blynk app if the letter or parcel goes into the box. In addition, this system also allows there to save their time than often to check their mailboxes. This system is very important to ensure product quality and to ensure that the journey in the implementation of this project always runs smoothly. This system uses several components such as Node MCU ESP8266, TCRT5000 Infrared Module and Infrared Obstacle Avoidance Sensor. If the mailboxes are full, they will receive message via Blynk app and take the letter or parcel sent by the shipment.In conclusion, this system is very useful for the high area housing resident to make it easier for them to get reminders about their parcel.

Keywords: Arduino, Node MCU ESP8266, Infrared Obstacle Avoidance Sensor, Blynk App.

1.0 INTRODUCTION

According to Chinnasami (2022) Internet Of Things (IOT) is one of the five main technologies that support the development of industry 4.0. Arduino is widely used in IOT (Internet of Things) applications to connect between machines/object or between humans/machines and humans via the internet. It allows many smart objects to sense the condition or activities of the surrounding environment, sending data to the internet for automatic monitoring or control. IOT microcontrollers, also known as development boardslike Arduino, are low-power devices that support a variety of programming conditions, making them excellent prototype solutions. Microcontroller is used to accumulate sensor data and then sends it to a local or online server. Arduino boards, such as the Node MCU ESP8266, are widely used for Internet of Things applications because of their built-in Wi-Fi capabilities (Tri Sulistyorini, 2022)

A large of research done using Node MCU, a few works are presented that (Jalil et al, 2021) describes the implementation of vehicle ventilation system using Node MCU ESP8266 for remote monitoring. Moreover, (Kamna Singh and Deepa Bura, 2020) presents different algorithms for the connection between different types of sensors like IR sensor, Ultrasonicsensor, temperature and humanidity sensor with Arduino IDE using Node MCU. Beside (Mariza Wijayanti, 2022) and (Satria, 2022) works when the Blynk application to activate or deactivated the door lock solenoid sensor to measure the room temperature. However, (MacHeso et al, 2021) set the Node MCU outputs for home automation and displays sensor data on a Node-RED dashboard from the sensor node made by interfacing Node MCU ESP8266 and DHT 22 with LED. Researcher (Yuliantoro) et al, 2021) discusses the use of P5 RGB LED panels and Node MCU ESP8266 microcontroller with the PxMatrix library to create real time signboards. The paper mentions that the NodeMCU is not suitable for largepanel configurations but works well with small panels. In addition, (Ayu Agustini, 2021) determine the amount of electrical energy consumption every day. This IOT based monitoring tools uses the PZEM-004T sensor to read the amount of electrical

energy consumption such as voltage, current, power and energy. Meanwhile (Nonthaputha et al. 2020 used two Arduino boards, node MCU, buzzer for warning in the abnormal situation and mini-CNC for automatic signing, keypad and relays. However (Barai Suvankar et al. 2017) using the RSSI technique with this Node MCU to estimate the distance between two nodes. The authors collected 300 RSSi sample values and used curve fitting to find a suitable equation for distance estimation, achieving an average error level of 8.32%.

2.0 OVERVIEW OF NODE MCU

The module is mainly based on ESP8266 that is a low-cost Wi-Fi microchip that has a microcontroller and TCP/IP networking software built in (Al Dahoud A, Fezari M, 2018). The module was were performed following a well establish basic TCP/IP connection and connect to Wi-Fi protocol; into these devices to make them compatible with internet (Singh Parihar Y, Pariha, 2019).

2.1 TCRT5000 Infrared Module

An infrared (IR) sensor module liked the TCRT5000 for proximity detection and obstacle avoidance. This will lead to a light-sensitive transistor called a phototransistor and a distributed infrared emitter, usually an infrared LED, packaged in a box. Its basic operation involves the emission of infrared light, which is followed by the detection of light that is reflected back to the phototransistor, increasing its conductivity, and producing an electrical signal (Mustapha B, Zayegh A. Begg R, 2014)

2.2 Infrared Obstacle Avoid Sensor

Infrared sensors use light emission from an emitter to identify objects in theirsurroundings. Motion and object access are both possible with an infrared sensor. Overview of Blynk App, this section introduces the Blynk App, a platform that allows you to create Internet of Things applications without knowing a lot of programming. With Blynk, users can utilise a smartphone or tablet to remotely operate projects that are built on Arduino. The procedure for integrating Arduino with the Blynk App, which involves setting up the hardware and software and installing the Blynk library.

3.0 METHODOLOGY

Block diagrams in Figure 1 shows the overall functioning of the system. The primary processor is the ESP8266, which receives its measurement data from the DHT11 sensor via pins D2 and D1. Pins D2 and D1 on the ESP8266 will receive the sensor's data and measurement results. The required libraries for the Node MCU ESP8266 board are installed in Proteus 7 and the Arduino IDE in order to code the Node MCU (Bento Antonio, 2018). Next, afirmware programme is written to enable the Node MCU to read the digital output obtainedfrom the TCR5000 module. then a setting that is suitable for writing and uploading the programme to the Node MCU (Avi, A M, Rana, M S Bedar, M. B Talukkder 2023).

The code is uploaded to the Node MCU for obstacle detection testing, and the result is viewed by opening the serial monitor. When the Node MCU notices an object in front of the sensor, it should print, "Obstacle detected." Once the obstacle is detected, implement actions to avoidthe obstacle. Modify the code to include additional logic and control mechanism based on the detected obstacle. Enhancements the system by adding more sensors for a wider detection range or more complex obstacle avoidance behaviors. Integrate other components like motors or servos to enable physical movement based on the detected obstacles. Implement measures to avoid the obstacle as soon as it is identified. On the basisof the barrier that has been detected, modify the code to add more logic and control.

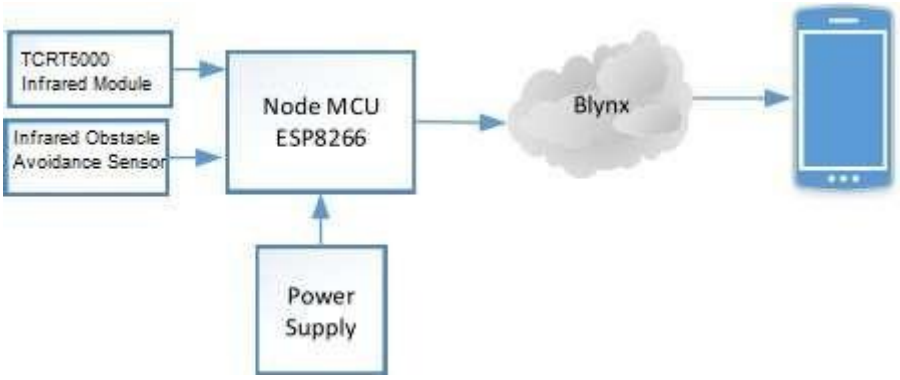


Figure 1: Block diagram of project Node MCU ESP8266

3.1 Schematic Diagram

Figure 2 shows how the schematic diagram detects the letters or parcels. The project makes use of IR sensors (IR tracker and obstacle sensor) with Node MCU, which operate ona 5volt input source and connect the GND pin of TCR5000.

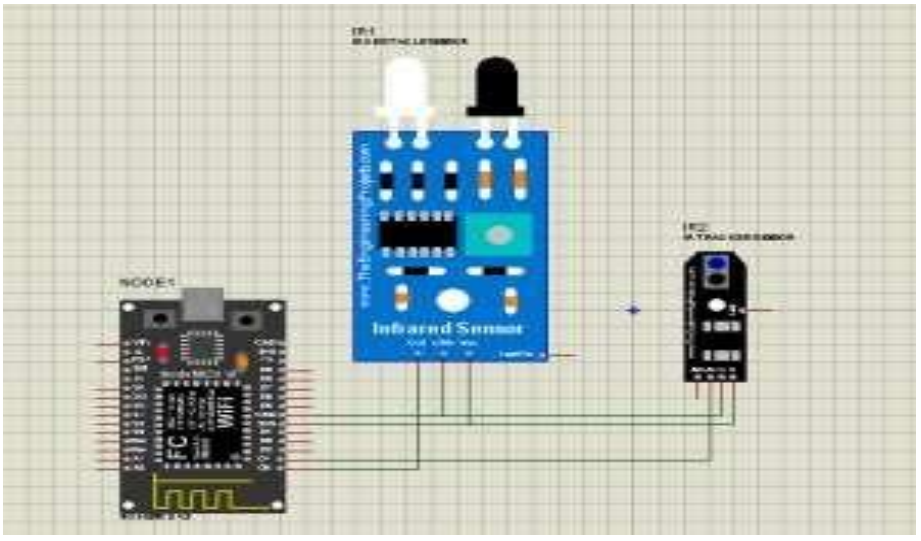


Figure 2 : IR Sensor Connected with Node MCU

3.2 Flowchart

The functional project flowchart is depicted in the Figure 3. The power supply switch needs to beturned on first. Letters or parcels placed in the mailbox we created are detectedby a sensor. The client's smartphone will then receive the information that the sensor hasdetected. A letter or package has been left in the mailbox, according to Blynk Apps.

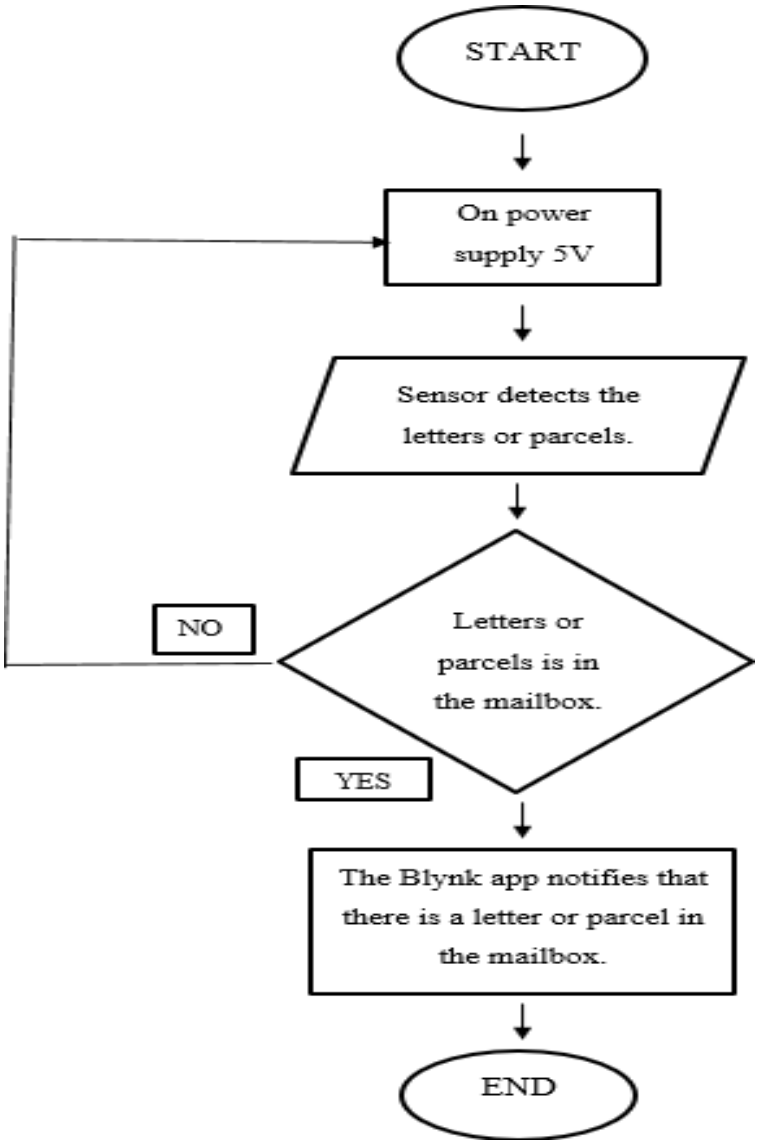
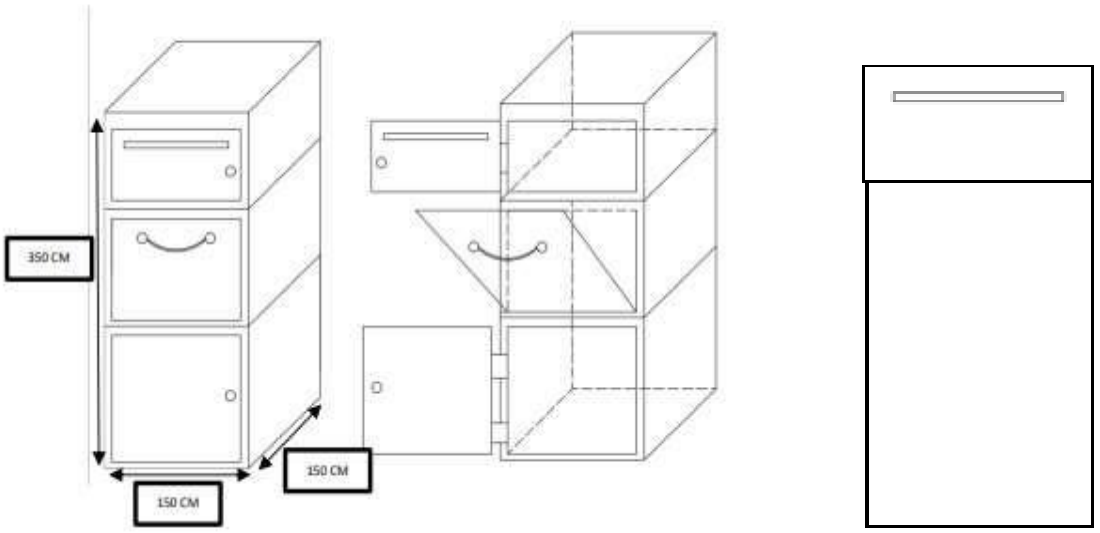


Figure 3: Flowchart of functional project

4.0 RESULTS AND APPLICATION AREAS

The project application is seen from the exterior of buildings, including homes, offices, andother spaces. The optimization of delivery routes, inventory control, and general logisticsefficiency for delivery services are all aided by the analysis of mailbox usage data. Safe places to drop off and pick up items for a variety of uses, such returning rental equipment or delivering meals. The hardware is designed by sketching up the box which is shown in Figure 4 above. The front side is shown in Figure (a), the inside view shows in Figure (b) and the back side is show in Figure (c). It has three door drawers up front for parcel delivery and mail, howeverthe inner drawer can only hold a maximum of 150 cm by 150 cm in parcels at the bottom.



(a) (b) (c)

Figure 4: Sketch design of the project

Figure 5(a) and (b) is the front side and the side view of the box. It is detected object in twopart for receiving mails and parcel posts. The dimension of the parcel post is 150cm x150cm.However, the implementation of the automatic detection object is shown in Figure 6, where there is a notification on user phone screen. The front side of the box is shown in Figure 5(c)that has a key to open the door to get the parcel post and the mails by the customer. Moreover, the box is made by wood that safe from damage. In addition, the box is constructedfrom damage-resistant wood.

(a) (b) (c)

Figure 5 : Picture of the project from the (a) fron view (b) the side view (c) Insideview

Table 1 summarizes some technical specifications of the sensors used in this research (Purnomo B et al., 2023; Muhd Zain et al., 2024). Because the sensors will be positioned within the door, the weight, specifications, and interfaces of the sensors to an Arduino are crucial to this study.

Table 1: Technical specification of product

Description	Details
Blynk Apps	Software
Postbox	Hardware
Box color	Black and brown
Product box	Wood
Gross weight	10kg-15kg (approx..)
Product dimension	350cm x 150cm x150 cm
Power rating	5V

Blynk App notified when a letter arrives in the mailbox. After inserting a letter into the mailbox, the Blynk app notifies the user when the mail is detected by the IR sensor to the letter's existance through email alert. In order for consumers to be aware that a letter in the mailbox.

Figure 6 : Notification that appears on user phone screen.

4.1 Future Scope

After this project is finished, several techniques have been suggested for future emphasis in order to facilitate improvement. Smart mailboxes should be weather-resistant to protect mail and packages from the elements, including rain. Look for variants with sufficient weather scaling and sturdy construction.

5.0 CONCLUSION

This paper introduces an intelligent letterbox powered by Arduino that can receive parcel for individuals who are forgetful. This letterbox suggests the Intelligent Letterbox initiative,which will help users reduce the loss of important parcel or mail. The Intelligent LetterboxAssembly will help users by keeping any bills or mail closer at hand. This is so that when the letterbox notifies the user of the mobile application that their parcel or letter has arrived, they will be reminded of it. With an efficient WIFI connection, the clever Letterboxwill function and send notifications through "Blynk" apps. The box measures 350 x 150 x 150 centimetres. The smart box's design incorporates a wooden parcel post that requiresa key to access the door.

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An Electronic Tourism Information Player Utilizing DFPlayer for Application on Tourist River Cruise Boats

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Abstract. The tourism sector has played a pivotal role in contributing to Malaysia's economy and development. This industry not only attracts international visitors but also brings significant benefits to local communities. One key aspect of tourism in the country is the regional tourist boat service, which capitalizes on the captivating biodiversity along Malaysia's rivers. For local tourist boat operators, a notable challenge arises in effectively delivering tourist information to passengers aboard the boats. Traditionally, this has been done by the boat owner, who acts as thetour guide. Recognizing this issue, a solution was developed in the form of a voice recording player. This innovative device utilizes common electronic components and incorporates user-friendly features. The device comprises key components such as the DFPlayer mini connected to the Arduino Uno, a voltage regulator, a 12VDC battery, the TDA2822M Amplifier, and a horn speaker.The results of the project development demonstrated that the device functions effectively, allowing passengers to hear audio content at distances ranging from 5 to 20 meters. The audible sound level varies between 41 dBA to 84 dBA, depending on the adjustment scale's strength on the device and the suitability of the boat's length.

Keywords: Tourism information device, river cruise boat, DFPlayer.

1.0 INTRODUCTION

Travel and tourism, a vital sector contributing to Malaysia's economic success, has been asubject of profound analysis and reflection. Drawing insights from the Annual Report of the Ministry of Tourism, Arts, and Culture (MOTAC) for the year 2022, it's evident that the tourism sector has demonstrated significant prowess in bolstering the nation's economiclandscape. According to the MOTAC report, the tourism sector yielded an impressive revenue of RM29.70 billion during the period from January to December 2022. This substantial figure is coupled with a noteworthy influx of tourists, recording a total of 10.07 million arrivals to Malaysia within the same timeframe. Such statistics vividly underscore the pivotal role of the tourism sector in fostering economic development within a nation. One of the tourism sub-sectors that may have been overlooked in driving the country's economy is the river tourism industry. Prideaux and Cooper (2009) assert that rivers serve as significant tourism resources, offering breathtaking scenery, recreational opportunities, andpicturesque waterfronts in numerous tourist hubs. They also functionas transportation arteries andvital water sources for human consumption. Throughout history, the world's great rivers have fascinated travelers, serving as prime destinations for exploration and adventure. Notably, water adventure tourism, including activities like water rafting, river cruising, fishing, and kayaking, presents exciting opportunities for attracting tourists and potentially fostering development in specific areas (Nasarudin & Bahar, 2013).

A case study conducted by Badaruddin Mohamed, B. M. in 2012 reveals the critical importance of preserving river ecosystems, particularly mangrove areas, in Malaysia. This preservation is vital as itnot only attracts various related industries such as fish farming,sports tourism, floating restaurants,and recreational boating but also suggests necessarysteps to prevent further deterioration of the physical environment. The emergence of secondary economic sectors from the tourism sub-sector can provide added financial value to residents. However, failure to maintain river ecosystems could lead to a reductionin the number of tourists engaging in river tourism activities. One of the possible reasonsfor the lack of support for tour boat operators, especially due to the absence of tourists, particularly during the COVID-19 pandemic. Additionally, there are tour boats that receive little attention from tourists, possibly due to their lack of attractiveness, making this sector rather bleak and quiet. Many of the tour boats operated by local entrepreneurs in Malaysia only offer water-based travel services without providing information about the situation or background behind the river routes. This can lead to boredom for visitors seeking relevant information. If there is a tour briefing, it is usually conducted by the boat operators themselves, and the frequency of these briefings for each tour session can be tiresome and may render the information delivery ineffective.

Therefore, a specialized innovation product has been developed to facilitate tour boat operators in providing tourism information while cruising the rivers with tourist boats. The project aims to introduce a tourism information sound player specifically designed for tourist cruise boats. This initiative was undertaken to aid tour boat operators in delivering recorded voice narrations about tourist attractions along the route. The tour boat driver simply needs to press a button on this device, and it will play the pre-recordedaudio. Additionally, a microphone is integrated into the device. Thisproject utilizes an Arduino microcontroller connected to the DFPlayer as its main component. This project has outlined several objectives, which include building a voice recording player device capable of capturing and playing audio descriptions relevant to the tourist experience during a river cruise. Additionally, the project aims to develop a portable device with minimal cost, user-friendly operation, and a suitable design for secure placement on a river tour boat.

2.0 LITERATURE REVIEW

To develop the product, several literature reviews have been conducted to assess the suitability of the forthcoming product. These prior studies were identified to examine appropriate methods and to identify the strengths and weaknesses of the project. Furthermore, significant references have been explored to gauge the feasibility of this project and serve as valuable guidance in producing a more refined innovative product. Itcannot be denied that there are already many products on the market with basic functions similar to that of a portable audio amplifier that can play audio from a USB drive. However, using such products is more common and does not utilize solar power besides being slightly expensive due to high wattage power consumption. Solar energy is undeniably the optimal method for reducing carbon footprint and does not contribute to environmental pollution. Additionally, it is a clean and renewable energy source that does not emit greenhouse gases. Numerous studies and innovative products have successfullyimplemented projects utilizing solar energy, proving them to be safer, more environmentally friendly, and more cost-effective (Hill, C. A., 2012). The inclusion of solar-powered equipment in this project will assist tour boat operators in easily recharging batteries.

The use of tourist guidance devices is not uncommon in certain tourist locations or destinations. A study conducted by Bhagyashree, S. in 2017 successfully developed an audio guidance device in multiple languages, installed in museums, increasing the number of tourists visiting the location, particularly from various parts of the world, eager to learn about India's historical culture. The product developed consists of sensors, a controller, and an audio player. When a tourist stands in front of an exhibit, the device detects the specific exhibit and automatically plays the appropriate message. One of the conclusions drawn is that the production of audio in multiple languages is crucial in disseminating tourism information to visitors from outside Malaysia. Base on literature review

sources, there are also high-end advanced products based on voice assistance for tourism information that have been developed, utilizing an interactive voice assistant system to automatically guide tourists in historical places based on the Google Map API and GPS (Keerthana, R., et al., 2020). The automatic narration from smartphones directly to usersis seen as more cost- effective. This method can also be applied directly through Google Maps or various application apps. Although it may seem quite sophisticated, its implementation is still at the research stage and requires extensive software developmentinvolvement.

Furthermore, there is also a tourist assistance system utilizing electronics with voice, based on RFID technology, allowing control by visitors or tourists (Srinivasan, S., & Kumar, R., 2013). This device operates automatically and plays audio related to tourism when an RFID card is swiped on the corresponding device, acting as a switch. However, adrawback of this device is that it is only suitable for use by one individual at a time with earphones, and the use of RFID can be replaced with a button switch to save costs. Nevertheless, it cannot be denied that the implementation of technology-basedtourist information devices is crucially important and extends to the use of tourist cruise boats. Research by Moguel, E., et al., in 2023 suggests a solution involving tourism information methods using smartphones, where chatbots and voice assistants can provide a new intelligent interface with real-time updates on all tourist offers. This approach is said to be effective for large rural areas lacking internet connectivity. It represents a new technological solution based on voice assistants without the need for an internet connection, allowing the provision of all relevant tourist information updated in real-timeto the tourists in question. However, for most tourists, the smartphone they usewill primarily function as a camera for capturing moments while on tourist cruise boats navigating along the river. Once again, this study does not negate the importance of providing tourist information devices to attract tourists to a particular location.

The findings from several literature reviews successfully clearly indicate that voice-basedtourism information devices are capable of attracting more visitors and increasing tourist numbers. The insights obtained from the literature review served as a guiding force and a source of inspiration in completing this project. The innovative product developed, is capable of reducing the operational costs of a tourism service, as it eliminates the need for additional labor resources to fulfill the role of providing information. Therefore, a newmethod of producing tourism information devices, especially for tourist cruise boat usage, is introduced for this purpose and will be elaborated upon in the following section.

3.0 METHODOLOGY

To transform this project into a fully functional product with high safety standards, a comprehensive strategy is being implemented. This methodology is crucial to ensuring that the project is completed within the specified time frame, following a systematic step-by-step approach. The primary objective behind developing this innovative project is to assist tour boat operators who require tools for providing tourism information to their passengers. This project also aids tour guides in delivering information to tourists more effectively while reducing the need for additional manpower. The product is designed to be lightweight, portable, easy to operate, and powered by renewable energy sources. It features a main switch button for powering the device and three push switch buttons for controlling audio playback (play, next, and previous). The tour guide simply presses the play buttonto activate the pre-recorded audio. The audio recordings are stored on a MicroSD card inserted intothe DFPlayer Drive Module.

Figure 1 illustrates the overall connection block diagram in this project. This device operates using a 9VDC to 12VDC power supply derived from a 12V 7.2AH battery as the main power source. The battery can be charged using a solar system or other charging systems. Additionally, a microphone device is incorporated based on a circuit using the ICTDA2822M, which is directly connected to a trumpet/horn speaker. This trumpet speaker, with a capability of 25W and 8 Ohms, serves as the main output for the audio system to be produced, suitable for use in tourist cruise boats. The sound volume can be adjusted using an audio amplifier with a knob located outside the product case.

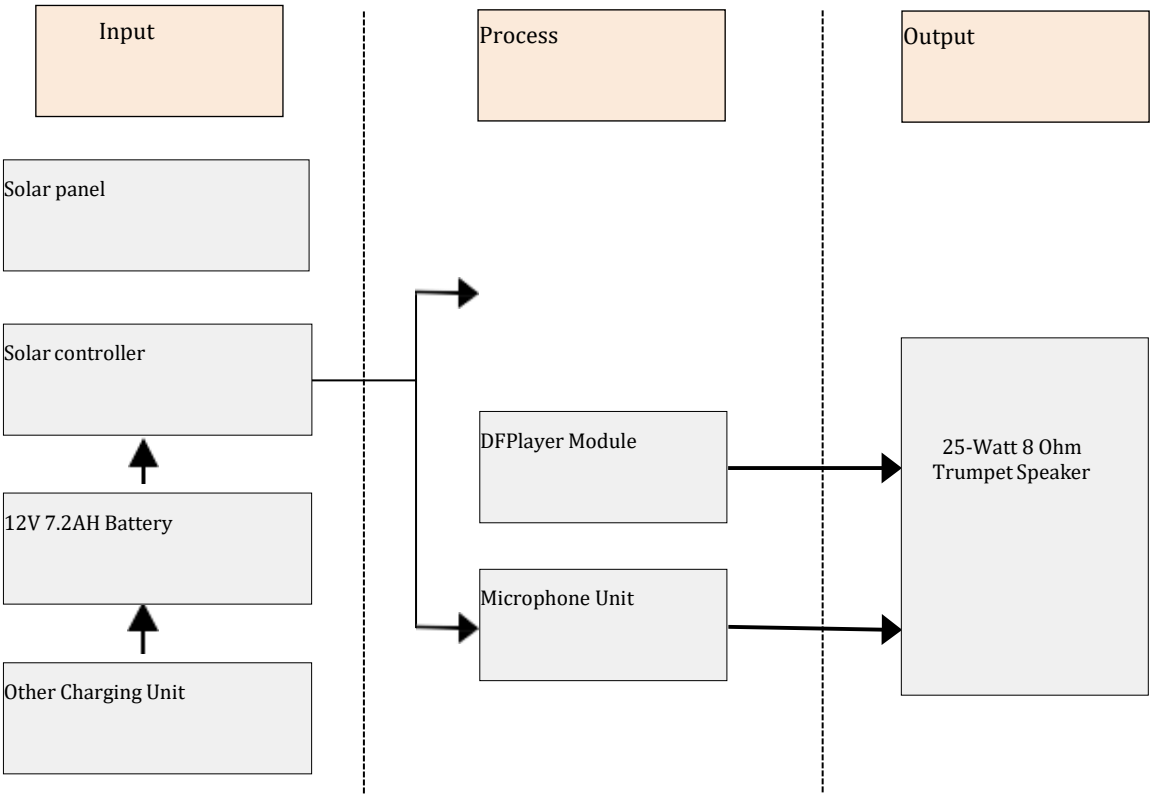

Figure 1: Block diagram of the project.

Figure 2 illustrates the schematic circuit diagram for connecting a voice recording playerusing the Arduino Uno microcontroller and DFPlayer Module. The DFPlayer Module, also known as the DFPlayer Mini MP3 Player, is a compact and affordable MP3 module that offers simplified output directly to the speaker. It can function independently with a battery, speaker, and push buttons, or it can be integrated with microcontrollers like Arduino, ESP32, Raspberry Pi, and any other microcontrollers with Uart capabilities. TheDFPlayer Module is subsequently linked to an amplifier unit and then to a trumpet/horn speaker. In Figure 3, the schematic circuit diagram for connecting a microphone system using the IC TDA2822M is depicted. This system is designed to function as a dual audio power amplifier, ideal for low-output applications. The output connection for the TDA2822M is the same trumpet/horn speaker as mentioned before.

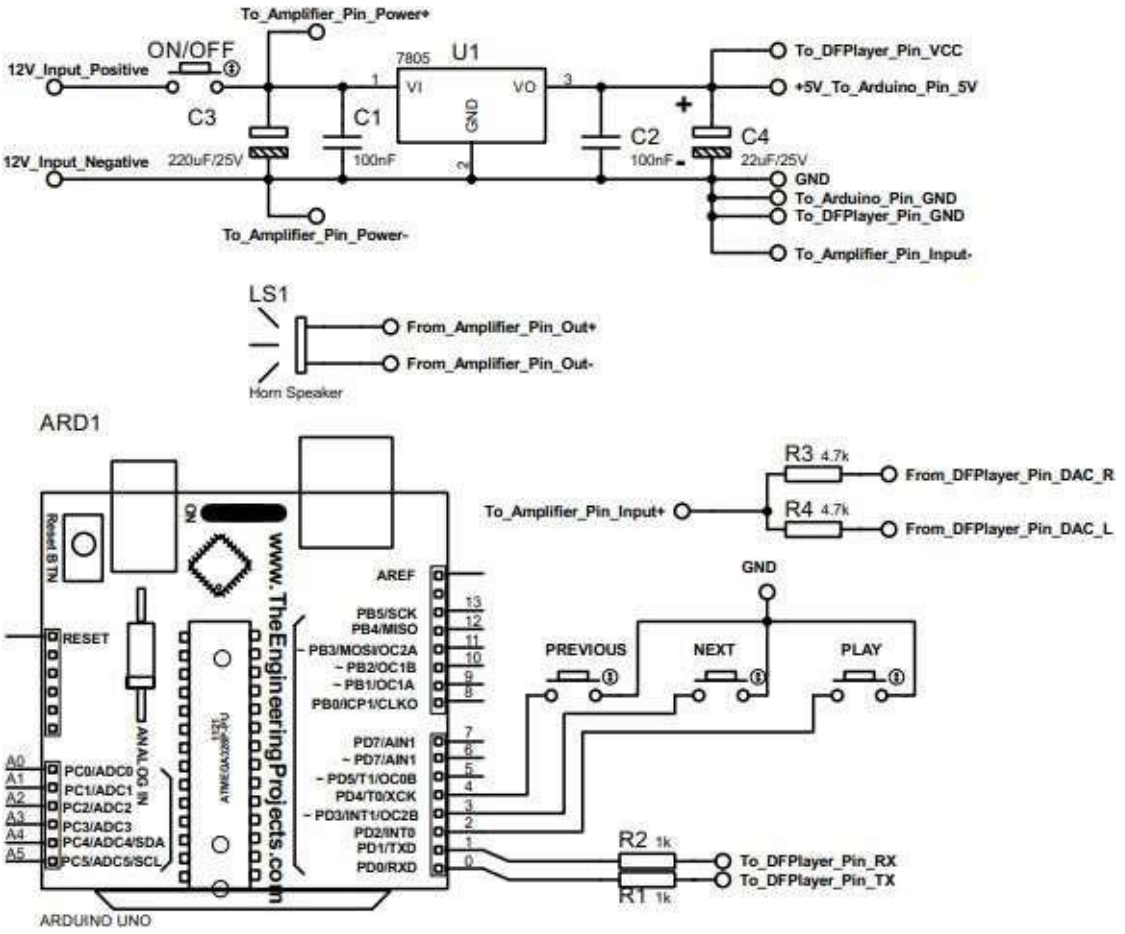

Figure 2: Schematic diagram of voice recording player using Arduino Uno and DFPlayerModule.

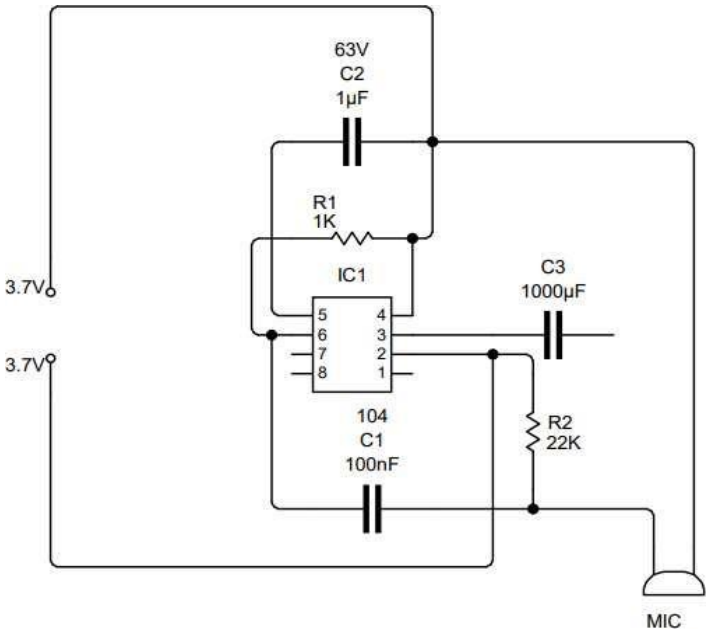

Figure 3: Schematic diagram of microphone system using IC TDA2822M.

In this innovation project, an Arduino Uno microcontroller is utilized within an open-loopnetwork system. The Arduino IDE software is employed to program the Arduino Uno board, with a focus on activating MP3 sound in the DFPlayer Module based on three selectable buttons: 'Play', 'Next', and 'Previous'. Each selection is handled through if-else loops with a time delay of 0.5 seconds for each option.

Figure 4 illustrates the simplified flowchart process and some of the primary code functions in the Arduino IDE for the project's operation. This project operates only when the push button is activated. To deactivate it, simply press the main on-off switch button. This straightforward operating manual reflects the project's objective, which is to create a simple and user-friendly product.

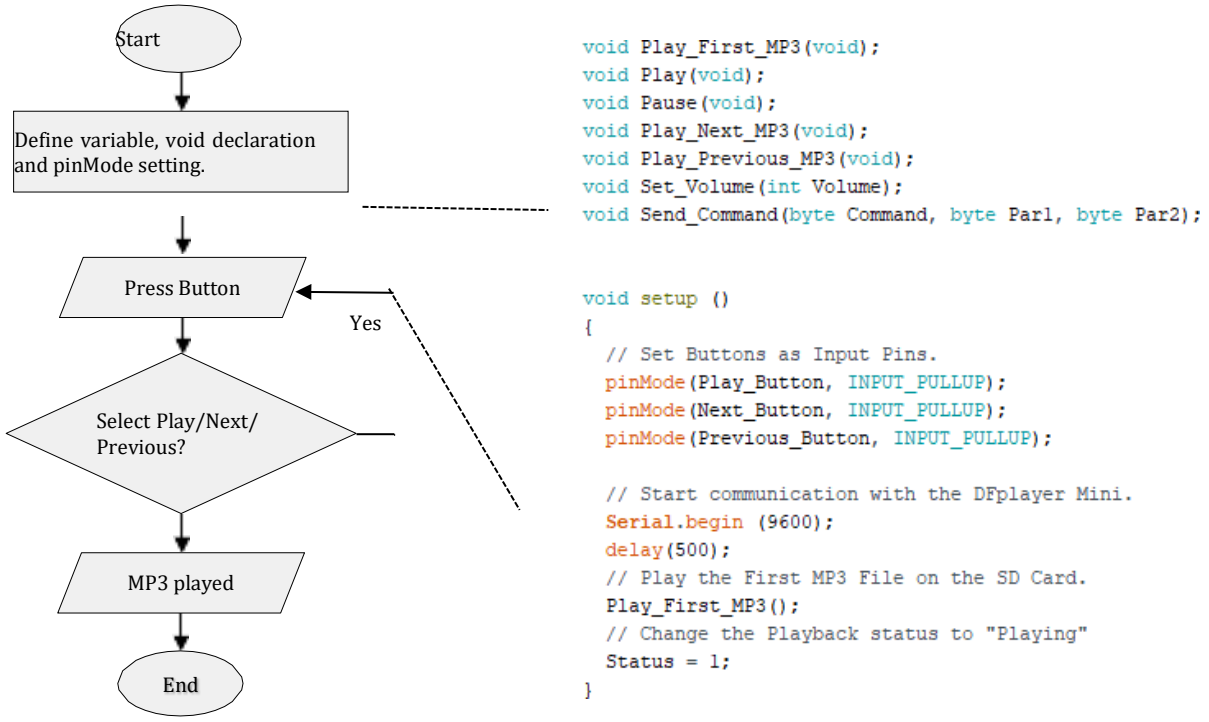

Figure 4: A simplified operational flowchart and some of the primary code functions ofArduino IDE.

The project is housed in a waterproof casing box, with the trumpet/horn speaker mounted on top of the box and the solar panel and solar controller located outside the box. The optimal overall duration to reproduce this product can be achieved in less than 2 weeks with expenses totaling less than RM300.00. If produced in bulk or manufactured,the production cost is sure to be even lower. The effectiveness of this project has been tested and its results are explained in the following section.

4.0 RESULT AND DISCUSSION

In this section, some important measurement results on innovation product output have been obtained. These results are then used to measure the adequacy of the objectives set.The results of this section are then summarized in detail in the next section, which is the conclusion. To gain insight into the final results and output of the innovative products produced, several methods have been implemented that are based on the measurement of the value of electrical elements, the physical parameters of the object, and scientific measurements of sound strength and light brightness using the appropriate software from a smartphone.

Figure 5 provides a comprehensive view of the exterior of the completed project, while Table 1 presents the specifications for the innovative products. These details are primarily obtained from the input system via the rechargeable battery and the output of the trumpet/horn speaker. Additionally, other particulars are derived from the exterior of the project. The total weight of the project is estimated to be around 10 kg, with dimensions of 50 cm x 12 cm x 35 cm, making it easy to transport and suitable for placement anywhere on a tourist river cruise boat. The project requires a 2 Ampere current to activate the 25 W power output from the 12 VDC supply obtained from the solar system with an output power of 50 W. The audio intensity emitted from the alarm exceeds 100 dB. Based on usage testing observations, the operating voltage range required to activate this product is between 11.8V to 13.8V, depending on the capacity ofthe supplied rechargeable battery.

Figure 5: Completion of the project's visual aspects.

Table 1: Technical output specification of innovation product.

Descriptions	Details
Battery voltage	11.8 V – 13.8 V
Power rating	25 W (Maximum)
Audio intensity	<100 dBA (Maximum)
Product Dimension	50 cm × 35 cm x 12 cm (approx.)
Gross weight	10 kg (approx.)
Solar panel type	Mono Crystalline Cell
Solar panel output	12 V, 50 W
Output impedance	25W (Max) 8 Ohms

Table 2 illustrates the levels and categories of audio intensity and their corresponding effects on human hearing, as well as the corresponding duration of continuous exposure.The data from Table2 was obtained from studies conducted by the American Speech- Language-Hearing Association in 2019 and by Kardous et al. in 2016. This data will be utilized for comparison with the measurement

findings. Meanwhile, Table 3 provides the data concerning the output performance of the innovative products, as derived from the conducted measurements. The distance for hearing the sound emitted by the trumpet/horn speaker is captured using the Decibel X:dB Sound Level Meter software application. This application serves as a professional sound level meter developed by SkyPaw Co. Ltd, specifically for use with iPads, and can be freely obtained from the App Store. This application can act as a frequency spectrum analyzer and is capable of detecting harmful environmental noisesfor hearing and health purposes. It is one of the very few noise meter apps that offer highly reliable, pre-calibrated measurements, supports dBA, and dBC, and precisely measures the sound pressure level (SPL). The observation method using the Decibel X:dB Sound Level Meter involves establishing a fixed location for the project and conducting measurements at four distance stages, ranging from 5 to 20 meters. At each distance, three sound level scales are tested: low (10% to 20%), medium (40% to 60%), and high (90% to 100%).

Table 2: The level of audio intensity and its impact on humans.

Audio categories	Audio intensity (dBA)	Effects	Permissible Exposure Time
Painful steady noise	120 – 130	Not safe for any period	None
Very/extremely loud	90 – 119	Dangerous to hearing	2 hours to 1 minute
Faint and moderate	40 – 89	Safe for listening	8 hours to 2 hours

**Note*: Adapted from American Speech-Language-Hearing Association, 2019 and Kardous, C., et al., 2016.

Table 3: The percentage range of audio intensity about observation distance anddecibels of sound for the project.

Low, s_1 (5% - 10%)	62 dBA	58 dBA	49 dBA	41 dBA
Sound scale, s_α	Observation distances, d_β (m)			
(% intensity range)	5 meters, d_1	10 meters, d_2	15 meters, d_3	20 meters, d_4
Medium, s_2 (40% - 60%)	77 dBA	70 dBA	63 dBA	56 dBA
High, s_3 (90% - 100 %)	84 dBA	78 dBA	71 dBA	65 dBA

Based on the data presented in Table 3, it is evident that the highest audio intensity recorded for the worst-case scenario, at a distance of 5 meters from the project device, is84 dBA. This level falls within the safe range of human hearing. The table also suggests that the device is suitable for use at an appropriate distance and should be positioned at a reasonable distance from the human ear to avoid potential harm. Additionally, the findings reveal that the overall decreasing rate of audio intensity per meter, ρ across all categories of the sound scale is 1.02 dBA/m, as determined by the following formula;

$$\rho = \frac{\sum_{s=1}^{3} n_s}{3d_4}$$

$$\text{where } n_s = s_{d_1} - s_{d_4}$$

In the other hand, Figure 6 illustrates the graph depicting the relationship between audiointensity (in dBA) and observation distance (in meters) of the project. The results of the measurements indicatethat the minimum audio intensity level considered suitable for listening during the measurements is 46 dBA. This value considers the disruptive noise emitted from the tourist boat engine. From thisgraph, it

can be determined that the maximum distance or critical distance suitable for passenger hearing on the tourist rivercruise boat is up to 16.9 meters. It is known that the typical size of river cruise boats usedin Malaysia is approximately 10 meters in length. Therefore, this device is highly suitableand ready to be used in real-life situations.

Based on the comprehensive testing conducted, it is evident that the project is safe for use in proximity and can be heard within the tourist river cruise boat. Furthermore, the results indicate that the circuit design and installation system do not pose any issues andhave functioned effectively. The data obtained also affirm that this innovative project hasbeen successfully developed in a compact, lightweight, portable, and easy-to-install form suitable for use on a tourist river cruise boat. Additionally, the project has effectively utilized a solar energy system, contributing to environmental preservation while enhancing commercialization prospects. More detailed and concise conclusions regarding this project will be elaborated in the next section.

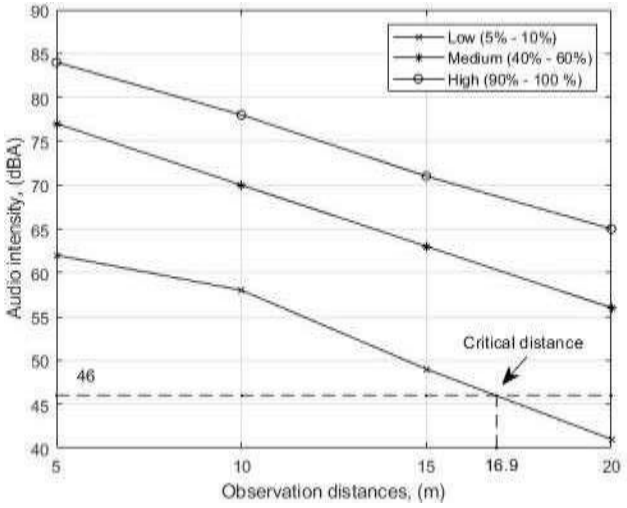

Figure 6: The relationship graph between audio intensity (in dBA) and observationdistance (in meters) of the project.

5.0 CONCLUSION

It can be concluded that the innovation project titled "An Electronic Tourism Information Player Utilizing DFPlayer for Application on Tourist River Cruise Boats" has been successfully developed and has demonstrated effective and safe functionality. This devicehas been skillfully engineered to deliver tourism information audibly to passengers on tourist river cruise boats within a safe hearing range, and tour guides can utilize it for extended periods. The original idea for this project arose from observing the difficulties and fatigue experienced by tour boat operators when repeatedly explaining tourism information to passengers on each trip while also navigating the boat. With the introduction of this product, related tasks can be simplified, and the need for additional tourism staff can be reduced. The device can be produced cost-effectively using only a fewmain components, including the Arduino Uno, DFPlayer module, and TDA2822M IC, whilealso utilizing solar power asan environmentally friendly energy source. Additionally, this device is incredibly user-friendly, as it operates simply by pressing the audio button, allowing audio to be played through the speakers.

The results of the conducted tests indicate that this device can be safely operated at a distance not too close to passengers, typically ranging from 3 to 5 meters depending on the sound output of the device. For worst-case scenarios, the maximum distance at whichit can be heard is 16.9 meters with an audio intensity capability of 46 dBA. Considering the typical length of river cruise boats commonly used by boat operators in Malaysia, it ishighly suitable for use. It can be concluded that this project has

successfully achieved its production objectives, which are to develop a voice recording player device capable of capturing and playing audio descriptions relevant to the tourist experience during a rivercruise, as well as producing a portable device with minimal cost, user- friendly operation,and a suitable design for secure placement on a river tour boat.

For future enhancements, several suggestions and approaches have been identified to be emphasized. Firstly, incorporating an automatic GPS tracker into the device would enabletracking of the boat's position and movement for safety purposes. Additionally, improvements to the direct recording system of the device should be made to facilitate users in customizing audio recordings according to their needs. Lastly, this innovation project has the potential to be used in various locations or tourism premises beyond its original purpose, such as museums or by tour guides in tourist buses. Apart from tourism, it can also be applied in other sectors, such as education, for example, providing announcements to students during assemblies where important announcements can be made automatically from this device. Returning to the original goal of producing this product, it has successfully achieved its goal and objectives, aiming to contribute to the enhancement of the country's economy through river tourism products in Malaysia.

ACKNOWLEDGEMENT

This project received partial support from the innovation project conducted as part of the DEE40082 Project 1 and DEE50102 Project 2 courses at the Department of Electrical Engineering, Politeknik Merlimau, Melaka, during the study sessions of Semester 2: 2022/2023 and Semester 1: 2023/2024.

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Information Board for Electrical Engineering Department at Polytechnic Merlimau With ControlThrough Internet Of Things

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Abstract. This project about Information Board For Electrical Engineering Department at Polytechnic Merlimau With Control Through Internet Of Things. The main component is P10 LED Display is use for communication solution that delivers real-time information and dynamic content presentation. It features a high-resolution P10 LED display for clearvisibility and allows users to control the board through a mobile app. Using Arduino unoas a microcontroller, the system supports text messages running over 300 words, with adjustable speed settings. The mobile app allows users to enter and modify text content on the go, and the system provides automatic synchronization with the Real Time Clock for accurate time information. Brightness control adapts to different lighting conditions, contributing to energy efficiency and optimal visibility. The board supports running text messages of over 300 words, with adjustable speed settings for running text. User- defined content features allow users to enter and modify text content running through the mobile app, increasing flexibility. The system also provides manual and automatic options for resetting the time, date, and day, as well as automatic synchronization with the Real Time Clock.

Keywords: IoT, Bluetooth, LED P10 Display, Sensor, RTC (Real time Clock)

1.0 INTRODUCTION

The Internet of Things (IoT) has revolutionized the way organizations communicate and disseminate information. Department of Electrical Engineering is embracing this technology to enhance efficiency and connectivity within its operations. The IoT Information Board is an innovative solution that promises to redefine how information is shared, managed, and accessed within the department, fostering a more dynamic and responsive environment. Key features of the IoT Information Board include real-time updates, customizable dashboards, energy efficiency monitoring, remote accessibility, integration with IoT devices and sensors, enhanced security measures, an interactive user interface, LEDP10 display integration, high visibility, color options, resolution and content design, dynamic content updates, IoT protocols, data synchronization, errorhandling, remote management, and the Arduino Uno. The Bluetooth HC-05 module facilitateswireless communication, allowing for remote updates and control of the LED P10 display. The RTC module ensures accurate timekeeping, essential for scheduling and managing time-sensitive information. The Arduino sketch integrates the functionalities of the Bluetooth HC-05 module and RTC, enabling reliable connection with external devices. The RTC configuration ensures accurate time, while the LEDP10 display controluses appropriate libraries and functions.

User input handling includes commands for updating information, changing display settings, or triggering specific actions. Error handling mechanisms address potential issues, such as communication

errors or displaymalfunctions. A mobile app can be developed to communicate with the Bluetooth HC-05 module, providing an intuitive and user-friendly interface for updating information on the IoT Information Board. This system allows for both local and remote control, enablingefficient information management and display. The project aims to achieve the following objectives that is can be display a clock on a P10 LED display, can be show a moving texton a P10 LED display and can be control all settings through IoT using MIT Application.

2.0 LITERATURE REVIEW

Remote Monitoring and Control by adding IoT connectivity to the countdown timer, it canbe remotely monitor and control the timer's operation. This means that examination staffor administrators can access the timer's status, start or stop the timer, and make any necessary adjustments from a central control panel or even through a smartphoneapplication. This remote access provides convenience and flexibility in managing the timers across multiple examination halls or locations. User Interface(UI) technology refers to the tools, technologies, and techniques used to create and interact with the graphical user interface (GUI) of a software application or system. The choice of UI technology depends on the platform, device, and specific requirements of the project.

2.1 Mobile Applications

MIT App Inventor is a visual programming environment that enables users to create mobile applications for android devices. The platform is designed to make app development accessible to beginners, offering a simple, intuitive interface. It allows users to create functional and interactive mobile apps without a programming background. MITApp Inventor also offers real-time testing on a connected android device, allowing users to see their app's behaviour on the device. The platform offers a wide range of components, including buttons, text boxes, sensors, and maps. The community supports users through tutorials, forums, and resources. MIT App Inventor is often used as an educational tool to introduce students to programming and app development concepts. Itis open source, allowing users to contribute to its development and educators to host their own instances.

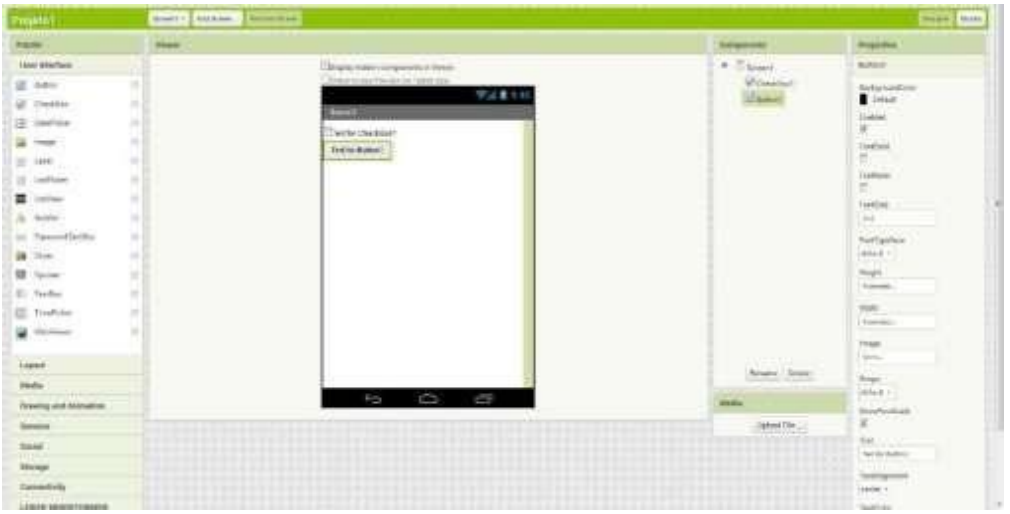

Figure 1: MIT App Inventor

2.2 Microcontroller Technology

The Arduino Uno is an 8-bit AVR microcontroller from Microchip, operating at 16 MHz with 32kb of flash memory, 2kb of SRAM for variables, and 1kb of EEPROM for data storage. It has 14 digital input/output (I/O) pins, labelling from 0 to 13, for reading digitalsignals or controlling external devices like LEDs, motors, and sensors. Six of these pins can be used as pulse-width modulation outputs for smooth control of analogue like signals. The Arduino Uno also has six analogue input pins labelling from a0 to a5, which can read analogue signals from sensors and other devices. It supports serial communication through a USB connection and has a built-in UART (universal asynchronous receiver-transmitter) for external device communication. The Arduino Uno can be powered via a USB connection from a computer or an external power source,with a built-in voltage regulator for operating between 6v and 20v. It can also be powereddirectly through the vin pin or barrel jack. The Arduino Uno is programmed using Arduino software (IDE), a development environment based on the processing programming language.

Figure 2: Arduino Uno

3.0 RESEARCH METHODOLOGY

The "IoT Information (JKE) Board" project aims to create an innovative and interactive platform for disseminating crucial information in a dynamic and user-friendly manner. This system leverages the power of the Internet of Things (IoT) to provide real-time updates and customizable displays of information relevant to stakeholders. Whether in educational institutions, corporate settings, or public spaces, the IoT Information (JKE) Board offers a versatile solution for broadcasting essential data.

3.1 Application Design

Figure 3 shows that conceptual of the project's front and rear aspects. The project is designed in a closed-loop system, where the Arduino serves as the master controller that will embed the programming on Arduino Uno board before it is fully functional. Programming just focuses on panel led p10 for show the time the subject take of output.Next buzzer will give sound that sow the data receive to Arduino Uno and then will showing to the led 10.

These products are all assembled in casing box that hold the panelled p10, Arduino Uno, Bluetooth hc05 and buzzer. So can hanging the led panel at Electrical Engineering Department.

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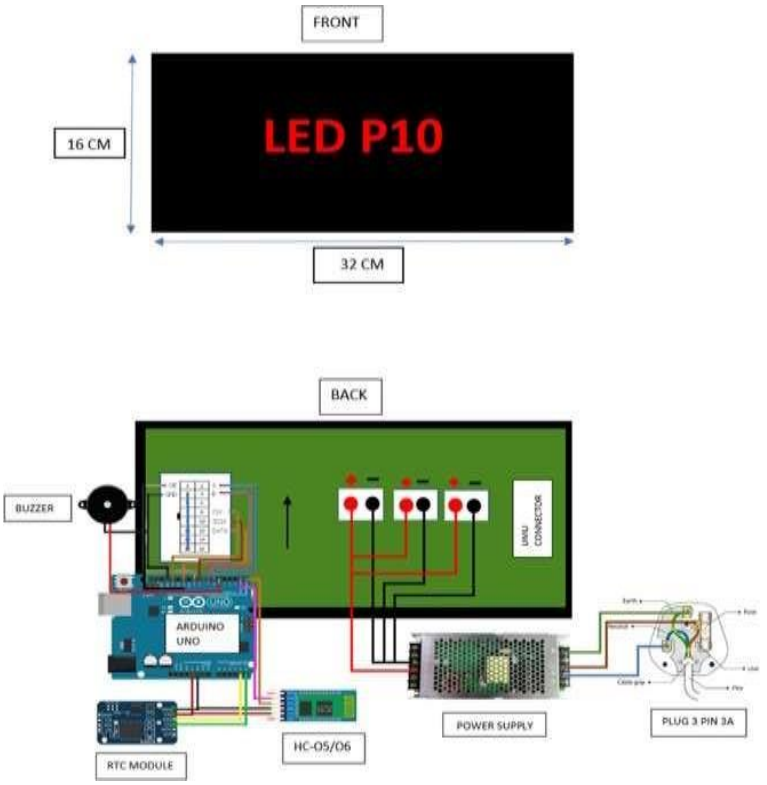


Figure 3: Conceptual of the project's front and rear aspects

3.2 Block diagram of the project

The block diagram in Figure 4 shows the basic connection structure of the main components used to complete this innovation project. The project uses two main input that is Bluetooth as a link to the device to make any changes on the p10 led display usingthe p10 remote application, which willbe transferred to the Arduino Uno to be shown, aswell as on the p10 led and buzzer. Second is Power Supply is a component used to supply or provide electrical power to one or more devices.

Figure 4: Block diagram of the project

3.3 Schematic Diagram

Figure 5 shows the complete connection diagram of the innovation project circuit developed using Fritzing Software that can know the connection of component.

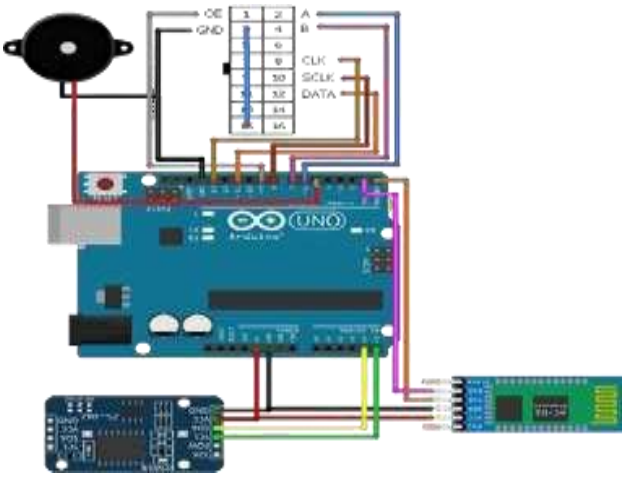


Figure 5: Schematic Diagram

3.4 Flowchart of the Project

Figure 6 shows a simple process of flowchart on how to use the developed innovation product. This project only works when connecting to Bluetooth on smartphone when connecting open to remote control p10 that can inserting the timer, subject and information that will upload to p10 and will displaying what we insert lastly the buzzer will sound that show the data is receive.

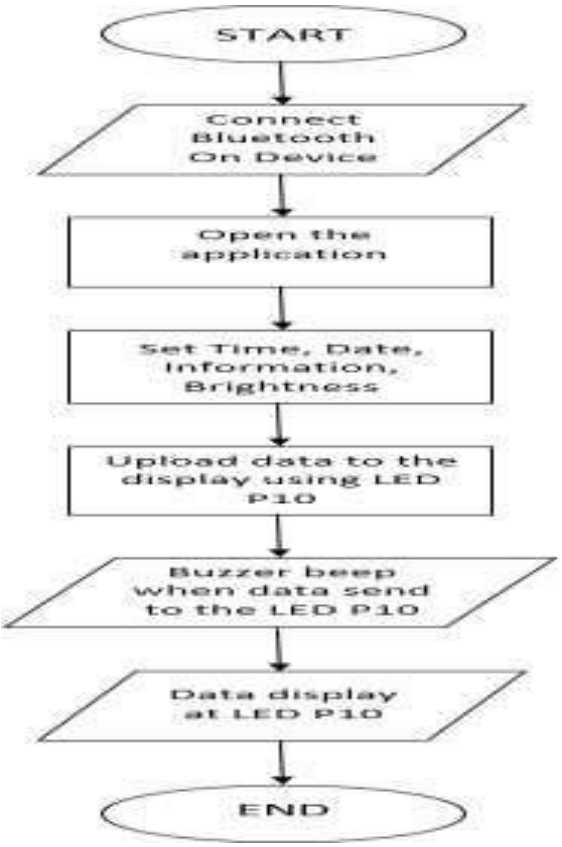


Figure 6: Flowchart of functional project

4.0 RESULT AND ANALYSIS

Several approaches have been thoroughly detailed in this chapter, beginning with the original design process based on an overview sketch of the innovation product and ending with information about the hardware and software used to produce this project.

4.1 Design and Testing

Design and testing of a Information Board For Electrical Engineering Department With Control Through Internet Of Things. This prototype design is using an Arduino UNO board, LED matrix display (P10), buzzer module, jumper wire, and RTC module. Make a connection on the Arduino UNO from buzzers, P10 LEDs, power supplies, RTCs and othercomponents as shown in Figure 7. The Arduino IDE is the best platform to write a coding using C and C++ software to make all components work perfectly. Testing the countdowntimer with upload the code to your Arduino UNO. Figure 8 shows that the LCD display a running in right information.

Test button functionality to start and reset the countdown. Verify that the countdown timer is working correctly. Finally, design and build a suitable enclosure for your Arduino UNO and LCD display. Arrange the push buttons in a convenient way for exam use.

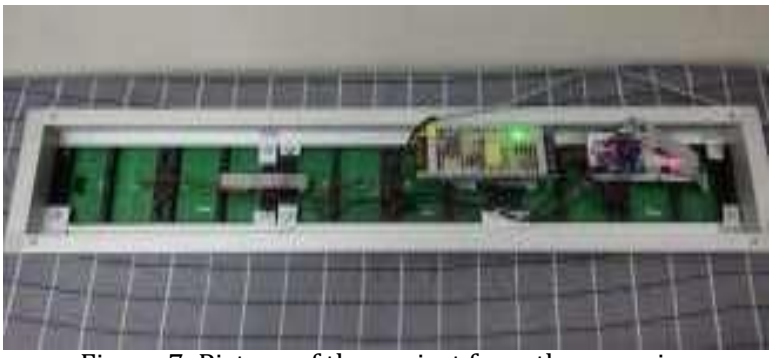
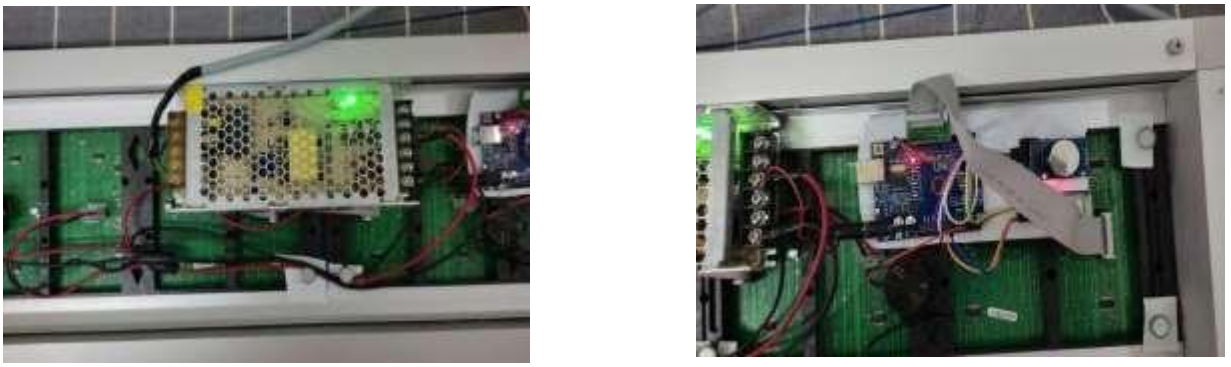


Figure 7: Picture of the project from the rear view

Figure 8: Picture of the project from the front view

Figures 9 (a.) and (b.) show a complete picture of the interior and exterior of the projectfor the top side and the side for those that have been produced.



(a.) (b.)

Figure 9: Picture (a.) Inside view of the project and (b.) MIT APP Inventor Software

Figure 10 shows a MIT APP Inventor is a visual programming environment that enables users to create mobile applications for android devices. Initially developed by google, it is now maintained by the Massachusetts institute of technology (MIT). The platform is designed to make app development accessible to beginners, offering a simple, intuitive interface. It allows users to create functional and interactive mobile apps without a programming background. MIT app inventor also offers real-time testing on a connectedandroid device, allowing users to see their app's behavior on the device. The platform offers a wide range of components, including buttons, text boxes, sensors, and maps. Thecommunity supports users through tutorials, forums, and resources. MIT app inventor isoften used as an educational tool to introduce students to programming and app development concepts. It is open source, allowing users to contribute to its developmentand educators to host their own instances.

Figure 10: Development of interface design at smart phone

5.0 CONCLUSION

This paper presented the IoT information board is an innovative solution that promises to redefinethat information is shared, managed, and accessed within the department, fostering a more dynamic and

responsive environment. Key features of the IoT Information Board include real-time. It can beused through an application on a smartphone using a bluetooth connection. IoT information boards can be used at any areain Polytechnic Merlimau. The application used is also user-friendly but for now only android smartphones can be used. For future research it is suggested that improve the user interface need enhance the mobile app interface for a more intuitive user experience.By consider using graphical elements for setting parameters and a visually appealing design. Power management that can consider main aspects especially if the project is intended for long-term use. Optimize power consumption to extend the device's operational life and provide information on power requirements. Thus, the proposed application that will improve to be placed on play store, apple store and also can be usedon laptops.

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Development of Automatic Recycle Bin Using Three Sensor Circuit Controlled By Arduino

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Abstract. Garbage is an important element of our lives because we always produce garbage. We need to know how to manage the waste so that the waste that can be recycled and disposed of can be well isolated in order to adopt green culture to avoid the warming effects of the earth. Hence the result of the existing problem has given the idea of making recycling bins for the separation of plastics, cans and others. The development of recycle bin use three sensor which one induction proximity sensor and two LDR sensors. The recycle bin uses Ultrasonic sensors that can detect objects within 24cm of this recycled bin. The induction proximity sensor will detect whether the objectis metal while the LDR Sensor detects whether the object is plastic or paper. The sensor will detect the object and separate the object into four parts which are paper, can or metal, plastic and waste. This recycle bin project can contribute to community for separate the rubbish effectively.

Keywords: automatic, recycle, sensor, Arduino, waste

1.0 INTRODUCTION

According to the Ministry of Housing and Local Government in a newspaper clipping The Star stated that Malaysians throw away 38,699 tons of solid waste every day, which is 1.17kg of waste generated per person. This will lead to environmental pollution that will cause natural disasters. Therefore, to reduce the production of solid waste, recycling activities are strongly encouraged. However, recycling requires efforts to separate waste materials according to their respective categories. Therefore, this Automated Sorting Recycle Bin project powered by Arduino UNO Microcontroller makes the working of the system to be smooth and convenient and helps humans facilitate the work of sorting recycled materials. In this extend, it is counting two sections of the full model.

First, the section is the sensor section, and the mechanical section. In this section there will be four components which is the Ultrasonic sensor, Light dependent resistors (LDR) sensor, Inductive proximity sensor and LED. In this section, the sensors will automatically identify the type of waste putted in the sensor part. For the second section, which is the mechanical part will sort the waste into its categorized section using two servo motors to be operated. Thus, this smart recycle bin can be seen very useful to the society in which can help not only to save us time but also can keep the environment clean and most importantly, taking other peoples hands and walking some small steps towards applying recycling in our daily lives. This model sense and detects the type of waste putted inside the bin which this sensor associated with servo motor to drop and sort waste to categorized bin.

2.0 LITERATURE REVIEW

Nowadays, most of the smart recycle bin product in the market, are mostly comes in high quality and

some of them are very good product. Thus for us to build a new automated sorting recycle bin product, we must look at other product's idea of good quality and apply it into our project. Other than that, we can also use ideas of other people's project and add some improvements to the product which is also a best way in building our project. Secondly is to look on a low-cost Automated Sorting Recycle Bin powered by Arduino Microcontroller. As what was stated in the problem statement, for the project of Automated Recycle Bin product that has already available, we can see that the production of this product can consumes a very high cost. Thus, a research on the costing is needed so that the production of Automated Sorting Recycle Bin can be build using the most minimum cost but still can maintain the quality of the project. Other than that, is to look on the design and assembly of a Smart Recycle Bin and the plan on how to build a smart waste place using Based Distance Sensor. This is important as design and assembly is also needs to be highlighted because the safety of a product is through good design and components that we assemble. Finally, design and development of an Autonomous Trash Sorting System.

2.1 A Low-Cost Automated Sorting Recycle Bin powered by Arduino Microcontroller

According to (Harnani Hassan, Fadzliana Saad and Muhammad Suhaimi Mohd Raklan, 2019), This project objective is to construct a recycle bin prototype with a sensing mechanism that's ready to sort recycle waste (such as metal, paper and plastic) and automatically assign the waste to specific bin partition in step with their types. The development of the recycle bin prototype is split into two parts:

i. Sensing

The sensing part detects variety of waste like metal, paper and plastic. The metal-based waste is detected using an inductive proximity sensor; while, for paper and plastic-based waste, a lightweight emitting diode (LED) and a lightweight dependent resistor (LDR) are utilized.

ii. Mechanical.

The mechanical part assembled a servo motor along with the microcontroller to sort the waste type accordingly.

The outcomes of this work show that the recycle bin prototype is in a position to sort the waste successfully especially the plastic waste and it's highly potential to be utilized within the future.

2.2 Review of the design and assembly of a Smart Recycle Bin

According to (M. Makhseed, Salmiya, Kuwait, F. Abdel Salam, S.El Aswad and S.E. Esmaeilion, 2021), Air pollutions exceeding levels and the increased risk of health programs requires a healthier quality of life with minimized health risk which a reduction of pollution is needed. The prototype smart recycle bin (Enviro-Bin) is an automated waste material filtering system contains infrared sensor, two proximity sensors, an inductive sensor and a capacitive one, to determine the presence and type of material. Each compartment includes an IR sensor to detect the level of waste in the container. A design and implementation of a smart recycle bin (Enviro-Bin) is created to reduces waste. It filters waste by plastic, paper, and metal which will consequently lead to decreasing the amount of harmful gases produced from burning waste and encouragesrecycling.

A work by (A. Elfasakhany, A. Arrieta, D. M. Ramírez,F and Rodríguez, 2015) presented the to design, build and test an autonomous system capable of sorting common recyclable materials, namely ferrous and nonferrous metals, plastics and glass into distinct waste containers. The system was designed with an aluminum chassis, loading carrier moved by a geared motor and a rubber band, sensors, control

board, air fan for blowing the plastic bottles, DC motor to push the sorted material, and containers for the sorted materials. Electromagnetic sensors used electrical and magnetic properties to distinguish different metals. An air fan and a light sensor are used to distinguish between plastics and glass materials. A microcontroller combined the interfaces of all the system components using programming to control all the system actions. Diverse iterations were used for distinguishing different trash materials. The system was able to sort trash materials of different shape, size, weight and color without being affected by dust, coatings or other impurities covering the trash materials.

3.0 METHODOLOGY

The design of the controller circuit using Arduino is for the process and ultrasonic sensor, Inductive proximity sensor, LDR sensor, servo motors for output. This project also use microcontroller Arduino Uno and the Arduino software. The coding design based on fllow chart operation of the project.

3.1 Block Diagram of the Project

This project design has two part namely ;sensing part and mechanical part, as shown in Figure 1. The sensing part content ultrasonic sensor, inductive proximity sensor and light dependent sensor. These ultrasonic sensors use for transmission and reception of ultrasonic waves means the sensor may both transmit and receive ultrasound. The inductive proximity sensor function is to detect object as can, metal or etc. while the light dependent sensor uses to decrease resistance to receive luminosity (light) on the component surface each item enter the dustbin. The mechanical part have two servo motors for moving the compartment.

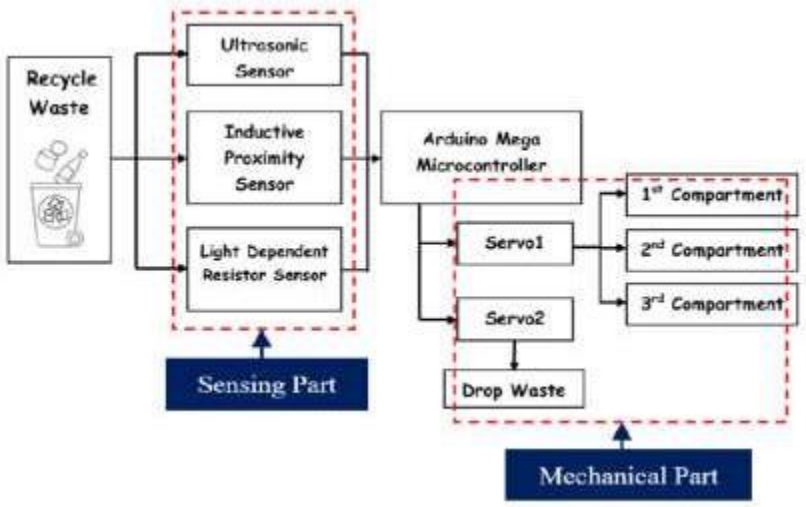

Figure1: Block Diagram of the project

3.2 Flowchart of the Project

The flow chart shown in Figure 2 present the overall work of the project. The function of the ultrasonic sensor when the sensor detects an object, the light dependent resistor LDR and the inductive proximity sensor will function to able recognize the object's type either alluminium, paper or plastic to separate and send it to categorize bin using servo motors. First the ultrasonic sensor sense the presence of recycle waste.

Then the ultrasonic sensor detects the object, it will trigger The inductive proximity and LDR sensor to operate and detect the material process. The distance of an ultrasonic sensor for detect an object is set from 0 to 24cm. After that, the inductive proximity will detect the object like an aluminum material. The servo2 is located the upper part of the bin to drop the waste into the bin. While the servo1 is use to sort parts in the bin. The bin is attached to the three sort openings. The first sort opening is set for aluminum cans, the second sort opening is for papers and the third sort opening is plastic bottles.

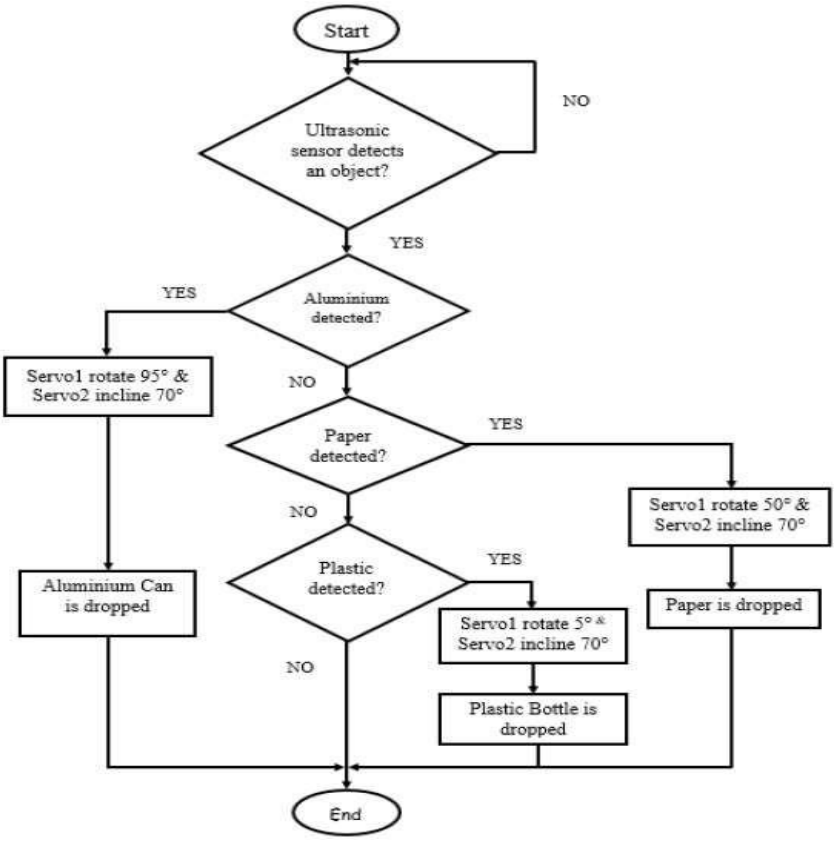

Figure 2: Flow chart operation of the project

3.3 Prototype Project

Futhermore, this section present the development of the project's hardware prototype where the purpose of hardware prototype is to ensure the electronic devices can be located in the dustbin with safe and good condition, as it is shown in Figure 3 (a) and (b) .


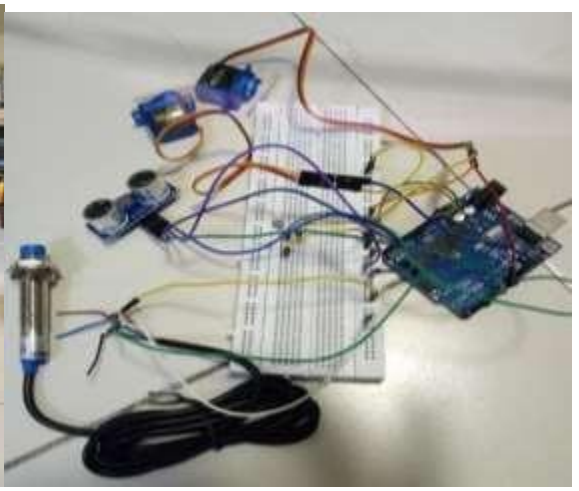

Figure 3a: Dust bin prototype Figure 3b: Electronic design prototype

4.0 RESULTS AND DISCUSSIONS

This section presented the result of the testing that have been done through out the developed automatic recycle bin. The testing run 30 trials for detection of materials of plastic, paper and metal . The results given that the success attempt is 28 and failed attempt only 2. This means the success rate is 93% , as well as the score of the testing is tabulated in Table 4. Moreover, the collection of the material waste is shown in Figure 4(a), (b), (c) , as well as the view inside the dustbin is shown in Figure 5(a) , (b) and (c)

.

Table 4: the result of 30 sampel for automatic recycle bin

Testing	Plastic	Paper	Metal
1	✔	✔	✔
2	X	✔	✔
3	X	✔	✔
4	✔	✔	✔
5	✔	✔	✔
6	✔	✔	✔
7	✔	✔	✔
8	✔	✔	✔
9	✔	✔	✔
10	✔	✔	✔

(a) : Paper Object (b): Plastic Object (b): Metal ObjectFigure 4: Collection outputs of the smart dustbin

(a) : The dustbin (b): The top view (c) : Inside view

Figure 5: Physical view of the smart dustbin

5.0 CONCLUSION

In this project we exceed the objective to develop the automatic recycle bin using three sensor by Arduino. The dustbin succeed to separated the paper, metal and plastic waste by servo motor and operate as objective need. The automatic recycle dustbin important for us to live in clean environment and produce greenearth effect. We learn each type of sensor used, the servo motor we used and the programming in Arduino microcontroller for automatic function. In the future this project we suggest to upgrade the dustbin for using internet of thing product which the dustbin can be monitor by mobile user.

ACKNOWLEDGEMENT

We are very pleased to have completed this writing successfully. Thank you especially to the Department of Electrical Engineering and the Merlimau Polytechnic Innovation unit for giving us the opportunity to produce technical writing in this e digest. We hope we have more opportunity to produce more writing in the future.

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The IOT Based Solar Powered Recycle Bin with Monitoring System

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Abstract The realization of the importance of recycling and the establishment of recycle bin is undoubtedly a positive step towards sustainable waste management. However, the lack of proper monitoring and management of these recycle bin can lead to significant challenges, including the overflow of recyclables. The IOT Based Solar Powered Recycle Bin with Monitoring System project aims to tackle the challenges of ineffective waste management and low recycling rates in public areas. It involves creating a smart waste management system that utilizes IoT technology and solar power to enhance waste recycling and monitoring. The main components of the project include a solar-powered recycling bin with height and weight sensors, a NodeMCU controller for data collection and transmission, and a cloud-based storage system for data analysis. The height and weight sensors allow real-time monitoring of waste levels in the recycling cube, providing valuable insights into the filling status and optimizing waste collection schedules. Using Arduino IDE and Blynk software, connectivity enables real-time monitoring, fill-level detection, and remote management, providing valuable data insights for optimizing waste collection routes, scheduling, and resource allocation. The solar-powered feature ensures the system's environmental sustainability and reduces reliance on traditional energy sources. The user interface also facilitates communication between users and the management of the recycle bin in more effective management of the recycle bin. Finally, by integrating IoT technologies, this project improves waste management efficiency and decreases the overflowing of recyclables and also promotes sustainable waste management practices, increases recycling rates, and creates cleaner and healthier public spaces.

Keywords: Waste management, solar, recycle

1.0 INTRODUCTION

Malaysia aims to reduce the amount of recyclable waste sent to landfills by more than 40% by 2025. To achieve this goal, we need to focus on minimizing the amount of waste we create, reusing or repurposing items instead of purchasing new ones and recycling our waste. This is commonly known as the 3R Program (Reduce, Reuse, and Recycle). Every Malaysian needs to embrace this initiative. By doing so, we can drive our nation towards becoming a Zero Waste Nation. Recycling plays a crucial role in diverting waste from landfills and conserving valuable resources.

Implementing comprehensive recycling programs and infrastructure, coupled with raising awareness about proper recycling practices, is essential. By segregating and recycling materials like paper, plastic, glass, and metal, Malaysia can recover valuable resources and reduce its environmental footprint. In most developed countries, there are effective waste management systems and services put in place which have ensured that the waste that is produced from homes, restaurants, offices and several other gatherings is properly managed, which in effect keeps the surroundings clean [1].

The IOT Based Solar Powered Recycle Bin with Monitoring System proposes a solution that leverages the power of IoT technologies and solar energy to create a smart waste management system. Solar energy is available everywhere, even in remote locations, making it an adequate substitute for fossil fuels [2]. The main objective of this project is to design and implement a solar-powered recycling cube equipped with height and weight sensors. These sensors enable real-time monitoring of waste levels in the recycling cube, providing valuable insights into the filling status and optimizing waste collection schedules. By integrating IoT technologies, the project aims to improve waste management efficiency, reduce the overflow of recyclables and minimize litter in public spaces such as parks and beaches. In addition to waste monitoring, the project emphasizes user engagement and awareness. A user interface will be developed to allow individuals to actively participate in recycling efforts, monitor waste levels, and receive incentives or notifications for their contributions. This interactive approach aims to foster a sense of responsibility and encourage sustainable behaviour among the public.

Furthermore, the project includes the implementation of a cloud-based storage system for data analysis. Waste management authorities and organizations can access comprehensive and accurate information about waste levels and trends, leading to more informed strategies and resource allocation. This data-driven approach can optimize waste management operations, reducing costs and improving overall efficiency. Through the IOT Based Solar Powered Recycle Bin with Monitoring System project, the aim is to contribute to a cleaner and healthier environment, promote sustainability, and encourage active participation in recycling efforts. By harnessing the potential of IoT technologies and solar energy, we believe this project can make a significant positive impact on waste management practices in public spaces.

1.1 Problem Statement

Waste management is critical for sustainable, healthy towns, cities, and communities in general, yet it is very overlooked, particularly in developing countries. Solid waste management includes the construction of facilities to recycle these goods, which include scrap metal, glass, cans, paper, plastics, wood and similar materials [3]. These are some of the problems that are related to waste management. Firstly, our public space has inefficient waste management practices, such as overflowing trash cans and litter on the ground are common problems in public spaces like parks and beaches. This not only creates an unpleasant environment for visitors but also poses a threat to the ecosystem. Second, the waste collection schedule was lack of real-time monitoring and optimization. Traditional recycling management systems are often inefficient as they rely on fixed schedules for recycling collection. This approach can lead to an overflow of recyclables, which not only creates an unsightly environment.

Finally, there was low public engagement in recycling because many people are not aware of the benefits of recycling and may not feel motivated to participate in recycling programs. So, to solve this problem, a project with the title The IOT Based Solar Powered Recycle Bin with Monitoring System was implemented. This initiative has the potential to increase public engagement in recycling and promote a sustainable waste management culture.

Overall, the IOT Based Solar Powered Recycle Bin with Monitoring System has the potential to make a significant contribution to sustainable waste management practices. Therefore, the objective of this study are:

i. To design an attractive recycling station.
ii. To develop a solar-powered recycling station using Blynk software.
iii. To implement real-time monitoring of waste collection using IoT sensors.

2.0 LITERATURE STUDY

There is no unique definition available for the Internet of Things that is acceptable to the world community of users. Recent technological trends have led to a rise in demand for efficient communication between devices without any human intervention, thus creating a huge market for IoT [4]. The Internet of Things (IoT) is a developing concept that enables electronic devices and sensors to communicate through the Internet. This allows for improved convenience in our lives. The term has been defined by various groups, including academicians, researchers, practitioners, innovators, developers, and corporate professionals. Kevin Ashton, an expert on digital innovation, is often credited with coining the term. Regardless of the source, all definitions share the idea that the first version of the Internet dealt with data created by people, while the next version deals with data created by things. A concise definition for the Internet of Things would be: "An open and comprehensive network of intelligent objects that can self-organize, share information, data, and resources, and react to changes in the environment." While most of us think about "being connected" in terms of electronic devices such as servers, computers, tablets, phones, and smartphones, the Internet of Things expands this connectivity to include sensors and actuators embedded in physical objects. The "Internet of Things" refers to the coding and networking of everyday objects and things to make them machine-readable and traceable on the Internet. Much of the existing content in the Internet of Things has been created through coded RFID tags and IP addresses linked into an Electronic Product Code (EPC) network. These objects are linked through wired and wireless networks, often using the same Internet Protocol (IP) that connects the Internet.

Solar energy is one of the most promising, renewable, eco-friendly, green and alternative energy sources [5]. Solar technology has emerged as a promising solution for sustainable and renewable energy generation. This literature review aims to explore key advancements, challenges, and applications in solar technology, focusing on solar photovoltaics (PV), solar thermal systems, energy storage, grid integration, economics, and emerging trends. Numerous studies have investigated the development and efficiency improvements in solar PV technology. Research has explored different types of PV cells, including monocrystalline, polycrystalline, and thin-film solar cells, assessing their performance, cost-effectiveness, and environmental impact. Additionally, research on emerging PV technologies, such as perovskite solar cells and multi-junction solar cells, shows potential for higher efficiency and lower manufacturing costs. Advancements in solar panel manufacturing processes have been a key focus of research.

Studies have explored techniques such as screen printing, laser processing, and roll-to-roll production to improve efficiency and reduce costs. Optimization of manufacturing methods, including the use of advanced materials, surface texturing, and anti-reflective coatings, has also been investigated. Solar energy conversion and storage technologies play a crucial role in the utilization of solar power. Research has focused on solar thermal systems, including parabolic troughs, power towers, and dish collectors, aiming to enhance efficiency and storage capacity. Studies have also examined energy storage technologies, such as batteries, pumped hydro storage, and thermal energy storage, to address intermittency and facilitate grid integration. Various applications of solar energy have been explored in the literature. Studies have investigated solar water heating, solar cooling, and solar-powered transportation systems. The integration of solar energy systems into buildings, industries, and off-grid or remote areas has been extensively studied, highlighting their potential to reduce reliance on fossil fuels and mitigate climate change.

3.0 METHODOLOGY

In this section, the project based on IoT encompasses a systematic approach to design, develop and implement the Cube, integrating IoT connectivity for enhanced functionality and efficiency. This introduction outlines the key stages of the methodology, including conceptualization, design, prototyping, IoT integration, testing, and deployment. Each stage involves specific tasks and activities that contribute to the successful realization of the Solar Green Recycling Cube. The first stage involves defining the project goals and objectives, understanding user needs, and identifying the desired functionalities and features enabled by IoT. Market research is conducted to assess the demand and potential impact of the Cube. The design stage focuses on translating conceptual ideas into detailed plans, incorporating IoT connectivity, renewable energy technology, waste separation and compaction mechanisms, and user interface design.

Prototyping allows for testing and refining the Cube's performance, IoT connectivity, and user experience. The integration of IoT involves connecting the Cube to a central management system, enabling real-time monitoring, data collection, and remote management. Deployment entails installing the Solar Green Recycling Cube in suitable locations, training personnel for operation and maintenance, and monitoring the system's performance in real-world scenarios. The IOT Based Solar Powered Recycle Bin with Monitoring System aims to achieve its objectives of promoting sustainable waste management practices, leveraging IoT connectivity for efficient waste collection and monitoring, and contributing to a cleaner and greener environment. Solar Green Recycling Cube Based on an IoT project is built using a NodeMCU ESP8266 board, which is connected to various sensors including an ultrasonic sensor, load cell, and LED lights. A sketch design and a block diagram of the project are shown in Figure 1 and Figure 2, where Figure 1 shows the sketch design of the project while the block diagram in Figure 2 shows the basic connection structure of the main components used to complete this innovation project.

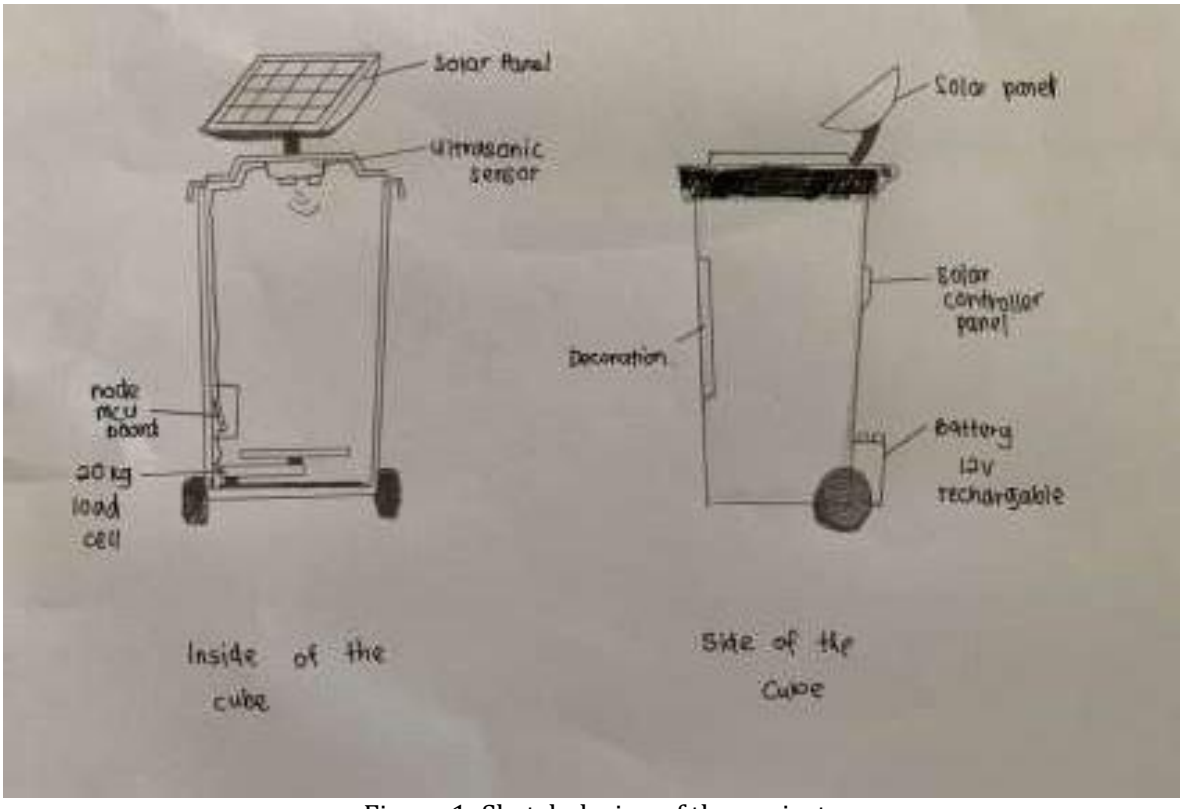

Figure 1: Sketch design of the project

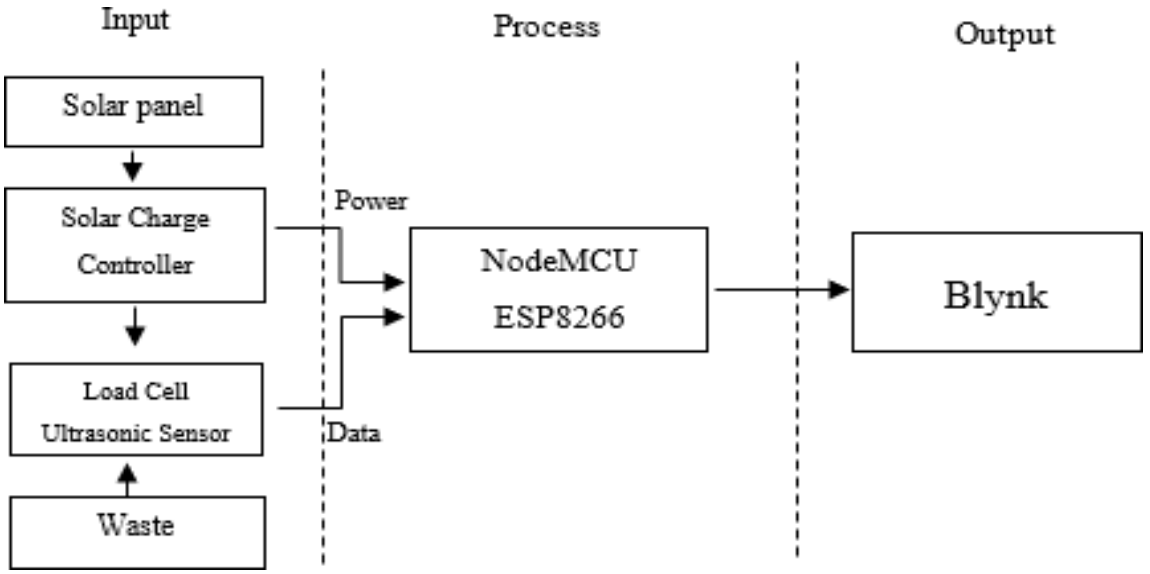

Figure 2: Block diagram of the project

Figure 3 shows a simple process flowchart on how to use the developed the. This project works to monitor waste height and weight using the Blynk database which is collected from the NodeMCU ESP8266 module. Figure 4 shows the complete connection diagram of the the IOT Based Solar Powered Recycle Bin with Monitoring System circuit developed using Livewire Professional Edition software version 1.11. Figure 5 shows the rough connection of components based on object images.

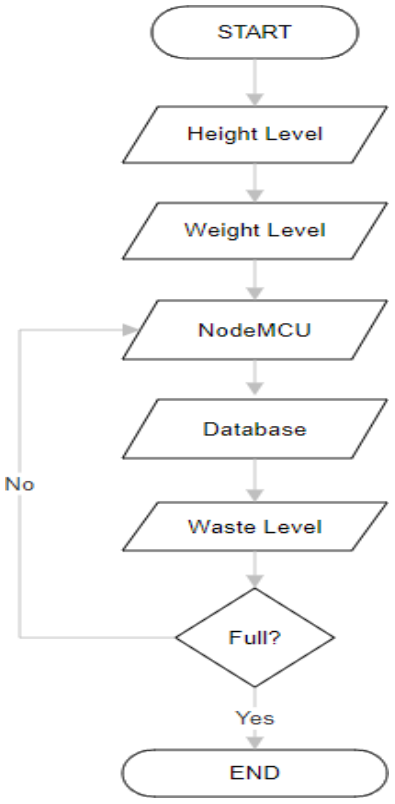

Figure 3: Flowchart of functional project

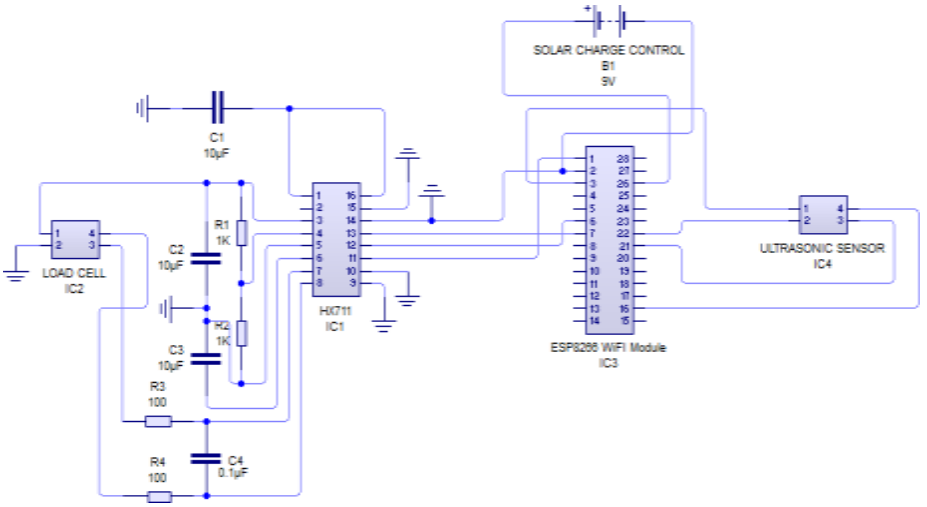

Figure 4: Circuit schematic diagram of the project

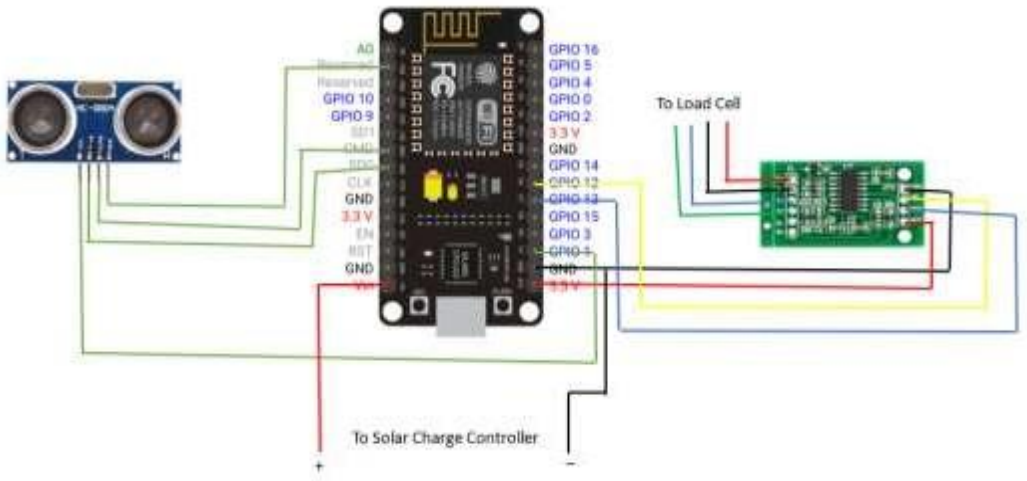

Figure 5: Sketch of component wiring of the project

The Software uses C and C++ are the programming languages which is standard across all Arduino boards and can be used either online or offline. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board and NodeMCU. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. User-written code only requires two basic functions, for starting the sketch and the main program loop, which is compiled and linked with a program loop, that is compiled and linked with a program stub main () into an executable cyclic executive program with GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program Avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's program.

The Blynk software is used in this project to prototype, deploy, and remotely manage connected electronic devices at any scale. With Blynk, anyone can connect their hardware to the cloud and build

no-code iOS, Android, and web applications. These applications can analyze real-time and historical data coming from devices, control the devices remotely from anywhere in the world, receive important notifications, and much more. Blynk is a multi-tenant solution that configures how users access the data by setting roles and configuring permissions. Applications made with Blynk are ready for end-users such as the management of the recycle bin.

4.0 RESULT AND DISCUSSION

The IOT Based Solar Powered Recycle Bin with Monitoring System connectivity allows for real-time monitoring, fill-level detection, and remote management, providing valuable insights for optimizing waste collection routes, scheduling, and resource allocation. This project utilizes Arduino IDE and Blynk as shown in Figure 6 and Figure 7.

Using Arduino IDE and Blynk for real-time monitoring, recycle bin management can monitor the current content of recycled materials in the bin through fill-level detection. Recycle bin management can be done remotely and does not require on-site presence. This makes it easier for recycle bin management, as there is no need to check the recycle bin every day. The recycle bin management can organize waste collection routes, scheduling, and resource allocation based on thenotifications received. This will save time and labour resources.

Figure 6: Arduino IDE

Figure 7: Blynk

This project uses a 100W Solar Panel Kit 12 V battery charger. The resulting prototype is as shown in the Figure 8.

Figure 8: Prototype of The IOT Based Solar Powered Recycle Bin with Monitoring System

5.0 CONCLUSION AND FUTURE WORK

In conclusion, the IOT Based Solar Powered Recycle Bin with Monitoring System is a unique solution for sustainable waste management in public spaces. The Cube's design integrates renewable energy sources, real-time monitoring, and IoT technology to optimize waste management processes and encourage public participation in recycling. The Cube's user-friendly interface makes recycling more accessible and rewarding. The project's significance lies in its potential to reduce the carbon footprint of waste management while also improving recycling rates and reducing the amount of waste sent to

landfills. The Cube's real-time monitoring system allows waste collection teams to optimize their collection schedule, leading to reduced operating costs and improved efficiency. The Cube can be a valuable addition to any city or public space, promoting sustainable waste management practices and a cleaner environment. Overall, the Solar Green Recycling Cube-Based On IoT is an innovative and significant project that has the potential to make a positive impact on the environment and the community. For improvement, several approaches have been identified to be highlighted in the future after this project added compartments for 3 types of recycling products such as glass, paper, and tin, and added a red light LED and green LED to indicate whether the cube is full or not.

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Gas Leakage Detector and Safety System at Home

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Abstract. The system was developed to detect and solve gas leakage problems using esp32 and smartphones. It is used in many aspects including consumer home security and the environment. This shows that the system is associated with IOT (internet of things), which means that when a gas leak is detected, it will notify users via the smartphone and the system can also overcome the leakage of the gas by closing the main channel of the solenoid valve which can prevent the gas from spreading more widely. Using this system, users can take the first step in overcoming fire.

Keywords: IoT, gas, leakage, fire

1.0 INTRODUCTION

Gas sensors play an important role in ensuring safety in a home. They are used to detect gas leaks and prevent possible dangerous situations that could result in loss of life and damage to the home. Traditional gas detection methods such as pellet or catalyst bead sensors and non-dispersed infrared sensors have limitations, leading to the development of new technologies such as Molecular Property Spectrometers. In this article, we will discuss the importance of gas sensors, the limitations of traditional gas detection methods, and the benefits of upgrading gas sensors to IoT using the MCU Esp 32 Node. In addition, gas sensors can help prevent environmental damage by detecting leaks, protecting the home owner and protecting the home from burning. Enhancing gas sensors into the IoT using the MCU Esp 32 Node can improve their capabilities and provide real-time monitoring and connected sensor networks to improve the response to gas leaks.

2.0 LITERATURE REVIEW AND HYPOTESIS

The ESP32 is a powerful and versatile microcontroller that combines Wi-Fi and Bluetooth connectivity, making it suitable for IoT (Internet of Things) applications. This study presents the processing power and I/O capabilities necessary to control and interact with the gas sensor, solenoid valve, and other components. Gas leakages results a serious problem in household and other areas where household gas is used, therefore the proposed gas leakage detection and monitoring system is developed (Suma, V., Shekar, R. R., & Akshay, K. A., 2019).

2.1 Gas sensor (MQ-2)

The gas sensor technology depends on the specific sensor model used in the project. In this example, the MQ-2 gas sensor is utilized, which is based on a semiconductor sensing element that changes its resistance in the presence of specific gases. It is commonly used for detecting flammable gases such as methane, propane, and butane. We demonstrate a high-performance gas sensor using partially reduced graphene oxide (GO) sheets obtained through low-temperature step annealing (300 °C at maximum) in

argon flow at atmospheric pressure (Han, D. M., & Lim, J. H.,2010).

2.2 Solenoid Valve

A solenoid valve is an electromechanical device that controls the flow of gas or other fluids. It typically operates by using an electromagnetic coil to actuate a valve mechanism, either opening or closing the flow path. A solenoid valve is an electromechanical device that controls the flow of gas or other fluids. It typically operates by using an electromagnetic coil to actuate a valve mechanism, either opening or closing the flow path (Subramanian, M. A., Selvam, N., Rajkumar, S., Mahalakshmi, R., & Ramprabhakar, J. (2020)

3.0 RESEARCH METHODOLOGY

The ESP32 is a powerful microcontroller board that can be used to interface with gas sensors for detecting various types of gases. Gas sensors generate a voltage that is proportional to the concentration of the gas being detected. The ESP32 board reads this voltage and processes it to determine the gas concentration. The ESP32 board can also be programmed using the Arduino IDE, and the code can be used to upload gas sensor data to a cloud server such as adafruit. With this setup, it is possible to create a gas leakage detector with email alert notification system.

3.1 Application Design

This system is designed using one of the main inputs generated by the MQ2 Gas sensor that processes using ESP32 NodeMCU.The project's innovation results are LCD, LED, Buzzer and Solonoid vailve, Figure illustrated the connection of this project.

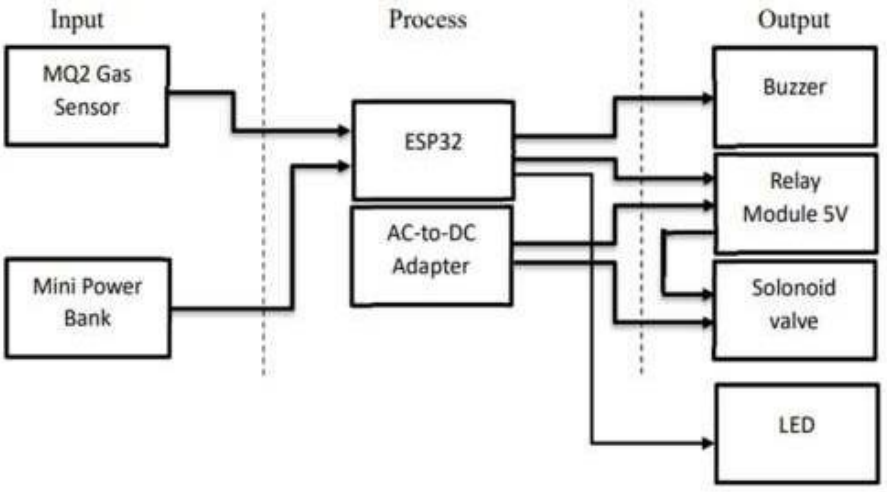

Figure 3.1 : Block Diagram

3.2 Flowchart of the System

Figure 3.2 illustrates the sequential steps involved in a gas leakage detector monitoring system. The purpose of this system is to track and manage various aspects of gas leakage detector with alert notification system and well-being. This system will initially detect gas leakage and then the project's innovation results are LCD, LED, Buzzer and Solenoid valve On for cut the gases.

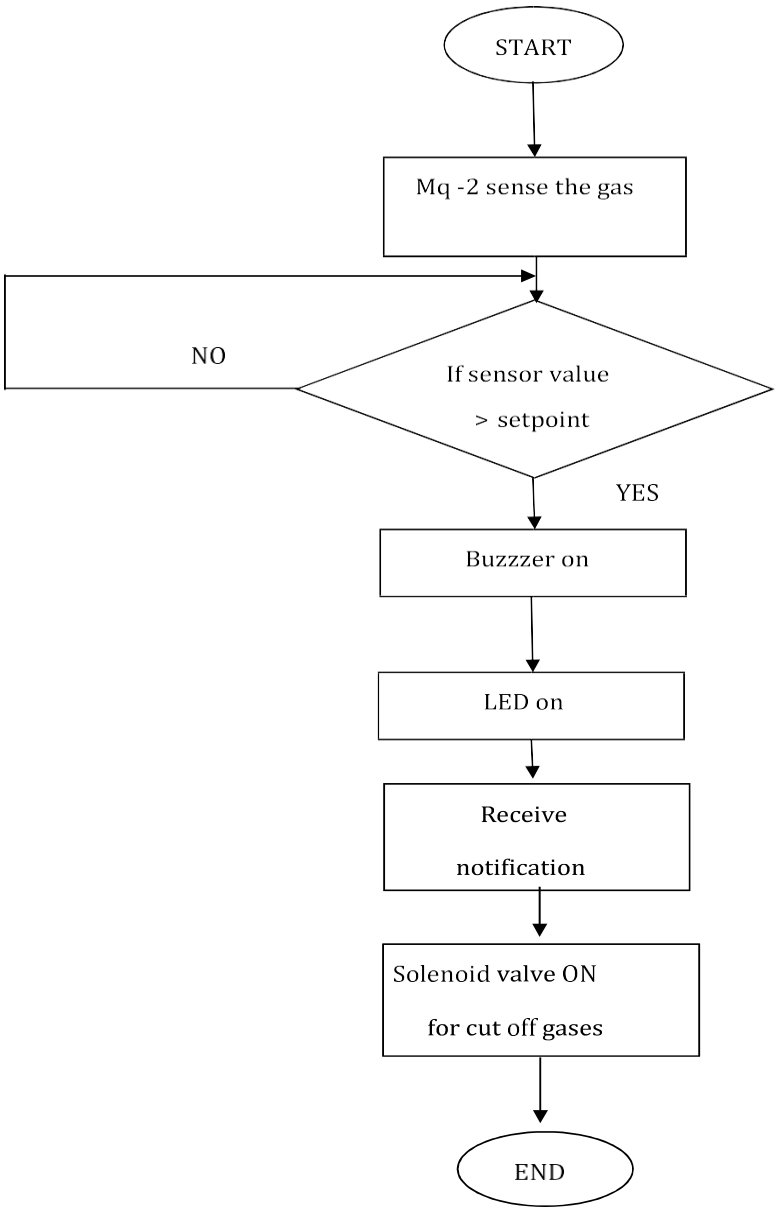

Figure 3.2: Flowchart of functional project

4.0 RESULT AND ANALYSIS

This project at last demonstrates the function of the entire endeavour once the product is prepared. The MQ2 gas sensor detects the gas leakage it will notify users via the smartphone and the system can also overcome the leakage of the gas by closing the main channel of the solenoid valve which can prevent the gas from spreading more widely. It is then processed by the microcontroller immediately gives a signal by ringing the buzzer, turning on the red LED, which in this case is an ESP32, and the level of gas rate is displayed on the phone using Blynk application. Gas detection systems with solenoid valves have been successfully implemented and tested in controlled environments and the data will be shown and recorded through Blynk application.

Figure 4.1 shows the display gas leakage via Blynk application and Figure 4.2 shows the display solenoid

valve on. The user can monitor the gas leakage through Blynk apps.

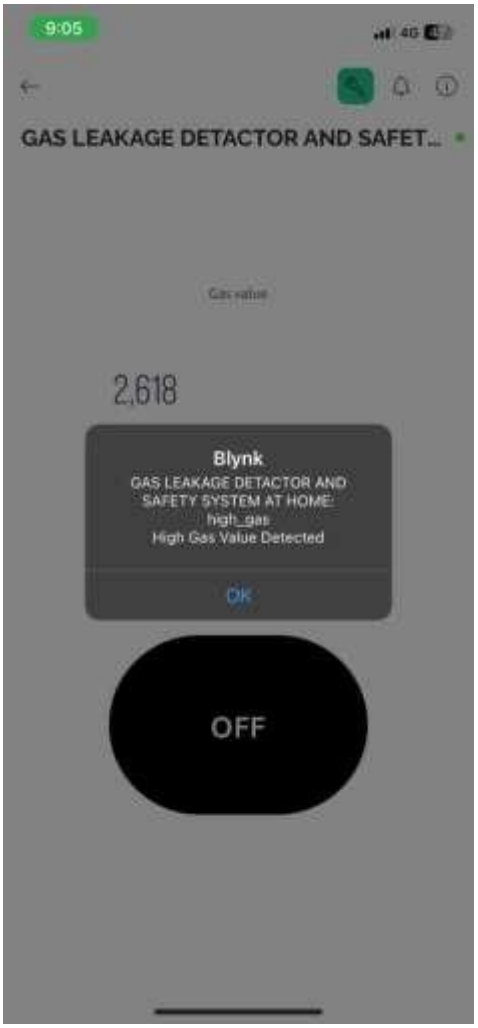

Figure 4.1: Display Gas Leakage

Figure 4.2: Display Solenoid Valve On

This project involves the cost of purchasing components and materials throughout its implementation components involving the cost of hardware. Most of the hardware components are from online purchases. The price is compared from surveys at several online shops such as Shopee and Lazada. This method makes it easier as well because it will save time and costs.

The overall gross budget estimate of this project is RM105.2 as shown in Table 4. According to this budget cost, this project is compared to other projects that can cost over a thousand ringgit. The cost of the project is also in line with one of the key features of a good project developer which is low cost but a high-quality project.

Table 4: List of the components and materials

No.	Component and materials	The unit price	Quantity	Total
1.	ESP32 microcontroller	RM30	1	RM30
2.	MQ-series gas sensor	RM6	1	RM6
3.	Solenoid valve	RM30	1	RM30
4.	Power supply (AC/DC adapter)	RM20	1	RM20
5.	Jumper wires	RM3	2 set	RM6
6.	LED	RM1	2	RM2
7.	Resistors	RM0.1	2	RM0.2
8.	Casing (box)	RM8	1	RM8
9.	Buzzer	RM3	1	RM3
TOTAL				RM105.2

5.0 CONCLUSION

This IoT application has been developed using a NodeMCU ESP32 microcontroller to control the MQ2 Gas Sensor and solenoid valve can provide an effective solution for detecting gas leaks and preventing potential safety hazards. By accurately sensing gas concentrations and automatically cutting off the gas supply when necessary, the gas detector can help protect homes and buildings from the dangers of gas leaks. The control of each component involved is designed on the smartphone by using the Blynk application to display the record of gas leakage. It was innovation results to appear at LCD, ringing Buzzer and Solonoid valve to cut off the gas leakage. The project scope can be tailored to fit the specific needs and requirements of the user, such as incorporating wireless connectivity, customization and expandability options, battery backup, and cloud connectivity and data analytics. Besides, the design of the product is only in the kit from this project, and the customers can put this kit in their homes. The recommendation is to enhance the device to add chemicals for stopping the gas from coming out. So that the gas will stop immediately and avoid gas spreading.

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TRACK 5: CIVIL ENGINEERING

Reka Bentuk Elemen Air Di Persekitaran Kampus: Satu Kajian Awal Ke Atas Reka BentukLandskap dan KesanTerhadap Pelajar

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Abstrak. Air merupakan antara satu elemen yang memainkan peranan penting khususnya dalam reka bentuklandskap. Perancangan reka bentuk kampus yang melibatkan elemen air mampu memberi impak yang besar kepada sesuatu persekitaran. Di samping meningkatkan kualiti persekitaran, ianya mampu menjadi pusat tumpuan aktiviti pelajar serta sebagai rangsangan kepada perkembangan kognitif pendidikan mereka. Selain dari melembutkan suasana persekitaran, elemen air di kampus juga mampu mengurangkan tekanan psikologipelajar dengan kewujudan hidupan akuatik, flora dan fauna di kawasan berair. Kehadiran elemen air pada tempat yang betul dan jenis reka bentuk sebenarnya membantu menceriakan suasana pendidikan dan secara tidak langsung dapat menghidupkan suasana kampus. Kampus yang tidak mempunyai elemen air pastinya hambar dan tidak ceria. Air hujan merupakan aset percuma yang perlu dimanfaatkan sebaik mungkin. Larian air dipermukaan secara graviti mengikut kecerunan topografi merupakan satu peluang terbaik dalam reka bentuk elemen air seterusnya meningkatkan nilai estatik serta meminimakan kos penyelenggaraan. Kajian ini bertujuan bagi meninjau reka bentuk elemen air yang berpotensi di kampus Politeknik Merlimau, Melaka (PMM) dan kesannya terhadap pelajar serta strategi sistem reka bentuk elemen air di kampus ini. Para pelajar perlu mengenal pasti potensi kawasan elemen air sebagai pusat tumpuan kehidupan di kampus. Di samping itu, kesan elemen air ke atas pendidikan pelajar perlu di beri pendedahan yang positif bagi mengekalkan suasana kampus yang ceria dan mapan. Kriteria reka bentuk elemen air dan perletakannya di kawasan kampus juga perlu diberikan keutamaan agar dapat dimanfaatkan secara komprehensif. Menerusi tinjauan literatur, persepsi pelajar dan warganya (72 orang responden) secara soal selidik dengan menggunakan *'skala likert'* dapat dirumuskan bahawa para pelajar perlu mengenal pasti potensi kawasan elemen air sebagai pusat tumpuan kehidupan di kampus. Oleh yang demikian, kesan elemen air ke atas pendidikan pelajar perlu di beripendedahan yang positif bagi mengekalkan suasana kampus yang ceria dan mapan. Kriteria reka bentuk elemen air dan perletakannya di kawasan kampus juga perlu diberikan keutamaan agar dapat dimanfaatkan secara komprehensif. Tuntasnya, dengan penggunaan proses ini dapat memberi satu petunjuk serta satu cadangan awal reka bentuk landskap berdasarkan elemen air di PMM.

Kata Kunci: Perancangan, reka bentuk elemen air, pendidikan diluar kelas.

1.0 Latar Belakang

Pendidikan di politeknik banyak menekankan kepada kecemerlangan pelajar amnya secaraholistik. Oleh itu penambahbaikan reka bentuk landskap haruslah dipertingkatkan pada masa akan datang supaya memberi kesan psikologi dan merangsangkan perkembangan kognitif yang baik kepada warganya. Kebanyakan pelajar politeknik amnya datang daripada latar belakang pencapaian sederhana sewaktu sekolah menengah. Mereka memerlukan satu ruang Pendidikan yang dapat

menggilap masa depan mereka. Kursus-kursus yang ditawarkan di peringkat politeknik lebih berfokuskan kepada bidang-bidang kemahiran *(hand on)*. Oleh itu, keperluan kepada persekitaran yang baik akan mampu memberi pengaruh yang kuat kepada pencapaian pelajar. Peranan persekitaran penting dalam perkembangan kognitif, psikomotor, pelajar berkesan dan sosial (Rusni, 2005 dan Sabariah 2006). Kesan dari sudut psikologi, reka bentuk air mampu menyejukkan persekitaran dan bertindak sebagai pusat tumpuan pelajar berkumpul pada masa terluang, pertukaran kelas dan sebagai kawasan pendidikan terbuka. Persekitaran pembelajaran di kawasan luar, kemudahan dan struktur yang menyokong penerokaan dan percubaan pembelajaran jarang diberi perhatian oleh pihak universiti (Julie M. Johnson, 2000).

Perancangan reka bentuk elemen air sebagai elemen landskap di pusat pengajian tinggi merupakan satu langkah pemurnian kepada persekitaran yang lebih sejahtera. Kebanyakanpersekitaran pusat pengajian tinggi tersedia dengan kewujudan elemen air sebagai kawasan rekreasi dan kawasan tadahan air hujan. Menurut Kenney (2005), pelajar dan ahli akademikhari ini melihat pada kawasan rekreasi sebagai bahagian yang penting dalam kampus, kedua-duanya adalah dari sudut ameniti sosial dan kemudahan kesihatan.

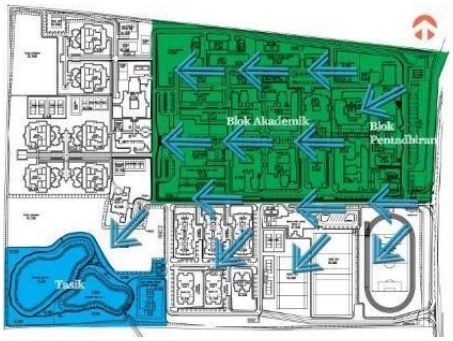
Namun begitu, kewujudan ruang ini seolah-olah tidak memberi kesan kepada pengguna (pelajar). Reka bentuk ruang sediada gagal berfungsi sebagai tempat pertemuan pelajar. Ini kerana, perancangan reka bentuk tidak begitu menyeluruh, peluang serta sumber yang ada tidak dimanfaatkan sepenuhnya. Pemurnian reka bentuk elemen air ini harus dikembangkan di kawasan yang lebih sesuai mengikut jenis reka bentuk elemen air yang digunakan. Strategi pengunaan air secara semulajadi harus ditingkatkan supaya lebih memberi manfaat kepadawarganya. Penggunaan semula air hujan dari larian permukaan tanah dan bumbung bangunan harus dimanfaat sewaktu awal perancangan reka bentuk. Bentuk topografi PMM yang agak bercuram dan berteres merupakan satu *'bonus'* kepada perancangan larian air secara graviti menerusi reka bentuk landskap sebelum limpahannya memasuki saliran (longkang). Limpahan air hujan khususnya, bukan hanya sekadar dilihat sebagai tabiat alam tetapi harusnya digunakan bagi pendidikan pelajar secara langsung. Selain itu, ianya turut menyumbang kesan ke atas psikologi mereka. Peranan reka bentuk landskap harus diberi perhatian oleh pihak terbabit dalam perancangan pembangunan kampus di masa akan datang.

1.1 Ciri-Ciri Fizikal, Persekitaran dan Budaya Kampus PMM

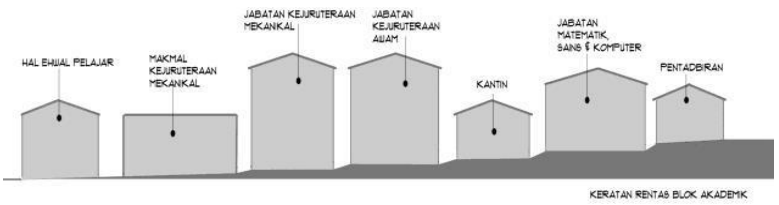
Kajian tapak ini dilakukan secara rawak berdasarkan kepada ciri-ciri fizikal persekitaran dan budaya. Kajian analisis dilakukan berdasarkan kepada rujukan dari buku *Site Analysis: Linking Program and Concept in Land Planning and Design. (James A. Lagro Jr. 2001)* yang merujuk kepada fizikal, biologikal serta budaya.

1.1.1 Fizikal- Topografi dan Saliran

Sejarah kawasan PMM pada asalnya merupakan kawasan ladang kelapa sawit yang dibangunkan. Keseluruhan topografi PMM agak bercerun (anggaran 25-30%) dan berteres mengikut zon-zon jabatan. Kawasan tertinggi terletak di sebelah timur manakala kawasan paling rendah terletak dibahagian barat. Secara tidak langsung, pengaliran air berlaku mengikut topografi sediada dan berakhir ditasik semu- lajadi. Tasik semulajadi ini menjadi kawasan rekreasi bermusim bergantung kepada aktiviti pelajar dan staf. Purata taburan hujan tahunan (anggaran 2000mm-Melaka) mengikut cuaca dan iklim Malaysia sudah cukup untuk memberi tampungan kepada tumbuhan sekitarnya. Sistem saliran sekitar kawasan kajian amat baik. Namun begitu kedalaman longkang yang melebihi satu meter dan kebanyakannya terbuka mampu mengundang risiko kepada pelajar.



Rajah 1: Pelan tapak kajian (hijau), ruang serta rekabentuk elemen air di PMM dan petunjuk arah kecerunan topografi.



Rajah 2: Keratan rentas bentuk topografi antara jabatan dan potensikawasan tasik (biru)

1.1.2 Biologikal

Secara keseluruhannya kawasan PMM mempunyai pokok-pokok besar dan sederhana. Namun demikian, pokok- pokok renek dan akuatik amat berkurangan. Pokok besar di PMM kebanyakannya dianggarkan berusia dalam lingkungan 15 tahun. Banyak pokok besar ini ditanam di sempadan kawasan dan sedikit pokok-pokok sederhana ditanam dibahagian tengah kawasan. Terdapat ruang-ruang terbuka hijau yang hanya terdiri daripada rumput karpet dibahagian ruang tengah antara jabatan.

1.1.3 Budaya dan Pendidikan

Suhana (2007), menegaskan bahawa integrasi di antara bilik kuliah dan ruang luar amat penting bagi meningkatkan in- tegrasi sosial dan budaya intelek di kalangan pelajar kampus. Ruang tengah setiap jabatan di PMM mempunyai 'courtyard' dan ia menjadi tumpuan para pelajar dalam melakukan pelbagai aktiviti tetapi ianya bermusim. Berdasarkan kepada pemerhatian, kawasan ini, mempunyai potensi yang tinggi sebagai pusat pertemuan pelajar pada setiap waktu terluang. Namun begitu, ruang ini tidak dimanfaatkan sebaik mungkin serta tidak menjadi 'nodes' kepada pelajar.

1.1.4 Objektif dan Skop Kajian

Para pelajar perlu mengenal pasti potensi kawasan elemen air sebagai pusat tumpuan kehidupan di kampus. Di samping itu, kesan elemen air ke atas pendidikan pelajar perlu di beri pendedahan yang positif bagi mengekalkan suasana kampus yang ceria dan mapan. Kriteria reka bentuk elemen air dan perletakannya di kawasan kampus juga perlu diberikan keutamaan agar dapat dimanfaatkan secara komprehensif.

Kajian ini hanya dilakukan dikawasan persekitaran jabatan di kampus PMM sahaja. Ianya hanya tertumpu kepada ruang luar bangunan kampus dan *nodes* pelajarserta kepada bidang reka bentuk landskap sahaja.

Kajian ini bertujuan meninjau reka bentuk elemen air yang berpotensi di kampus berdasarkan kepada sumber sekitar, kesannya terhadap pelajar dan strategi sistem reka bentuk yang berpotensi di kampus PMM.

2.0 TINJAUAN LITERATUR

2.1 Air dan Ciri-Cirinya

Menurut Catherine Dee (2005), Elemen air dalam landskap merujuk kepada karektor, dan penumpuan dalam sesuatu lokasi atau ruang serta menarik orang ramai secara menegak, bunyi, tekstur, cahaya, pergerakan atau kesejukannya merujuk kepada perletakkan atau konteks. Menurut beliau, lagi ciri-ciri air merujuk kepada perincian air yang mempamerkan kepelbagaian karektor. Ia bersifat dinamik dan boleh dimanupulasikan berdasarkan alunan. Selain percikannya mampu terbentuk seakan rerama. Air yang tenang mampu bertindak sebagai refleksi kepada awan, pohon, manusia dan burung-burung. Air mempunyai kemampuan bunyi yang pelbagai.

Kebanyakannya manusia gemar melakukan aktiviti yang mempunyai hubungkait dengan bunyi-bunyian air. Secara psikologinya, ia mampu memberiransangan kepada deria dan emosi. Air juga boleh disentuh, dirasai dan dihidu. Percikan air yang boleh dirasai dari jarak tertentu menjadikannya karektor yang unik. Manakala, bunyi air yang mengalir memberi kesan yang positif kepada fikiran. (Reyhan Arasuli, 2011).

2.2. Fungsi Elemen Air Ke Atas Persekitaran

Reka bentuk aliran air mampu membentuk satu 'ecological corridor' yang mantap selain berupaya menghidupkan sesuatu kawasan menjadi subur dengan kepelbagaian tumbuhan. Kewujudan ini mampu mengimbangi kawasan yang padat dengan elemen buatan dan semulajadi. Catherine Dee, (2005) menegaskan bahawa ruang air menarik perhatian orang ramai sebagai potensi rekreasi yang pelbagai dan sering menjadi habitat yang penting kepada kehidupan flora dan fauna. Menurut Stephen Siu Yu Lau and Zhonghua (2014), pembinaan kawasan lembab (wetland) bertindak sebagai penapis air sisa dari bangunan dan pelajar dapat mempelajari proses biologi, habitat dan kepentingan sistem ekosistem. Menurut beliau lagi, taman-taman air boleh digunakan untuk penerokaan habitat semula jadi dalam kajian ekologi akuatik. Melalui pertukaran jisim air kepada kabus yang halus (lembab), ia mengubah atmosfera menerusi bunyi, cahaya, sentuhan dan rasa.

2.3 Kesan Penggunaan Elemen Air Di Kampus Ke Atas Tingkah Laku Pelajar.

Kehadiran elemen air di dalam kampus akan merancakkan dan menghidupkan aktiviti sosial pelajar. Selain bertindak sebagai agen penyejuk kawasan air mampu menjana, mengembangkan dan meningkatkan daya kreativiti pelajar dalam proses pembelajaran diluar kelas. Manakala *ABC Water Design Programme (2011),* Singapura menjelaskan, elemen air mampu memberi pengalaman pendidikan supaya pelajar sering membangkitkan persoalan dan pertanyaan berdasarkan reka bentuk *'rain garden'* dan elemen air bertindak sebagai fokal aktiviti di dalam sesebuah kampus. Ulrich (1991) menegaskan bahawa hidupan tumbuhan bersama air ini mampu mengurangkan tekanan sekaligus meningkatkankesan positif ke atas emosi seseorang dan mengurangkan tekanan emosi.

Menurut Stephen Siu Yu Lau and Zhonghua (2014), lenggokan air yang turun dan alunan gemanya dikawasan tertutup mewujudkan perasaan yang tenang dan damai. Secara tidak langsung mengembalikan emosi ke titik asal dan merehatkan minda selepas kelas tamat. Menerusi kajian Marcus and Wischemann (1998) menunjukkan 14% pelajar gemar kepada kawasan terbuka berhampiran dengan elemen air, 14% kawasan yang senyap, 28% kawasan yang semulajadi, hijau dan berpohon. Manakala menurut Shamsul (2015) hampir 60% pelajar di kampus bersetuju bahawa bermain bersama elemen air ini mampu meningkatkan daya kreativiti mereka.

2.4 Jenis-Jenis Reka Bentuk Elemen Air dan Fungsinya

Jenis reka bentuk elemen air untuk habitat hidupan yang berbentuk semulajadi atau geometri mempengaruhi ruang persekitaran disamping memberi kesan kepada tingkah laku serta emosi pelajar. Jenis-jenis reka bentuk haruslah bergantung kepada saiz, skala ruang, dan fungsi kepada ruang tersebut (Catherine Dee, 2005). Jika ruang tersebut lebih menjurus kepada aktiviti aktif, maka kolam yang berbentuk geometri mungkin lebih sesuai. Manakala ruang separuh aktif yang menekankan pendidikan alam sekitar, reka bentuk semulajadi adalah lebih sesuai. Elemen air juga mampu menarik keinginan manusia dan bertindak sebagai pusat pertemuan (*foci*) aktiviti.

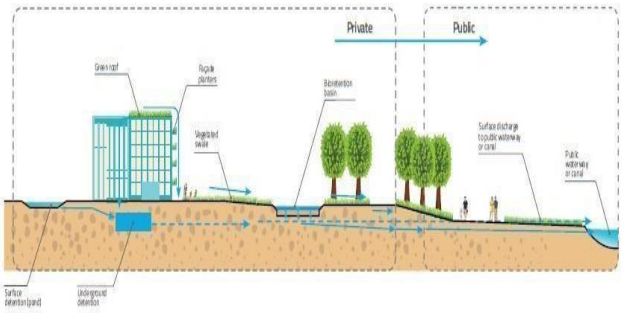
2.5 Strategi Sistem Reka Bentuk Elemen Air

Satu kajian kes yang dibuat penulis terhadap satu garis panduan reka bentuk elemen air yang telah diaplikasikan di negara jiran, Singapura boleh dijadikan sebagai panduan. Strategireka bentuk air dari projek negara tersebut yang dikenali sebagai *ABC (Active, Beautiful andClean waters) Water Design Guidelines* boleh dijadikan rujukan walaupun kawasan projek berskala kecil. Strategi pengurusan air ini termasuk sistem air longkang, kawalan banjir, kualiti larian air dan risiko kesihatan awam seperti pembiakan nyamuk. Namun begitu terdapat beberapa pendekatan yang berbeza mengikut zon berdasarkan beberapa faktor kawasan tersebut. Teknik yang digunakan dalam reka bentuk *ABC* Singapura antaranya; *Vegetation Swales, Wetland Swam Forest, Cleansing Biotope, Bioretention Swales and Rain Garden, Meandering Jogging Track, Environmentally Friendly Construction, Ecological Lake System, Reed Bed And Wetland Filtering System, Bring People Closer To Water, Maintaining AnAquatic Ecosystem, Infiltration Trenches With Integrated Subsoil Drainage, Green Roofs and Vegetated Swales, Bio-Ponds, Corridor And Roof-Top Plants, Yishun Pond, Green Roof and Green Wall, Native Plant Species, Lookout Deck, Sedimentation Basin, Floating Wetland, Fa- cade Greenery, Planter @ Balcony* dan lain-lain lagi. Namun begitu, kaedah *vegetation swales, bioretention basin, permeable pavement, rain gardens, bio ponds* merupakan satu kaedah yang menarik dan boleh diaplikasikan di PMM, berdasarkan potensi topografi, skala dan ruang serta kos.

Rajah 3: Sistem reka bentuk *'rain gardens'* (Rivervale Arc) mampu mengurangkan larianair permukaan. *Sumber: ABC Water DesignProgramme (2011)*

Rajah 4: Sistem vegetation swales (Sungei Ulu Pandan). Sumber: ABC Water Design Programme (2011)

Rajah 5: Lokasi: Waterway Ridges @PunggolEast, Singapura.
a. Tanaman akuatik disekitar mempamerkankecantikan kolam mini semulajadi.
b. *Bioretention basin* sebagaikawasanrekreasi umum.
c. Reka bentuk air terjun juga boleh merawatkebersihan air.
Sumber: ABC Water Design Programme (2011)



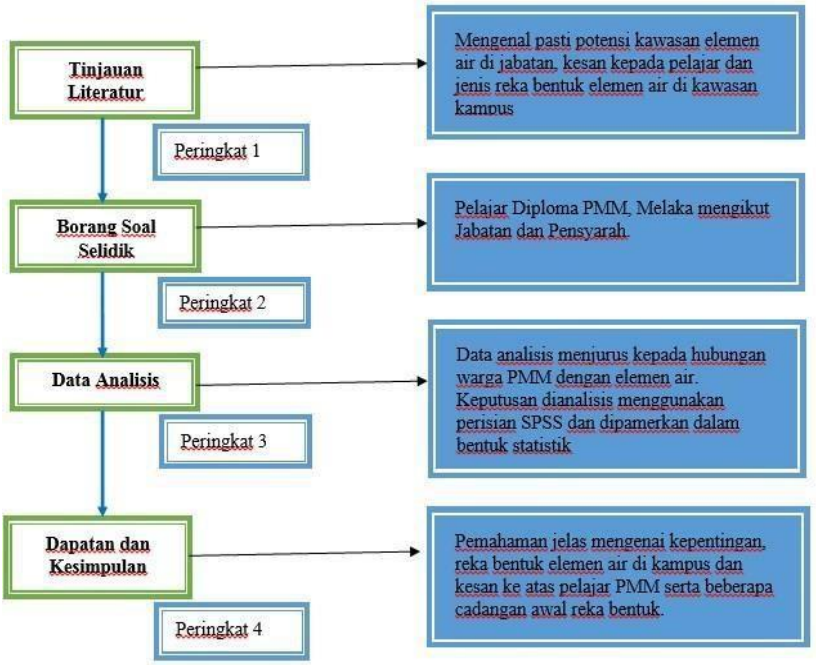
Rajah 6: Reka bentuk persekitaran juga mampumengurangkan larian air dipermukaan tanahdengan dibangunkan sebagai kawasan riadah bertemakan air.
Sumber: ABC Water Design Programme (2011)

3.0 METODOLOGI

Terdapat beberapa prosedur-prosedur yang digunakan bagi mencapai matlamat kajian ini. Di antaranya ialah reka bentuk kajian, populasi dan sampel, instrument kajian dan kaedah analisis data. Reka bentuk kajian berfungsi sebagai panduan perjalanan kajian yang berperingkat menurut fasa 1 sehingga 4. Manakala populasi dan sampel terdiri daripada 10 orang pelajar dan 2 orang pensyarah di enam jabatan di PMM (72 orang responden). Kajian ini melibatkan borang soalselidik yang diedarkan kepada pelajar dan pensyarah. Borang soalselidik ini merangkumi 4 tahap, seperti ditunukkan di dalam Raah 7.

i. Tahap I-latar belakang responden,
ii. Tahap II- soalan berkaitan dengan potensi kawasan,
iii. Tahap III-Bentuk berinteraksi dengan elemen air dan kesan elemen air ke atas pendidikan pelajar
iv. Tahap IV- Kriteria dan kawasan reka bentuk elemen air sebagai pusat kehidupan di kampus.

Kaedah analisis data menggunakan perisian SPSS bagi mencari skor peratus maksimum dan minimum dalam kajian ini dan mengikut skala Likert. berkaitan dengan potensi kawasan, tahap III-Bentuk berinteraksi dengan elemen air dan kesan elemen air ke atas pendidikan pelajar serta tahap IV-Kriteria dan kawasan reka bentuk elemen air sebagai pusat kehidupan di kampus. Kaedah analisis data menggunakan perisian SPSS bagi mencari skor peratus maksimum dan minimum dalam kajian ini dan mengikut skala Likert.



Rajah 7: Kerangka rekabentuk kajian.

4.0 HASIL KAJIAN

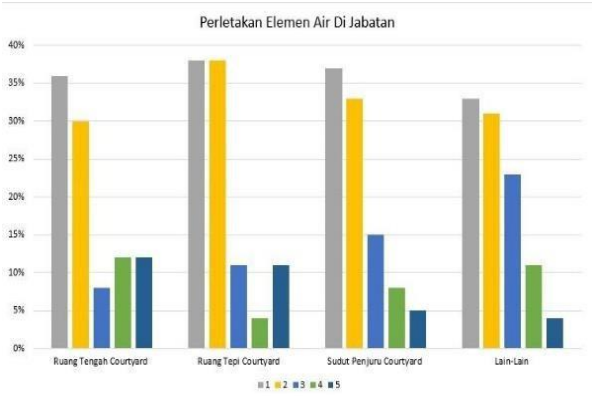
Persepsi Pelajar Terhadap Reka Bentuk Elemen Air Di Persekitaran PMM boleh dibahagikan kepada beberapa aspek:

4.1 Demografi

Sampel kajian ini melibatkan 72 orang yang terdiri daripada 60 orang pelajar peringkat diploma dan 12 orang pensyarah. Mereka terdiri daripada 40 lelaki dan 32 wanita. Hasil soalselidik menunjukkan bawah 95% orang bersetuju bahawa jabatan masing-masing memerlukan elemen air sebagai pusat tumpuan manakala 5 % menyatakan tidak pasti.

4.2 Perletakkan Elemen Air Di Setiap Jabatan

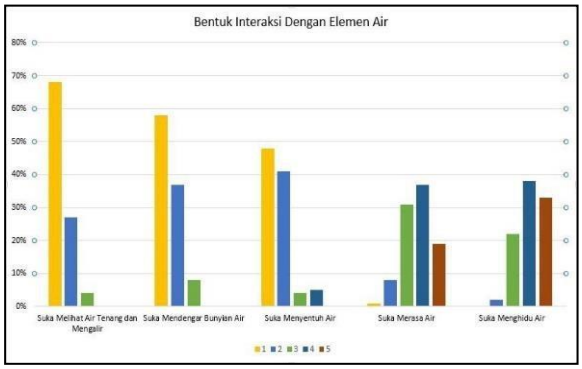
Hasil kajian menunjukkan hampir 40% responden bersetuju bahawa lokasi perletakan elemen air di jabatan diletakkan di ruang tepi courtyard (skor1dan 2) dan manakala 37% responden bersetuju (skor 1) elemen air ini diletakkan di tengah dan sudut tepi courtyard dan selebihnya 35% bersetuju untuk diletakkan di kawasan lain-lain tempat di sekitar jabatan. Faktor pemilihan tempat ini juga dipengaruhi oleh keadaan courtyard jabatan masing- masing. Ini Kerana terdapat perbezaan dari segi turapan dan semulajadi.



Rajah 8: Perletakkan Elemen Air Di Setiap Jabatan

4.3 Bentuk interaksi dengan elemen air

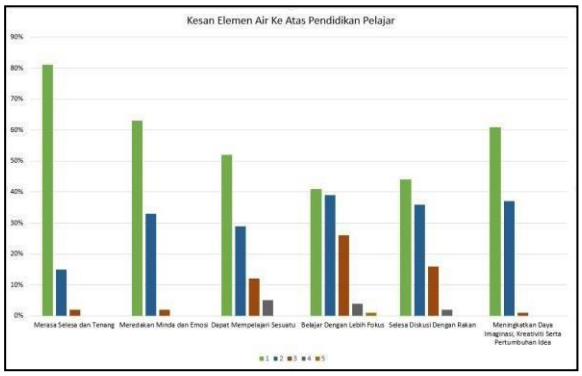
Hasil kajian menunjukkan (skor1) bahawa ramai responden suka melihatair yang tenang dan mengalir (68%), suka mendengar bunyian air (58%) dan gemar menyentuh air (48%). Keadaan ini jelas menunjukkanbahawa para pelajar PMM ini suka berinteraksi dengan elemen air.



Rajah 9: Bentuk Interaksi Dengan Elemen Air

4.4 Kesan Elemen Air Ke Atas Pendidikan Pelajar

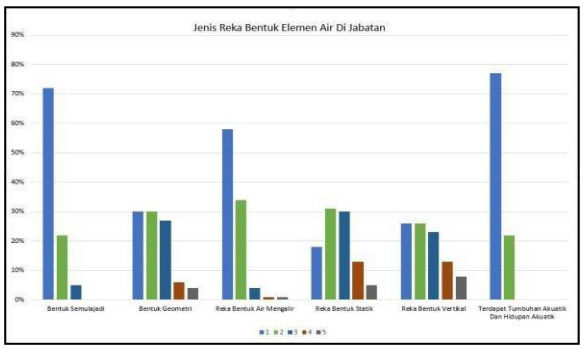
Soal selidik mengenai kesan elemen air keatas pendidikan pelajar (skor 1) menunjukkan bahawa 80% responden bersetuju mereka berasa selesa dan tenang, 62% responden bersetuju elemen air ini meredakan minda dan emosi, 52% responden bersetuju dapat mempelajarisesuatu, 40% belajar dengan lebih fokus, 44% responden selesa sebagai tempat untuk berdiskusi bersama rakan dan 60% responden bersetuju elemen air ini dapat meningkatkan daya imaginasi, kreativiti dan pertumbuhan idea. Hasil kajian jelas menunjukkan bahawa elemenair ini memberi kesan yang baik kepada pendidikan pelajar secara langsung mahupun secara tidak langsung.



Rajah 10: Kesan Elemen Air Ke Atas Pendidikan Pelajar

4.5 Jenis Reka Bentuk Elemen Air Di Jabatan

Jenis reka bentuk elemen air di jabatan pula menunjukkan bahawa ramai reponden suka reka bentuk yang berbentuk semulajadi (72%-skor1), reka bentuk air mengalir (58%-skor1) dan terdapat tumbuhan dan hidupan akuatik (78%-skor1). Hasil dapatan ini memberi gambaran bahawa warga PMM (pelajar dan pensyarah) suka kepada reka bentuk yang berbentuk semulajadi secara keseluruhannya dan lebih bersifat*'greenery landscape'* dan yang bertemakan 'alam asli'.

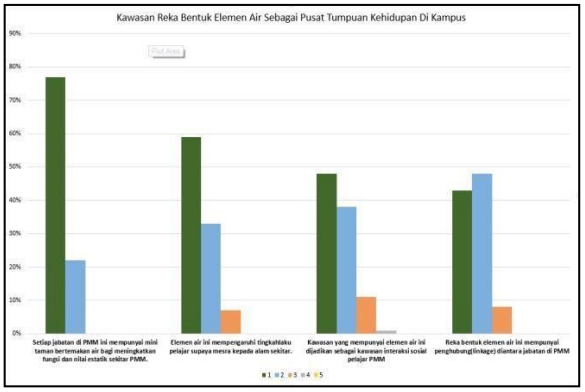


Rajah 11: Jenis Reka Bentuk Elemen Air Di Jabatan

4.6 Kawasan Reka Bentuk Elemen Air Sebagai Pusat Kehidupan Di Kampus

Menurut dapatan hasil soal selidik bagi kawasan reka bentuk (zon) elemen air sebagai pusat kehidupan di kampus, ramai reponden 78% (skala 1) bersetuju bahawa setiap jabatan di PMM ini mempunyai mini taman bertemakan air bagi meningkatkan fungsi dan nilai estetik sekitar PMM, 60% (skor 1) bersetuju elemen air ini mempengaruhi tingkahlaku pelajar supaya mesra kepada alam sekitar. 48% (skor 1) responden setuju bahawa kawasan yang mempunyai elemen air ini dijadikan sebagai kawasan

interaksi sosial pelajar PMM dan hampir 50% (skor 1dan 2) bersetuju jika reka bentuk elemen air ini mempunyai penghubung (linkage) di antara jabatan di PMM. Reka bentuk elemen air yang berhubung dari jabatan ke jabatan, responden memberi reaksi yang berbagai mungkin disebabkan oleh responden tidak dapat berimaginasi situasi sebenar dengan apa yang dimaksudkan oleh penulis.



Rajah 12: Kawasan Reka Bentuk Elemen Air Sebagai Pusat Kehidupan Di Kampus

5.0 DAPATAN DAN PERBINCANGAN

Dapatan soalselidik dari warga PMM dapat dirumuskan bahawa cadangan reka bentukelemen air dan perletakannya di persekitaran PMM perlu dikhususkan kepada kawasan yang aktif iaitu kawasan *'nodes'* pelajar dan kawasan penghubung antara jabatan (semi aktif). Kawasan yang aktif akan bertindak sebagai kawasan pertemuan aktiviti pelajar berkumpul selepas kelas dan waktu petang. Jangkaan penggunan masaoleh pelajar dijangka agak lama berbanding kawasan semi aktif. Manakala kawasan semi aktif yang terletak di antara jabatan boleh bertindak sebagai ruang perbincangankecil, peribadi dan pendidikan langsung berdasarkan jumlah tumpuan hidupan fauna lebih tinggi.

5.1 Kriteria dan Rekabentuk Perletakan Air di Kawasan Kampus.

5.1.1 Sumber Air

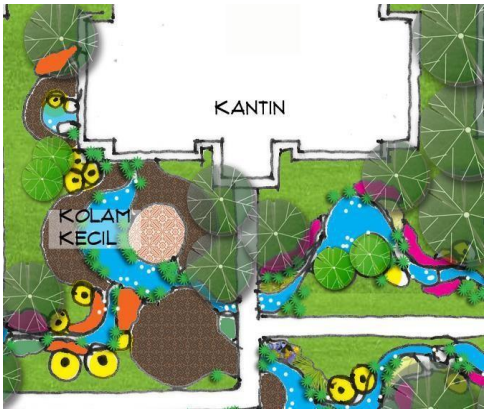
Selain daripada hujan secara terus, sumber air jugaddapati daripada setiap bumbung binaan seperti bangunan, binaan susur gajah dan langsung dari permukaan tanah *(ground surfaces).* Larian air daripada permukaan bumbung bangunan akan menerusi talang air, tangki penyimpanan air atau kawalan air dan disalurkan kepada kawasan *'nodes'* pelajar (kawasan reka bentuk air utama).

Manakala larian air dari permukaan tanah juga boleh diarahkan ke kawasan yang sama. Oleh kerana jumlah kapasiti air dari susur gajah minima, aliran air boleh disalurkan kepada kawasan larian air di penghubung antara jabatan.

Rajah 13: Kawasan Reka Bentuk Elemen Air Sebagai Pusat Kehidupan Di Kampus

5.1.2 Reka Bentuk Di Kawasan Pertemuan Aktiviti

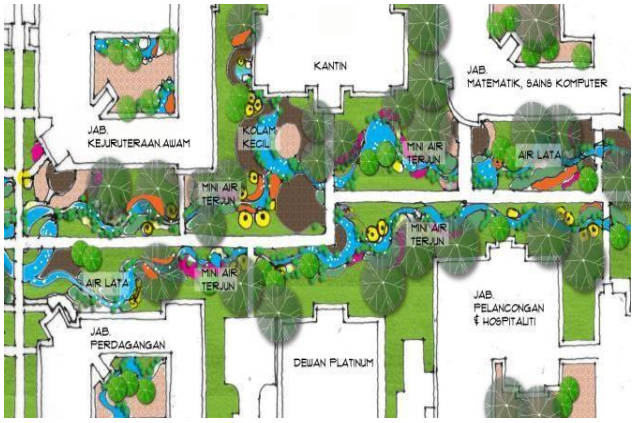
Menerusi inventori dan analisa tapak dapat disimpulkan bahawa terdapat potensi besar di kawasan courtyard pada setiap jabatan dan kantin sebagai 'nodes' aktiviti pelajar dan sebagai tempat terbaik bagi memfokuskan reka bentuk berasaskan elemen air. Reka bentuk yang dicadangkan adalah berdasarkan kepada kehendak pengguna di kawasan tersebut, potensi ruang yang ada dan sistem yang sesuai digunakan seperti rain garden, bioretention basin, facade greenery, planter @ balcony dan vegetation swale. Reka bentuk kawasan ini perlu penggunaan skala yang agak besar (bergantung pada ruang dan kapasiti pengunjung) dan penjiwaan reka bentuk perlu lebih ceria dan aktif.



Rajah 14: Rekabentuk elemen air dikantin

5.1.3 Reka Bentuk Di Kawasan Penghubung (link- age) Antara Jabatan

Larian air dari satu ruang ke ruang yang lain *(linkage)* khususnya dari lain-lain jabatan hendaklah mengikut potensi laluan pelajar sediada dan berhampiran dengan kawasan laluan susur gajah. Pengguna dapat memaksimumkan penggunaannya di kawasan tersebut setiap hari. Reka bentuk lelurus badan ini tidak memerlukan saiz yang besar dan hanya memerlukan reka bentuk '*arching shape' supaya* lebih menampakkan aliran semulajadi. Tumbuhan-tumbuhan di persekitarannya juga boleh bertindak sebagai alat pendidikan, meredakan tekanan dan menyejukkan pandangan sewaktu dalam perjalanan. Penggunaan tumbuhan akuatik juga boleh meningkatkan kejernihan kualiti air. Pengaliran air secara *linkage* ini hanya menggunakan keadah graviti berdasarkan topografi PMM. Ia dapat menjimatkan kos. Teknik *vegetation swale* adalah yang paling sesuai di tempat larian air lata.



Rajah 15: Reka bentuk elemen air dipenghubung antara jabatan

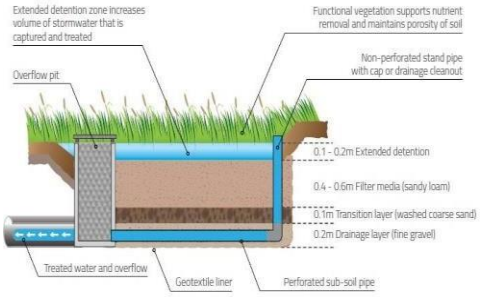
5.1.4 Kawasan Berteres

Kawasan berteres yang terdapat di kawasan tertentu yang biasanya terletak antara jabatan boleh dijadikan mini air terjun. Deruan air ini mampu menarik keinginan pelajar sebagai tempat berkumpul dan ruang perbincangan. Ruang ini boleh bertindak sebagai ruang diskusi dan ilmiah. Reka bentuk di kawasan ini lebih terlingkung, persendirian dan lebih berfokus. Namun begitu, jumlah kapasiti air juga menjadi faktor tarikan di kawasan ini. Dijangka, kunjungan dikawasan ini akan bertambah selepas hujan berhenti kerana bunyian deruan dan percikan-percikan air mula berfungi dari hari kebiasaan. Jika lebihan air berlaku, ia terus disalurkan ke dalam longkang.

Rajah 16: Reka bentuk elemen air di kawasan berteres

5.1.5 Limpahan Lebihan Air

Lebihan air yang terdapat di pada reka bentukelemen air ini akan disalurkan terus menerusilongkang berhampiran. Jika kapasiti air melebihi paras dari sepatutnya, terutama sewaktuhujan lebat, ia dapat diselesaikan dengan menggunakan *overflow pipe* dan *riser outlet*. Kesemua air ini akan terus menuju ke tasik PMM.



Rajah 17: Antara sistem reka bentuk 'bioretention basin' terdapat juga teknik mengawal limpahan air berlebihan.
Sumber: ABC Water Design Programme (2011)

6.0 RUMUSAN

Ramai yang berpendapat bahawa antara jalan terbaik untuk mendidik manusia ialah dengan mengubah sikap dan amalan seharian. Dari memfokuskan kepada pentingkan diri sendiri (anthropocentric) kepada berfokuskan alam sekitar (ecocentric) Knapp (1999); Callicott (2000). PMM perlu merangka satu kajian pelan induk secara menyeluruh bagi menilai setiap kawasan yang berpotensi bagi mewujudkan satu

reka bentuk yang berteraskan kepada penggunaan elemen air. Cuaca, bentuk topografi yang bercerun dan berteres merupakan satu peluang yang besar bagi mengetengahkan idea reka bentuk larian air permukaan secara graviti di setiap ruang jabatan. Ruang-ruang courtyard jabatan dan kantin yang mempunyai taman mini bertemakan air seolah-olah 'mini resort', mampu menjadi nodes kepada pelajar. Ruang penghubung antara jabatan harus dimurnikan dengan menerapkan elemen air agar menjadi 'taman lelurus' yang berfungsi sebagai pusat pertemuan pelajar, pendidikan luar, alam sekitar dan meredakan tekanan emosi.

Kehidupan kampus yang ceria, semangat dan bertenaga mampu menjana idea-idea pendidikan kepada pelajar. Tahap emosi pelajar terkawal dengan suasana yang hijau bersama aliran air sebagai penghubung antara ruang dan menjadi pandu arah kepada pelajar. Masa rehat dan waktu terluang antara kelas dimanfaatkan pada kawasan yang mempunyai aliran air secara tidak langsung dapat menyegarkan kembali minda selepas berfokuskan pendidikan di dalam kelas. Reka bentuk pengaliran air hari ini seolah-olah disisihkan dari isu pendidikan secara menyeluruh dan tidak memanfaatkan potensi ruang sediada dan alam sekitar supaya bersatu sebagai sumberpengeluar ilmu dan mendidik gaya berfikir pelajar. Oleh itu, manfaatkanlah air dengan sebaik mungkin. Ianya ditegaskan melalui kata-kata; *'Jangan membiarkan walaupun setitik air hujan mengalirke laut tanpa memberi faedah kepada manusia'*- De Casparis, J.G. (1975).

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TRACK 6: OTHERS

Pembangunan MySelenggara@POLYCC

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Abstrak. MySelenggara@POLYCC merupakan satu inovasi dalam penyelenggaraan aset tak alih melibatkan permohonan dan pemantauan melibatkan kerja- kerja penyelenggaraan, naik taraf dan kecemasan institusi di bawah Jabatan Pendidikan Politeknik dan Kolej Komuniti (JPPKK). Dengan pembangunan MySelenggara@POLYCC ini dapat membantu pihak jabatan dan institusi dalam menyelaras peruntukan dan kerja - kerja yang melibatkan penyelenggaraan, naik taraf dan kecemasan di JPPKK. Sistem MySelenggara@POLYCC ini dibangunkan dengan beberapa objektif iaitu memperluas akses akses kelulusan permohonan dalam penyaluran peruntukan kewangan berdasarkan kerja - kerja penyelenggaraan yang dimohon oleh pihak institusi; mewujudkan satu pusat pengumpulan maklumat berkaitan kerosakan yang perlu diselenggara dengan cepat dan berkesan selari dengan prinsip amalan Pengurusan Lean dalam aktiviti pengurusan. Pembangunan inovasi ini adalah disebabkan beberapa masalah yang dikenalpasti antaranya adalah permohonan institusi tidak diterima dengan sempurna; capaian maklumat berkaitan permohonan dan kelulusan permohonan sukar diperolehi kerana perlu disemak secara manual serta pertindihan permohonan atau berulang dihantar oleh pihak institusi. Kajian ini telah dijalankan melibatkan 98 orang responden yang melibatkan pihak pengurusan institusi iaitu staf pengurusan di institusi (10.2 peratus), Jurutera (13.3 peratus), Penolong Jurutera (63.3 peratus) dan lain-lain (13.3 peratus) dimana 76.5 peratus yang berkhidmat di kolej komuniti, 22.4 peratus di politeknik dan 0.8 peratus pula lain-lain. Dapatan daripada kajian ini mendapati inovasi ini bersesuaian dengan tahap kompetensi pelaksana. Ini dibuktikan dengan skor minimum keseluruhan dengan nilai mata 4.65 iaitu bersetuju dengan objektif penghasilan MySelenggara@POLYCC ini iaitu meningkatkan produktiviti dan kecekapan pengurusan di peringkat institusi melalui memendekkan tempoh masa dan mewujudkan pengakalan data bagi pemantauan kerja.

Kata Kunci: penyelanggaraan, MySelenggara@POLYCC, pengkalan data

1.0 PENGENALAN

Inovasi dalam pengurusan merupakan satu elemen penting dalam meningkatkan produktiviti dan penyampaian maklumat serta idea kepada pengguna. Inovasi boleh didefinisikan sebagai sesuatu yang baru melibatkan produk atau proses kerja melibatkan perkhidmatan dan menambahbaik nilai kepada sesebuah organisasi. Inovasi membawa maksud kepada idea atau kaedah baharu yang tidak pernah dilakukan oleh sesiapa (Scypinski & Drennen, 2009). Inovasi juga terlibat dalam menggalakkan perubahan yang radikal melibatkan kehidupan dan evolusi dalam inovasi (Pigola et al., 2021). Selain itu, inovasi juga membawa maksud sebagai penyelesaian yang diperkenalkan bagi menyelesaikan masalah yang timbul secara berkesan dan diakhirnya memberikan faedah yang sangat menguntungkan kepada kita. Bagi meningkat proses inovasi, pembangunan dan penyediaan ifrastruktur yang sesuai, sistem sokongan dan pendekatan pintaradalah penting. Dalam hal ini, pembangunan alat baharu yang dikenali sebagai *Computer Aided Innovation* (CAI) merupakan domain yang sedang berkembang (Dereli & Altun, 2013)

Pembangunan MySelenggara@POLYCC ini merupakan satu platform yang digunakan bagi urusan mengumpul maklumat kerosakan, memproses permohonan dan pemantauan kerja - kerja yang melibatkan penyelenggaraan aset tak alih, kerja – kerja naik taraf dan kecemasan melibat institusi di bawah Jabatan Pendidikan Politeknik dan Kolej Komuniti (JPPKK) dengan mudah dan cepat. Dengan pembangunan MySelenggara@POLYCC ini dapat membantu pihak jabatan dan institusi dalam menyelaras peruntukan dan kerja - kerja yang melibatkan penyelenggaraan, naik taraf dankecemasan di institusi Politeknik dan Kolej Komuniti seluruh malaysia. Melalui MySelenggara@POLYCC dapat membantu menyelesaikan permohonan yang banyak dalam satu masa. Dengan menghapuskan Bottleneck dalam mana - mana operasi, peningkatan yang besar itu akan menjadi automatik (Ahmad Nur Aizat Ahmad at el., 2021). Sistem MySelenggara@POLYCC ini dibangunkan dengan tujuan bagi mencapai spesifik objektif seperti di bawah;

i. **Memperluas** akses kelulusan permohonan dalam penyaluran peruntukan kewangan berdasarkan kerja - kerja penyelenggaraan yang dimohon oleh pihak institusi.
ii. **Mewujudkan** satu pusat pengumpulan maklumat berkaitan kerosakan yang perlu diselenggara dengan cepat dan berkesan selari dengan prinsip amalan Pengurusan Lean dalam aktiviti pengurusan.

Melalui penggunaan MySelenggara@POLYCC, urusan kerja-kerja penyelenggaraan melibatkan 36 buah politeknik dan 102 Kolej Komuniti dapat ditambahbaik dengan mempercepatkan dan memudahkan akses kelulusan permohonan dalam penyaluran peruntukan kewangan berdasarkan kerja - kerja penyelenggaraan yang dimohon oleh pihak institusi. Selain itu, MySelenggara@POLYCC menjadi satu pusat pengumpulan maklumat dan berpusat kepada institusi bagi mendapatkan maklumat terkini melalui pautan https://sites.google.com/view/myselenggara-polycc selari dengan prinsip amalan pengurusan lean dalam aktiviti pengurusan.

2.0 SOROTAN KAJIAN DAN PEMBINAAN HIPOTESIS

2.1 Pengurusan *Lean*

Pengurusan Lean merupakan satu konsep dalam pengurusan pembuatan,pembangunan produk dan perkhidmatan yang bertujuan mengubah sasaran output dalam menghasilkan perkhidmatan yang berkualiti kepada pelanggan (Melović et al., 2016). Pengurusan lean juga merupakan konsep membanti sesuatu organisasi dalam mengurangkan pembaziran dan meningkat pengeluaran (Parkes, 2016). Terdapat juga sesetengah pembaziran mudah dikenal pasti tetapi ada di antaranya yang sukar dikesan. Contohnya, seringkali majikan memberikan ganjaran atau hadiahkepada pekerja yang mengeluarkan atau menghasilkan produk yang melebihi keperluan (overproducing). Namun, apabila dilihat dari sudut pandangan lean, situasi dianggap sebagai satu pembaziran yang besar kerana akan berlakunya lebihan yang membawa kepada pembaziran (Ahmad, 2021)

Dalam pelaksanaan pengurusan lean, terdapat 3 elemen utama iaitu tujuan, proses dan manusia iaitu:

i. **Tujuan** bermaksud bagi semua aktiviti mestilah untuk menyediakan nilai tambah kepada pelanggan.

ii. **Manusia** pula perlu menentukan apa yang penting bagi mengekalkan proses yang dapat memberikan nilai kepada pelanggan.

iii. **Proses** ialah satu urutan reka bentuk, tindakan, penghantaran dan sokongan yang perlu dijalankan pada keadaan yang betul, cara yang betul dan masa yang betul bertujuan mencipta nilai untuk pelanggan.

2.1.1 Alat *Lean*

Dalam melaksanakan aktiviti dan proses kerja, penggunaan alat lean biasanya digunapakai oleh pelaksana tetapi tidak dapat dinyatakan dengan jelas. Ini disebabkan kurang kefahaman berkaitan alat lean yang digunapakai. Setiap pelaksana hendaklah mengenalpasti alat lean yang sesuai bagi setiap aktiviti atau projek yang dilaksanakan dengan menganalisis aliran dan mengajar ahli menggunapakai alat lean tersebut. Lean juga merupakan satu budaya penambahbaikan berterusan yang disebut juga KAIZEN (Mat et al., 2020) Selain itu, penggunaan alat lean juga boleh dianggap sebagai satu inovasi dalam sesuatu penambahbaikan.

Terdapat 2 kategori alat lean iaitu alat mengesan pembaziran dan alat menghapus pembaziran. Alat mengesaan pembaziran biasa digunapakai bagi mencari punca dan mengesan proses kerja yang tidak bermanfaat bagi sesuatu kerja. Manakala alat menghapus pembaziran pula adalah alat yang bersifat peraturan dan tetap sifatnya bagi menghapuskan pembaziran disebabkan kerja – kerja berulang dan sebagainya. Melalui penggunaan alat alat ini boleh menghapuskan tiada nilai tambah dalam mengurangkan kitaran dan masa menunggu sesuatu kerja (Parkes, 2016). Sebagai contoh, alat mengesan pembaziran iaitu Value Stream Mapping. Alat ini merupakan satu kaedah dalam industri pembuatan dalam mengatasi masalah bottleneck dengan menganalisis dan membuat pelan sewajarnya. (Ahmad Nur Aizat Ahmad at el., 2021). Selain itu, segala pembaziran seperti lebihan produksi, masa menunggu dan inventori boleh dikurangkan penggunaannya (Ahmad, 2021)

Jadual 1: Jenis Alat Lean

Alat Mengesan Pembaziran	Alat Menghapus Pembaziran
a. Analisis Sebab dan Kesan *(Root Cause Analysis)* b. Lima Mengapa *(5 Why)* c. Pemetaan Arus Nilai *(Value Stream Mapping)* d. Proses Pemetaan (Flow Chart) e. Pemerhatian Masa (*Time Observation*) f. Masa Takt (*Time Takt*) g. Rajah Spaghetti *(Spaghetti Diagram)* h. Cadangan program *(Suggestion Program)* i. Kitaran komunikasi *(Circle Communication)* j. Turun Padang *(Waste Walk)* k. Suara Pelanggan *(Voice of the Customer)*	a. 5S/6S b. Ekosistem Kondusif Sektor Awam (EKSA) c. Standard Work d. Penyeragaman Kerja e. Poka Yoke f. Heijunka g. PDCA h. Pengurusan Visual *(Visual Management)* i. Kanban j. Petunjuk Prestasi utama *(Key Performance Indicators)* k. Carta Aliran Kerja *(Flowchart)* l. Sistem Keberkesanan Peralatan *(Overall Equipment Efficiency)*

Sumber : Garis Panduan Pelaksanaan Pengurusan Lean Edisi 1

3.0 METODOLOGI KAJIAN

3.1 Mengenalpasti Masalah

Penyelidik telah menjalankan dua (2) aktiviti bagi mengenalpasti masalah yang berlaku dalam proses pelaksanaan dan pembangunan MySelenggara@POLYCC iaitu:

a) Pemerhatian

Melalui pemerhatian, penyelidik dapat melihatkan proses dan kaedah penyampaian melibatkan 140 institusi di bawah Jabatan Pendidikan Politeknik dan Kolej Komuniti (JPPKK) dalam penyampaian maklumat dan penyaluran maklumat kerosakan di antara pihak institusi dan Jabatan bagi memproses permohonan dan meluluskan permohonan bagi tujuan tersebut.Didapati proses permohonan dan kelulusan projek penyelenggaraan tidak diuruskan secara teratur dengan beberapa masalah seperti kehilangan dokumen, tiada surat kelulusan dan tiada satu pusat pengumpulan maklumat berkaitan kerosakan yang perlu diselenggara dengan cepat dan berkesan.

b) Temubual

Dalam peringkat ini pula, pihak penyelidik juga mengadakan temubual di kalangan jurutera dan penolong jurutera institusi berkaitan pengurusan penyelenggaraan di institusi. Kebanyakan pihak institusi menyatakan masalah yang sama iaitu tiada satu panduan kepada institusi berkaitan pengurusan penyelenggaraan yang boleh menjadi rujukan utama. Selain itu, pihak institusi juga tiada maklumat terkini berkaitan pekeliling atau rujukan yang boleh digunapakai dalam melaksanakan kerja - kerja penyelenggaraan di institusi.

3.2 Pembangunan Myselenggara@POLYCC

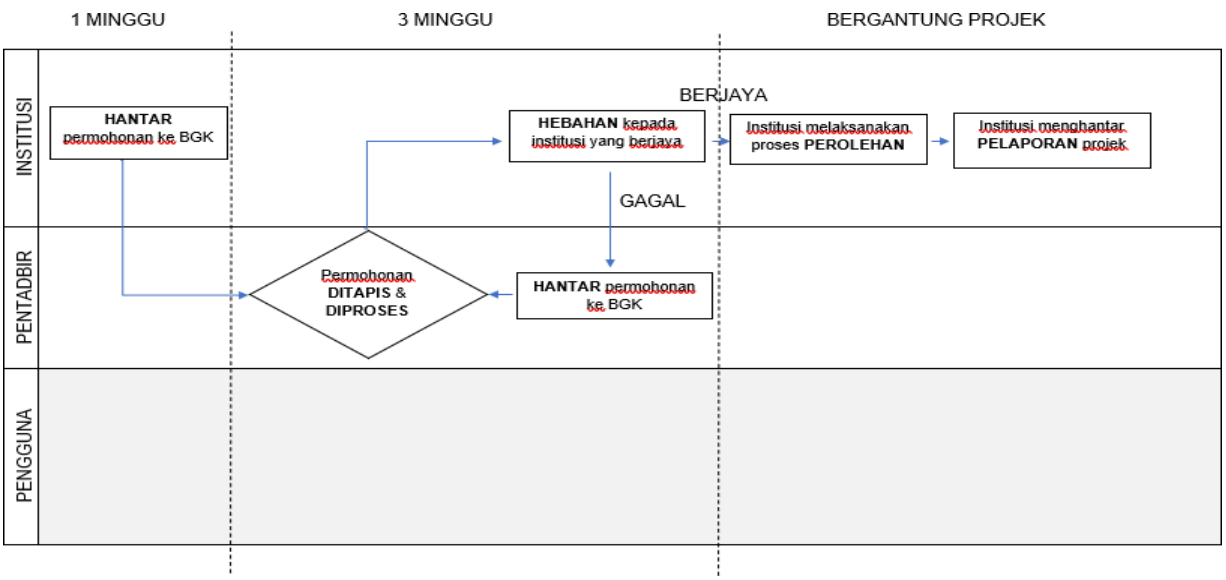
Pembangunan MySelenggara@POLYCC merupakan satu inovasi yang dibangunkan menggunakan Microsoft Google yang menggunapakai Google Sites bagi pembangunan MySelenggara@POLYCC.Inovasi bukan sahaja sekadar teknologi (Pigola et al., 2021) tapi ia merupakan satu penambahbaikan dalam pengurusan. MySelenggara@POLYCC ini digunapakai oleh 140 institusi bagi mencapai maklumat dan mengisi pelaporan bagi kerja – kerja penyelenggaraan yang diluluskan oleh pihak Bahgaian Governan dan Kecemerlangan (BGK). Google Sites umumnya digunakan untuk membuat laman web yang ringkas dan berfungsi seperti laman web maklumat, portofolio, atau laman web dalaman untuk sebuah organisasi.

Berdasarkan kepada kefungsian tersebut, pembangunan MySelenggara@POLYCC merupakan satu platform yang teapat bagi menyalurkan maklumat berkaitan pengurusan penyelenggaraan di institusi dan menjadi medium antara pihak institusi dan Jabtan bagi penyaluran maklumat serta kelulusan secara cepat dan berkesan.

3.2.1 Sebelum inovasi Sistem MySelenggara@POLYCC:

Rajah 1 dan 2 merupakan carta alir proses sebelum dan selepas pembangunan sistem MySelenggara@POLYCC. Terdapat 3 peranan utama dalam penggunaan MySelenggara@POLYCC iaitu pengguna, pentadbir dan institusi. Berikut adalah perincian peranan utama dalam penggunaan MySelenggara@POLYCC;

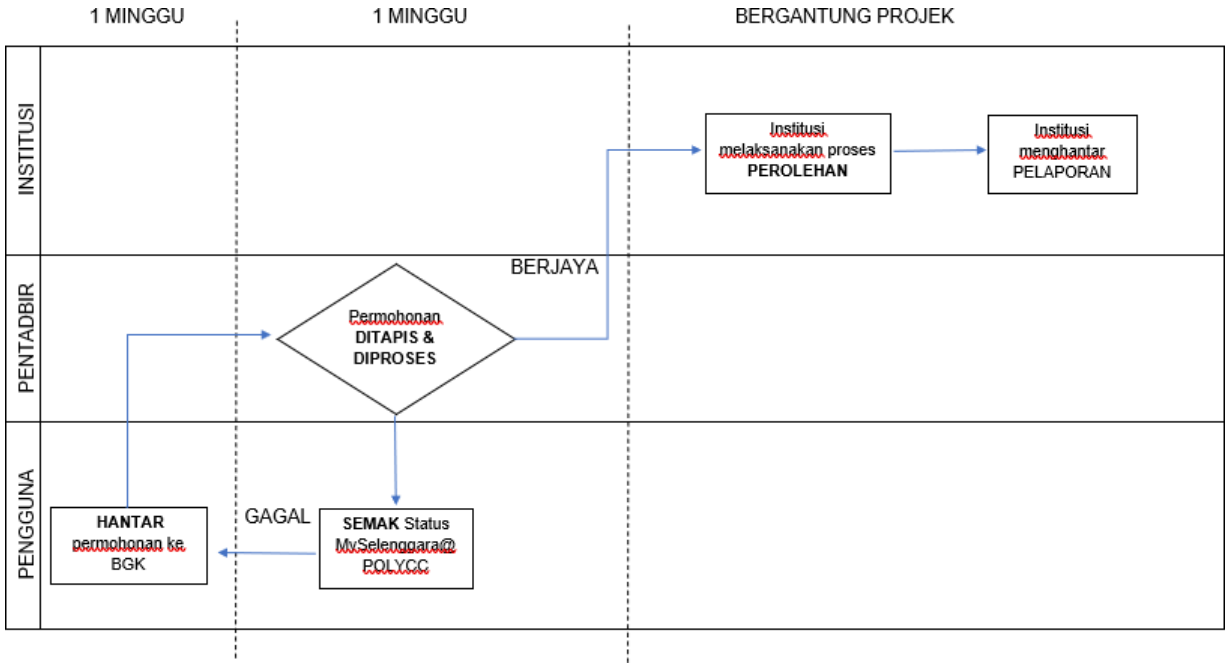
a) Pengguna melibatkan Jurutera, Penolong Jurutera atau pentadbiran institusi.
b) Pentadbir melibatkan urusetia dan Jawatakuasa di Jabatan
c) Institusi melibatkan Politeknik dan Kolej Komuniti yang terlibat



Rajah 1: Carta alir proses sebelum pembangunan Sistem MySelenggara@POLYCC

Berdasarkan Rajah 1, tatacara pengurusan penyelenggaraan bermula dengan permohonan penyelenggaraan aset tak alih di institusi dibuat setiap awal tahun. Proses pengurusan permohonan penyelenggaraan sebelum pembangunan sistem mengambil masa 4 minggu sebelum kerja - kerja boleh dimulakan di tapak bina. Melalui pembangunan MySelenggara@POLYCC ini telah memendekkan 50 peratus tempoh masa kepada 2 minggu proses permohonan. Ini secara tak langsung memperkemaskan aliran kerja diperingkat institusi dan jabatan supaya lebih bersistematik dan mengurangkan masa menunggu (Ahmad, 2021). Selain itu, tempoh pelaksanaan projek di institusi adalah bergantung kepada jenis skop kerja yang dilaksanakan dan bergantung kepada keadaan cuaca jika melibatkan kerja luar bangunan seperti penyelenggaraan bumbung bangunan.

3.2.2 Selepas pembangunan Sistem MySelenggara@POLYCC



Rajah 2: Carta alir proses selepas pembangunan Sistem MySelenggara@POLYCC

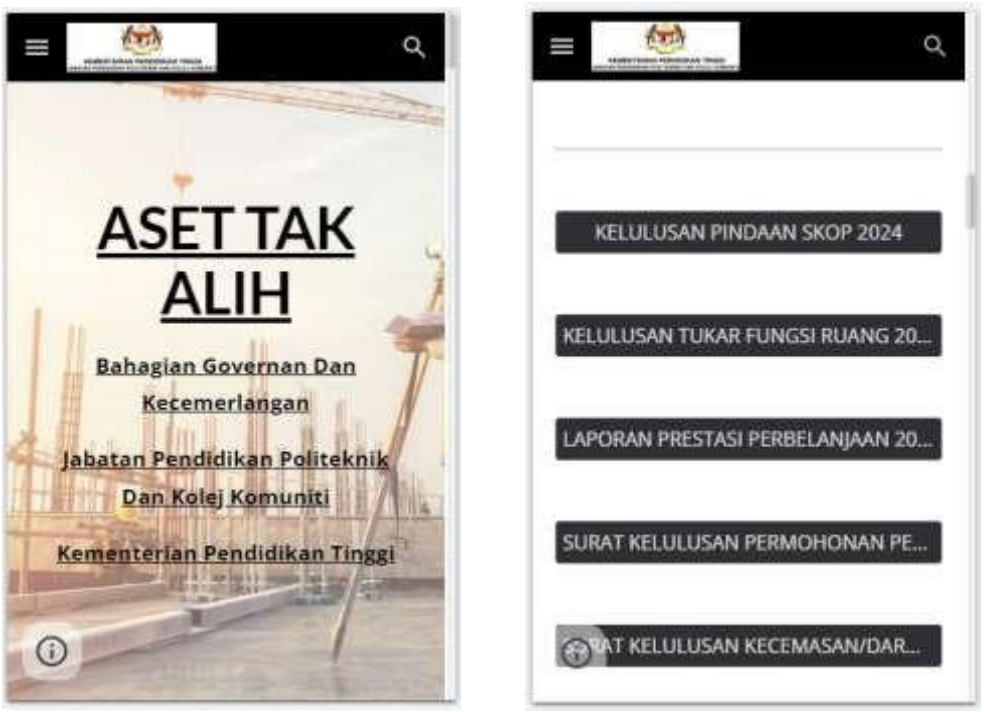
Berdasarkan rajah 2, penggunaan MySelenggara@POLYCC ini mengambil masa tempoh 2 minggu daripada tempoh permohonan sehingga kelulusan diterima oleh pihak institusi. Jika permohonangagal, pengguna perlu menghantar semula permohonan kepada BGK dan melalui proses tapisan dan permohonan diproses semula. Jika permohoan berjaya, pemohon boleh menyemak melalui platform MySelenggara@POLYCC dan mencetak surat kelulusan tersebut dan melaksanakan kerja – kerja perolehan di institusi masing- masing.

3.3 Paparan penggunaan Myselenggara@POLYCC

MySelenggara@POLYCC mempunyai 2 paparan utama iaitu paparan utama serta pelaporan projek. Rajah 3 dan rajah 4 menunjukkan paramuka paparan utama dan pelaporan dalam MySelenggara@POLYCC. Dalam paparan utama, terdapat 5 item yang boleh diakses oleh pengguna iaitu:

a) Kelulusan Pindaan Skop
b) Kelulusan Tukar Fungsi Ruang
c) Laporan Prestasi Perbelanjaan
d) Surat Kelulusan Permohonan
e) Surat Kelulusan Permohonan Kecemasan/Darurat

Manakala paparan pelapoaran adalah rumusan perbelanjaan semasa yang telah dilaporkan oleh pihak institusi setiap 5 haribulan setiap bulan.



Rajah 3: Paparan utama MySelenggara@POLYCC

Rajah 4: Paparan maklumat dan pelaporan dalam MySelenggara

3.4 Soal Selidik

Reka bentuk kajian yang akan dilaksanakan adalah berbentuk tinjauan, iaitu dengan menggunakan kaedah borang soal selidik yang akan diedarkan kepada pelanggan pengguna Myselenggara@POLYCC secara atas talian. Kajian ini juga berbentuk kajian deskriptif dan infrensi yang bertujuan untuk mempercepatkan dan memudahkan akses kelulusan permohonan dalam penyaluran peruntukan kewangan berdasarkan kerja - kerja penyelenggaraan yang dimohon oleh pihak institusi.

Pengumpulan data dilakukan melalui dua kaedah iaitu menggunakan data primer dan datasekunder. Dalam kajian ini, data primer diperolehi dengan menggunakan borang soal selidik yang dibina mempunyai 2 bahagian iaitu butiran responden berdasarkan kepada objektif kajian dan keberkesanan penggunaan MySelenggara@POLYCC oleh pengguna. Manakala data sekunder pula diperolehi melalui sumber internet, buku rujukan dan artikel. Borang soal selidik ini diedarkan kepada 98 orang responden yang terdiri daripada pelbagai kategori pengguna. Kesemua responden yang diedarkan boring soal selidik akan menjawab berdasarkan Skala Likert (Rujuk Jadual 3).

3.5 Analisis Keberkesanan Sistem

3.5.1 Efisien (Kecekapan)

Melalui pelaksanaan sistem ini, didapati proses pengurusan penyelenggaraan dapat dijalankan dengan lebih cekap berbanding kaedah sebelum ini. Melalui MySelenggara@POLYCC ini juga, tempoh masa pemprosesan dapat dipendekkan sebanyak 50 peratus daripada proses permohonan asal yang dibuat oleh institusi kepada jabatan. Berdasarkan Rajah 2, pembangunan sistem yang dibangunkan telah memendekkantempoh masa kepada 2 minggu proses permohonan. Melalui MySelenggara@POLYCC ini juga pemohon lebih memahami proses kerja melibatkan permohonan penyelenggaraan di institusi masing- masing. Selain itu, pengguna dapat menyemak surat kelulusan dan maklumat terkini berkaitan perolehan melalui MySelenggara@POLYCC.

3.5.2 Signifikan

MySelenggara@POLYCC yang dibangunkan ini memberi impak yang sangat tinggi kepada pengurusan penyelenggaraan aset tak alih. Selain itu, pengguna dapat mengetahui kesilapan dan komen penilai berkaitan permohonan yang dibuat. Ini dapat meningkatkan kefahaman dan motivasi pemohon untuk membuat permohonan. Selian itu, MySelenggara@POLYCC ini sangat diperlukan kepada jabatan kerana perlu mambuat pemantauan terhadap 140 institusi di bawah jabatan dan mempunyai masalah berlainan mengikut skop kerja dan lokaliti.

3.5.3 Pemantauan projek

Elemen pemantauan projek adalah penting bagi memastikan projek yang dilaksanakan dalam keadaan baik dan teratur mengikut tempoh masa yang ditetapkan. Tempoh masa kerja menyiapkan satu jenis penyelenggaraan adalah berdasarkan skop kerja yang dimohon adalah berbeza- beza dan menggunakan kaedah yang berlainan. Melalui MySelenggara@POLYCC, pemantauan projek oleh jabatan, bahagian dan pengarah institusi berkaitan status terkini permohonan yang dibuat dapat dilihat kerana data yang ditunjukkan dikemaskini setiap kali pemohon melaporkan data perbelanjaan yang telah selesai. Melalui MySelenggara@POLYCC, pemohon dan pentadbir institusi dapat melihat perkembangan kerja yang dilaksanakan di institusi masing-masing.

4.0 KEPUTUSAN KAJIAN DAN ANALISIS

Borang kaji selidik telah diedarkan kepada semua pengguna MySelenggara@POLYCC melibatkan pengurusan di Politeknik dan Kolej Komuniti, Jurutera, Penolong Jurutera dan lain-lain respondenseperti pegawai pembangunan. Responden ini merupakan pegawai yang diberi tanggungjawab dalam menguruskan kerja - kerja penyelenggaraan di institusi masing- masing.

Soal selidik ini telah diedarkan kepada 98 responden melibatkan 75 buah Kolej Komuniti, 23 buah Politeknik dan 1 buah institusi lain. Berdasarkan jadual 2 menunjukkan jumlah responden yang terlibat dalam kategori pengguna MySelengggara@POLYCC. Berikut adalah penjelasan untuk setiap kategori pengguna dan jumlah respondennya:

a) **Pengurusan Institusi**: Terdapat 10 responden dari kalangan pengurusan institusi yang terlibat.
b) **Jurutera**: Sebanyak 13 responden adalah jurutera yang terlibat dalam penggunaan MySelengggara@POLYCC.
c) **Penolong Jurutera**: Terdapat 62 responden yang merupakan penolong jurutera.
d) **Lain-lain**: Ada 13 responden lain-lain yang terlibat dalam penggunaan MySelengggara@POLYCC, yang mungkin termasuk dalam kategori-kategori yang tidak tercakup dalam kategori-kategori sebelumnya.

Jadual 2: Bilangan responden MySelengggara@POLYCC

Bil	Kategori Pengguna	Bilangan
1	Pengurusan Institusi	10
2	Jurutera	13
3	Penolong Jurutera	62
4	Lain lain	13
	Jumlah	98

Bagi kaji selidik di Bahagian B, Skala Likert lima mata telah digunakan dengan tafsiran seperti Jadual 3.

Jadual 3: Skala Likert

Skor	1	2	3	4	5
Tafsiran	Sangat Tidak Setuju	Tidak Setuju	Kurang Setuju	Setuju	Sangat Setuju

Skala pengukuran skor min dirujuk berdasarkan interpretasi skor min bagi Skala Likert seperti Jadual 4.

Jadual 4: Tahap Kecenderungan Skor Min

Skor Min	Tahap Kecenderungan
1.00 – 2.33	Tidak Setuju
2.34 – 3.67	Kurang Setuju/Tidak Pasti
3.68 – 5.00	Setuju

(Sumber: Landell, 1977)

Jadual 5 menunjukkan analisis soal selidik berkaitan keberkesanan penggunaan MySelenggara@POLYCC beserta dengan skor minimum untuk setiap item. Daripada soal selidik yang diedarkan, pengguna bersetuju dengan item B4 dan B6 iaitu maklumat yang disediakan di platform ini membantu dalam menjalankan tugas rasmi dan pengguna memperolehi maklumat berkaitan pelaporan prestasi perbelanjaan tahun semasa lebih cepat, mudah, dan ringkas iaitu 4.68 mata. Item ini mendapat skor yang tertinggi dalam soal selidik yang diedarkan. Ini kerana kebanyakan pengguna menggunakan platform sebagai dokumen rasmi dan pelaporan kepada pengurusan bagi membentangkan prestasi terkini peritus belanja berdasarkan peruntukan yang diterima. Manakala responden skor yang rendah diperolehi bagi item B5 iaitu maklumat yang disediakan di platform ini dapat meningkatkan kecekapan terhadap bidang kerja penggunadengan min skor 4.65 mata. Ini adalah sebabkan pengguna yang bertukar dan penguasaanmenggunakan platform masih tidak mahir dan perlu penambahbaikan pada masa akan dating seperti mengadakan taklimat yang berkaitan kefungsiaan platform ini. Daripada maklumbalas dan cadangan penambahbaikan terhadap platform ini, terdapat beberapa perkara perlu dilakukan bagi memastikan hasil akan datang lebih berkesan kepada staf dan kakitangan terlibat. Antaranya;

i. Menyediakan satu aplikasi mengenai aduan kerosakan dan boleh dipantau oleh JPPKK supaya peruntukan mudah dipohon.

ii. Penghantaran permohonan peruntukan/pertukaran skop kerja boleh di muat naik dlm platformdan dimaklumkan melalui emel.

iii. Mencadangkan untuk penyediaan borang yang selaras untuk politeknik dan kolej komuniti yang diguna pakai di dalam kerja-kerja senggaraan seperti borang *Extension of Time (EOT)*, Arahan Perbendaraan, Pekeliling dan lain lain sebagai rujukan dan boleh di muat turun.

iv. Menyediakan jadual kadar harga bagi kesemua disiplin awam, elektrik dan mekanikal atau sebarang nota bagi anggaran harga Jabatan Kerja Raya (JKR) bagi rujukan yang terkini.

Jadual 5: Analisis Soal Selidik

Bil	Item	Skor Min	Tafsiran
B1	Platform MySelenggara@POLYCC mudah diakses di manamana sahaja	4.65	Setuju
B2	Paparan pada platform ini menggunakan Bahasa yang mudah difahami	4.67	Setuju
B3	Paparan pada platform ini bersesuaian dengan tahap kompetensi pengguna	4.64	Setuju
B4	Maklumat yang disediakan di platform ini membantu dalam menjalankan tugas rasmi	4.68	Setuju
B5	Maklumat yang disediakan di platform ini dapat meningkatkan kecekapan terhadap bidang kerja pengguna	4.56	Setuju
B6	Proses pelaporan prestasi perbelanjaan tahun semasa lebih ceopat mudah dan ringkas	4.68	Setuju
B7	Maklumat yang disampaikan dalam platform ini lebih efiien serta menjimatkan masa dan kos	4.64	Setuju
	Skor Min Keseluruhan	4.65	Setuju

5.0 PERBINCANGAN DAN KESIMPULAN

Daripada analisis yang dibuat oleh penyelidik, terdapat beberapa perbincangan yang boleh dibuat bagi memastikan MySelenggara@POLYCC yang dibangunkan signifikan dan kecekapan dapat ditingkatkan oleh institusi dalam pengurusan penyelenggaraan berjalan lancar.

Pembangunan MySelenggara@POLYCC telah memberi impak positif kepada pengurusan di institusi. Antaranya;

a) Tiada permohonan bertindih dalam tahun semasa disebabkan ada rekod untuk dirujuk
b) Proses kerja lebih jelas danrujukan yang terkini berkaitan pengurusan penyelenggaran di institusi boleh diakses melalui MySelenggara@POLYCC
c) Format pelaporan prestasi belanja diselaraskan oleh pihak jabatan
d) Pihak pentadbir boleh mengakses prestasi kerja melalui MySelenggara@POLYCC

Kesimpulannya, pembangunan MySelenggara@POLYCC ini membantu responden meningkatkan produktiviti dan kecekapan pengurusan di peringkat bahagian dan institusi berkaitan pengurusan penyelenggaraan aset tak alih. Selain itu, Pembangunan MySelenggara@POLYCC ini juga membantu dalam memastikan pangkalan data berpusat bagi semua yang terlibat pengemaskinian data dan membuat pelaporan semasa termasuk penyediaan peratus perbelanjaan sebenar dilaksanakan dengan cepat, mudah dan ringkas bagi tujuan pelaporan kepada pengurusan institusi masing – masing. Ini dibuktikan dengan skor minimum keseluruhan dengan nilai mata 4.65 daripada soal selidik yang diedarkan kepada pengguna platform ini.

PENGHARGAAN

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