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KATA-KATA ALUAN PENGARAH

Setinggi-tinggi kesyukuran ke hadrat Allah SWT kerana dengan limpah kurnia dan keizinan-Nya, Diges Projek Pelajar Akhir Tahun PSMZA bagi tahun 2021 ini berjaya diterbitkan. Sekalung tahniah diucapkan kepada semua pelajar dan pensyarah yang terlibat dalam penerbitan diges ini walaupun berdepan pelbagai kekangan dalam situasi pandemik yang melanda seluruh negara ketika ini.

Harapan saya, amalan pelaksanaan penyelidikan dan inovasi seumpama ini dapat diteruskan dan diperhebatkan lagi supaya kita dapat sama-sama mewujudkan ekosistem inovasi seiring dengan bidang tujahan menerusi Lonjakan ke-7 PPPM (Pendidikan Tinggi) yang menjadi tunjang kepada pembangunan ekonomi negara. Saya percaya dengan adanya pembudayaan penyelidikan dan inovasi ini akan dapat meningkatkan lagi taraf pemikiran dan teknologi dan tidak mustahil untuk kita berdiri sama tinggi duduk sama rendah dengan negara-negara maju yang lain.

Dengan persiapan yang telah kita berikan kepada pelajar untuk sentiasa berfikiran secara inovatif dan kreatif, dapatlah mereka menyesuaikan diri di dalam bidang kepakaran masing-masing di alam pekerjaan kelak. Semoga penerbitan jurnal ini turut membina keyakinan kepada semua pelajar juga warga pendidik untuk melaksanakan penyelidikan dengan sehabis baik dan seterusnya untuk dikongsi kepada umum bagi kebaikan bersama.

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Sekian.

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KATA-KATA ALUAN PENASIHAT

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Segala cabaran, pengalaman dan kejayaan dikecapi menjadikan kualiti inovasi dan penyelidikan semakin matang dan berimpak tinggi. Semoga budaya penyelidikan dan penghasilan inovasi ini dapat diteruskan dan mendapat sokongan daripada semua pihak.

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KANDUNGAN

Smart Chili Fertigation

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Abstract
Agriculture is a significant sector in Malaysia. This sector has led to the success of the Malaysian economy for many years, producing agricultural products for local consumption while also earning foreign exchange. Chili, also known as Capsicum annum, is a high-value commercial crop. The traditional method and fertigation system were used to cultivate chili. In Malaysia, there are two types of fertigation systems: planting beneath a rain shelter as well as planting without a rain shelter. Smart Chili Fertigation is more focusing an open fertigation and without rain shelter. This study was conducted to improve the original systems because farmers lack of attention about the importance of pH value accuracy and the importance of spraying pesticides regularly. Therefore, the objectives of this study are to design and develop a smart device that able to collect data from various sensor points which records a variety of information such as moisture of the coco peat conditions and pH level in tank. Smart Chili Fertigation were designed to watering, fertilizing and spraying pesticides automatically according to data that has been collected. NodeMCU ESP32 enables the connectivity of any android device to be controlled and to change the setting times needed by using the Blynk applications. Also, because of the specialty of this product that it can be controlled from a far, it is completed with CCTV so that farmers can monitor everything that happens in real lifetime. The results showed that smart chili fertigation now have a good viability and are capable of increasing chili yield. The high output yield will offset the substantial initial capital cost. Apart from complying with current national agriculture, this smart device is also more environmentally friendly than conventional ways and in line with the practice of sustainable agriculture and rural development.

Key Words: *Chili Fertigation, Pesticides, NodeMCU ESP32, Blynk, PH Sensor, Water Level Sensor, Moisture Sensor*

1.0 INTRODUCTION

Chili is a member of the Solanaceae family, which typically includes other economically important species such as potato (Solanum tuberosum), tomato (Lycopersicon esculentum), and eggplant (Solanum melongena). Depending on the variety and how it's used in different countries, it's also known as capsicum, paprika, pimiento, cayenne, or chili pepper (Cili Padi Projek Komuniti, 2018). The more pungent types are normally referred to as chili while the mild to moderate pungent type is known as capsicum (Purseglove et al. 1981). The hot chilli is one of the most widely grown commercially in the tropics, mainly for personal use and with minimal export to temperate nations. Capsicum is a plant with several alkaloids, including carotenoids and capsaicinoids. Chili's pungency comes from capsaicinoids, which have both taste and pharmacological effects.

Malaysians consume a great deal of chili, both fresh and dried, with 64,723 tons in 1991 and 68,800 tons in 1995, respectively (Anandarajan 1992). Because of the strong demand, more farmers are starting to plant this crop (Nodemcuesp32). In 1995, 3733 'cili merah' plants and 159 'cili padi' plants were grown. Chili is perhaps the most widely grown fruit vegetable in Malaysia, second only to long bean in terms of hectares. Local production is still insufficient to meet local

demand because chili production hampered by inferior varieties and susceptibility to pests and diseases. To encourage increased output, a significant amount of chili should be imported. In 1995, Malaysia imported about RM56 millions of chili, more than 80% of which was in dried, fresh and ground forms, respectively. Agricultural technologies are often developing, and the product can not only be doubled in size, but the planting method can also be simplified to minimize pest enemy attack and labor costs may be minimized at the same time. Fertigation is a type of cultivation system that combines fertilizer with irrigation. This implies that fertilization and irrigation are indeed performed simultaneously.

Chili Fertigation is a prototype that improves the original process to make it more effective. Whereas watering plant system of current product is manually done. It takes a long time to complete all the task and also need lots of energy. For the planting laborers, they can suffer from back problems (health risk) and also having trouble controlling and monitoring every plant at one time. With this prototype, it can reduce repeated tasks and minimize labor costs. As a result, automatic irrigation and fertigation monitoring and control systems are effective at delivering water and fertilizers at the appropriate time and in the right quantities. This prototype uses IoT to operate and monitor while NodeMCU ESP32 as the controller. Projects that use completely automated control are expected to increase agricultural product productivity, with the purpose of helping farmers in the agricultural sector.

The controller, ESP32 is a low-cost, low-power system-on-a-chip microcontroller that includes integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series contains built-in antenna switches, RF baluns, power amplifiers, low-noise receive amplifiers, filters, and power-management modules, as well as a Tensilica Xtensa LX6 CPU in dual-core and single-core models. The Arduino integrated development environment (IDE) is a Programming language cross-platform application that runs on Windows, Mac OS X, and Linux computers. (Internet of things, 2016). It came from the IDE for the Processing and Wiring programming languages. It comes with a code editor that enables text cutting and pasting, text searching and replacement, automatic indenting, brace matching, and syntax highlighting, as well as one-click compiling and uploading to an Arduino board. A message section, a text console, a toolbar with common function buttons, and a hierarchy of operation menus are also included. The GNU General Public License, version 2 has been used to license the IDE's source code. The Arduino IDE has specific code structuring guidelines to support the languages C and C++.The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the 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 firmware.

The Internet of Things (IoT) is a network of connected devices which allows device to connect, interact, and exchange data. In other words, the phrase IoT refers to anything that can be connected to the internet, and it is widely being used to refer to devices that can communicate with one another. (How to Grow a Chili Plant from a Seed ,September 2020). IoT is also one of the core components for industry 4.0. Data collection on weather, rain, humidity, wind, pest infestation, and soil conditions are just a few of the IoT uses in farming. This information may be used to automate farming methods, make more informed decisions to increase quality and quantity, reduce risk and waste, as well as manage crops with less labor. For example, in our project, we use IoT to monitor water and the plants, as well as use IoT data for precision fertilization programs.

Nowadays, farmers are having trouble controlling and monitoring every plant. This is due to the fact that it takes a long time to monitor each plant on a row regularly for manual operation. Also, the existing system focusing only on fertilizing and giving less attention about the importance of pH levels accuracy. Next, farmers also giving less attention about spraying pesticides regularly. Soil-borne disease such as pathogens can lead to poor quality of plants. These pathogens infect the plant's roots, blocking water and nutrient uptake and flow through the plant. Wilting, yellowing, stunting, dieback, and eventual death are all symptoms that can be confused with other conditions such drought and nutrient imbalances. Lastly, manual methods also the reason why crops produce poor quality product. When watering or pesticide is done manually, there will be plants that over-fertigate and under-fertigate. Furthermore, farmers did not know about the current condition or moisture of the plant. It is really important for farmers to know about the current condition of the plants before irrigating and fertilize it because the plants can grow too fertile or unfertile.

The three objectives are to study the process of developing smart device that can help farmer works in cultivation using fertigation system that watering, fertilizing and spraying pesticides automatically, to design a smart device that able to collect data from various sensor points which records a variety of information such as moisture of the coco peat conditions, pH level of fertilizer mixture and to detect rain as the project is an open fertigation and without rain shelter and to develop a smart chili fertigation using IoT that can take a shorter time to monitor all the plants as well as reduce labor with the practice of sustainable agriculture development.

This Water Fertigation System was manufactured by Noble Procetech Engineers in India. This Water Fertigation System is available in semiautomatic and fully automatic versions. (Fertigation Systems,2009). Rain Bird Corporation is a privately held firm that was created in 1933 during California's agricultural boom. They are the global leading manufacturer and supplier of irrigation products and services (Automatic Plant Watering System with Soil Moisture Sensing with Suitable Electronics and its Applications for Anthropological and Medical Purposes, 2017). Rain Bird has received more than 450 patents worldwide over the last eight decades, including the first in 1935 for the original horizontal action impact drive sprinkler (U.S. Patent 1,997,901), which reinvented the food production industry and ushered in a new era in irrigation around the world. Abdel-Salam, Eslam, Elgorban, Abdallah, and Ahmed, Mukhtar from the Department of Natural Resources and Environment (2016) studied the effect of fertigation through surface and groundwater drip irrigation on growth rate and concluded a Fertigation System project. Most of this fertigation system was used in Malaysia. This system is offered with semiautomatic which only irrigation work automatically. This research presents a reliable, to reduced and precise system that has been tested in the field for three years and can deliver personalized quantities of fertilizer at the same time. The importance of fertigation in increasing productivity with efficient and reduced consumption of water and nutrients with practically no pollution is emphasized. The advantage of this product is cheaper than product above (water fertigation system, noble procetech engineers) and disadvantage for this product is it doesn’t provide the automatic mixture.

Fertigation Tomato Plants was made by researcher from Federal University of Goias. The purpose of this research was to develop and test a low-cost automation system for managing different fertigation regimes in tomato plants (Solanum lycopersicum L.) cultivated in a controlled environment. An irrigation controller was connected to substrate moisture sensors and a programmable logic controller in the system (PLC). As a result, we found that the automation system worked well for fertigation control. It had no issues with malfunctioning, and it was still less expensive than commercial controllers.

Automation Irrigation System is a project was made by Anitha K from GSSS Institute of Engineering and Technology for Women. The purpose of the project is to create an automatic

irrigation system that can detect soil moisture content and controls the pump motor on or off. In the sector of agriculture, it is important to use the proper irrigation system. The benefit of this technology is that it requires less human intervention while still ensuring proper irrigation.

A researcher from Annasaheb Dange College of Engineering and Technology is researching agriculture automation using PLC. The Indian market is mostly based on agriculture, and the isotropic environmental climate limits the full utilization of agricultural assets. The main reason for this is a shortage of rain in many parts of India, as well as a scarcity of land water. Many challenges happen because of manual control irrigation techniques, such as increased water consumption, delayed water supply, excess or insufficient fertilizer consumption, poor fertilizer preparation quality, and so on. Fadhli Dzul Mohd Fauzi, from University Technology MARA, 23000 Dungun, Terengganu, Malaysia, created this Supervisory Fertigation System. Farmers typically spend most of their time monitoring a wide area of planting, which leaves them exhausted. This project's aim is to create a smart monitoring system. To overcome this problem, this project utilized Interactive Graphical Supervisory Control and Data Acquisition (IGSS) software and a Programmable Logic Controller (PLC) that connected with a fertigation system.

2.0 METHODOLOGY

Methodology seems likely as a component where we bridge the gap between the objectives and the eventual outcome. This chapter will explain the method adopted in mechanical and electrical installation (hardware) and programming the IoT and Blynk application (software). Thereby, this chapter will also mention every component involved and the designing in conducting this Smart Chili Fertigation.

2.1 Flowchart of Project

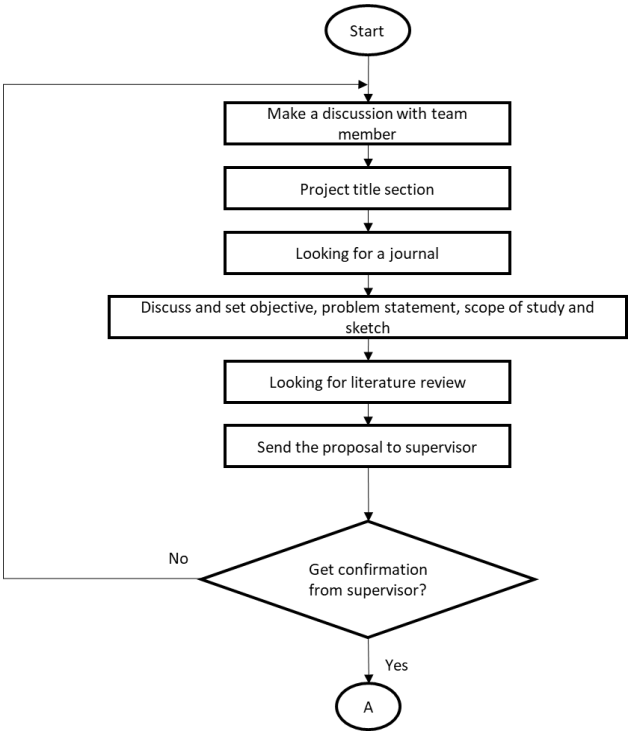

Figure 1: Plan of Project Flowchart (1)

A flow chart is a graphic that illustrates an algorithm. It is often used by programmers as a program-planning strategy to tackle an issue. Refer figure 1 and figure 2.

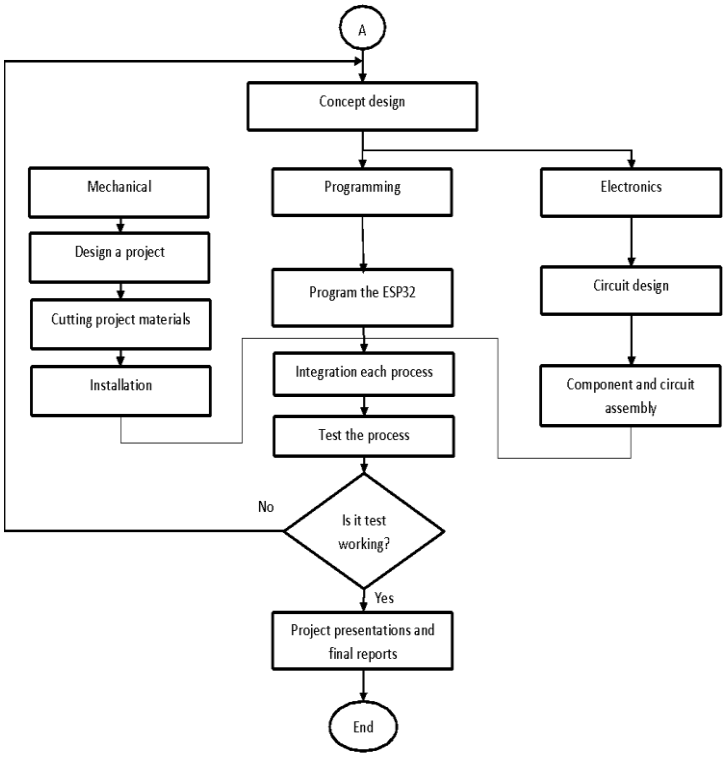

Figure 2: Plan of Project Flowchart (2)

2.2 Flowchart of System

Based figure 3, when system is started, all the sensor will active and will read data from water level tank fertilizer and tank pesticides, pH value of fertilizer, soil moisture and time inputs. Ultrasonic sensor will detect water level in the tanks and give notification to user if water in the tanks is below that 30%. Next, moisture sensor will detect soil moisture and give notification if soil is dry. After that, pH sensor will give pH value of fertilizer and give notification if pH value is too LOW and too HIGH. Time inputs, if user insert time for fertilizing and pesticides and the time is up fertilizing and pesticides will start watering and spray according to the time that use set. When timer is up watering and spray will stop. Lastly if power off all whole system will stop if not this system will continue reading all data non-stop.

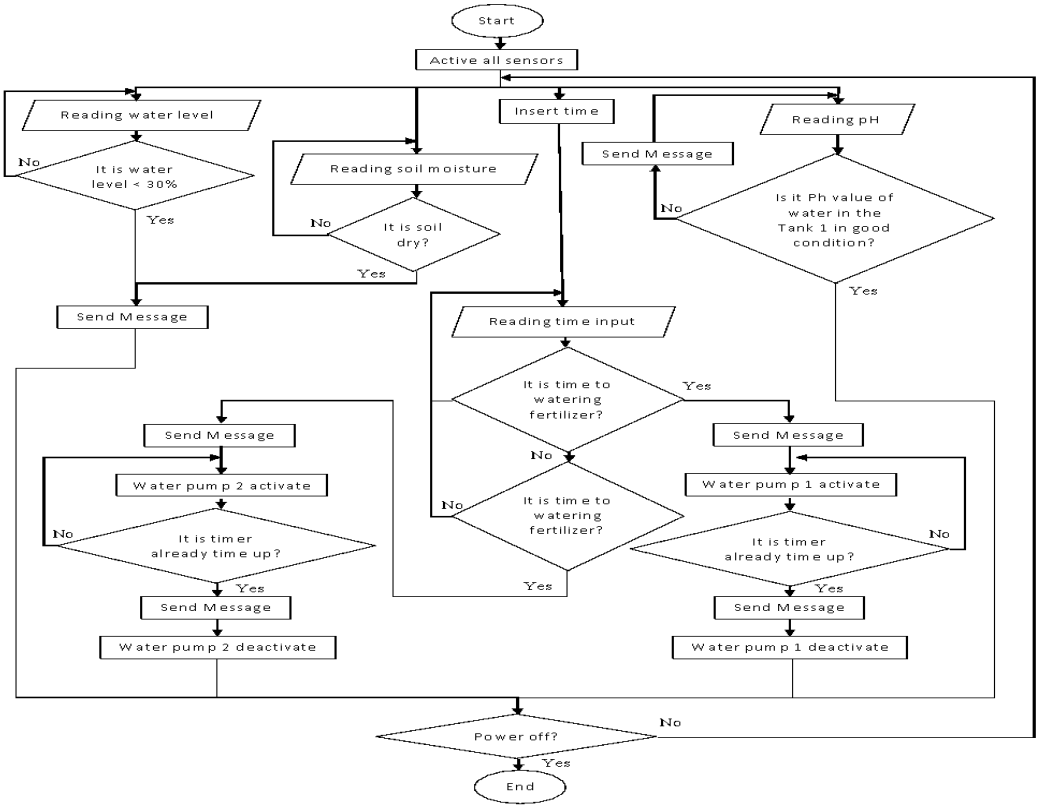

Figure 3: Flowchart of system

2.3 Project Design

In this section, the design contains 3 design forms namely mechanical, electronic and programming design.

2.3.1 Mechanical Design

The primary features, structure, success criteria, and major deliverables of a project are all planned out throughout the project design phase. The purpose is to create one or more designs that can be used to achieve the project's objectives. Investors can then choose the best design for the project's actual execution. As shown in figure 4, the project design phase can produce a wide range of different outputs, such as sketches, flowcharts, prototypes, and more.

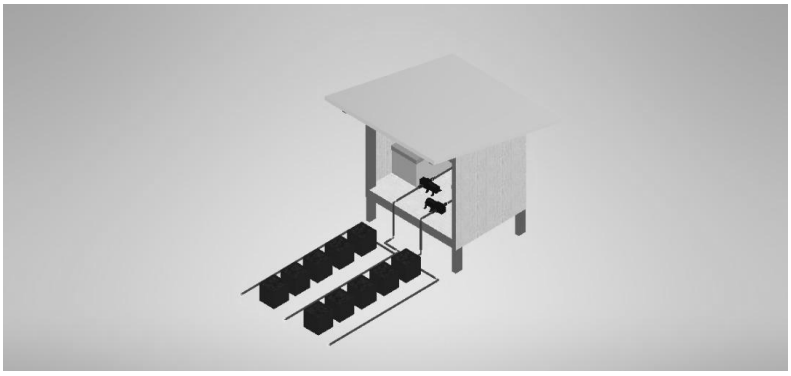

Figure 4: Isometric View

2.3.2 Electrical Design of a Circuit

Circuit design can apply to a wide range of systems, from sophisticated electronic systems to multiplier circuits within an integrated circuit. Simple circuits can often be created by one person without the requirement for a planned or structured design process, but more sophisticated designs are increasingly requiring teams of designers to follow a systematic approach with intelligently directed computer simulation. The phrase "circuit design" is commonly used in integrated circuit design automation to refer to the stage in the design cycle that produces the integrated circuit schematics, as shown in Figure 5.

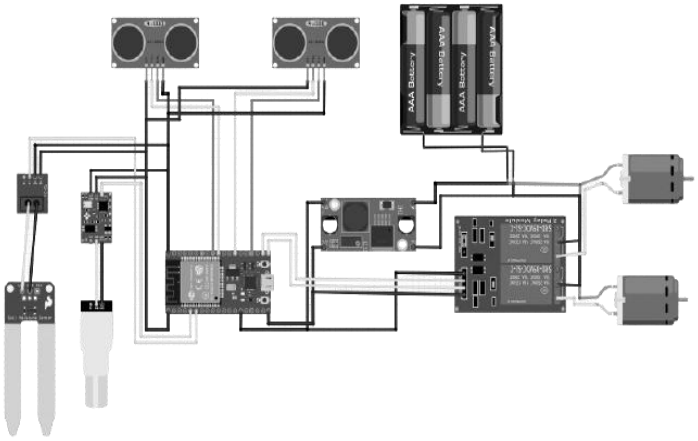

Figure 5: Electrical Circuit Design

2.3.3 Programming Design

In this programming design have 3 flowcharts of sensor for Ultrasonic sensor, Moisture sensor and PH sensor. Refer figure 6, figure 7 and figure 8.

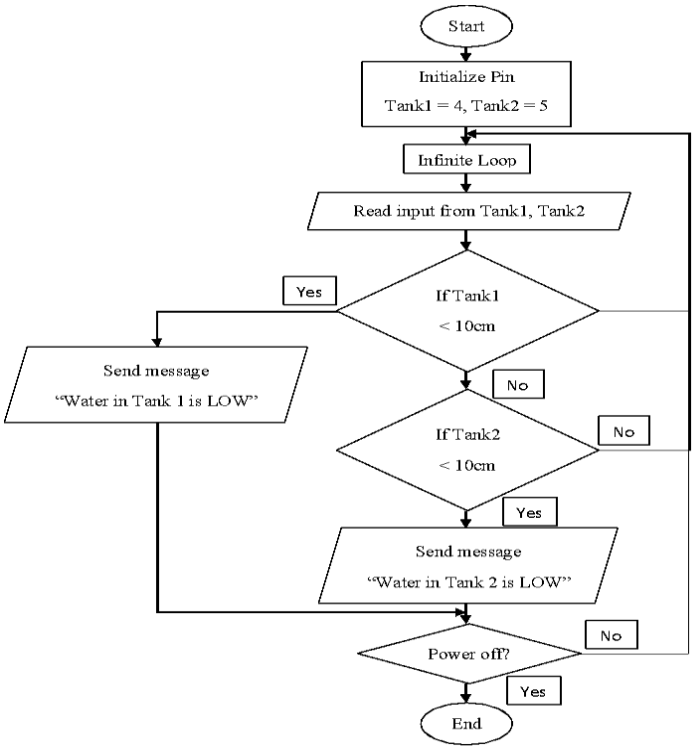

Figure 6: Flowchart of Ultrasonic Sensor

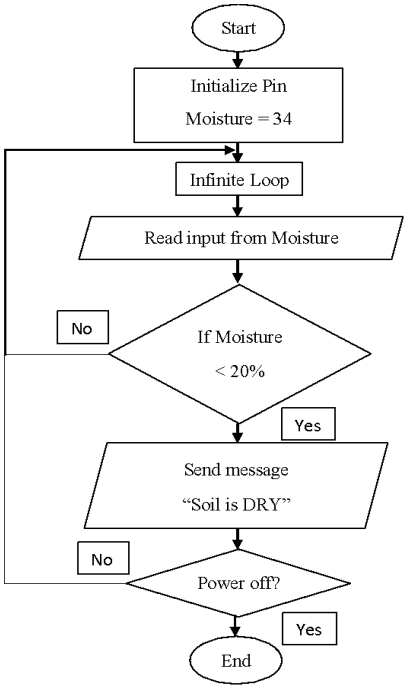

Figure 7: Flowchart of Moisture sensor

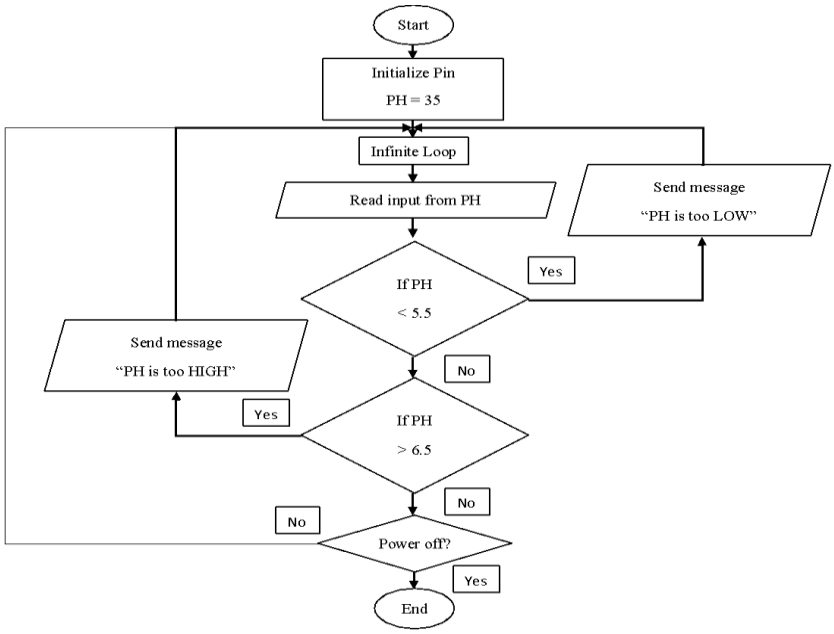

Figure 8: Flowchart of PH Sensor

3.0 RESULTS AND DISCUSSION

3.1 Performance of Smart Chili Fertigation

The purpose of this experiment is to observe the performance of this Smart Chili Fertigation. The experiment will last a month and the growth of chili will be recorded once a week. The records will be compared to the conventional methods that has been obtained through surveys. Things that will be observed and recorded is based on the plant height (in cm) as figure 9.

Figure 9: Shelter

The objectives are to observe the performance of Smart Chili Fertigation, to observe the growth of chili based on its height and the growth of chili that has been

recorded will be compared with current conventional method surveys. The results of this observation as shows below in table 1.

Table 1: Result of performance of Smart Chili Fertigation

Week	Height of chili plant (cm)
1	10
2	12
3	13
4	18
5	20
6	25

By using our Smart Chili Fertigation, all the 20 bags of chili plant grow healthily and evenly based on the size & height. It is because Smart Chili Fertigation will be watering and spray pesticide automatically with the same amount for every bags. Also, the chili plant gets the exact pH value of fertilizer to balance it with the pH of the soil as it can always be monitored through smartphone. The conclusion is, the height of chili plant is increasing from week to week. Also, it was sprayed with pesticides to prevent fungal and insect from destroying the plant. This Smart Chili Fertigation proved that it helps in increasing the quality and quantity of chili plants.

3.2 The Watering at the Appointed Time and Receive the Notification

The purpose of this experiment is to make sure proper watering fertilizer and spray pesticides at the appointed time occurs at a set time and day. Then, will receives notification from Blynk application so can monitor the plants from far. The expected result for this experiment is that watering occurs at a set time and day. Then, will receives a notification when the water pumps are active and deactivate from Blynk application when start watering and watering is finish. The results are show in table 2.

Table 2: Result of watering at appointed time and receive the notification

Number of trials	Activation of water pump (Yes or No)	Delay time of notification email
1	Yes	No delay
2	Yes	No delay
3	Yes	No delay

By using the time-input in the Blynk application where the user can set the time and also the day for watering such as fertilizer water and also pesticides to chili plants, with this watering can be done periodically without worrying about forgetting to water. In conclusion, everything going well and do not have any problem with this experiment because 3 times we do this experiment, water pump active at the time that we set. Problem that may occur to water pump maybe because of wiring and for notification will have delay maybe because of connection internet slow the chili plants.

3.3 Ph sensor in Smart Chili Fertigation

This experiment is to determine the functionality of the ph sensor through the smartphone. As the objective of the project is to monitor the plant from far, it is clearly that almost overall of the project is doing it job automatically including watering and fertilizing. So, it is really important to keep updated with the current ph level of so that it does not damage the plant if it is over water or fertilized. Ph sensor will detect ph level from 5.5 to 6.5 and the data will send to the Blynk application.Smart chili fertigation will work perfectly. The results in table 3.

Table 3: Result of Ph Sensor in Smart Chili Fertigation

Number of trial	Value of pH sensor	Delay of pH sensor
1	6.4	No delay
2	6.2	No delay
3	6.3	No delay

The value of the pH sensor is still at the acceptable range. Also, it can be monitored well through Blynk application without any delay. In conclusion, these pH sensor differences are not very significant and have no problems when performing experiment. No delay occurred during the experiment.

3.4 Moisture Level Sensor in Smart Chili Fertigation

This experiment to determine the functionality of the moisture level sensor through the smartphone. Beside that to test whether the system notify the owner if the moisture of the coco peat is below than 20%. Table 4 show the result of Moisture Sensor in Smart Chili Fertigation.

Table 4: Result of Moisture Sensor in Smart Chili Fertigation

Number of trials	Soil moisture <20%	Soil moisture >20%	Notification receives (yes or no)
1	/		Yes
2		/	No
3	/		Yes
4		/	No

By using our product “Smart Chili Fertigation”, all the 20 bags of chili plant will grow healthily based on the moisture of coco peat. It is because when using the moisture level sensor in the Blynk application where the user can set the percentage of moisture of coco peat, the user does not have to worry if did not know either have to watering the plants or not, because when used the moisture level sensor it will send you a notification through the phone when moisture of coco peat on your plants are starting to dry. The conclusion is the moisture level sensor can be monitored through Blynk application and if the moisture of the coco peat is below than 20%, it will notify through the application. But if the moisture of coco peat is above 20%, it won’t notify but the moisture will always can be detected and be shown in the application.

4.0 CONCLUSION AND RECOMMENDATION

In conclusion, the Smart Chili Fertigation that has been designed to watering, fertilizing and spraying pesticides automatically can be used in agriculture commercialize. The results showed that Smart Chili Fertigation is capable of increasing chili yield and has high viability. In addition to having to conform to current national agriculture, this smart device is more environmentally friendly than conventional methods and is in accordance with the law involved in sustainable agriculture development. This technology had a great impact on agriculture. The application rates of fertilizers and irrigation water can be significantly reduced, and crop yields can be increased appreciably. At the same time, it has proved to be profitable for farmers. This technology has not only made farmers profitable, but has brought us good products. Overall, this project was successful and achieved all its objectives.

After knowing the result, there are several suggestions that can be used to upgrade on this project. The first suggestion is to use CCTV. There are plenty of things that should be done on the farm to avoid interruptions and delays in daily operations. Every interruption or change in routine can lead to huge losses. Therefore, monitoring everything at any moment is an essential part of every farmer's daily life. Usually, from early in the morning to late in the evening. In this case, the CCTV can be added in the system so the owner doesn't have to worry because the owner can monitor the farm with CCTV in real time through a smartphone or tablet. Secondly, the production of agricultural water has a good impact on productivity and crop yield. A lack of using improper irrigation, both productivity and yield will also decrease. The most significant way to promote agricultural water use and maintain optimal production potential is to use management. The aim is to use management strategies that promote water efficiency without decreasing productivity. Advanced irrigation scheduling and crop-specific irrigation management are also examples. Water and energy are highly conserved, and grower costs can be reduced, according to these strategies.

Finally, this project can be improved by adding a solar system. Solar energy can be used in a variety of ways, including solar irrigation and water pumping for livestock and crops. There is a pressing need to design or, more likely, re-design buildings in such a way that they can trap heat generated during the day when everything is heated. Some livestock require a constant source of fresh air in order to remain healthy. To avoid spending money on electricity bills, systems that can power coolers and other sorts of such boxes can be built. There is indeed a cost-effective way to do this, and it is to ask those that are in charge of creating the building to design the structure so that it maximizes the amount of sunlight it receives. Solar panel systems can be used to harness the sun's energy and use it to power homes and greenhouses.

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Integrated Student's Project Management System (i-ProMS)

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Abstract

Integrated Students Project Management System (i-ProMS) is a web-based Final Year Project management system used at Department of Information and Communication Technology, Politeknik Sultan Mizan Zainal Abidin. The proposed studies aimed to identify the requirement of an Integrated Student's Project Management System, develop it on web-based platform and conduct testing on the system. It serves to store inventory related to the Final Year Project (FYP) such as detailed project information, project proposal, technical report, project source code and achievements obtained. Before the system developed, it was difficult to access student project inventories quickly and accurately when needed because the information stored in a compact disc and also in Microsoft Excel file. This project used waterfall model as project methodology during the project development. This project involved three users scopes including students, project coordinator and project supervisors. PHP language, Visual Studio Code, Apache server and MySQL database are used to develop this project while Bootstrap software used as front-end of the web interface. White box testing SShave been conducted on this system. The result from system testing is positive meaning it is performed as expected from the given input. To be concluded the system helps a lot to make the FYP management and documentation well organized, ready and easy to access.

Key Words: *Final year project, project management system, web based, front-end, inventory*

1.0 INTRODUCTION

Currently the Information Technology (IT) has been the primary force driving the transformation of roles in the education. One of the most frequently used technology tools today is web based application (Putri et al., 2017). Web-based applications are a particular type of software that allows users to interact with a remote server through a web browser interface. It has seen a huge increase in popularity in recent years, replacing desktop applications and becoming a crucial instrument for education around the world. It is appropriate for educational institution to make use existing technology to ease the process of managing students' data.

Department Of Information and Communication Technology (ICT Department), is a main academic department at Polytechnic Sultan Mizan Zainal Abdin that strive to implement and integrate ICT to improve its academic and administrative. One of the important and regular processes needs to be managed efficiently and systematically is data related to Final Year Project (FYP). In most curricular in Information Technology (IT), students are generally expected to complete comprehensive software development projects in their final year studies. That is why it is commonly known as a final year project (FYP). This project-based study aims to provide integrated training on their team work skills, technical knowledge learned from different courses, and project management skills. In the diploma program at the polytechnic, this project-based course is delivered throughout in the final semester. Students are grouped to work on a project under the supervision of a professor. Before the semester begins, students are required to form a group of three people, and be involved in the project allocation process. This system will have a big impact management, thus helping supervisors to manage projects more efficiently.

The final year project management system currently used by the Information and Communication Faculty in Polytechnic Sultan Mizan Zainal Abidin is an offline system that uses paper and compact disk. The process of inserting, deleting and updating projects and registering new projects is done at the specified location because the use of existing papers and CDs does not allow access by any party. A simple solution for this data storage is much more limited and controlled than a central or office, where primitive database storage is replaced by hardware.

At first implementation of FYP, students have to form group and propose their project title by filling group and project registration form manually. Project coordinator will collect all these manual forms and start to assign students to project supervisors. After group assigned students will communicate with their project supervisors for further action. At this stage submission of project approval and project proposal will involve both parties. Without the centralized of data storage, sometimes project coordinator missing important information related to the changes of project title.

Another problem frequently faced by the project coordinator is the difficulty in accessing student project inventories such as group information, proposals, technical reports and project source code quickly because it is stored manually in Microsoft Excel and compact disc. The data related to FYP also essential for reporting on annual achievements in PSMZA strategic plan. The information like student participation and achievement who participated in innovation competition only kept by project supervisors. Due to decentralized information storage, the reporting process takes time. Therefore, the Department of Information and Communication Technology requires a centralized and practical ways to store and processing student's project inventories to tackle these issues.

One of the previous studies referred is Student Project Management. It is web-based system which manages the activities of student and project supervision. Surveys conducted have shown that in recent years, due to the increasing number of students and the project supervisor's workload, the conventional project supervision have yielded poor results. Current practice uses a log book to document meetings and discussions between supervisors and students. The manual transaction in managing FYP will become more difficult and stressful job (Sanket et al., 2017). To improve project monitoring and supervision, a web-based supervision management system was developed. It will manage the database and maintain a list of all student or groups of students that are registered as project students under a supervisor. The programming language used is PHP (Hypertext Preprocessor) and MySQL database.

The advantage of this system are supervisors can prepare project schedules, collect project proposal documents, schedule it, organize project presentations, compile final project dissertations, and record students grade into the student management system. While the disadvantage of this system is it cannot store data like project achievements.

Besides that, another web-based application has been studied during project development is Transport Management System. Today, one of the most frequently used technology tools is web-based applications in any business (Putri et al., 2017). The features and function makes transport maintenance easy and requires less man power and less time for maintaining the records of the transportation firm. As everything is automated in new system now user need minimal clerical work involved to manage transport work. New transport management system is required less man power since more transaction is automated in new system. The web-based transport management system is user friendly with good look and feel and accurate. However, this system does not have an interesting interface because the background of the page looks empty. Maybe user will not be interested with this website for their first time.

Every school has day-to-day operational issues ranging from the registration to the departure of students. Currently, most of the school's operations are not integrated and hence it takes a lot of effort for creating and maintaining the student and employee's records. This inevitably leads

to higher costs in terms of staff processing time, higher level of inaccuracies, costly corrections, and duplication of work. In addition, real-time statistics and performance information is difficult, if not impossible, to derive.

For overcome this problem School Management System (eSMS). eSMS are customized and user-friendly system for school management. It has been designed to automate, manage and look after the over-all processing of even small to large school. This Software is capable of managing Student Details, Fees Details, Employee Details, Payroll Details, Library Details, Result Details, Class Routine etc. It also provides very helpful report for managing the school in easy and accurate way. Table 1 shows the comparison between three systems provided.

Table 1: Comparison of each system

System	**Supervision Management System**	**eSMS -School Management System**	**Transport Management System**
Web	Yes	Yes	Yes
Online Application	Yes	Yes	Yes
User Friendly	Yes	Less	Less
Interface	Attractive	Not Attractive	Not Attractive

After all the previous studies relevant referred, we have set that this project has following objectives to be achieved which are to identify the requirement of an Integrated Student's Project Management System, to develop it on web-based platform, and conduct testing on the.

2.0 METHODOLOGY

Methodology is a system of method used in a particular area of study or activity (Mounir, 2018). The waterfall model is a sequential development approach, in which development is seen as flowing steadily downwards (like a waterfall) through the phases of requirements analysis, design, implementation, testing (validation), integration, and maintenance (refer Figure 1). Since no formal software development methodologies existed at the time, this hardware-oriented model was simply adapted for software development.

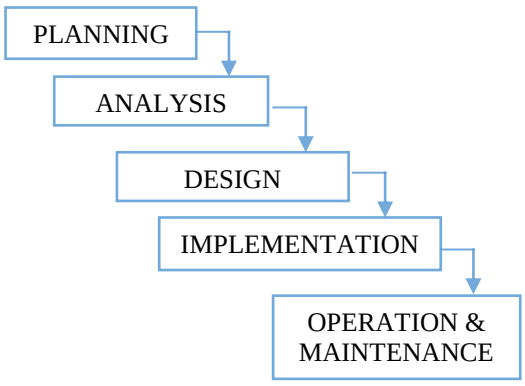

Figure 1: Waterfall Model

The reason we choose Waterfall Model because project is divided into sequential phases, with some overlap and splash back acceptable between phases. Emphasis is on planning, time schedules, target dates, budgets and implementation of an entire system at one time. Tight control is maintenance over the life of the project via extensive written documentation, formal reviews, and approval or signoff by the user and information technology management occurring at the end of most phases before beginning the next phase.

2.1 Requirement Specification

2.1.1 Functional Requirement

Functional requirement defines the fundamental action the system must perform. Functional requirements can be define as the basic system behavior. It means it described what the system does or must not do and how the system responds to inputs. Functional requirements are behaviors include calculations, data input, and business processes. In the case of this system, the functional requirements are as follow below:

a. Project group registration
b. Project title and proposal information
c. Project capstone uploading
d. Project title and proposal approval
e. Project capstone compilation
f. Project group assign
g. Generate related report

2.1.2 Non-functional Requirement

The definition of non-functional requirements is quality attributes that describe ways system should behave. It can be described as the system's operation capabilities and constraints that enhance its functionality such as performance, speed, security, reliability and usability. In the case of this system, the non-functional requirements are as follow below:

a. The ability of storage capacity to store compilation of project capstone
b. Retrieval of important information become more easier and quickly
c. System performance to save a lots of time by providing convenience report and statistic
d. The compatibilities of user interface with all web browser to produce nice display
e. The reliability of system prevent from failure
f. The ability of security implement in the system

2.1.3 Software and Hardware Requirement

The Software and Hardware Requirement are show such as table 2 below

Table 2: Software and Hardware Requirement

SOFTWARE	HARDWARE
PhpMyAdmin	Laptop
Notepad++	External Hard Disk
Hostinger	
XAMPP	

2.1.4 System Configuration

i. PhpMyAdmin
   Tool for MySQL. As a portable web application written primarily in PHP and as a database for this website.
ii. Visual Studio Code - As a development tool for PHP to be written
iii. Hostinger - As a hosting and domain for the website
iv. XAMP
   To open PhpMyAdmin for make database and run the website as web server

2.1.5 Security Requirement / Exceptional Handling

Security Report – it is a must for modern web applications to security our users report to save them from hacker that may steal all the information including sensitive personal data from their account.

2.2 Logical Design

This system starts with the design phase. System design is anexplains about how to function or creation of a new system. It translates system requirements into easy ways to understand and made operational. For that, it provides the understanding and procedural details necessary for the implementation. Context Diagram (CD), Entity Relational Diagram (ERD) and Data Flow Diagram (DFD) is used to supplement the working of the new system. It should overcome all the drawbacks of the existing system and most important of all meet the user requirements. Figure 2 and figure 3 shows the Context diagram and Entity Relationship Diagram of i-ProMS.

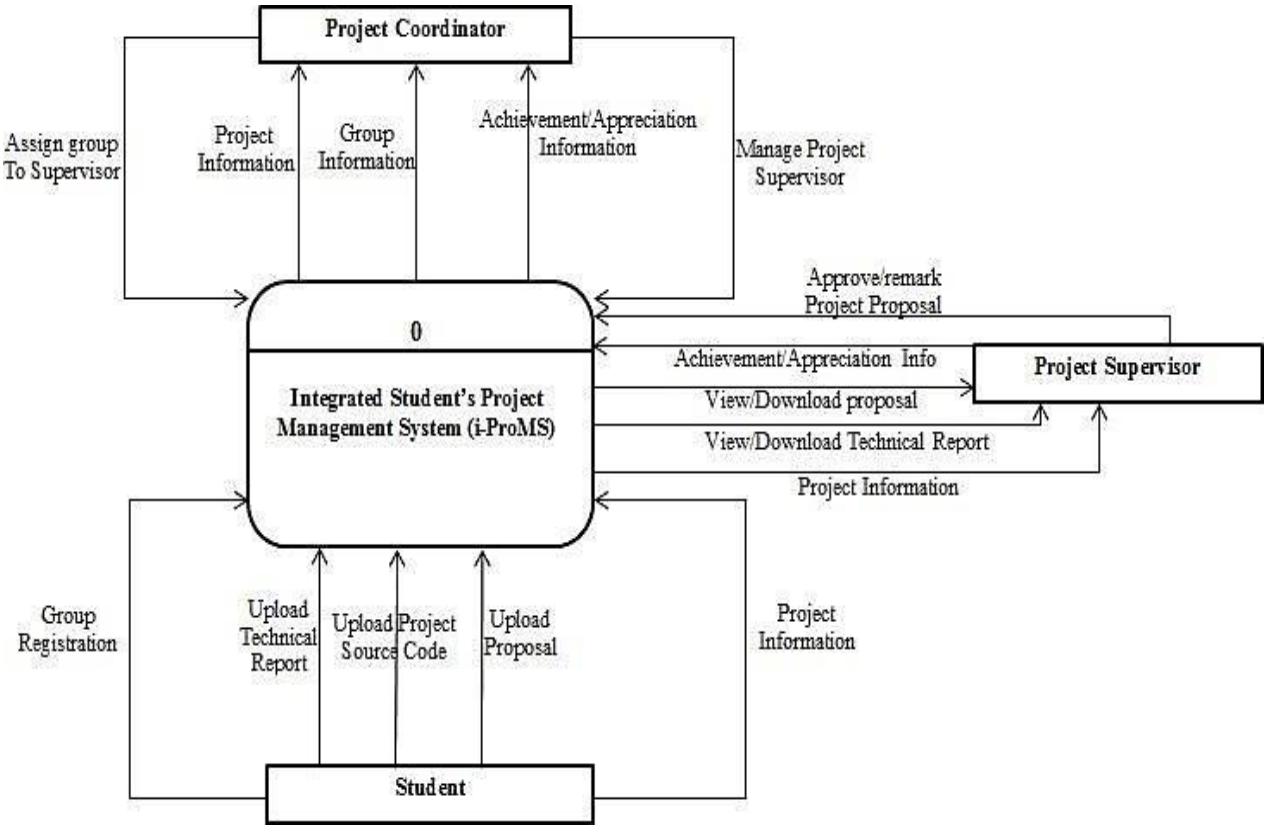

Figure 2: Context Diagram of i-ProMS

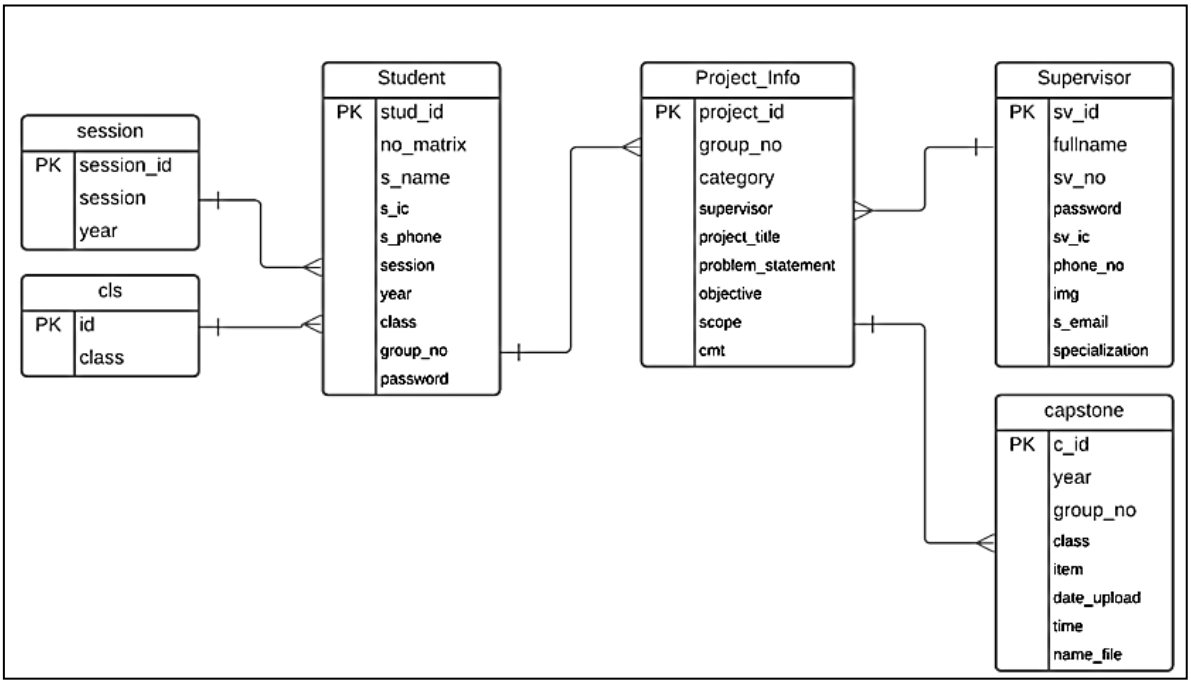

Figure 3: Entity Relationship Diagram of i-ProMS

2.3 Physical Design

The physical design is a kind of system design. It is a graphical illustration of the system, representing external and internal entities of the system with to and from data flow. An external entity is an entity exterior to the system and internal entity is an entity inside the system where both can convert the data.

2.3.1 Domain website

To start, search this domain on any web browser as figure 4.

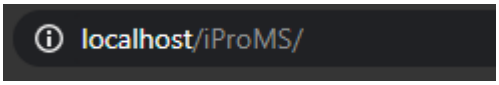

Figure 4: Domain

2.3.2 Index

Index of I-ProMS as figure 5.

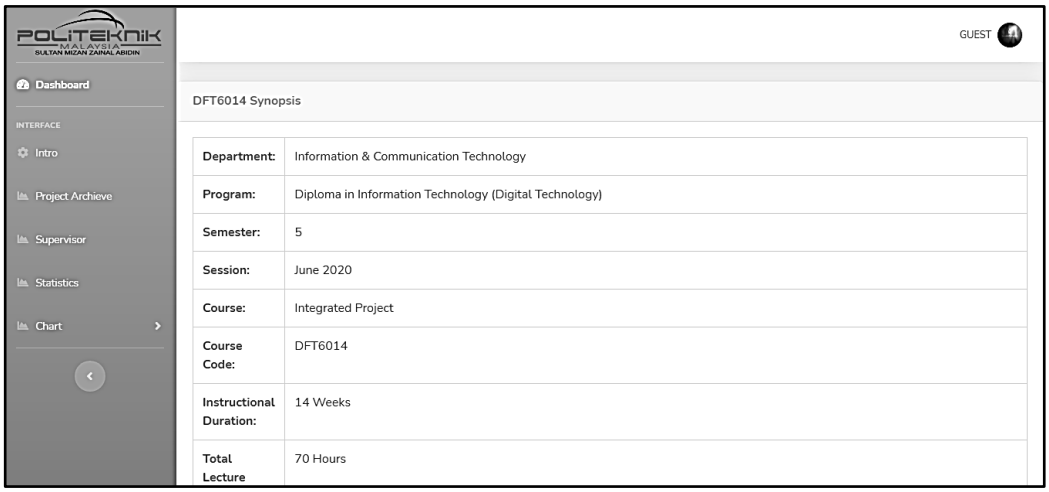

Figure 5: Guest Dashboard

2.3.3 Login Page

Student, Admin and Supervisor login session as figure 6.

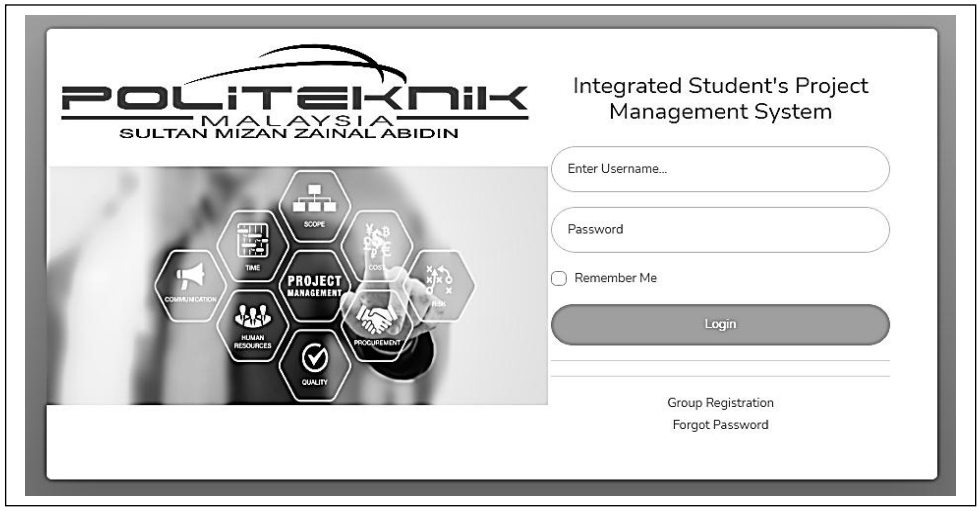

Figure 6: Login

2.3.4 Project Group Registration Page

Student register session such as figure 7.

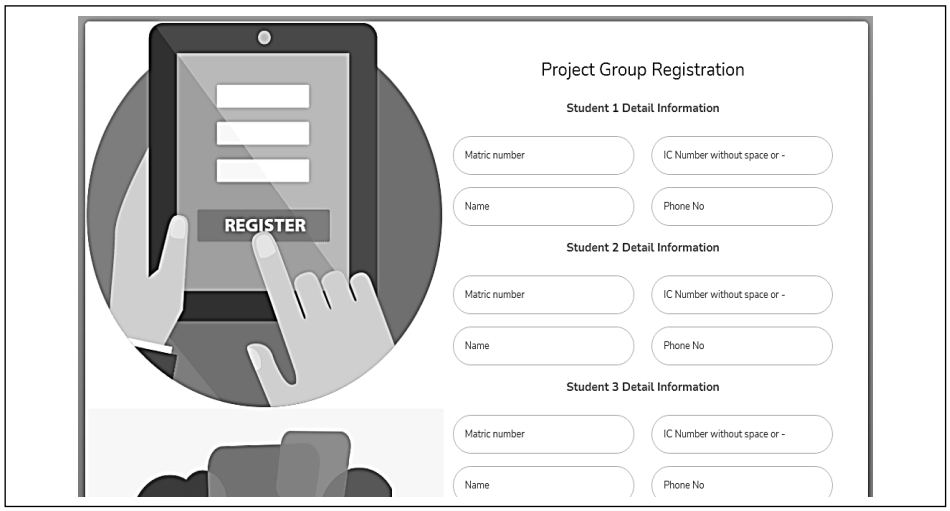

Figure 7: Project Group Registration

2.3.5 Admin Dashboard

Admin Dashboard session as figure 8.

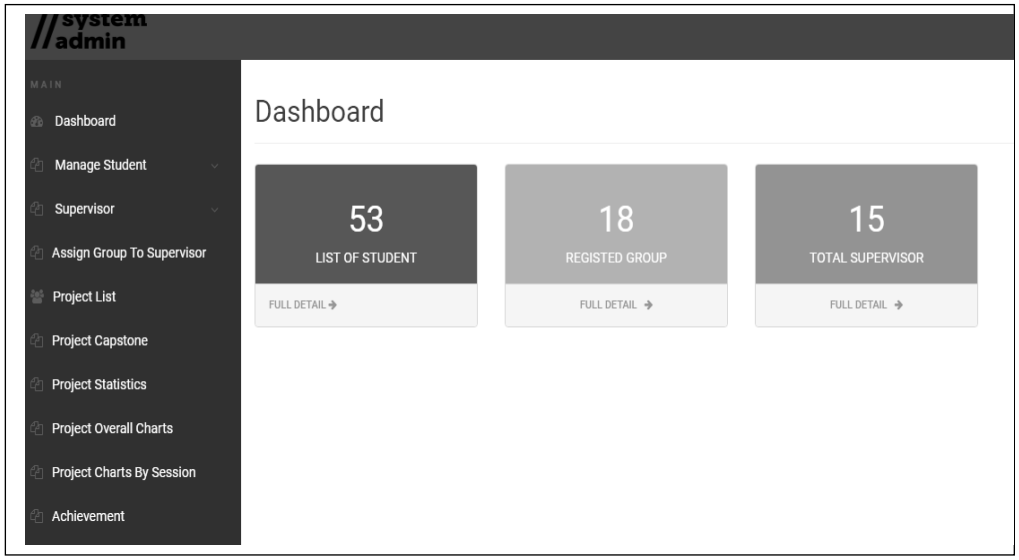

Figure 8: Admin Dashboard

2.3.6 Student Group Page (Upload Proposal)

Student can upload project title, problem statement, objective and project scope as figure 9.

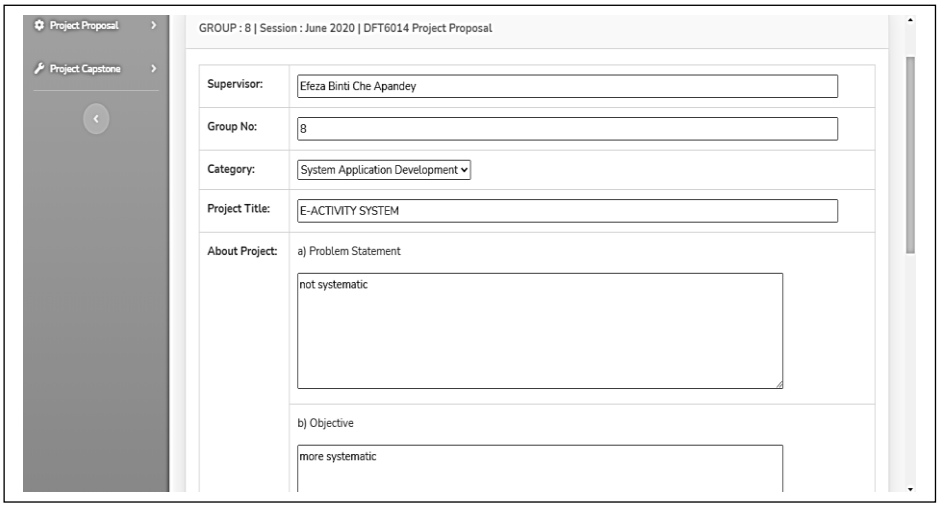

Figure 9: Student Proposal

2.3.7 Upload Capstone

Student can upload project abstract, report chapter 1, report full and project source code such as figure 10.

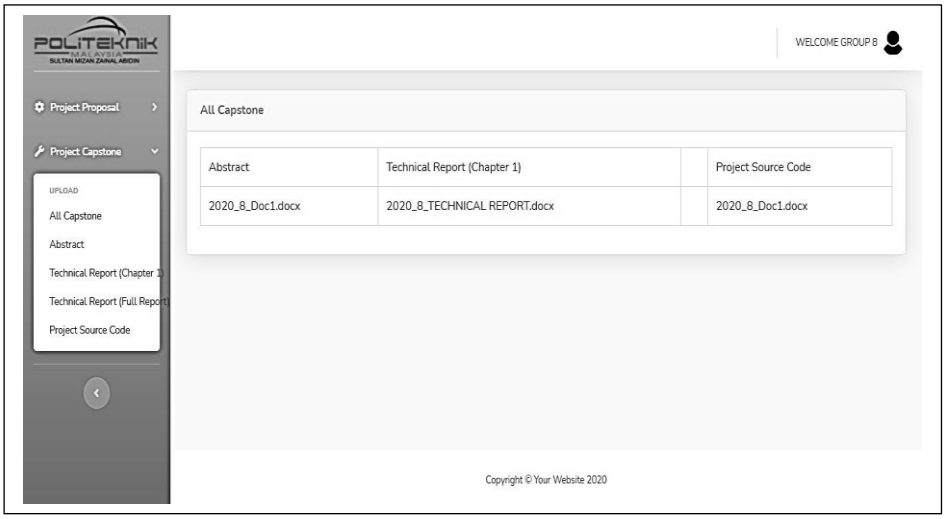

Figure 10: Upload Capstone

2.3.8 Supervisor Dashboard

Supervisor can see the project group and full detail of project such as figure 11.

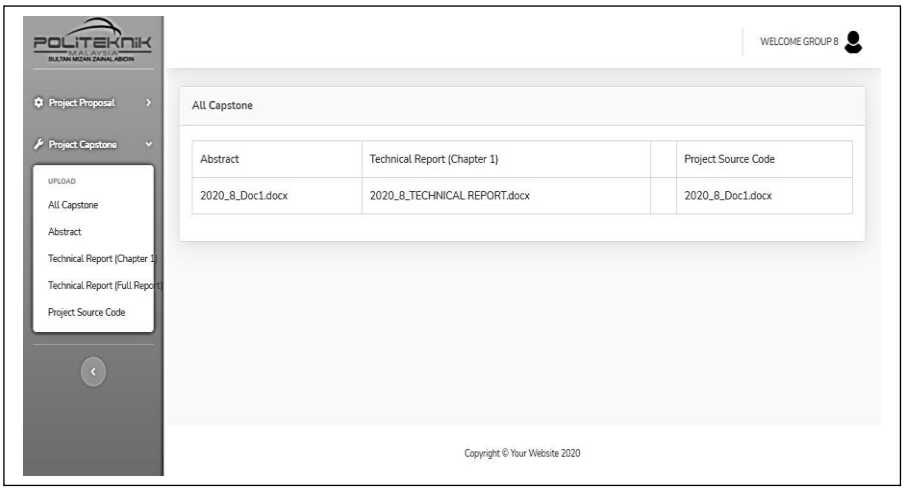

Figure11: Supervisor Dashboard

2.3.9 Project Achievement/Award

Supervisor can submit the achievement or award for the group as figure 12.

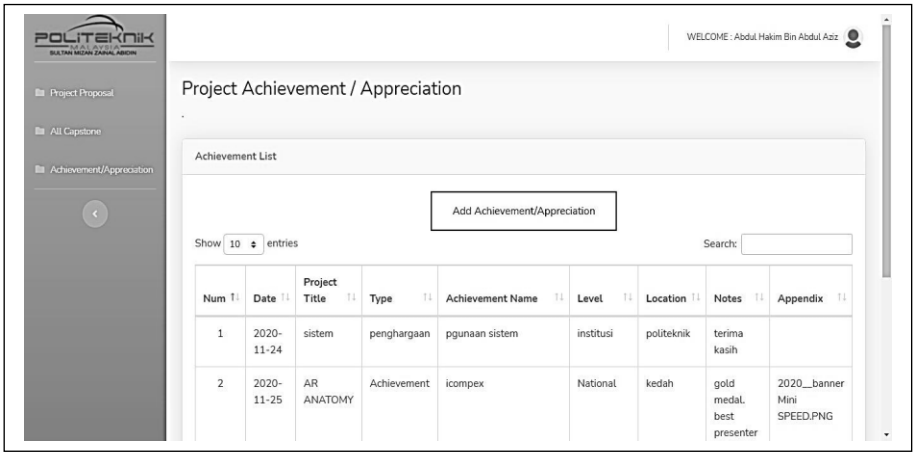

Figure12: Project Achievement

3.0 RESULTS AND DISCUSSION

After the development of project completed, testing has been done to detect possible error or discrepancies of the project. White box testing (unit testing and integration testing) performed to identify the accuracy of the developed process in software and validate that each unit of the software code performs as expected. Table 3 shows the analysis of unit testing that has been done. Based on the analysis, it can be concluded that i-ProMS passed the testing overall.

Table 3: Unit Testing Plan

Unit Testing Plan						
NO.	Test Case Name	Test Procedure	Pre-Condition	Expected Result	Tester	Result (PASS/ FAIL)
1.	Login	User is required to fill in the username and password field before access the system.	User need to register or sign up before login	Redirected to Index	Rafiqi	PASS
2.	Register	User is required to fill in username, email, password and confirm password to register	Username is either lecturer's ID or students Matrix Number Email validation must have the character "@" Password and confirm password must be the same	Redirected to index.php.	Khairul	PASS
3.	Dashboard	User is required to click the home button	A strong internet connection is required	Redirected to index.php	Khairul	PASS
4.	Submit Proposal	User is required to write the proposal and press "Submit"	User need to have access as Student	Successful message	Ikram	PASS
5.	Upload Abstract	User is required to press the edit button to add abstract	User need to submit an event and press the edit button	Successful message	Rafiqi	PASS
6.	Upload Report (Part 1)	User need to key in the necessary information of an event to generate a report	Must be logged in as Student	Successful message	Khairul	PASS
7.	Upload Report (Full)	User need to press the report button on Report page to download or print report	Must be logged in as Student	Successful message	Ikram	PASS
8.	Upload Project Source Code	User need to upload file of project source code and try to download it	Must be logged in as Student and Supervisor (for download)	Upload Successful and can download	Rafiqi	PASS
9.	Achievement	User is required to press the "Achievement" button to post about a new achievement	User need to login first as Supervisor	Achievement list updated and showcased on index	Khairul	PASS
10.	Create Achievement	User is required to fill in the achievement form to be display on index	Must include an achievement name and login as Supervisor	Achievement list updated and showcased on index	Ikram	PASS
11.	Edit Achievement	User can update an existed achievement	An existential achievement only can be updated	New data is inserted	Rafiqi	PASS
12.	Delete Achievement	User is required to press the delete button to delete an achievement	Must be an existential achievement	Data will be Deleted from list	Khairul	PASS
13.	Edit user	User is required to press the edit button to update user info, username and password	User must be logged in as Admin	New data is updated	Ikram	PASS

14.	Search	User is required to press the search button to find specific data	User need to choose which data to display User can also key in the keyword Login as Admin	A list of data fetched from the Database	Khairul	PASS
15.	Logout	User is required to logout after a session has ended	Internet connection to database	User will be redirected to login.	Rafiqi	PASS

Table 4 shows the analysis of integration testing that has been done. Based on the analysis, it can be concluded that i-ProMS passed the testing overall.

Table 4: Integration Testing Plan

Integration testing Plan						
O.	st Case Name	Test Procedure	Pre-Condition	xpected Result	Tester	Result (PASS / FAIL)
1.	Login	User is required to fill in the username and password field before access the system.	User need to register or sign up before login	Redirected to Index	Rafiqi	PASS
2.	Register	User is required to fill in username, email, password and confirm password to register	i. Username is either lecturer's ID or students Matrix Number ii. Email validation must have the character "@" iii. Password and confirm password must be the same	Redirected to index.php.	Khairul	PASS
3.	Dashboard	User is required to click the home button	A strong internet connection is required	Redirected to index.php	Khairul	PASS
4.	Submit Proposal	User is required to write the proposal and press Submit	User need to have access as Student	Successful message	Ikram	PASS
5.	Upload Abstract	User is required to press the edit button to add abstract	User need to submit an event and press the edit button	Successful message	Rafiqi	PASS
6.	Upload Report (Part 1)	User need to key in the necessary information of an event to generate a report	Must be logged in as Student	Successful message	Khairul	PASS
7.	Upload Report (Full)	User need to press the report button on Report page to download or print report	Must be logged in as Student	Successful message	Ikram	PASS

8.	Upload Project Source Code	User need to upload file of project source code and try to download it	Must be logged in as Student and Supervisor (for download)	Upload Successful and can download	Rafiqi	PASS
9.	Achievement	User is required to press the "Achievement" button to post about a new achievement	User need to login first as Supervisor	Achievement list updated and showcased on index	Khairul	PASS
10.	Create Achievement	User is required to fill in the achievement form to be display on index	Must include an achievement name and login as Supervisor	Achievement list updated and showcased on index	Ikram	PASS
11.	Edit Achievement	User can update an existed achievement	An existential achievement only can be updated	New data is inserted	Rafiqi	PASS

There are so many advantages of implementing and using this system at Information and Communication Technology Department. The main advantages of the system are students project documentation and all data related to final year student project management will store centralized in database and it became more efficient and effective. It will help users to access it quickly, fast and accurate when needed. Not only it is convenient but also the generate statistic of project ready to print out and send to the head of department. This system will help more a lot project supervisors by providing archiving of project supervise by every semester. the information about achievement, acknowledgement from other parties and any activities involved related to competition also recorded.

However, there are few problems and limitations that occur throughout the development of this project. Not be able to convert it into a mobile application due to time constraint and limitation. Second, the system is fairly new and converting it to a mobile application may take a new approach. Either it needs to be constructed with native android or hybrid. The elements of data security need to be improved and emphasized. The other limitation from this system is use rely heavily on internet connection. It can operate under using offline approach like using MySQL or localhost but it will not operate on mobile devices web browser and no modules related to the scoring system and monitoring of project progress reports.

4.0 CONCLUSION AND RECOMMENDATION

In this 21st century, web base applications play an important role in aiding human in performing the tasks which are very tedious and troublesome. Without the application, tasks would need longer time to be done and it would cost much effort for the human. The system uses verification during the user login to provide appropriate access to the system. Security features like user identification and authentication also used in this system, however system time out, disabling browser cache entries, and disabling options when the user is not qualified to use a certain feature are some of the security features should implement in the future.

The i-ProMS really give many benefits to users to manage final year project efficiently. However, it only can be accessed by PSMZA ICT department including lecturers and students. All the goals and objectives set for development of this project have been achieved. In conclusion, i-ProMS system is very useful to students, project supervisors and students project management unit. It can easily to manage final year project information without wasting time while other side can join it without any hassle.

As for the recommendations in the future it is hoped that this system can be shared with lecturers and students from other departments and make it as PSMZA one stop center related to the management of students final projects. However, there is still some improvements in the future for the additional module to be integrate in the system to be more convenience and attractive. The integrated student's project management system is hoped to perform very well in enhancing the quality of final year project management. The suggestion about the improvements for the system will slowly be implemented in the future for the purpose of upgrading towards better system.

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Smart Flood Notification

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Abstrak

Faktor hujan bermusim, tiada tempat tadahan takungan air dan juga proses perbandaran yang semakin pesat telah mengakibatkan sesetengah kawasan kediaman di Malaysia mengalami masalah banjir dan limpahan air di jalanraya. Dengan ini, satu alat inovasi telah dihasilkan iaitu "SMART FLOOD NOTIFICATION" bertujuan mengenal pasti beberapa objektif antaranya dari segi keberkesanan amaran awal paras air melalui lampu pada alat inovasi, mengukur tahap kedalaman air terutamanya jalan yang dinaiki air, dan masa tindak balas bagi meneruskan perjalanan kenderaan atau membuat pusingan balik bergantung kepada pemberitahuan alat serta membandingkan alat inovasi yang dihasilkan dengan peralatan yang sedia ada. Projek ini dilakukan di kawasan jalan rendah dan juga di bahu jalan raya yang kebarangkalian boleh berlaku limpahan air di atas jalan dengan memfokuskan kepada pengguna jalan raya supaya berhati-hati semasa memandu. Tempat yang dikenal pasti kawasan paras air banjir di kawasan sekitar dungun adalah di Durian Mas, Bukit Besi. Kawasan tersebut kerap dinaiki paras air akibat faktor aras permukaan bumi dan kekerapan berlakunya banjir di kawasan tersebut. Justeru itu, untuk menentukan ketahanan dan kestabilan projek ini, kajian ini akan menguji kedudukan penanda aras semasa ditenggelami air banjir. Tujuan alat ini direka adalah untuk memberi amaran awal kepada pengguna jalanraya berkenderaan yang melalui kawasan tersebut agar lebih berhati-hati dan dapat mencegah daripada berlakunya kemalangan jalanraya. Adalah diharapkan dengan terhasilnya alat ini, ia juga dapat membantu banyak pihak dalam menangani masalah banjir yang kerap berlaku bencana di samping dapat mengurangkan kos membaik pulih infrastruktur dan mengurangkan kos kerugian jika amaran awal dapat disampaikan kepada pengguna jalan raya dan penduduk sekitar.

Kata Kunci: *banjir, hujan, paras air, amaran, bencana, kos.*

1.0 PENGENALAN

Untuk pengenalan projek, kami terlebih dahulu ingin memberikan gambaran projek kami iaitu dengan menceritakan mengenai masalah yang dihadapi oleh negara Malaysia apabila musim tengkujuh atau musim peralihan monsun. Menurut Hamzah, H. (2015) Selain menyelamatkan nyawa, peranti yang dikenali sebagai Sistem Amaran Banjir Automatik Fotonik (Flood-SMS) juga mengurangkan berjuta-juta bernilai Ringgit kerosakan harta terutamanya semasa banjir kilat.Fenomena alam tersebut menyebabkan kadar kenaikan air yang terhasil daripada hujan dan air pasang menyebabkan air banjir kerap berlaku dan berkemungkinan boleh kehilangan nyawa. Dengan ini, sebuah inovasi telah direka cipta bagi membantu dan memudahkan pihak-pihak yang terlibat dalam penggunaan jalan raya. Alat tersebut adalah sebuah alat dan sistem yang telah dinaiktaraf dan dimajukan bagi menangani masalah yang sedia ada. Alat dan sistem tersebut dipanggil sistem amaran banjir dengan menggunakan alat penanda aras ketinggian air banjir. Alat ini dilengkapi dengan sensor atau sebuah peranti pengesan yang mengesan tahap kedalaman air untuk diberikan amaran awal kepada pengguna jalan raya.

Dengan penuh harapan, dengan terhasilnya sistem dan alat ini, dapat membantu banyak pihak dalam menangani masalah banjir yang kerap berlaku bencana ini. Di samping itu juga, dapat mengurangkan kos membaik pulih infrastruktur serta dapat mengurangkan kos kerugian jika amaran awal dapat disampaikan kepada pengguna jalan raya dan penduduk sekitar. Akhir sekali, adalah menjadi harapan kami agar ianya dapat memenuhi kehendak ramai pihak dalam membantu dan meringankan beban akibat bencana banjir yang boleh membahayakan penduduk

dan pengguna jalan raya. Dengan ini, segala aspek inovasi telah diambil kira dalam menangani masalah sedia ada dan telah mendapat sokongan dari pelbagai pihak seperti Jabatan Kerja Raya (JKR) dan Jabatan Pengaliran Saliran (JPS) di sepanjang proses perlaksanaan projek ini.

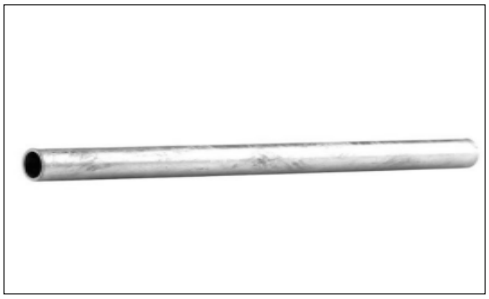
2.0 METODOLOGI

2.1 BAHAN YANG TERLIBAT

Pemilihan bahan yang tepat sangat penting dalam mereka bentuk *Smart Flood Notification* bagi mengelakkan sebarang penyalahgunaan bahan atau komponen yang akan digunakan. Antara komponen atau bahan yang digunakan ialah :

2.1.1 Paip Bergalvani

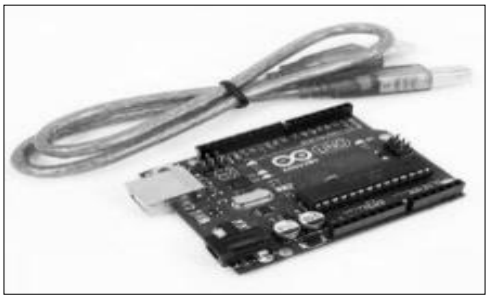
Mempunyai daya ketahanan terhadap air yang tinggi dan dapat menggantikan badan alat yang asal nya kayu kepada paip bergalvani. Reka bentuk ini dicadangkan oleh pihak JKR sendiri kerana ciri-ciri yang tebal, murah, mudah didapati, dan mempunyai daya ketahanan yang tinggi. Jenis yang digunakan juga seperti saiz dan kualiti dapat ditentukan mengikut SOP JKR dalam menentukan saiz yang akan digunakan.

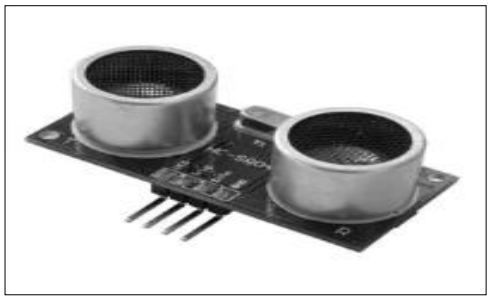


Rajah 1: Paip Bergalvani

2.1.2 Set Arduino Nano dan Ultrasonic Sensor

Bahan ini amat penting kerana digunakan untuk merancang prototype iaitu dipergunakan untuk membaca sensor serta berfungsi untuk mengawal pergerakan mesin dan lampu. Kegunaan arduino dalam alat pengukur air ialah menyambungkan kepada lampu dan sensor supaya dapat berfungsi dengan baik.Bahan ini diletakkan di dalam projek pengukur air. Bagi water sensor pula, sensor ini diletakkan di dalam badan alat pengukur air. Antara fungsi bahan ini adalah untuk mengetahui kedalaman paras air, pemilihan alat ini juga untuk meningkatkan lagi kesedaran kepada pengguna. Pemilihan alat ini berdasarkan keperluan utama dalam projek ini iaitu untuk mengetahui paras air dengan lebih tepat.





Rajah 2: Set Arduino

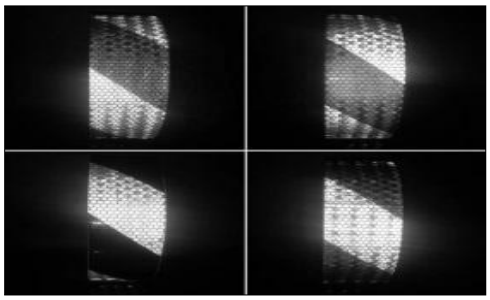
2.1.3 Lampu LED

Lampu kecil ini dikategorikan yang paling berguna pada alat inovasi kerana, dengan adanya diod pemancar cahaya (LED) ini pengguna jalanraya dapat mengetahui amaran awal keadaan jalan itu sama ada boleh dilalui atau tidak boleh. Diod pemancar cahaya ini (LED) diletakkan pada bahagian atas batang penanda aras air, bagi memastikan diod pemancar cahaya ini berfungsi melalui arduino dan sensor tahap air dan fungsi sebenarnya adalah berfungsi menunjukkan kehadiran arus elektrik, tanpa filamen, pelbagai warna yang digunakan seperti hijau untuk meneruskan perjalanan, kuning untuk kenderaan yang tertentu sahaja dan merah menutup laluan bagi semua kenderaan yang terletak pada atas batang penanda aras.

Rajah 3: Lampu LED

2.1.4 Pelekat Pantul Cahaya

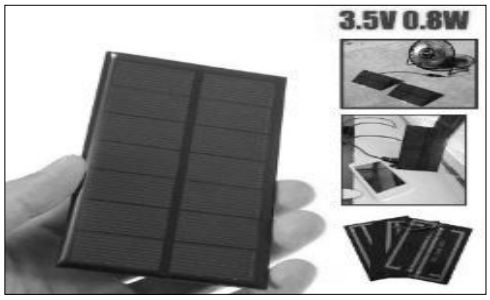
Bahan ini digunakan pada bahagian luar alat pengukur air.Fungsinya ialah memantulkan cahaya yang diperolehi daripada cahaya sekeliling. Pemilihan bahan ini kerana ia dapat menarik perhatian pengguna jalan raya pada waktu malam dan tiada kos penyelenggaraan terhadap bahan ini kerana ianya tahan lasak dan tahan cuaca.



Rajah 4: Pelekat Pantul Cahay

2.1.5 Panel Solar

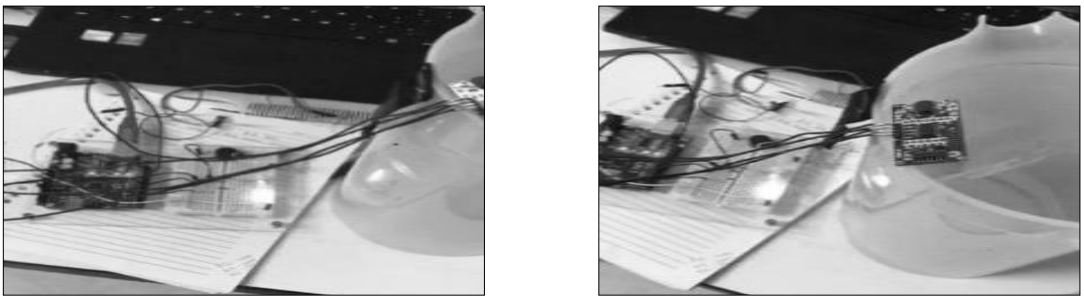
Bahan ini penting untuk menggantikan bateri kerana tenaga bateri mempunyai had keupayaannya berbanding tenaga solar yang boleh dperbaharui setiap masa, Solar ini hanya menggumpulkan kuasa daripada matahari yang mengcukupi bagi mengaktifkan sensor tahap air, arduino dan diod pemancar cahaya (LED) dalam projek ini. Solar ini diletakkan pada bahagian atas belakang batang penanda aras. Menurut Revotech (2019, May 5) Sistem tenaga solar secara umumnya tidak memerlukan banyak penyelenggaraan. Anda hanya perlu memastikannya sentiasa bersih, jadi dengan membersihkannya beberapa kali dalam setahun sudah mencukupi.



Rajah 5: Panel Solar

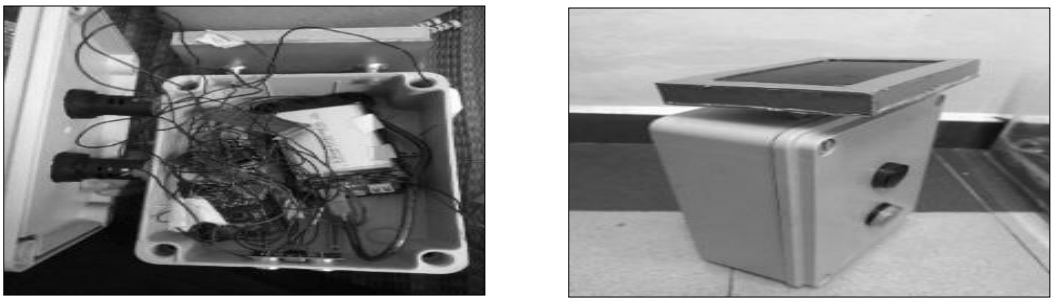
2.2 PEMBUATAN SMART FLOOD NOTIFICATION

2.2.1 Proses Pembuatan Komponen Dalam



Rajah 7: Proses Pengekodan dan Ujian Awal Terhadap Sensor dan Arduino.

2.2.2 Proses Pemasangan



Rajah 8: Proses Pemasangan Komponen Sensor dan Arduino Ke Dalam Kotak Eletrik Berserta Panel Solar Pada Bahagian Atas.

2.2.3 Proses Pemotongan Besi dan Paip Bergalvani

Rajah 9: Proses Memotong Besi Untuk Pemijak Kaki dan Tiang Alat Inovasi

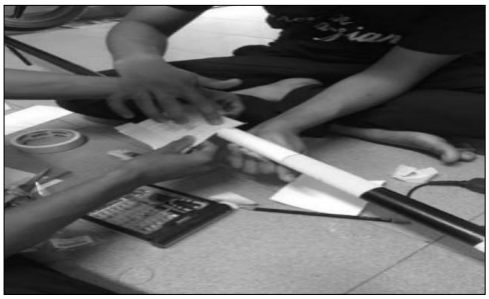
2.2.4 Proses Kimpalan

Rajah 10: Proses Kimpalan Bagi Tapak Untuk Pemijak Kaki Pada Tiang dan Tempat Untuk Meletakkan Kotak Eletrik

2.2.5 Proses Mengecat

Rajah 11: Proses Mengecat Menggunakan Cat Semburan Tin Berwarna Hitam Untuk Mengelakkan Daripada Berkarat

2.2.6 Proses Kemasan Tiang



Rajah 12: Proses Memasang Pelekat Pantul Cahaya Bagi Memudahkan Tiang Tersebut Dilihat Pengguna.

2.2.7 Proses 'Run-Test' Alat Inovasi

Rajah 13: Rekabentuk Inovasi dan Proses *'Run-Test'* Penggunaannya

3.0 KEPUTUSAN DAN PERBINCANGAN

Bahagian ini mengandungi maklumat tentang responden 'Smart Flood Notification" yang meliputi jantina,pekerjaan dan umur. Selepas 30 borang responden diberikan, didapati bilangan responden lelaki adalah 23 orang dan selebihnya 7 orang adalah responden perempuan. Dari segi pekerjaan pula adalah seramai 20 orang dari kalangan pelajar iaitu 15 lelaki dan 5 perempuan manakala untuk orang awam pula didapati bahawa seramai 10 orang responden terdiri daripada 8 lelaki dan 2 perempuan. Di samping itu juga, didapati seramai 14 orang responden(47%) menggunakan kereta dan seramai 16 orang responden(53%) adalah pengguna jalan raya bermotorsikal. Berkaitan dengan umur responden pula,kami mengambil responden yang berumur 18 tahun ke atas dan juga mempunyai kenderaan bermotor seperti kereta dan motorsikal untuk memenuhi objektif kajian iaitu melibatkan pengguna jalan raya.

Antara faktor-faktor utama kajian terhadap pengguna jalan raya adalah melibatakan pengguna jalan raya, bencana banjir yang mengakibatkan kerosakan harta benda pengguna jalan raya dan juga faktor kemalangan jiwa. Oleh itu, kami mengambilkira separuh responden terdiri daripada pelajar dan separuh yang lain adalah responden orang awam bagi mencapai target penyelidik mengenai respon responden yang menjawab borang soal selidik ini.

Objektif utama bagi kajian kami ialah keberkesanan alat inovasi untuk menguji pengguna jalan raya dari segi keterlihatan alat dan masa tindak balas untuk meneruskan perjalanan sama

ada membuat pusingan balik dan ia bergantung kepada pemberitahuan alat. Hasil daripada inovasi yang telah dilakukan terhadap alatan tersebut, terdapat ramai pengguna jalan raya yang sedar atas keberadaan alat inovasi kami pada tempat kajian yang dilakukan. Selain itu, pengguna dapat membuat langkah awal berjaga-jaga untuk meneruskan perjalanan atau pusingan balik. Hal ini akan sedikit-sebanyak dapat membantu para pengguna jalan raya untuk lebih berwaspada pada aras ketinggian air banjir.

Seterusnya, Menguji ketahanan alat inovasi seperti kukuh tiang yang ditanam sedalam 12 inchi pada tempat kajian yang kami jalankan. Setelah ujikaji dibuat, didapati tiang inovasi kami kukuh keberadaannya sedalam 12 inchi itu. Ekoran daripada itu, alat ini telah diletakkan kotak sensor, Arduino serta wayar-wayar yang boleh dipasang-buang bagi mengelakkan daripada berlakunya vandalisme masyarakat dan kecurian harta benda awam. Akhir sekali, mengukur masa tindak balas antara lampu terhadap kenaikan paras air banjir untuk memberi amaran awal kepada pengguna jalan raya.

4.0 KESIMPULAN

Segala maklumat berkaitan alatan sedia ada telah dikumpulkan, dan diambil permasalahannya bagi penambahbaikkan projek inovasi kami. Berdasarkan analisa tersebut, kami dapat beberapa idea untuk menambahbaik alat sedia ada dan akhirnya terciptalah produk inovasi ini iaitu *Smart Flood Notification*. Kami juga telah mendapat beberapa maklumbalas dan cadangan positif daripada responden dan pengguna jalan raya. Pihak JKR yang telah kami hubungi juga ada menyatakan bahawa produk inovasi yang dihasilkan ini amat berpotensi untuk dikomersialkan kerana menurut Revotech. (2019) Tidak hanya untuk alam sekitar tetapi juga bagus jika diambil kira tentang faktor perbelanjaan· Oleh itu, segala penambahbaikan alat dan cadangan positif daripada pihak berkuasa, para responden dan pengguna jalanraya bolehlah digunapakai bagi tujuan pengkomersilan, laporan yang bermutu dan pengumpulan data untuk rujukan ilmiah kepada kajian seterusnya dan para pengkaji produk inovasi yang lain. Tidak hanya untuk alam sekitar tetapi juga bagus jika diambil kira tentang faktor perbelanjaan·

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Kaca Mata Anti Lelap

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Abstrak

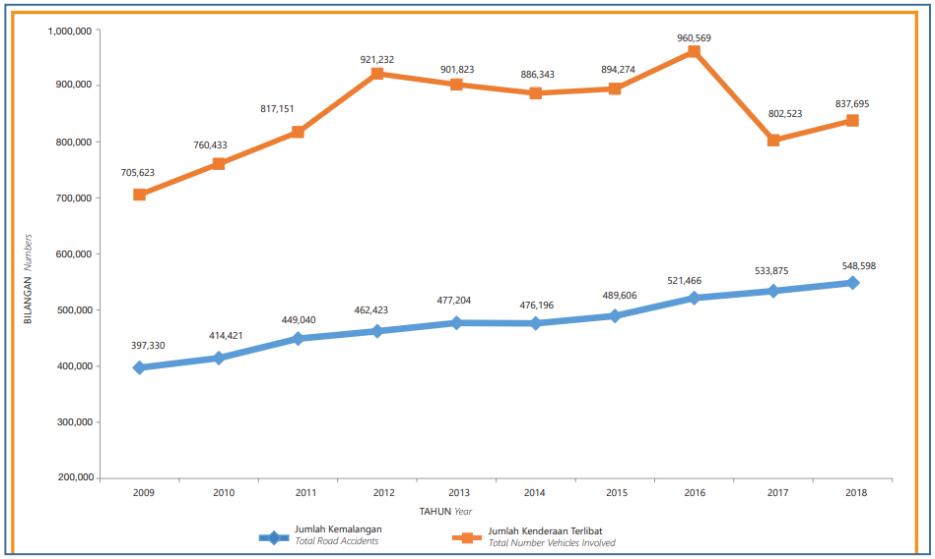
Saban hari media massa kerap melaporkan kes - kes kemalangan jalan raya yang berlaku di Malaysia. Antara faktor berlakunya kemalangan jalan raya adalah disebabkan oleh kelalaian pemandu, pemanduan secara melulu dan juga pemandu yang terlelap seketika (micro sleep). Micro sleep ialah keadaan di mana otak manusia terlelap seketika sedangkan anggota badan lain seperti mata, tangan dan kaki masih aktif. Sehubungan dengan itu, projek 'Kaca Mata Anti Lelap' ini dibangunkan bagi mengatasi masalah pemandu terlelap semasa memandu dan sekaligus mengurangkan kadar kemalangan jalan raya yang kian meningkat saban tahun. Objektif projek ini adalah untuk merekabentuk dan menghasilkan kaca mata yang berupaya mengesan dan mengeluarkan bunyi amaran kecemasan apabila pemakainya menutup kelopak mata. Kaca mata ini dilengkapi dengan sensor pengesan WSS IR Infrared Obstacle Detection Sensor Module FC-51 yang disambungkan kepada Arduino Uno sebagai unit kawalannya. Bekalan kuasanya menggunakan bateri 9 volts ataupun soket bekalan kuasa yang sedia ada terdapat di dalam kereta. Peranti ini beroperasi apabila sensor mengesan kelopak mata pemandu yang tertutup dan menghantar isyarat kepada Arduino Uno. Ia kemudiannya akan membunyikan amaran kecemasan (buzzer) yang bertujuan mengejutkan pemandu. Buzzer akan berhenti berbunyi apabila sensor mengesan pemandu membuka matanya. Berdasarkan pengujian ke atas peranti ini, didapati bahawa tempoh masa yang diambil oleh buzzer untuk berbunyi ialah setelah 1.2 saat kelopak mata tertutup dan berhenti berbunyi setelah pemandu membuka mata. Ini dapat mengelakkan para penggunanya daripada terlelap semasa memandu dan sekaligus dapat menghidari daripada berlakunya kemalangan disebabkan oleh micro sleep.

Kata Kunci: *Kaca mata; anti lelap; micro sleep; lelap seketika; kemalangan jalan raya*

1.0 PENGENALAN

Menurut Kamus Dewan Edisi Keempat (2005), kemalangan dari segi istilahnya ditakrifkan sebagai kecelakaan, kesialan, kerugian dan kesusahan. Manakala, kemalangan jalan raya pula didefinisikan sebagai kejadian atau peristiwa yang mana kecederaan berlaku ke atas seseorang manusia atau haiwan, kerosakan harta benda atau kenderaan dan berlaku di jalan awam dan termasuklah lain – lain strukturnya seperti jambatan, terowong dan jejantas (Akta Pengangkutan Jalan Raya, 1987). Kemalangan jalan raya berlaku disebabkan oleh pelbagai faktor dan boleh dikategorikan kepada jenis kenderaan yang terlibat dan tahap kecederaan mangsa samada kemalangan maut, kemalangan yang menyebabkan kecederaan parah mahupun kecederaan ringan.

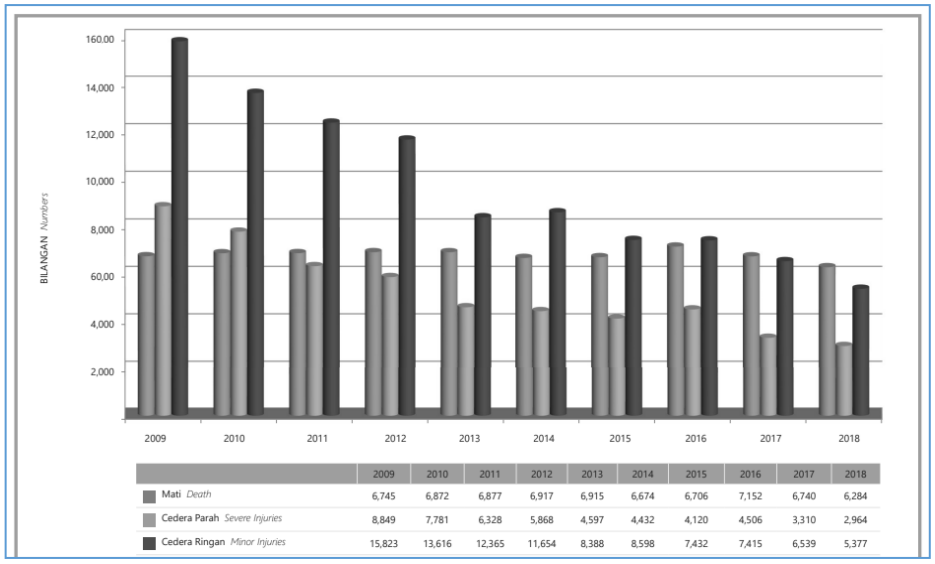
Malaysia merupakan antara negara yang mengalami kadar kemalangan dan kematian yang tinggi di dunia. Berdasarkan kajian yang telah dijalankan oleh Institut Penyelidikan Keselamatan Jalan Raya Malaysia (MIROS) di antara tahun 2000 hingga 2014, jumlah kemalangan jalan raya di Malaysia menunjukkan peningkatan yang ketara iaitu dari 250,429 kes setahun kepada 476,196 kes setahun (Statistik Pengangkutan Malaysia, 2019).



Rajah 1: Carta jumlah kemalangan jalan raya dan kenderaan terlibat dari tahun 2009 – 2018

(Sumber : Statistik Pengangkutan Malaysia, 2019)

Berdasarkan laporan Jabatan Siasatan dan Penguatkuasaan Trafik Bukit Aman, kadar kemalangan yang membabitkan kematian, cedera parah dan kecederaan ringan menunjukkan peningkatan bermula tahun 2009 sehingga 2018. Laporan daripada Statistik Pengangkutan Malaysia (2018) memperincikan bahawa jumlah kes kemalangan pada tahun 2009 dicatatkan sebanyak 397,330 dan jumlah ini meningkat kepada 548,598 kes pada tahun 2018. Begitu juga dengan dengan kes kematian semasa kemalangan jalan raya iaitu melebihi 6000 orang setiap tahun dengan puratanya sebanyak 6788 setahun (Naim et al, 2020)



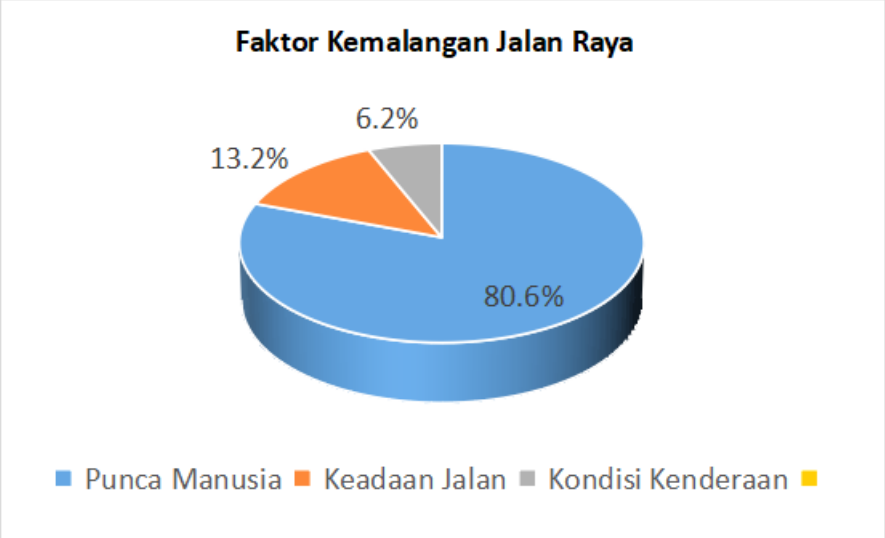
Rajah 2: Carta kecederaan dan kematian disebabkan oleh kemalangan jalan raya dari tahun 2009 – 2018

(Sumber : Statistik Pengangkutan Malaysia, 2019).

Bagi mengurangkan dan menangani kadar kemalangan jalan raya di Malaysia, Polis Diraja Malaysia (PDRM) telah melaksanakan pelbagai tindakan dan langkah pencegahan seperti Ops Sikap, Ops Selamat dan Ops Bersepadu bagi memantau keselamatan pengguna jalan raya. Selain daripada itu, kempen – kempen kesedaran juga telah dilaksanakan bagi memberi kesedaran para pengguna jalan raya berkenaan isu keselamatan jalan raya iaitu melalui Kempen Xsikap, Kempen Sifar Kemalangan dan Kempen Advokasi Keselamatan Lebuh Raya. Namun demikian, kadar kemalangan, kecederaan dan kematian terus meningkat saban tahun dan situasi ini amat membimbangkan dan memerlukan tindakan susulan untuk menanganinya.

1.1 Penyataan Masalah

Terdapat pelbagai faktor yang menyebabkan berlakunya kemalangan jalan raya. Kajian oleh pihak MIROS menunjukkan bahawa faktor – faktor yang menyebabkan berlakunya kemalangan jalan raya di Malaysia adalah 80.6% daripada sikap atau tabiat pemanduan manusia , 13.2% berpunca daripada kondisi jalan raya manakala hanya 6.2% disebabkan oleh kondisi kenderaan. Antara faktor yang disebabkan oleh sikap manusia atau pemandu kenderaan ialah kelalaian pemandu, pemanduan secara melulu dan juga pemandu yang terlelap seketika (*micro sleep*).



Rajah 3 Faktor kemalangan jalan raya

Micro sleep ialah keadaan di mana otak manusia terlelap seketika sedangkan anggota badan lain seperti tangan,kaki dan masa masih lagi aktif. Situasi tidur seketika ini terjadi dalam tempoh yang singkat tetapi boleh mengundang bahaya dan kemalangan sekiranya ianya berlaku semasa invididu terbabit sedang mengendalikan kenderaan atau jentera (Halina, 2019). Menurut Pakar Perunding Psikiatri Hospital Cancelor Tuanku Mukriz, Pusat Perubatan Universiti Kebangsaan Malaysia (UKM), Prof Madya Dr Azlin Baharudin berkata secara saintifiknya gejala *micro sleep* berlaku apabila bahagian otak yang berfungsi untuk mengatur tidur iaitu bahagian otak thalamus mengalami penurunan aktiviti. Keadaan ini seolah – olah otak dipaksa untuk tidur. Sedangkan pada masa yang sama, fungsi

bahagian otak yang lain seperti pengawalan anggota badan masih lagi aktif. (Afzan,2018).

Rajah 4: Keratan akhbar kemalangan jalan raya yang disebabkan oleh *micro sleep*

Antara faktor yang menyebabkan berlakunya *micro sleep* adalah tempoh pemanduan kenderaan, waktu pemanduan, cuaca, keadaan kesihatan dan kecergasan pemandu serta bentuk dan permukaan jalan raya. Semua faktor ini boleh menyebabkan pemandu menjadi mengantuk dan pada keadaan ini segala maklumat yang diterima daripada deria penglihatan dan pendengaran sudah tidak dapat diproses otak. Pemandu akan menjadi kaku dan lambat bertindak balas terhadap sebarang maklumat dan akhirnya terjebak di dalam kemalangan jalan raya.

1.2 Objektif

Objektif projek ini adalah bagi :

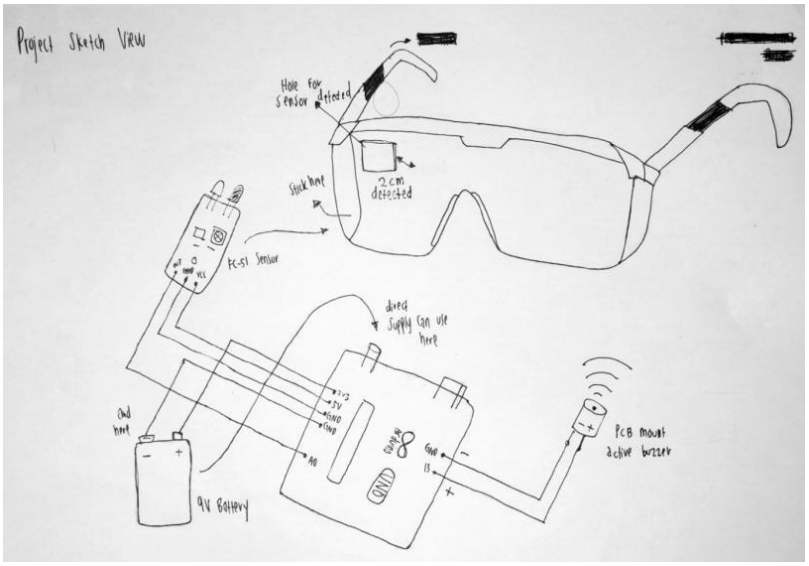
1.2.1 Merekabentuk dan menghasilkan kaca mata yang berupaya mengesan pemakainya menutup kelopak mata dan mengeluarkan bunyi amaran kecemasan

1.2.2 Mengatasi masalah pemandu terlelap semasa memandu

2.0 METODOLOGI

2.1 Rekabentuk Projek

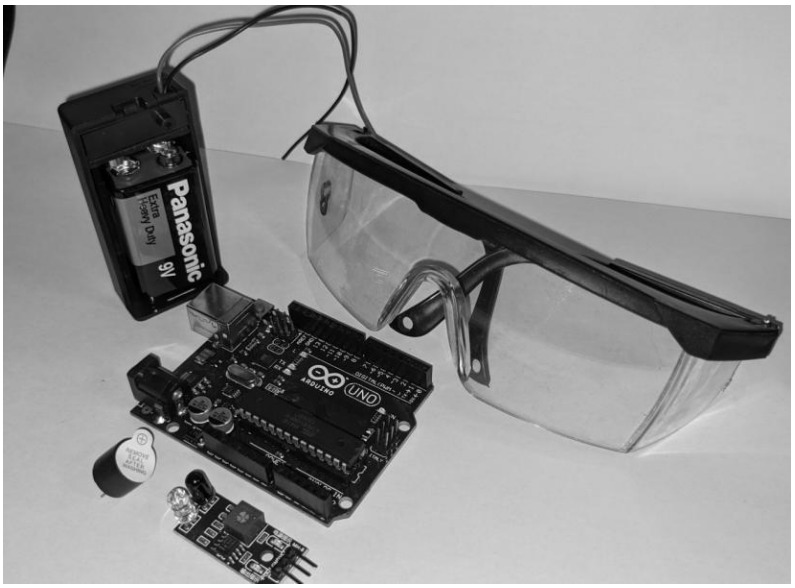
Peranti ini beroperasi apabila sensor mengesan kelopak mata pemandu yang tertutup dan menghantar isyarat kepada Arduino Uno. Ia kemudiannya akan membunyikan amaran kecemasan (*buzzer*) yang bertujuan mengejutkan pemandu. *Buzzer* akan berhenti berbunyi apabila sensor mengesan pemandu membuka matanya.



Rajah 5: Lakaran rupabentuk projek

Komponen yang digunakan di dalam membangunkan projek ini adalah sebagaimana berikut :

- WSS Modul Sensor pengesan halangan FC-51
- Arduino Uno Rev3 ATMEGA328 ATMEGA16U2
- Penggera (Buzzer)
- Bateri 9v
- Kaca mata



Rajah 6: Komponen utama iaitu Arduino Uno, Sensor pengesan halangan, buzzer, bateri dan kaca mata

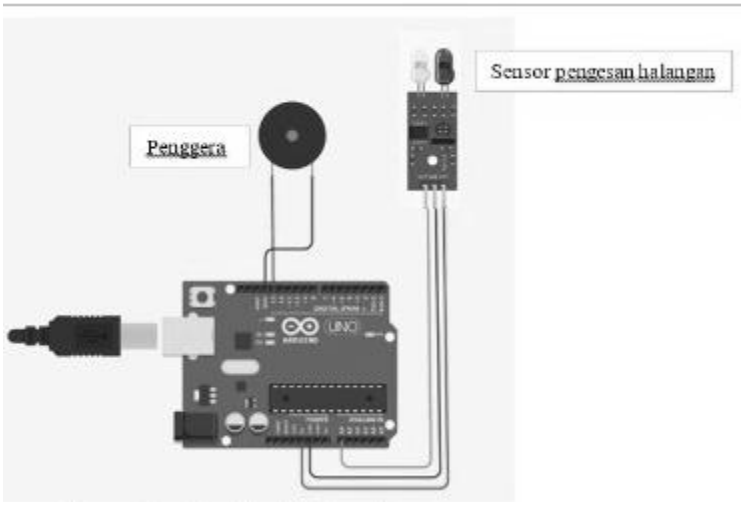
2.2 Kos Projek

Jadual 1: Kos projek

No.	Komponen	Kuantiti	Nilai (RM)	Jumlah (RM)
1.	ARDUINO UNO REV3 ATMEGA328	1	24.49	24.49
2.	OBSTACLE DETECTION SENSOR MODULE FC-51	2	4.50	9.00
3.	PCB MOUNT ACTIVE BUZZER 4V-7V DC 12MM	2	0.60	1.20
4.	BREADBOARD JUMPER	3	0.75	2.25
5.	SAFETY GOOGLE	2	2.30	4.60
6.	9V BATTERY	2	4.50	9.00
JUMLAH KESELURUHAN				RM 50.54

2.3 Pembangunan Projek

Proses pembangunan projek dimulakan dengan membuat penyambungan di antara kesemua komponen utama iaitu Arduino Uno sebagai unit pengawalnya, sensor pengesan halangan (IR Obstacle Detection Sensor) sebagai input yang berfungsi mengesan kelopak mata tertutup dan juga penggera (buzzer) sebagai output yang akan menghasilkan bunyi tanda amaran kecemasan. Penyambungan litar projek adalah sebagaimana Rajah 7. Setelah penyambungan dijalankan, papan Arduino Uno akan disambungkan kepada komputer dengan menggunakan kabel USB. Ini adalah memuatnaik kod program yang telah dihasilkan bagi memberi arahan operasi bagi projek .



Rajah 7: Litar skematik projek dan sambungannya

2.4 Perisian Projek

Kod program bagi papan Arduino Uno boleh dimuatnaik dengan menggunakan perisian Arduino IDE (Integrated Development Environment). Kod program yang dimuatnaik adalah sebagaimana di bawah:

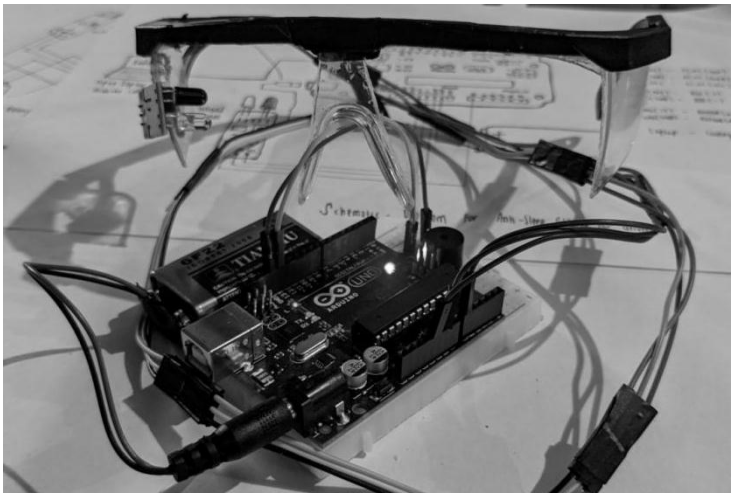
```
#define SENSE A0

void setup()
{
pinMode(SENSE, INPUT);
pinMode(LED_BUILTIN, OUTPUT);
}

void loop()
{
if(digitalRead(SENSE))
   {
   digitalWrite(LED_BUILTIN, LOW);
   }
else
   {
   delay (1200);
   if(digitalRead(SENSE))
      {
      digitalWrite(LED_BUILTIN, LOW);
      }
    else
    digitalWrite(LED_BUILTIN, HIGH);
    }
}
```

2.5 Hasil Binaan Projek

Litar Arduino Uno yang telah dimuatnaik kod program diuji pengoperasiannya. Setelah ianya berfungsi sebagaimana yang diprogramkan, sumber bekalan kuasa yang diperolehi melalui kabel USB tidak diperlukan lagi dan digantikan dengan bateri 9v agar projek ini lebih mudah untuk digunakan. Sensor pengesan halangan kemudiannya dipasang dan dilaraskan pada kaca mata agar ia dapat mengesan pergerakan kelopak mata dengan baik. Hasil akhir projek yang dibangunkan adalah sebagaimana Rajah 8 di bawah.



Rajah 8: Projek yang telah siap dibina

Secara ringkasnya, hasil projek ini terdiri daripada kaca mata ini dilengkapi dengan sensor pengesan WSS IR Infrared Obstacle Detection Sensor Module FC-51 yang disambungkan kepada Arduino Uno sebagai unit kawalannya. Bekalan kuasanya menggunakan bateri 9 volts ataupun soket bekalan kuasa yang sedia ada terdapat di dalam kereta. Peranti ini beroperasi apabila sensor mengesan kelopak mata pemandu yang tertutup dan menghantar isyarat kepada Arduino Uno. Ia

kemudiannya akan membunyikan amaran kecemasan (buzzer) yang bertujuan mengejutkan pemandu. Buzzer akan berhenti berbunyi apabila sensor mengesan pemandu membuka matanya.

Rajah 9: Cara penggunaan Kaca Mata Anti Lelap semasa pemanduan

3.0 DAPATAN DAN ANALISA\

3.1 Pendahuluan

Produk yang telah siap dibina telah diuji bagi melihat keberfungsiannya dan juga kecekapannya. Ujilari peranti ini telah menunjukkan bahawa ia telah berfungsi sebagaimana yang dirancang. Data bagi masa yang diambil oleh siren (buzzer) untuk mula berbunyi selepas kelopak mata ditutup dan masa siren berhenti telah direkodkan sebagaimana Jadual 2 di bawah.

Jadual 2: Data pengujian projek

	TEMPOH 1	TEMPOH 2	TEMPOH 3	PURATA MASA
Tempoh masa diambil oleh buzzer untuk mula berbunyi	1.2 saat	1.2 saat	1.2 saat	1.2 saat
Tempoh masa diambil oleh buzzer untuk berhenti berbunyi	0 saat	0 saat	0 saat	0 saat

3.2 Dapatan dan Analisa

Berdasarkan pengujian ke atas peranti ini, didapati bahawa tempoh masa yang diambil oleh siren (*buzzer)* untuk berbunyi ialah setelah 1.2 saat kelopak mata tertutup. Masa ini adalah tepat sebagaimana yang telah ditetapkan di dalam kod yang telah dimuatnaik ke dalam mikro-pengawal Arduino Uno. Manakala, tempoh siren berhenti berbunyi adalah sejurus selepas pemandu membuka mata, tanpa ada masa

tundaan (delay). Ini jelas menunjukkan bahawa projek ini telah berjaya dihasilkan dan berfungsi dengan baik.

Dari segi memenuhi objektif pembangunan projek ini, jelaslah bahawa peranti yang dihasilkan ini telah berupaya mengesan pemakainya menutup kelopak mata dan ia mengeluarkan bunyi siren (buzzer) yang kuat sebagai tanda amaran kecemasan. Ini akan dapat mengatasi kemungkinan pemandu terlelap atau mengalami *micro sleep* semasa memandu kenderaan. Pada masa yang sama, diharapkan agar ini akan dapat mencegah daripada berlakunya kemalangan jalan raya.

Dari segi praktikalnya pula, peranti ini dibangunkan dengan berdasarkan penelitian ke atas kelemahan produk sedia ada di pasaran yang kebanyakannya beroperasi apabila sensor mengesan pemandu tersengguk akibat tertidur. Sedangkan kemalangan jalan raya berlaku di peringkat lebih awal iaitu semasa pemandu mengalami micro sleep. Oleh itu, produk yang dibangunkan dalam projek ini lebih praktikal dan berkesan kerana ianya mengesan penutupan kelopak mata. Dengan sedikit penambahbaikan dari segi kosmetik, produk ini berpotensi untuk diketengahkan dan dipasarkan sebagai satu peranti keselamatan semasa pemanduan kenderaan.

4.0 KESIMPULAN DAN CADANGAN

4.1 Kesimpulan

Secara kesimpulannya, Kaca Mata Anti Lelap ini telah berjaya dibangunkan dan telah diuji keberkesannya di dalam mengelakkan para penggunanya daripada terlelap semasa memandu dan sekaligus dapat menghidari daripada berlakunya kemalangan disebabkan oleh *micro sleep.*

4.2 Cadangan Kajian Lanjutan

Sebagai cadangan bagi kajian lanjutan projek ini, beberapa kelemahan dan isu telah dikenalpasti bagi tujuan penambahbaikan iaitu :

4.2.1 Tetapan (setting) Sensor Pengesan Halangan (IR Obstable Sensor) pada kaca mata perlu dilakukan dengan cermat kerana sekiranya tidak, ia tidak akan dapat berfungsi dengan baik

4.2.1 Sambungan antara Sensor Pengesan Halangan (IR Obstable Sensor) dengan mikro-pengawal Arduino Uno seharusnya secara tanpa wayar (wireless) agar pengguna tidak merasa terikat atau tidak selesa dengan adanya kabel di belakang kepala mereka

5.2.3 Sekiranya ingin dikomersilkan, rupabentuk kosmetik peranti ini perlu ditambahbaik. Antaranya Sensor Pengesan Halangan (IR Obstable Sensor) seharusnya dipasang (built-in) di dalam kaca mata dan mikro-pengawal Arduino Uno dimasukkan di dalam kotak (casing) yang menarik.

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Scale Rice Dispenser

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Abstract
Scale Rice Dispenser is designed as an innovation to make it easier for consumers to measure rice more effectively. With the use of this dispenser, the user only needs to press the switch according to the desired quantity of rice and then the rice will be dispensed from the rice storage into the container provided according to the set quantity. Based on the products available in the market, there are already have similar rice containers but consumers still have to operate them manually and it is possible that the measurement is inaccurate. It is expected that this Scale Rice Dispenser can provide benefits and facilitate consumers such as housewives and food premise operators.

Key Words: *Scale, dispenser, measure, container, selector, accurate.*

1.0 INTRODUCTION

This project is aimed to all levels of society, especially housewives and restaurant operators. Users no longer have to measure rice manually by using this automatic system. It will be easier for users by pressing the scale selector switch according to the desired quantity accurately. The prescribed quantity scales are quarter (1/4), half (1/2) and full (1) standard rice pots. The project is operated by a forward and reverse motor circuit that will open and close the dispenser automatically according to a set time period based on the quantity of rice that has been set on the gauge switch (Manoj, Bibhuti, Deepak & Aieshwarya, 2017). The circuit operation is controlled in Arduino. Therefore, the users do not need to open the lid of the container regularly to take the rice. In addition to avoid wastage from consuming rice without proper dosage, the condition of rice is also better preserved in storage without having to open the storage lid regularly.

2.0 METHODOLOGY

Figure 1 shows flowchart of the process Scale Rice Dispenser. To use this Scale Rice Dispenser, the users have to press the selector switch to select the quantity of rice needed either ¼, ½ or 1 pot rice according to rice standard pot. The relay then closed the circuit to operate the motor that will open and close the dispenser according to a set time period in Arduino (Judy, 2019). In addition, an LCD is attached in to display the quantity of rice based on the selector switch pressed.

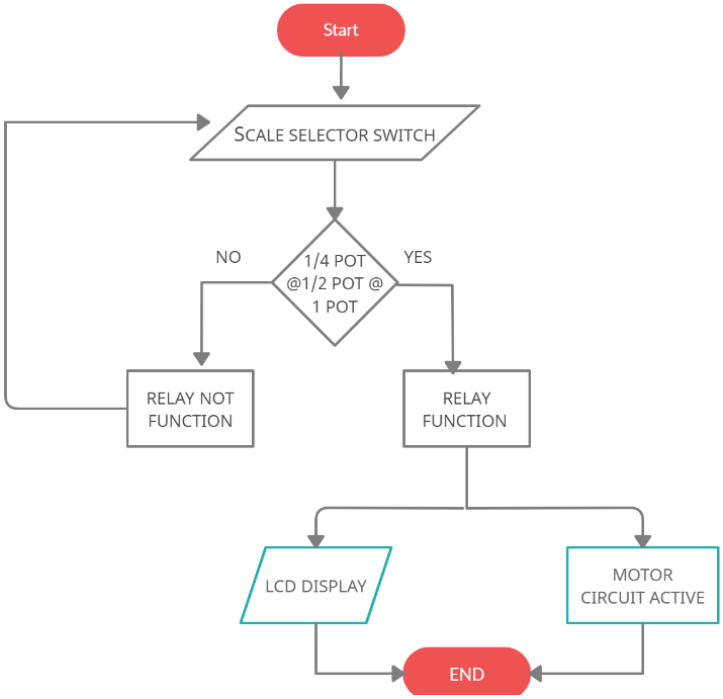

Figure 1: Flowchart of the process Scale Rice Dispenser

3.1 RESULT AND DISCUSSION

Figure 2 shows the prototype of Scale Rice Dispenser. It consists of a rice storage, rice container at the bottom of the storage, an LCD and selector switches are attached beside the storage. The users have to select any labelled switch at a time and the quantity of rice will be displayed on LCD. Then, the circuit will function which the motor will operate to open the dispenser to allow the rice dispense into the container within the time set at the gauge switch based on the quantity selected and then the dispenser is closed back immediately.

Figure 2: Scale Rice Dispenser prototype

4.0 CONCLUSIONS

In conclusion, the objective of this project has been achieved that it can facilitate consumers to manage the consumption of rice effectively. In addition, it can keep the rice clean from being contaminated due to opening the lid of the rice container regularly.

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Advanced Line Follower Robot

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Abstract

Petrosains RBTX Challenge is a platform for all robotics enthusiasts compete and battle. Robo Tracer as one of RBTX category requires robots to move on the provided track and complete various challenges in the fastest time. In this case, contestant usually buy a robot from local store. However, there are only few robot options available in local store. Most of the robot in RBTX are ready made robots such as Tuah and Kilat which is usually slow in speed. Most of this robot have to slow down the speed when passing curve line for avoiding missing line tracking. This project was intended to develop a robot that can follow line accurately and complete the track at fastest time to win RBTX challenge. Advanced Line Follower Robot was design in three variants with three difference controllers which is ESP32, STM32F103 and STM32F401. These robots used 16 channel line sensor for enhancing the accuracy of line detection so that any adjustment of speed can be implemented instantly by utilizing Proportional Derivative (PD) controller algorithm. The use of EDF Duct Fan is for the purpose of increasing the down force of the robot to immediately slowdown the robot so that robot continuously detecting and following the line without miss or off tracking. Based on experimental result, it has been proved that all robots manage to complete the track within 45s. As a conclusion, all objectives of this project are successfully achieved as all robots capable to finish RBTX track within 60s.

Key Words: *Line Follower Robot; Line Tracer; ESP32; STM32; Arduino; Proteus*

1.0 INTRODUCTION

Nowadays, robotic machines are increasingly evolved on the market and spread to all corners of the world. A large number of them are used in agriculture, marketing, industry, hospitality and others. Robots are found everywhere which is in factories, homes and hospitals, and even in outer space. In Malaysia, robotic technology begins to develop especially in Malaysian community which consist of school students, university students and researcher. Several competitions have been organized to boost up robotics technology among youngsters and teenagers. Petrosains RBTX Challenge is one of the competitions that being organized annually start from 2018 (Petrosains, 2018; Petrosains, 2019). This competition is an event where all robotics enthusiasts gather to compete and battle out their robotic creations in an open-source software environment. It is also a program that provides a common platform for all walks of life to learn, explore and share their interest and knowledge in robotics. This program is aimed to raise awareness and educate the public on the rapidly evolving digital era driven by the convergence of advanced technologies and inspire the masses to embrace the Fourth Industrial Revolution. This competition is also hoped to provide the younger generation with the relevant Science, Technology, Engineering and Mathematic (STEM) digital building skills such as coding and embedded programming. There are several categories in this competition which are Robo Sumo, Robo Tracer and Innovation. Robo Tracer category required contestant to build a line follower robot that can follow and finish the competition track at lowest time rates without having any problems like missing the track or break down. This category become the subject matter that has been studied in order to build fastest robot that can win the Petrosains RBTX Challenge competition.

There are several problems that often faced by line follower robot that join the Petrosains RBTX Challenge. All these problems are aimed to be solved by implementing this project. Firstly, there are shortage numbers of line follower robot in Malaysia that had been designed to compete in the competition. This problem occurred as no teachers in schools who are skilled in robotics that capable to design their own line follower robot. Most of teachers in schools are not exposed to the world of robotics. As the result, most of contestants in robotic competitions use ready-made robots in local market such as Tuah Bot and Kilat Bot (RSTechnology, 2019; Thinkerspace, 2021).

Moreover, the existing robots in local store are unsuitable to compete in Robo Tracer Open category. Robot like Tuah Bot and Kilat Bot unable to run at its highest speed as the robot might step up and get off track easily. Line sensors on both robots cannot sense the line quickly when robots running too fast. As the result, the speed of these robots needs to be reduced to make it follow the line consistently. The chance of winning the competition is decreased with this lower speed behavior (RSTechnology, 2019; Thinkerspace, 2021).

In addition, existing line follower robots in the market were unable to change their program quickly during the competition as there were no application had been provided in the smart phone to facilitate the process of changing the program. Most of these robots can only be program using computer. This limitation become an advantage to the contestant as the quick change of robot program cannot be done quickly to adapt the errors during competition.

Apart from all those problems, Advanced Line Follower Robot was proposed to be designed and fabricated to enhance the capability and performance of line follower robot in winning the Robo Tracer Open Category, Petrrosains RBTX Challenge Competition. In order to obtain the best result, three variants of line follower robot were designed and fabricated so that all the factors that affected the performance of this robot can be concluded at the end of this paper.

2.0 METHODOLOGY

There are few scopes that need to be listed in designing and developing Advanced Line Follower robot which are:

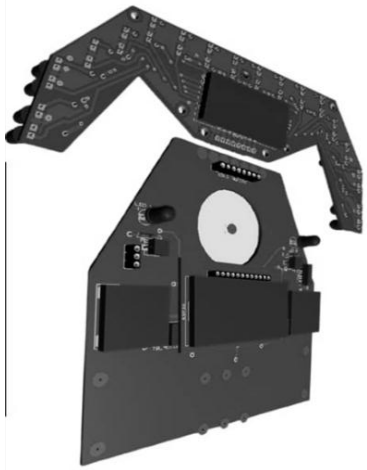
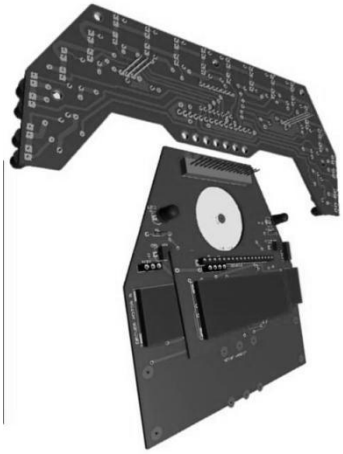
a) Able to detect line path on the floor using intelligent programming.
b) Use three different controller which are ESP32, STM32F401 and BLUEPILLS.
c) Use 14 channel and 16 channel sensors to detect the line to follow.
d) The robot is design to meet in competition Petrosains RBTX open category rules and regulations.
e) Use Arduino IDE to program the main controller
f) Can be controlled from far distance using smartphone application with Bluetooth.
g) Uses jet propeller as fan that function to help the robot slow down the speed.
h) Portability use on floor that have line only.
i) The robot must be controlled autonomously with no human aid.
j) The robot powered by a power source such as a battery fixed on to the robot.
k) Robot specifications: Width – 150mm max, Length – 150mm max, Height – no limit

At this section, several designs will be explained in detail which include mechanical design, electronics design, and programming design. All these designs are the most important elements that will determine the success of this project.

2.1 Mechanical Design

Table 1 below shows three complete robot designs for each robot variants. All three variants robot consist of three different Printed Circuit Board (PCB) boards which are mainboard, controller board and line sensor board. These three boards were combined together using screw and nut to produce a complete body of the robot. As the weight of the robot become one of the factors that determine the speed of the robot, the use of PCB as robot body was a good idea that has been implemented. On the mainboard, there are four holes that are used to mount the two high speed DC motors. There is also a place to attach 2S lithium polymer battery in between of these motors that being tied using two pieces of cable tied. The line sensor board is placed in front of the robot to make it sense the track easily before the action of the robot being determined by the robot controller. The controller board that acts as a brain of the robot is stacked on the mainboard to make it compact and fulfill the maximum dimension of the robot that being specify in rules and regulations.

Table 1: Mechanical design of three robot variants

Advanced Line Follower Robot (STM32F103)	Advanced Line Follower Robot (ESP32)	Advanced Line Follower Robot (STM32F401)
		

2.2 Electronics Design

There are three circuits that had been designed and fabricated for this project which are mainboard circuit, controller circuit and line sensor circuit. All these circuits were designed using Proteus software. Mainboard circuit is used for placing main component such as motor driver, boost converter, buck converter, power switch, push buttons and line sensor connector. This mainboard acts as medium for interfacing sensor controller circuit with the line sensor circuit and motor controlling. All these components were arranged in symmetry form so that the balancing of the robot can be achieved. Figure 1 below shows the circuit and PCB design of mainboard circuit.

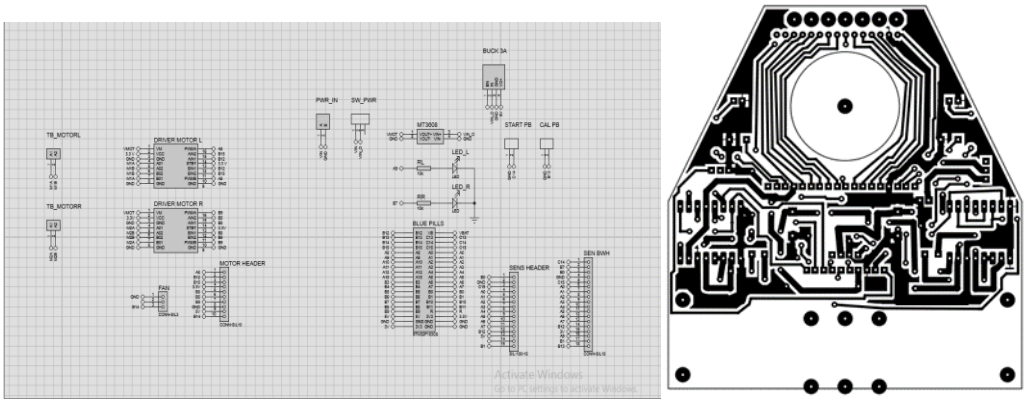


Figure 1: Mainboard

Meanwhile, controller board is used to locate the main controller of this robot. It is stacked on the mainboard to make it compact and light weight. There are three controller boards that had been designed and fabricated to accommodate three different controllers that had been used in this project. Figure 2 below shows the circuit and PCB design of the controller board.

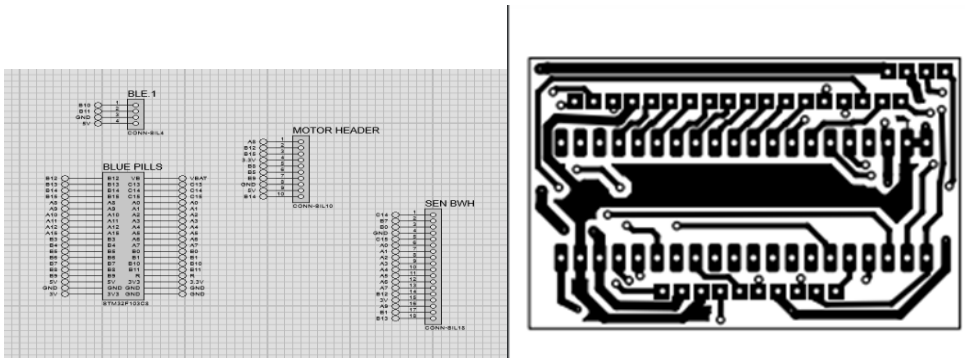


Figure 2: Controller board

Lastly, line sensor board is designed and fabricated to locate the sixteen arrays of super bright 3mm LED and 3mm photodiode. This combination of LED and photodiode is used to detect the competition track which is black line on the white background. Eight arrays of LED and photodiode were arranged in straight line to follow the track while the other 8 LED and photodiode were placed in both wings to make it detect sharp curves and junctions. Figure 3 below shows the circuit and PCB design of the line sensor board.

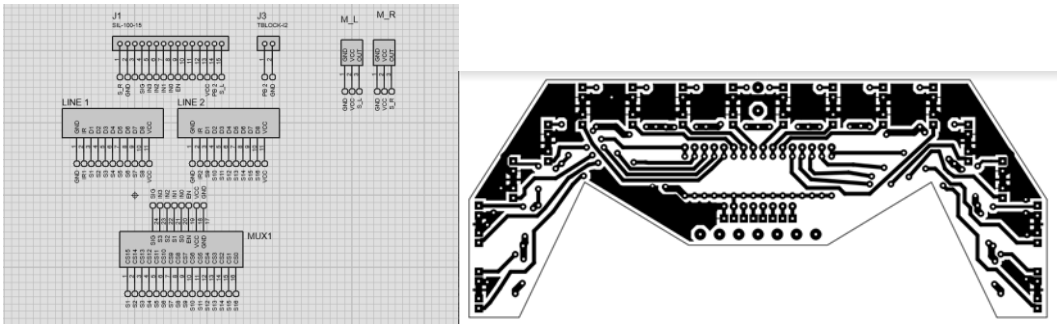


Figure 3: Line sensor board

2.3 Programming Design

In order to instruct the robot for following the track accurately, a Arduino based program had been designed based on the flowchart shows in Figure 4. At the beginning, the program waits for the user to push Cal button or Start button. If the Cal button is pressed, the program will enter calibration routines that allows the robot to read the maximum and the minimum value of line sensor reading before calculating the limit value for differentiating between black and white line. Program will exit the calibration routines as soon as Cal button is pressed again for the second time. If the Start button is pressed, robot will wait for 5 seconds before start reading the routes that have been set by the user via smartphone apps. Robot will determine the mode of the routes either Timer mode or Auto Mode. If the Timer mode is set by the user, robot will follow the line based on timer and stop immediately after the timer reach set time. Meanwhile, if the Auto mode is selected by the user, robot will trace the line until some of its sensors detect junctions or sharp curve which usually using the sensors located at both wings of the line sensors. This program will be repeated as long as the robot is turned on.

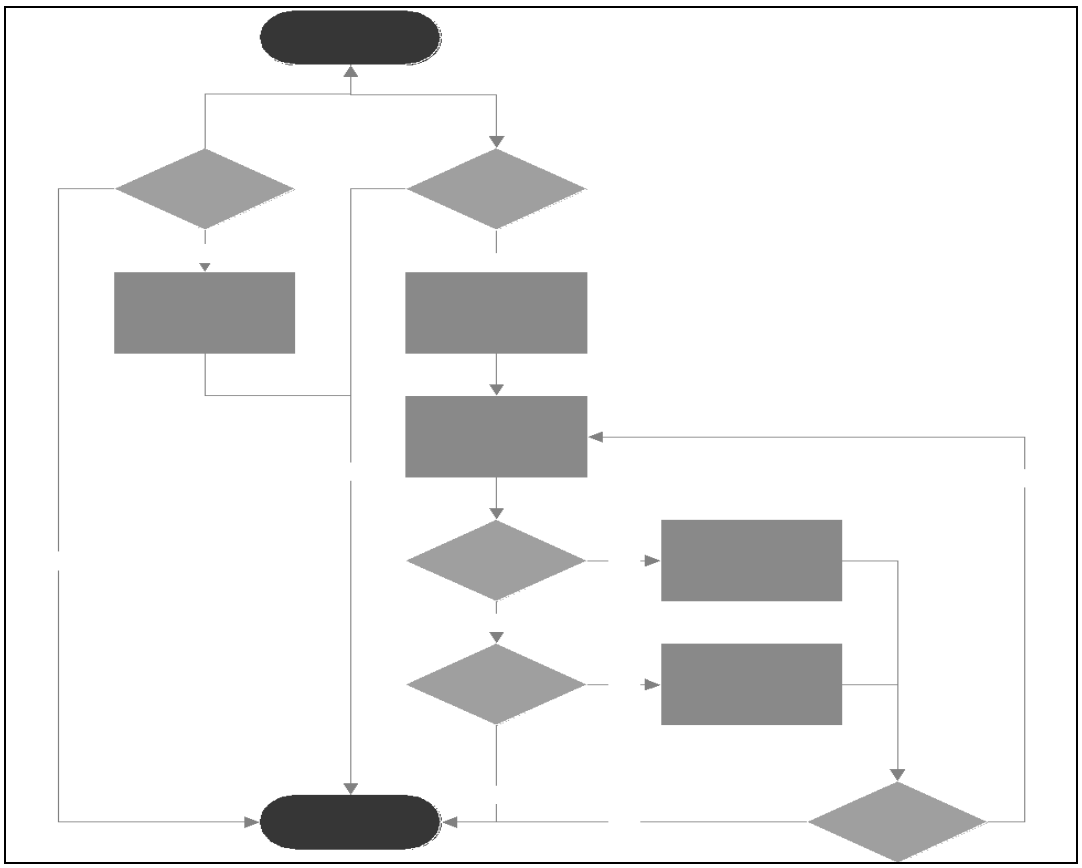


Figure 4: Programming flowchart

3.0 RESULTS AND DISCUSSION

Figure 5, 6 and 7 below shows the result of experiments that had been conducted to analyse the time taken for three variants of robot that utilized three different controllers in following the track until the finish line. There were five successful trials had been recorded for each robot to analyse the performance and consistency of each robot. Figure 5 shows the result of Advanced Line Follower Robot for ESP32 variants. Based on the time recorded, this robot managed to complete the competition track within 60s with 42s of fastest time after five consecutives trials.

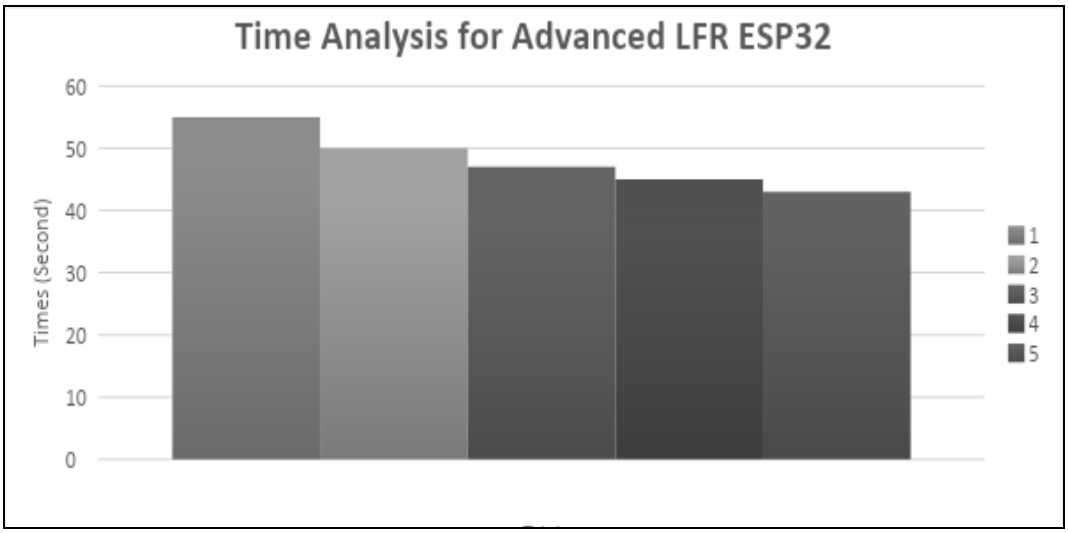


Figure 5: Time analysis for ESP32 controller

Meanwhile, result recorded for Advanced Line Follower Robot STM32F401 as shown on Figure 6 shows a slight improvement in all five trials compared with the previous one. This robot managed to record 45s as its best time to finish the competition track.

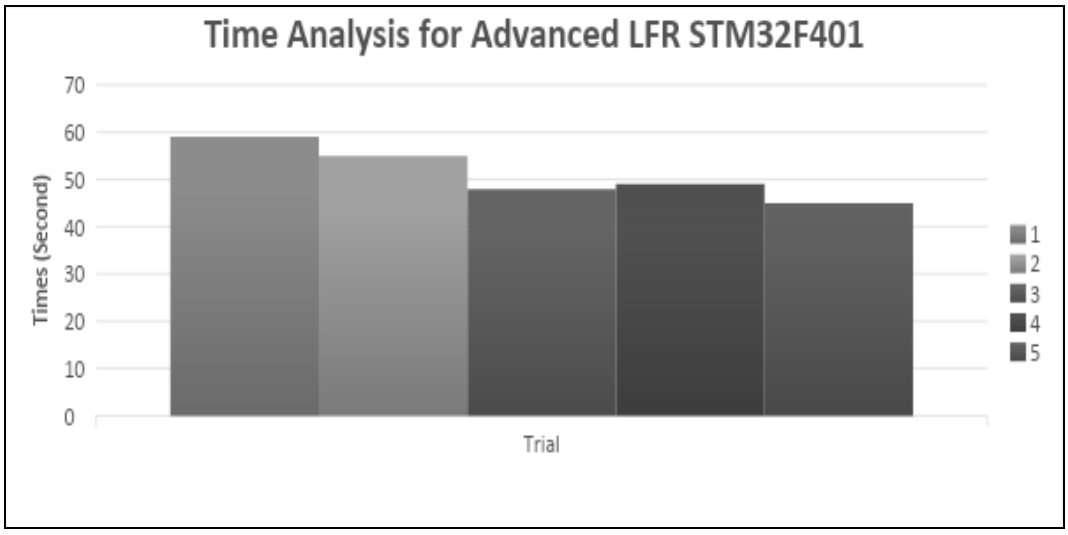


Figure 6: Time analysis for STM32F401 controlle

Finally, Advanced Line Follower Robot for STM32F102 variants had recorded the fastest time among the others. Figure 7 shows that this robot successfully reach the finish line as fast as 41s during its fifth trial. The time different among these three variants of robot can be study to identify the factors that affected the performance of Advanced Line Follower Robot.

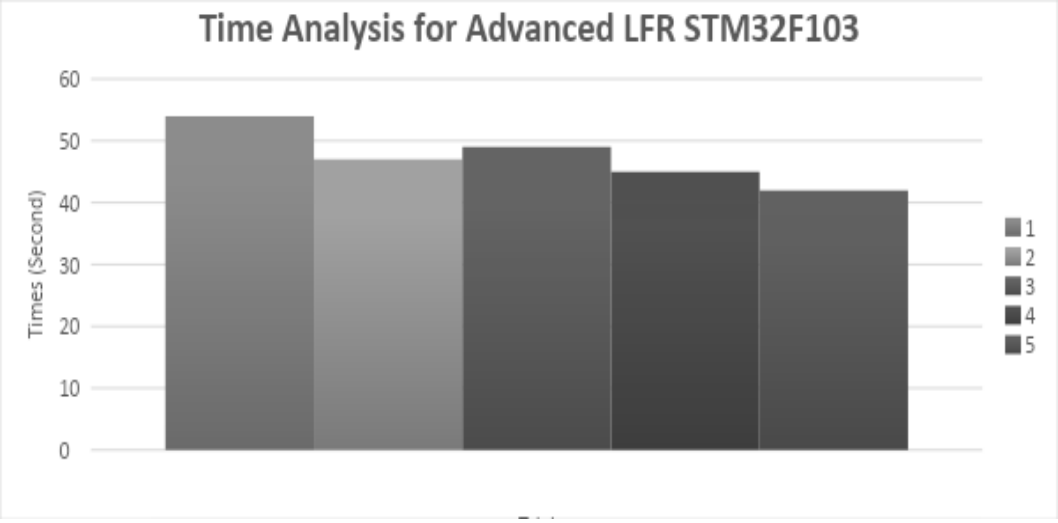


Figure 7: Time analysis for STM32F103 controller

In order to clearly analyze the performance of these three robots, average time for each robot variants were calculated and tabulated on Table 2. The result shows the average time taken for each controller to finish the competition track. Based on this analysis, it can be concluded that robot with STM32F401 controller managed to finish the track at fastest time compared to others. Moreover, all three controllers capable to finish the competition track within 60s and achieved the targeted time.

Table 2: Average time for each controller

Controller	Average Time (s)
STM32F401	50.8
STM32F103	45.8

4.0 CONCLUSION AND RECOMMENDATION

As a conclusion, Advance Line Follower Robot that had been designed and fabricated is eligible to compete in the Petrosains RBTX challenge since all the specification of this robot meets the rules and regulations of the competition. In addition, this robot has high potential to win the competition due to its capability to finish the track in less than 60 seconds. This conclusion was proven by the analysis data that has been collected throughout the experiments which indicates the capability of the robot to finish the competition track in less than 50 seconds in average. 60 seconds become the benchmark for this project as it was taken from the previous RBTX competition record for top 5 fastest robots in Robo Tracer Open category. Since robot with STM32F104 become the fastest robot during the experiment, it also can be concluded that the speed of processor is not the main factors that determine the speed of the robot as

STM32F104 is the slowest processor speed compared with others. Based on experiments and observations that had been made, it can be concluded that the type of motor, numbers of line sensors array, arrangement of line sensors and type of tyre become the major factors that affect the performance of Advanced Line Follower robot. Robot with high power motor seems to brake instantly at any junction compared with low power. This braking capability is important to ensure robot does not miss the track in sharp curves or junctions. With sixteen array of line sensors, the robot becomes more responsive in following the line on the right track. The arrangement of line sensors in curve form is observed to be more reliable to sense the curve track compared with the inline sensors arrangement. Tyre with silicone type and foam are observed to give more friction for the robot to stick on the ground during run time.

As a recommendation, LCD or OLED display with numbers of push button can be installed on this robot to give an option to the user for programming the robot directly on the robot without using computer or apps. This method is very useful for the user to change the program on the robot immediately during competition period when facing any errors in program. This option should include the route selection, speed adjustment and the capability to change PID value so that the user can fully utilize the on robot programming similar with the programming using computer or apps.

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