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FLOOD MONITORING AND WARNING SYSTEM WITH IOT

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Abstract

In Malaysia, flooding is one of the most common disasters occurring at the end of the year, especially in monsoon time, where it will cause death and loss of property. Today, human activities are the major problem contributing to this disaster such as uncontrolled development, river obstruction, deforestation that damage the catchment area and other factor contributing to flooding. Public use conventional ways to forecast events in many rural areas in Malaysia to track flood occurrence where they will be waiting for some expected activity near the river side. By observing the area that had known in danger, this action is risky. The population always has its own deficiency of society, which will influence the measured data. Thus, a flood protection plan was planned based on human and property. This project idea was generated to solve this issue by developing a Flood Monitoring and Warning System with IoT (FMWSI). This project used Arduino IDE for coding and Blynk software for Internet of Things (IoT) which it can help the user to monitor the road from a long distance. Using ultrasonic sensors, the detection system acts as water level detectors. The i2c 16X2 LCD display and traffic light module were used in this FMWSI to reveals the river's state to the user where it will be located 1km from the selected area so that the citizen will always recognize and be warning. When ultrasonic sensor detects the water level, the led will turn on according to the condition of the water level and the IoT will sends the notification to the user. The device plays an important role in keeping properties and human life safe and monitoring them. This system will help the residence to act before the flood gets worse and prevent flood trap.

Keywords: Flood; Flood monitoring and warning system; IoT; Arduino IDE; Blynk software.

1.0 INTRODUCTION

In many countries around the world, flooding is one of the major events impacting most residents each year. This is destroying property, natural resources and the environment. Flooding in these disasters is the most important occurrence. Due to various factors, such as rising sea levels and floods, the flood risk has been enhanced.

In Malaysia, flooding or flash floods are two famous floods which usually occur every year. Flash floods are triggered by slow-moving thunderstorms that frequently pass over the same region, or by heavy rain from hurricanes and tropical storms. It takes about a few minutes or two hours to develop. Flash floods arenot seasonal, but it can happen at any time and have some disadvantages relative to the flooding in the channel.

Normally, floodwater moves quickly and flash floods occur when the barrier holding back water fails or when waterfalls too quickly on saturated soil or dry soil that has poor absorption capacity. Flash floods frequently take place in a dry place and do not have a strong drainage system.

Nevertheless, river rains (monsoon floods) generally occur during the regional tropical wet season from October to March. Flooding occurs when heavy rain lasts for a few days or when heavy rain in a short time causes the water level of the river or stream to sink tothe ground. Usually, this flood happens in east coast countries such as Kelantan, Pahang, and Terengganu. The flood of the river is a growing natural disaster. Inundation of the water causes loss of human life and damage to property. Every year, the number of deaths from floods in the river is more than any other natural disaster in Malaysia.

Flooding is the world's most severe natural disaster without warning. It was understood that floods did

some significant damage and ruin houses, plants, vehicles, buildings and everything. Animals and people are caught in the flowing water current and are unable to escape before rescue attempts are made. Although flooding was an anomalous phenomenon in the past,it is now considered a life for mankind that treats natural disaster. Flooding has always created immense fear in countries across the world where people lost lives, displaced people, agricultural land washed away in water, highways, bridges, and homes. As a consequence of floods, property damage.

1.1 PROBLEM STATEMENT

Several individuals and organizations had to devote time and allow the flood recovery plans to reduce the expense for the affected sites and survivors as well. Most of these projects involve a lot of resources and physical power, such as rescue workers, surgeons, teachers, technicians, and so on. The state has to spend a large amount of cash on numerous restorations of physical structures in flood-infected places other than the armed resources. If only an effective early flood warning mechanism has been used, such casualties can be minimized and sufficient steps can be taken within the available resources in the shortest possible time to tackle the flooding scenario.

In most situations, the rate of flood water increases higher and the people are given fewer time to evacuate. The residents around the flood-prone areas have to prepare carefully in some situations and adapt by themselves based on the water level. For the respective organizations and agencies, warnings to early flood warning systems are usually intended. This will take time for them to hit when there is a flooding situation in a certain area as the liquid in most situations increases quickly. At the height of the storm, there will be congestion of residential areas, public buildings and roads, and significant disruption will be experienced.

In general, flooding is inevitable, but it is possible touse the early detection or warning system to reduce the victims and government's overheads. In fact, there are many advanced devices that are commonly used by some organizations or responsible governments to control flood rates at a certain venue. Most of these machines are difficult to use and manage. Such machines, in fact, are typically only used for surveillance purposes between the flood-prone area and the monitoring station.

Such a system allows all private and government agencies to focus on the preparations for emergency evacuation or prevention before the flood situation gets worse. The rescue team has to prepare for the best possible evacuation and recovery operations during the flood in a limited time with sufficient resources.

1.2 BACKGROUND OF THE STUDY

The FMWSI was designed to be a smart flood monitoring system at remote locations with high flood intensity. FMWSI is one of the technologies that can be used to prevent loss of life in floods, especially in states on the East Coast such as Kelantan, Terengganu and Pahang. This system is fully automated, operating at all times without human intervention.

FMWSI has many features that enable the monitoring station and others at flood-prone locationsto be alert before the flood reaches a critical level. This system's purpose is to calculate the river's water level and give a report on the water level to the user. This device has been designed specifically for rescue teams such as PDRM, BOMBA, and JPAM. With this tool, the rescue team can collect water level data and alert the public of flood victims for evacuation purposes in particular.

The self-monitored system allows the control station to be notified on a real-time basis about any changes in water level at a specific location. The area prone to flooding requires regular surveillance, particularly during rainy seasons, as precipitation can continue to cause flooding. FMWSI can be implemented for effective and rapid monitoring at a high potential flood location.

1.3 RESEARCH OBJECTIVES

This research relies on construction fieldwork to study and examine the water level inside the river when it rains. The main goals of this project are, in general, to develop a system for measuring the level of water and the rate of water that will help people track the actual level of water. There are specific objectives to be achieved in this project as follows:

- To fabricate a prototype of Flood Monitoring and Warning System with the aid of IoT.
- To generate flood level indicator and risk warning system.
- To develop a closed connection betweenuser and prototype via IoT.

At the completion of this course, students can learnon way to get the optimal situation that will render the process in the best possible shape and be able to design a plan that will benefit the community and nature. Students can also study and improve their process and soft skills for time management, technical skills, and common knowledge.

1.4 SCOPE OF STUDY

The project's context was to incorporate the built-in technologies and research the control process and the field of the project in order to achieve the goals of this network. Research was conducted in Bandar Seri

Alam in Johor Bahru, Malaysia, at the Universiti Kuala Lumpur Kampus Cawangan, Malaysian Institute of Industrial Technology (UniKL MITEC). The project aims to develop IoT (FMWSI) Flood Monitoring and Warning System that can control water levels and warn consumers and rescue teams. This system will be applied. In this task, which is the FMWSI format and what sort of right sensor has to be used, there will be afew items to be focused on. The following section contains information on the study of the company.

1.5 SIGNIFICANCE OF STUDY

The outcomes of this plan will benefit society in this country and play a significant role. Indeed, the problem of a large number of deaths can be minimized by the implementation of FMWSI. This is because it initiative, particularly in rural areas, could raise people's awareness. Actually, this device can increase the risk of loss of personal property.

2.0 EXPERIMENTAL

The data was collected from the publications that are relevant to the venture in the process of developing the program. This technique involves gathering the essential information for the studies by implementing some field research data that was embraced in others. Secondary data was obtained from archive archives and institutions to help the information collected. In this venture, a study was conducted on the functionality of the system and project design to meet the goals.

The project for the final year was split into two phases. The first phase was Project 1 of the Final Year(FYP 1) and Project 2 of the Final Year (FYP 2). The time given for the first phase was one or six months. A topic for the research project will be selected in this phase, and research must be done to prepare solid reasonsfor the selection of the topic. In addition, a study will be conducted based on past research to generate ideas on how to implement the project.

At the same period, the project's hardware and software have been established. To ensure smooth integration of hardware and software, the right hardware and software must be chosen. The electrical circuit and figure were built to give an overview of the project's implementation. Other than that, the design must complete the electrical circuit, software and coding. In a nutshell, FYP 1 will focus on writing the introduction chapter, reviewing literature and methodology as well as developing the prototype. The time given to finish the project in the second phase was similar to FYP 1. Unit evaluation must be carried out onthe model in this process to ensure that the design hasmet the research project's objectives. FYP 2 focused primarily on maintaining the smooth running of the system through the trial and troubleshooting. To assessthe output off the process, the tests are evaluated.

2.1 PROCESS FLOW

The system uses an ultrasonic sensor on the banks of theriver or wherever a calculation of water level is required, as shown in Figure 1. With the shift in water level, the sensor sensitivity rises as the sensor location. The sensors are sending the sensed information to the control unit wirelessly. The control device decides which output port to mean the water level is to be used. The new change to alerting remote station staff and consumers to details at a real-time level by Flood Monitoring and Warning System via IoT is an innovative and efficient strategy. The data at water level can be sent to customers using the ports defined. IoT is the most popular software used by citizens during working hours and during their free time to provide instant warnings on shifts in the level of water.

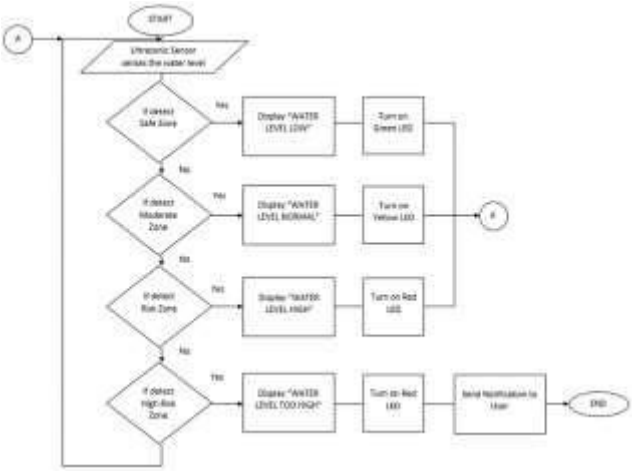

Fig.1 Process flow

The program can also be used, in addition to notifying the user, to automatically cause flood warnings to road users, buildings and public areas. The system flow for this plan is shown in Figure 1. The bestway to show this data in public places is through thedigital display system. If changes in water levels happen in areas vulnerable to floods, this display system may interpret and display information. Depending on the location and the rate of raise of thewater the number of sensors used can differ. The traffic light is automatically activated after the warning signs has been shown and the user is alerted. The flood ratearea shown in Figure 2.

Fig.2 Flood level zone

2.2 BLOCK DIAGRAM

In this project, ultrasonic sensor is being used to determine the water level. For sending the current level and alert to local people during flood times, the LCD and IoT was been used. Figure 3 shows the block diagram of the flood monitoring and warning system with IoT.

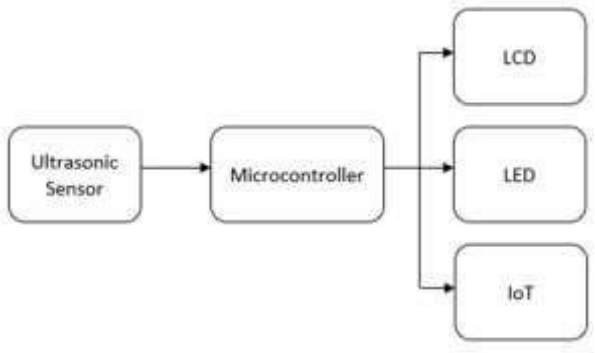

Fig.3 Block Diagram

2.3 ANALYSIS METHODS

The analysis methods used were split into two parts.The first part was development of software and the second part was hardware development.

Software Development. A coding framework is introduced in the chapter on software development, which is Arduino IDE. This paragraph should describe the technology in depth.

Arduino IDE. The Arduino IDE or Arduino Integrated Development Environment or Arduino Software (IDE) included a text editing software for code composition,a message region, a product field, a toolbar with simple functionality catches and menu progression. The transfer of programs and interface with them was associated with the Arduino and Genuine equipment.It was used in this project to create programming codes to work with the microcontroller. The software generated for this project must be compatible with the framework. This software was used for IoT where the code in C language was written. Because of its ability to integrate and link with wireless fidelity devices, such as Cytron WiFi Shield consisting of ESP8266, the application is ideal for IoT.

Blynk (IoT). Blynk is a system that is compliant with iOS and Android phones to power Arduino andRaspberry PI. No plate or shield is attached to it. It supports hardware for users to choose from and connects via Wi-Fi to the Internet. According to Durani.
H. Sheth. M. Vaghasia. M. & Kotech. S (2018), users could create a draft dashboard and place buttons, sliders, charts, and other widgets on the monitor. The system client uses and shows sensor data are allowedor deactivated by the consumer. Developers can therefore quickly develop applications to monitor and manage hardware projects for customers. It is a virtual dashboard that allows users to just drag and drop icons to create a visual task. The client can create a development template using the Blynk software and track different related objects.

Hardware Development. The device consisted of several variations of major components and machine circuit architecture for the hardware development portion. These main components consisted of several electrical and electronic elements being mixed. The suitable hardware components are chosen based on best performance and well-calibrated to reduce any errors found in the next section when analyzing datafor the test.

WeMos D1R1. The D1 board can be set up to workin the Arduino environment with BOARDS MANAGER, however, the arduino board itself cannot be connected to the arduino IDE. The panel is also comparing the D1 board can be set to work in the Arduino environment with the same NODEMCU feature. The name means D1 Mini is a smaller versionof R1, R2 boards are like Arduino UNO boards, but the model is not written. The ESP12 unit is built from WEMOS, which is also written on some panels. Also, D1has been published on some other panels where the AI Thinker machine is the ESP12 chip. Because ESP12 only has an ANALOG button, the deck is only dummy with A0 and other analog pins.

Ultrasonic Sensor. Ultra-Sonic detector for water level assessment. It is mainly a distance detector for calculating space using the SONAR system. It has two ultrasonic transmitters, the amplifier and the control chain. The transmitter transmits a high-frequency ultrasound wave which rebounds and receives any solid object as an echo. The echo then is measured by the control loop to determine the duration and the discrepancy between the transmitter and the receiver signal. The distance between the detector and the artifact it serves can then be calculated using this time. The high-frequency sound waves that cannot be detected through a transducer through human ears are generated by this ultrasonic sensor. When the wave passes and reaches a flat surface, the ultra-sonic waves can move backwards to reach the ultra-sonic detector via the same transducer again. The detector calculates and provides the average length of the distance between the time span and these deux waves. The ultrasound detector has a precise value and is therefore more accurate to the ultra-sonic device. The ultra-sonic sensor will give the exact range with minimal error possible. The four pins are composed of VCC, GND, TRIG, ECHO. The ultrasonic detector creates the sound waves, which a person cannot listen to at high speeds. When the sound waves are produced and the sound waves are transmitted to the ultra-sonic detector when the target or obstacle is hit. The ultra-sonic detector teststhe duration between the produced sound waves and the sound waves.

I2C LCD. Although LCD and some other displays greatly increase the interaction between man-machine, they share a common weakness. Once the controller is attached to a device, it has many IOs with not so many internal ports. It also restricts the other features of the system. The LCD1602 is equipped with an I2C bus to solve the problem. I2C bus is a serial bus system built by Philips. This is a serial bus with high performance and multiple host systems with bus control and network synchronization function. Only the serial data line and the serial clock line (SCL) I2C bus have two bidirectional parts. The Blue Potentiometer I2C LCD1602 is used for switching the backlights so that the I2C LCD1602 becomes easier to view.

2.4 DEVELOPMENT OF SYSTEM

This study developed the flood monitoring and warning system with IoT. The system can display the level of flood from the sensor of water level. In addition, a design of this system needs to be illustrated and well designed in order to achieve the system development of this project.

2.5 DESIGN OF WIRING DIAGRAM

This design consisted of the actual overall project wiring diagram. This wiring diagram showed how to combine and connect the main components of this project. This design was done early in the next stage to ensure that a prototype of this project will not be mistaken. A software called as Fritzing was implemented for this design where this software consisted of many electronic components for easy design. Figure 4 demonstrated the layout of the wiring diagram.

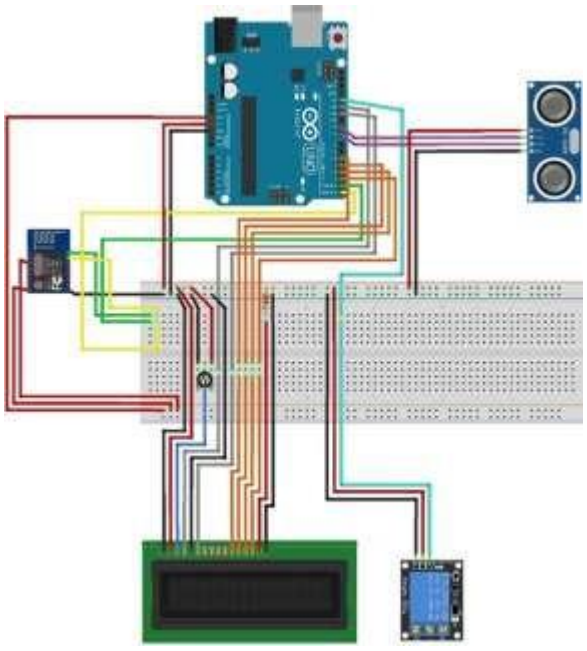

Fig.4 Wiring Diagram

2.6 PROJECT DESIGN

The project design of this project that will be considered in completing this project is been showed in this section. There are 3 perspectives shown which is Figure 5 for front view, Figure 6 for isometric view and Figure 7 for top view. This is a sketch design to what this project will be.

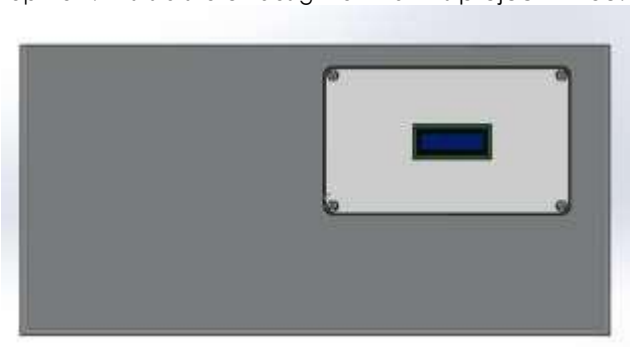

Fig.5 Project design in front view

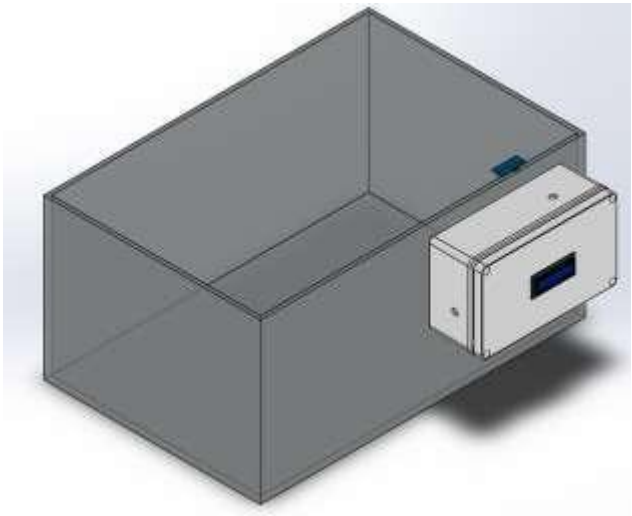

Fig.6 Project design in isometric view

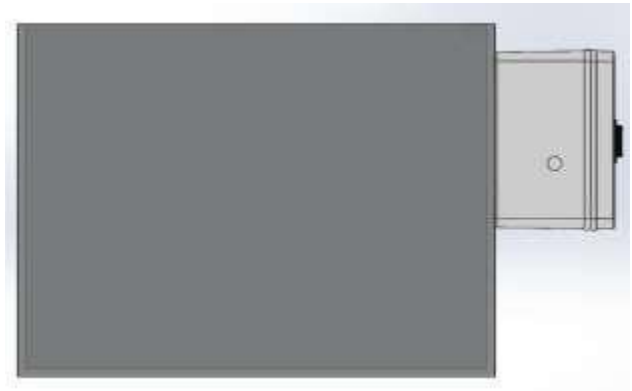

Fig.7 Project design in top view

3.0 RESULT AND DISCUSSION

The design process consists of checking the ultrasonic sensor features and evaluating all the hardware and software for the device. The results obtained from this

research will be clarified throughout this section fromthe final testing carried out. Result of the projectincludes the results obtained by using a PLX-DAQ Excelfor real time monitoring and Arduino IDE for internet ofthings. In other to obtain the best result for this system,all the matters stated were considered and followed. **Hardware.** Based on the first objective, which is to develop the prototype of FMWSI, this chapter hasexplained how the process was done and the result.The development of prototype is the objective for thisproject. The development of this project includeshardware and software. This paragraph will explainhow the process is performed and the result based onthe first purpose of using IoT to create the flood control and warning system template. The creation of designis the goal of this venture. Hardware and software arepart of the project's growth. The tank and electricalwiring schematic for this plan are included in theequipment. The code of the project contains theinstallation of the Blynk. The development of thisprototype using WEMOS R1D1 is shown in this section.Ultrasonic sensor is installed at the top of the tank tomonitor water level when the water is poured in. Water level will be displayed at the front of the tank.

Fig.8 Isometric view prototype of FMWSI

Electrical Wiring. Wiring has been done along the frame and the top of the tank for easier installation. Testing has been done for each electrical of the main components before installing the frame of the prototype.

Results of Flood Level Indicator and Warning System. In this project, PLX-DAQ software was used to monitor the data in real time. The project results include the results obtained through the use of an Arduino IDE for real-time water level monitoring. Ultrasonic can detect water rise to measure the current water level. Usually, the ultrasonic can measure the range of measurement for the water from 10 cm to 400 cm. Ultrasonic must link to the Arduino in this venture to monitor the water level. Butthis plan has just made those measurements from 0 cm to 15 cm for now. This project created an algorithm to make the ultrasonic works. Figure 9 shows the graph oftime/s vs water level/cm of the water level and all the data obtained from PLX-DAQ Excel. The operation starts when the ultrasonic sensor detected when the water is poured into the tank and LCD will display its current condition. If the water was 0-2 cm, the LCD islow and the led becomes green. The LCD shows thewater level normal and transitions to a yellow switch when the water level has felt 3-7 cm. The LCD will display the water level high and the led turns red immediately when the water level hits 8-10 cm. At last,the LCD will be shown at water levels too high if it exceeds 11-15 cm, led changes and a pop-up alert emerges on the Blynk application.

Fig.9 Graph of time/s vs water level/cm of the water level

Table 1. Summary of Flood Level Indicator and Risk Warning System.

Water level (cm)	Display	LED Colour	Alert
0-2	Water Level Low	Green	Off
3-7	Water Level Normal	Yellow	Off
8-10	Water Level High	Red	Off
11	Water Level Too High	Red	On

Based on table 1, the LCD will display either the water level is low, normal, high or too high. The LED will change the colour from Green to Yellow and to Red, based on the water level indicator. The alert will on after the water level indicator is too high. For water level 0 cm to 2 cm, the level of water is low, and therewill be green colour for the LED. 3 cm to 7 cm the display will show that the water level is normal and theLED colour will change to yellow. For high water level which between 8 cm to 10 cm the LED colour will be Red. Last, the alert will on when the water level achieves the 'Water Level too High' which is the measurement of water exceed 10 cm.

Result for Internet of Things. This project used Arduino IDE for water level measurement, which was then sent to the internet for cloud computing and data storage. Due to its low-price Cloud Computer System relative to other cloud system, the Blynk application was used. Inaddition, the project developer could easily make thebilling on a Malaysian made platform since the project is analyzed in Malaysia. The software used to get the virtual dashboard is Blynk Application. Blynk is a network for Arduino, Raspberry Pi, and the like, utilizing IOS and Android software. This is a virtual dashboardwhere you can easily drag and fall widgets to create a graphical interface for the design. It can remotely

control hardware, show sensor data, store data, view and do a lot of other cool things. The ultrasonic sensorwill detect the water level that have been classify intothree layer which is low, moderate and high. The ledwill turn on depending the water level and when the water level is at very high a notification will pop up on the screen and the graph will be shown.

4.0 RECOMMENDATION

During that endeavor, most changes cannot be rendered because of lack of resources or open media. Several guidelines could be added to this project in order to increase its accuracy, usability and marketability. Power supply of the sensors and the centralized control unit is feasible with solar cells. The FMWSI can be easily installed and operated if powered by solar cells. Solar power is also a cheaper source of power to the complete system, especially when the device is situated in a remote location. A warning siren also should be installed at the flood area in order to alert the user around the area.

5.0 CONCLUSION

To conclude, this project has provided useful knowledge and understanding in conducting research and development of technology. This project was completed within a one-year cycle. This work proposed the development of disaster control technology in Malaysia primarily for disaster flooding to minimize property and life loss. It plans will allow authorities in Malaysia to monitor the flood situation by using a comprehensive sensor network system compared to existing networks. The model of the proposed design was built and tested successfully. The water level was registered, the warning system appeared and the information were sent to the consumer using the IoT software.

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