INVESTIGATION OF FLOOD MONITORING & DETECTION SYSTEM USING IOT APPLICATION

MUHAMMAD SYAFIQ BIN ZAINAL

BACHELOR OF ELECTRICAL ENGINEERING (ELECTRONICS) WITH HONOURS

UNIVERSITI MALAYSIA PAHANG

UNIVERSITI MALAYSIA PAHANG

DECLARATION OF THESIS AND COPYRIGHT

Author's Full Name : Muhammad Syafiq Bin Zainal

Date of Birth : 9th May 1997

Title : Investigation of Flood Monitoring & Detection System Using Iot Application

Academic Session : Semester 1 2021/2022

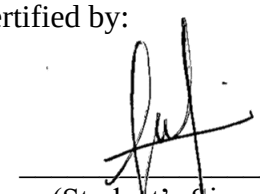
I declare that this thesis is classified as:

☐	CONFIDENTIAL	(Contains confidential information under the Official Secret Act 1997)*
☐	RESTRICTED	(Contains restricted information as specified by the organization where research was done)*
☑	OPEN ACCESS	I agree that my thesis to be published as online open access (Full Text)

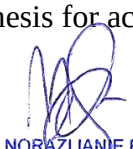
I acknowledge that Universiti Malaysia Pahang reserves the following rights:

1. The Thesis is the Property of Universiti Malaysia Pahang
2. The Library of Universiti Malaysia Pahang has the right to make copies of the thesis for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

Certified by:



(Student's Signature)



DR. NORAZLIANIE BINTI SAZALI
PENSYARAH KANAN UNIVERSITI
FAKULTI KEJURUTERAAN MEKANIKAL
UNIVERSITI MALAYSIA PAHANG
26600 PEKAN, PAHANG.
TEL: 09-424 5846

(Supervisor's Signature)

970509-10-5313
New IC/Passport Number
Date: 11th February 2022

Dr. Norazlianie Binti Sazali
Name of Supervisor
Date: 11th February 2022

NOTE : * If the thesis is CONFIDENTIAL or RESTRICTED, please attach a thesis declaration letter.

THESIS DECLARATION LETTER (OPTIONAL)

Librarian,
Perpustakaan Universiti Malaysia Pahang,
Universiti Malaysia Pahang,
Lebuhraya Tun Razak,
26300, Gambang, Kuantan.

Dear Sir,

CLASSIFICATION OF THESIS AS RESTRICTED

Please be informed that the following thesis is classified as RESTRICTED for a period of three (3) years from the date of this letter. The reasons for this classification are as listed below.

Author's Name	Muhammad Syafiq Bin Zainal
Thesis Title	Investigation Of Flood Monitoring & Detection System Using Iot Application
Reasons	(i)
	(ii)
	(iii)

Thank you.

Yours faithfully,

DR. NORAZLIANIE BINTI SAZALI
PENSYARAH KANAN UNIVERSITI
FAKULTI KEJURUTERAAN MEKANIKAL
UNIVERSITI MALAYSIA PAHANG
26600 PEKAN, PAHANG.
TEL: 09-424 5846

(Supervisor's Signature)

Date: 11th February 2022

Stamp:

Note: This letter should be written by the supervisor, addressed to the Librarian, *Perpustakaan Universiti Malaysia Pahang* with its copy attached to the thesis.

SUPERVISOR's DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Electrical Engineering (Electronics) with Honours.

(Supervisor's Signature)

Full Name : Dr. Norazlianie Binti Sazali

Position : Senior Lecturer

Date : 11th February 2022

_____

(Co-supervisor's Signature)

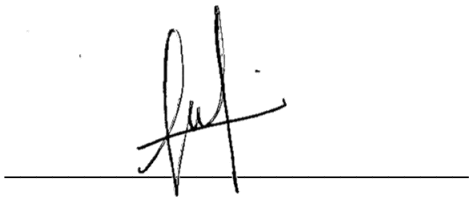
Full Name :

Position :

Date :

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.



(Student's Signature)

Full Name : MUHAMMAD SYAFIQ BIN ZAINAL

ID Number : EA18134

Date : 11th February 2022

INVESTIGATION OF FLOOD MONITORING & DETECTION SYSTEM USING IOT APPLICATION

MUHAMMAD SYAFIQ BIN ZAINAL

Thesis submitted in fulfilment of the requirements
for the award of the Bachelor of
Electrical Electronics Engineering (Electronics) with Honours

Faculty of Electrical & Electronics Engineering
UNIVERSITI MALAYSIA PAHANG

FEBRUARY 2022

ACKNOWLEDGEMENTS

In the first place, Alhamdulillah and all praises Allah in fulfilling this thesis for the strengths and his blessings. Special appreciation goes to my supervisor, Ts. Dr. Norazlianie Binti Sazali for her advices and continuous support. Her indispensable contribution to the completion of this project has been insightful observation and recommendations during the research and experimental work. Not forgetting my family members and my parents in particular. I would like to thank Mr. Zainal Bin Md Din and Ms. Nor Azwa Binti Mohd Nor, my beloved parents who have always been inspired and supportive for me to complete my final year of project. In addition, to my family members that are also contribute with great ideas and also help to develop this project. Finally, not least to all my friends who participated in this project directly and indirectly. Thank you.

ABSTRAK

Kajian ini dilakukan untuk mengkaji prestasi sistem pemantauan dan pengesanan banjir dengan mengaplikasikan teknologi Internet of Thing (IoT) menggunakan sistem solar sebagai bekalan kuasa. Banjir adalah sesuatu musibah yang berlaku tanpa diduga dan tidak dapat diramal. Ianya merupakan musibah yang sering berlaku pada setiap tahun, terutamanya sekali pada musim tengkujuh. Sejurus kepada arus teknologi pada masa kini, ianya dapat membantu kehidupan seharian orang ramai yang menetap di kawasan terdedah kepada banjir menjadi lebih mudah. Teknologi pemantauan dan pengesan banjir dengan sistem amaran ini dibina untuk memantau dan memberi amaran kepada orang ramai yang tinggal di kawasan berisiko tinggi untuk banjir agar mereka sentiasa bersedia untuk menghadapi banjir sebelum ianya berlaku. Projek ini menggunakan Internet of Thing (IoT) dimana ianya merupakan konsep perhubungan secara tanpa wayar. Sistem ini lengkap dikawal oleh salah satu teknologi mikropengawal yang hebat iaitu ESP8266 NodeMcu, sistem mikrokawalan ini boleh diprogram mengikut program yang ditetapkan. Sistem ini memerlukan beberapa pengekodan untuk berfungsi. Sensor Ultrasonik digunakan dalam sistem ini untuk menghantar isyarat kepada mikrokawalan untuk menganalisa data kepada pengeluaran. Dalam era globalisasi sekarang, internet merupakan sesuatu yang sangat penting pada hari ini, ianya boleh digunakan pada bila-bila masa dan dimana sahajaPengguna boleh memantau situasi sebenar paras air sungai dengan menggunakan aplikasi. Tambahan pula, sistem ini dibina menggunakan tenaga solar sebagai tenaga bekalan, ianya boleh bertahan lebih lama dan efektif berbanding sistem pengesanan banjir konvensional.

ABSTRACT

This research was conducted to investigate the performance of the Flood Monitoring & Detection System applying Internet of Thing (IoT) with solar system as a backup source. A flood is a catastrophe that happens unexpectedly and unpredictably. It is a disaster that often happens every year, especially once during the monsoon season. With the development of technology nowadays, it can help people's that live in the flood risk areas daily lives become easier. Flood Monitoring and Detection technology with warning system is built to monitor and warn people living in areas a high risk for floods so that they are always prepared for floods before it happens. This project is applying the Internet of Thing (IoT) which is applying the wireless connection concept. The system is completely controlled by one of the great Microcontroller technologies, namely the ESP8266 NodeMcu, this microcontroller system can be designed according to a set program. This system requires some programming part for interfacing. Ultrasonic sensor is used in this to transfer the signal into the microcontroller board for the data output signal analysis. In current world, internet is the very most important thing nowadays, it also can be applied anytime and everywhere. Users can monitor the current situation of river water level on the application. In addition, this device also constructs as a back-up energy source with the presence of solar energy, which can be longer lasting and effective compared to conventional flood detection systems.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVIATIONS

IoT	Internet of Things
JPS	Jabatan Pengairan dan Saliran
PWM	Pulse with Modulation
UART	Universal Asynchronous Receiver-Transmitter
Hz	Hertz
MHz	Mega Hertz
USB	Universal Serial Bus
ICSP	In Circuit Serial Programming
PCB	Printed Circuit Board
LED	Light Emitting Diode
AVR	Automatic Voltage Regulator
m/s	Milli per second
UID	Unique Identifier
ASEAN	Association of Southeast Asian Nations
PVC	Polyvinyl Chloride
Mm	Millimetre
uS	Microsecond
A	Ampere
V	Voltage
MIT	Massachusetts Institute of Technology
PLC	Programmable Logic Circuit
SCADA	Supervisory Control and Data Acquisition
HMI	Human Machine Interface
PIC	Peripheral Interface Controller

CHAPTER 1

INTRODUCTION

1.1 Floods Disaster

The flood is one of the worst natural catastrophes in Malaysia. The floods can be characterized as overflow of rivers and lakes causing or endangering damage. Floods are severe natural disasters that annually cause deaths and monetary damage (Lopez-Fuentes et al., 2017). According to Centre for Research on the Epidemiology of Disasters (CRED),in Asia, flood is the most common natural disaster happened. Fluting is caused by natural forces such as severe precipitation, high flooding and high tides, and by human factors such as channel obstruction or aggravation of drainage channels, poor land use, headwaters deforestation, etc. (Tingsanchali, 2012). The growth in population leads to increased urbanization, permeability and less infiltration and a higher peak flood. The serious and regular flooding caused by the changes of climate, the socio-economic disruption, populations affected, public outrages and limited funds are becoming increasingly serious problems. In developing countries, the economic effect and impact of natural disasters are greater (Mai Syaheera et al., 2016). Natural disasters could lead to significant levels of stress and other mental disorders (e.g. trauma) for the people affected (Mohd Taib et al., 2016). The prevention and mitigation of flood losses includes structural flood control activities such as dam building or water dikes and non-structural policies such as flood prediction and notification, management of risks and flood hazards, public engagement and institutional arrangements.

Malaysia experiences severe floods in 2010, with negative effects on the economy and society in general in numerous states (Khalid & Shafiai, 2015). In Malaysia, the average rainfall is about 2000 mm to 3000 mm per year, making it one of the world's heavy rainfall countries (Toriman et al., 2009). Homes were flooded and people were

forced to evacuate in several instances. The flow of traffic was disturbed and often lives lost due to drowning. In addition, in Malaysia most people are concern less about environmental issues, in particular, because they consider the issue a trivial problem that the district or local authority can address, and expect the government to be the only flood insurer in the event of floods. In order to minimize flood damage and provide early warning about flood probability, governments or authorities have established a flood delivery mechanism to speed up recovery. The delivery system usually specifies protocols for the implementation of government services for local authorities that are more reliable and efficient. The aim of preparation is to minimize residual risk by using early warning systems and action to mitigate flood disaster effects.

Problems associated with flooding have developed considerably, and an effective flood impact study is required to identify and manage the problem (Muqtada et al., 2014). The management of flood response is quite difficult and requires an excellent computer support system so that suitable action may be performed quickly (Katuk et al., 2009).

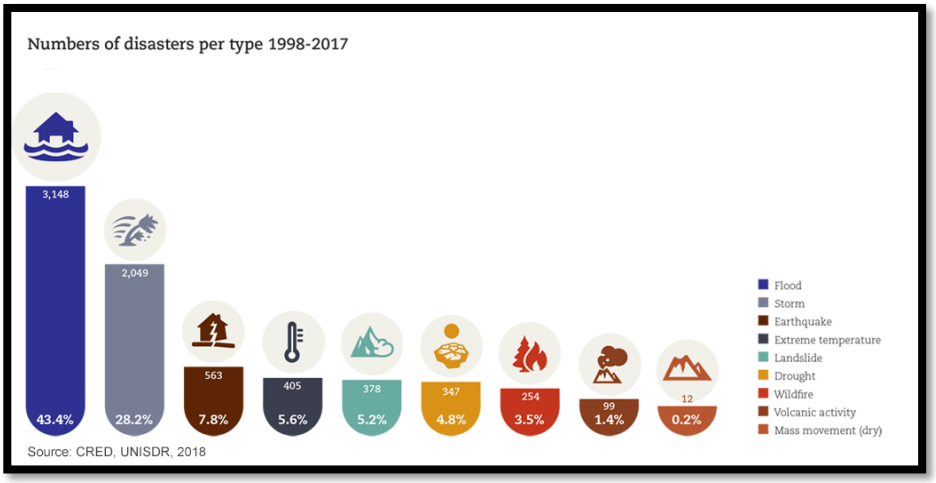


Figure 1.1 Percentage of Occurrences of Natural Disaster based on Disaster Type (Source : *Number of Disasters by Type 1998-2017 | Economic Losses, Pov… | Flickr*, n.d.)

The Figure 1.1 illustrates the data percentage of world's worst natural disaster. The graph is a combination with the data information from the United Nations Offices for Disaster Risk Reduction, Centre for research on the Epidemiology of Disaster that has

been recorded 3062 and it’s said that natural disasters in between 1998-2017. The figure highlighted that the flood is the most frequently natural disaster happened recorded.

Our lovely country Malaysia is one of the equator-based Asia countries. The climate in Malaysia is humid and hot all year round. Malaysia is subjected to heavy rains, resulting in flooding. The statistic from National Disaster Management Agency Malaysia stated that flood is Malaysia's most serious disaster occurred between January 2011 and October 2016.

A flood detector is designed with a monitoring system. The flood detector device has been designed to detect water level at various levels. This system is positioned in a strategic location with structured technique such as a pole. The device has also been designed to track the water level in the region. This offers the public early water measurements without having to head to places with high flood probabilities.

1.2 Problem Statement

Flood are one of the unpredictable natural disasters. Excess water, resulting from prolonged heavy precipitation and other local causes, generally leads to flooding. We know that Malaysia is one of the equator countries which has an annual engagement with climate change. The occurrence of natural catastrophes has significantly increased in recent times due to various factors such as environmental degradation, climatic change, rapid population growth, and intensified and improper land uses (Dano et al., 2019). Climate patterns produce heavy rainfall, after which natural catastrophes such as flash flooding occur. Floods are widely considered to involve serious disruption, including demolition of homes and buildings, crop destruction and animal mortality. Animals and people have to wait for the evacuation if they are trapped in the water.

The old detector was only used in certain areas to track the water level. However, in addition to tracking and receiving the data, the flood detector and alert system provides early warning for people earlier and also can allow them to prepare to save their properties and families before the flood become more hazardous. It would also decrease the risk of the above-mentioned issues.

1.3 Project Objectives

In this project, there are certain targets to accomplish and the objectives will serve as a reference to complete successfully project.

I. To develop a flood detector prototype system using the specified hardware and software.
II. To create a system that reduces flood risk effects and expense by delivering local the flood warning, monitoring and detection.
III. To study the implementations of Arduino Mega and the fundamental of communication device principle.

1.4 Project Scope

The project will be followed by a number of scopes to limit and specify the project. These scopes are listed in order to achieve the objectives.

1. Conduct a project that constructs mainly a flood indicator, monitoring and alarm system with applied hardware and software.
2. In this project, the Arduino Mega based microcontroller will be used. All of the codes programmed will be installed inside the Arduino.
3. Studying on the application of Internet of Thing (IoT) technologies. The flood detector will send the information about the situation and the current water level of the river to the public on the Blynk application using IoT.
4. Built a system that can warn the communities if the flood exceeding the safe level. It is necessary to have early warning system that will warn the residents about the risk and threats when there is upcoming flood.
5. Learning and implement about Arduino's software since Arduino IDE software will be used to program all the hardware used in this project.
6. Studying on solar power system for power source and backup energy and it will be installed in this project.

1.5 Thesis Outlines

This thesis contains of five chapters with all the project information and details.

Chapter 1 will discuss more about flood causes and consequences in Malaysia, explaining about flood detection system overview, project's problem statement, briefly about the objective for this project and scope of project.

Chapter 2 consist of overall view of the project. This will explain about architecture and functionality of the flood detection system are included. The past journals also will be included in this chapter.

Chapter 3 will explain the techniques, some methods and strategies applied to develop this flood detector system will be begin from the scratch stage. The solar system architecture also indicates as an alternate source of energy. It also contains how to overcome the systems and circuits involved.

Chapter 4 are briefly explaining the outcome from the project development. The results of the Arduino ATmega328P Microcontroller implementation built will be explained and discussed.

Chapter 5 will give the conclusion and some recommendation for future development on this project and the conclusion of this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Types of Floods Frequently Happens in Malaysia

Based on the STATISTA a database website, the statistic of the risk index natural disaster in Malaysia show that flood disaster is the second highest natural disaster happen (• *Malaysia: Risk Index for Natural Disasters 2020 | Statista*, n.d.). This natural disaster is the common thing happen compared to the others natural disaster. Every year our country suffered a big losses due damages happen from this natural disaster and also took peoples life. Generally, There are three types of river flood, flash flood and coastal floods in Malaysia (*Floods*, n.d.). These types of floods are frequently happening every year. But on this paper, we focusing on very common type of flood which is river flood and flash flood.

2.1.1 River Flood

When a river overflows its banks, a flood occurs when the stream is nowhere near its canal (*What Is a River Flood?*, n.d.). Flooding can be categorized as a normal and frequent issues for many rivers which helps to make sculptures of soils and disseminate nutrient in alluvial valleys and support variety of ecosystems adapted to occasional flooding, such as swamps and bottom forests. This type of flood also gave life to human societies that relied upon them for soil fertility and agriculture. However, humans also experience inundations as a result of destruction and loss of life when natural floods are highly built and populated. Heavy rains, especially peak seasonal rains in tropical river systems, such as the Amazon, are common causes and the torrential deluge induced by tropical cyclones that produces landfall and further storms is a defining element of this largest river basin in the world (*What Is a River Flood?*, n.d.). Sudden river flooding

events occur more often on smaller rivers, rivers with steep valleys, rivers that flow for much of their length over impermeable terrain, and normally dry channels (*What Is a Flood? | What Causes a Flood? | Flooding | Earth Networks*, n.d.).

The river can also develop when a river or river falls over and the water flows over the banks of the river. The numbers of river floods due to precipitation usually depends on the location and the time taken to collect the rain until local saturation and the area around the river system. For instance, in an environment that is not diminished for long time, A constant flood and water in rivers and streams inside a board are often caused by flat surface areas.

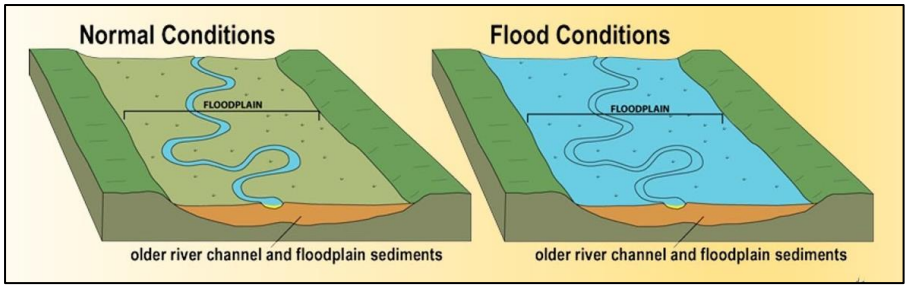


Figure 2.1 River Flood Between Normal & Flood Condition

(Source : *What Is a River Flood?*, n.d.).

2.1.2 Flash Flood

When significant rainfall rushes cause the water height (stage) of a stream or normally dry channel to quickly rise (*What Are the Two Types of Floods?*, n.d.). In areas of dry climate and rugged terrain, flash floods are more likely because the lack of soil or vegetation causes torrential rain to overland instead of entering the field. In general, a flood can happen in less than six hours causes by heavy or extreme rainfall (US Department of Commerce, n.d.). Flash floods are generally characterised by intense rainy streams that run across river beds, city roadways or mount canyons, all over them (*Flood and Flash Flood Definitions*, n.d.). You will experience an extreme rainfall within a few minutes or hours. They can also occur when no rain drops, e.g., after a dam has collapsed or when water has suddenly been released from a rubble or ice jam.

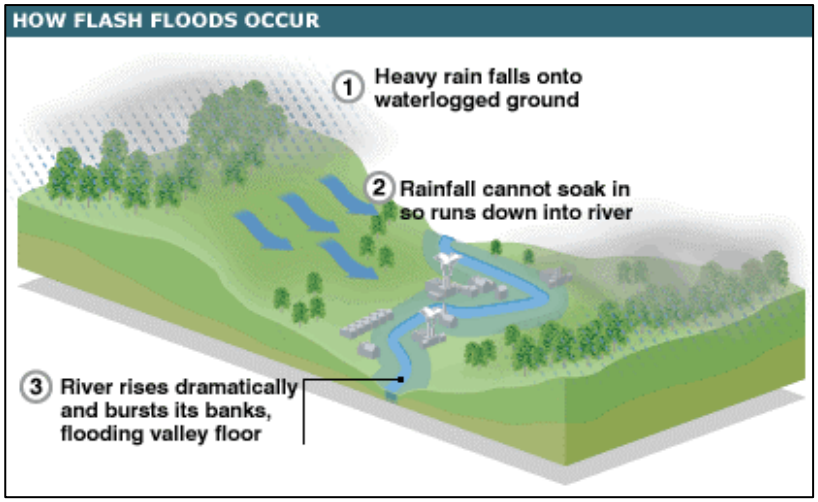


Figure 2.2 Flash Flood Condition

(Source : *The Process of Floods - Tweed River Flooding*, n.d.)

2.1.3 Coastal Flood

Coastal flood happen is when a coast is flooded by the sea, its cause of a storm surge (*Coastal Flooding*, n.d.). The wind from the storm pushes the sea water up and make a high wave. Then, it will be flooded the city or the resident around the nearby the sea area. This storm is formed due to a low-pressure area. Interestingly enough, the water level is higher under a low-pressure field. Consider a balloon. When it was compress tight and flat, then it will rebound when the pressure is released. When waves pass within an in defensive coast or overtop or violate coastal defence, the flood begins as dunes and dikes. The wave will attack the shore continuously. Every wave of storm takes sand away when it's a sandy shore. A dune will eventually collapse. A coastal flood can be characterised by drops and risings of water with the tide. The water can come in at high tide and it can flow out at low tide.

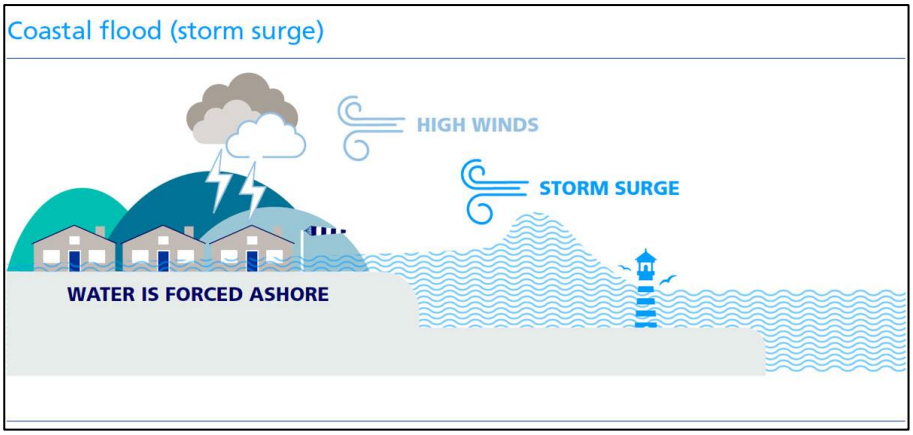


Figure 2.3 How Coastal flood happen

(Source : *Three Common Types of Flood Explained | Zurich Insurance*, n.d.)

2.2 Department of Irrigation and Drainage Malaysia's System

The Irrigation and Drainage Department (JPS) is founded in Malaysia to monitor into the river's present level. This department applying several technique and technologies to measure the water level on the river surface, one method is telemetry, in which the sensor is installed underneath the pump house. Telemetries is enabled if the water looks up and is exposed to the sensor and data from the sensor is sent to the host within the specified range. Data on water level are also provided via the website in this position. In 1970/71 catastrophic flooding took place in several parts of Western Malaysia. It became so bad that on 5 January 1971 a national catastrophe must be declared (*Department of Irrigation and Drainage*, n.d.). This process shows that Malaysia only have one way of tracking and warning against floods and that data are updated to the web application for every hour. Telemetry equipment only can detect water level. The figure below shows that the data of the water level at Wilayah Persekutuan River.

Not secure | infobanjir.water.gov.my/waterlevel_page.cfm?state=PRK

Home | Main Page | Explaination

Water Level Data

StationID (Photo)	Station Name (Cross-section)	District	River Basin (Trend)	Last Update Time	River Level (Graph)	Normal level	Alert Level	Warning Level	Danger Leve
5411066	KualaKenderong	Hulu Perak	Sg.Perak	Rainfall Only	111.11	111.50	111.90	112.08	112.50
3907403	Pasang Api	Hilir Perak	Sg.Perak	28/03/2021 - 06:00	-0.19	1.00	3.00	3.30	4.00
5108401	Sg.Ijok di Bekalan Ijok	Selama	Sg.Kerian	31/03/2021 - 14:00	32.85	29.00	35.00	35.15	35.50
5206432	Sg. Kerian di Selama	Selama	Sg.Kerian	31/03/2021 - 13:30	-99.99	10.00	12.00	12.30	13.00
5005405	Samagagah	Kerian	Sg.Kerian	31/03/2021 - 14:00	0.62	1.00	2.00	2.15	2.50
4907422	B14BatuKurau	Larut Matang	Sg.Kurau	31/03/2021 - 14:00	20.11	23.50	24.00	24.70	25.40
5007421	Sg.Kurau di Pondok Tanjung	Selama	Sg.Kurau	- 00:00	-99.99	13.00	15.00	15.24	15.80
5006401	Kolam Air Bukit Merah	Kerian	Sg.Kurau	31/03/2021 - 14:00	7.92	8.68	9.00	9.04	9.14
5513401	Tasik Temengor di Banding	Hulu Perak	Sg.Perak	31/03/2021 - 14:00	237.65	240.00	247.00	247.69	248.38
4911445	Sg.Plus di Kg.Lintang	Kuala Kangsar	Sg.Perak	31/03/2021 - 13:45	52.56	52.00	54.00	54.24	54.80
4809443	Sg.Perak di Jam. Iskandar	Kuala Kangsar	Sg.Perak	31/03/2021 - 14:00	32.75	32.00	35.00	35.65	36.30
4409401	Sg.Perak di Parit	Perak Tengah	Sg.Perak	31/03/2021 - 14:00	18.33	18.00	19.80	20.70	21.60
4310401	Sg.Kinta di TanjungTualang	Kinta	Sg.Perak	31/03/2021 - 14:00	11.12	10.00	13.00	13.75	14.50
4209493	Sg.Perak di Teluk Sena	Perak Tengah	Sg.Perak	27/03/2021 - 14:15	-99.99	8.50	11.00	11.90	12.80
4109401	Sg.Perak di Kampong Gajah	Perak Tengah	Sg.Perak	31/03/2021 - 14:00	5.01	5.00	6.50	6.65	7.00

Page 1 of 2 Next

Figure 2.4 Current Water Level Data of River

(Source : *Department of Irrigation and Drainage*, n.d.)

2.3 Flood Stages

There are several stages of the flood that can be identify. This research is based on the information from the previous journal and information.

Table 2.1 Flood Stages & Description

Flood Stages	Description
Action Stage	The surface of the water is at this stage almost or slightly above river banks. No structures created by man are flooded at this point. This overflowing is usually confined to a small parkland area.
Minor Stage	The next stage is minor flood stage this is still a minimal flood stage where buildings are not normally impacted (*Episode 141: The 5 Stages of Flooding*,

	n.d.). This is the stage in which roads usually begin to be flooded by water.
Moderate Stage	This phase will begin on the road, the road will probably be closed and the area will be closed. This stage normally occurs during monsoon inundations. This phase also happens mainly in the East Coast State (Malaysia)(Ramizu & Halim, n.d.).
Major Stage	Buildings are typically flooded at this point and life loss starts happening. This stage is widely known as disastrous floods.
Record Flood Stage	The highest point of the river since the records of the region in which the flow indicator has been situated started. This does not mean that there is a massive flood. Some regions may have never had a major flood, and the medium-sized record.

2.4 GSM & Web-based Flood Monitoring System

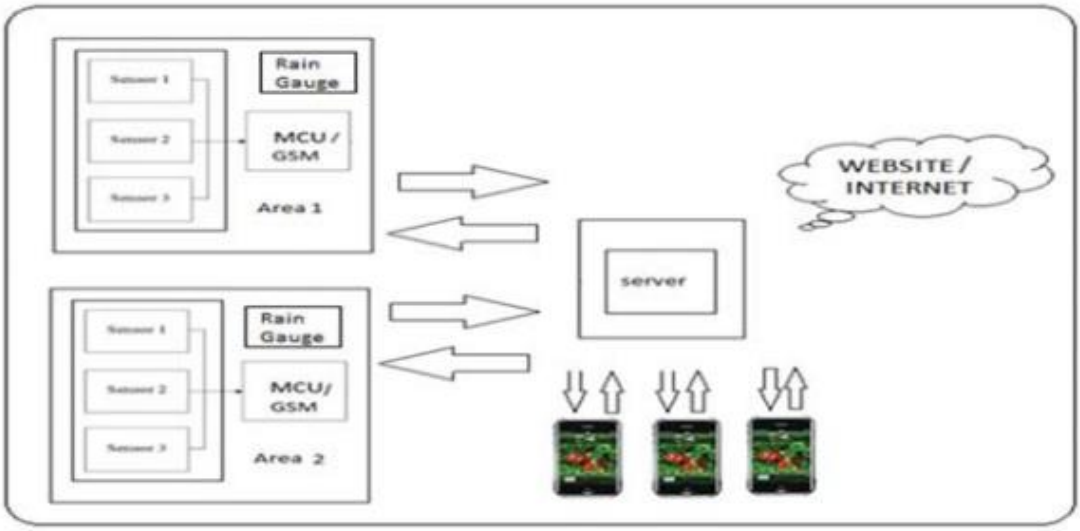


Figure 2.5 The Project Overall System Design

(Source : Shokova et al., 2015).

This project builds a prototype to detect current water levels across the river of Mandulog and its neighbouring areas in Philippines. The physical area of the river was separated into areas with sensors. When a sensor is switched on, the output signal is sent on to an alert SMS message to the server. The output signal activates the attached GSM modem (Shokova et al., 2015). After that, a text message will automatically send to the numbers that have been stored in the database. In addition, the device then automatically uploads a warning message to social media websites such as Facebook and Twitter. As the water level rises and activates the next sensor, the process is repeated. After the level of the water hits its critical level, it will transmit to the surrounding areas a message warning. In addition, the communities will be asked by sending a message via keywords.

2.5 LabVIEW Based Flood Monitoring System

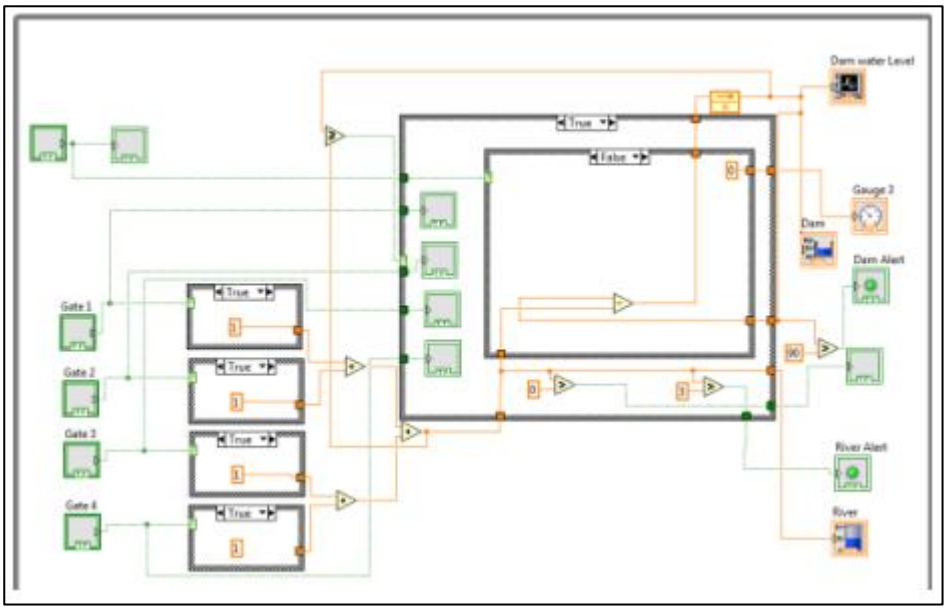


Figure 2.6 Back-end Panel shows the program's system

(Source : Journal, 2020).

To detect and monitor the water level, this project is using LabVIEW as their main platform. This system is fully coordinated and program in LabVIEW software. LabVIEW is a forum for system design and a visual programming language development environment by the National Instruments. This software requires both the front and back-

end panels. A dam and pipe tank knobs and the dam level warning indicator can be held at the front end. The back end will keep the circuit Virtual Instruments consist of the circuits. The data of the system will always flow to the data sinks from the data sources (Journal, 2020). In addition, this system will show the inflow and outflow rates. The sensor will be triggered the buzzer if the water level reached the danger level and it will also be displayed on the monitor.

2.6 Flood Detection and Alert System Based On IoT

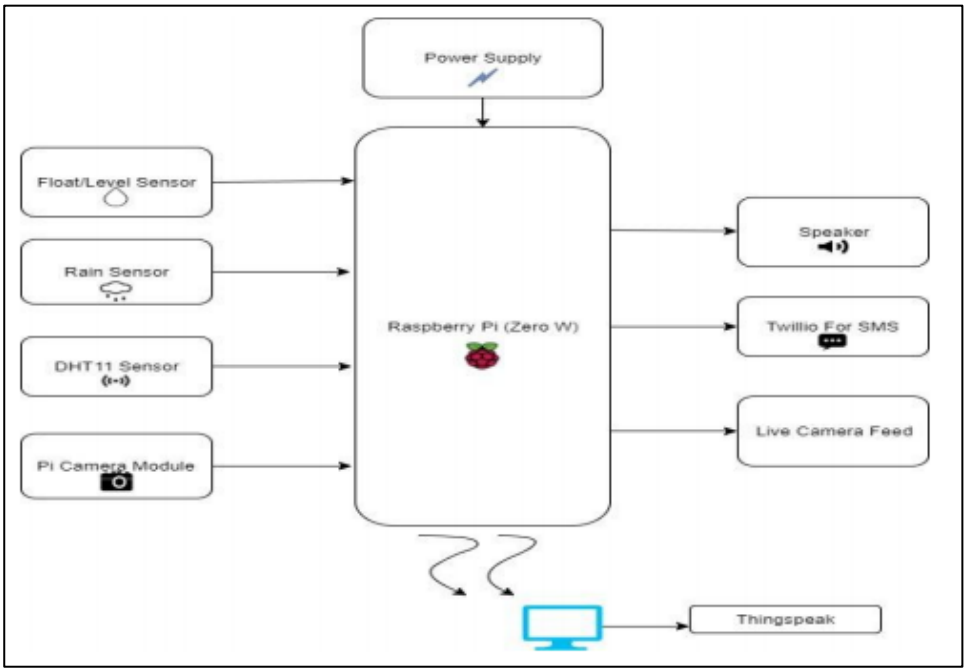


Figure 2.7 Block Diagram of the system

(Source : Deokamble, 2020)

The main unit of this system is Raspberry Pi in which this microprocessor will act as a controller to control all the components that are connected to it. Furthermore, the system are using dht11 temperature & humidity sensor, water level sensor and the raindrop sensor (Deokamble, 2020) as their input. The water level sensor will detect and measure the level of water with defined measurement as an indicator to indicate the situation of the water levels. It will run continuously to monitor the variety of water levels and will give an alert to the authorities using varieties of platform such as using Twilio platform by using GSM messaging. The system also can be monitored by using IoT platform to give a live situation of the water level. In addition, users also can use the Live

Camera Feed on YouTube. Temperature and humidity can be measure on this system and the buzzer also will triggered if the water level reached the critical level and will alert the users.

2.7 Flash Flood Warning System Using SCADA Systems

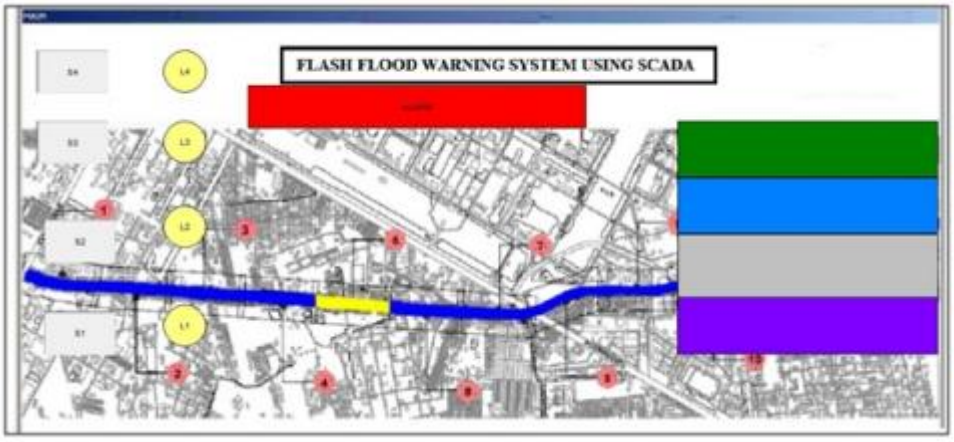


Figure 2.8 The Display View of SCADA

(Source : Rahaman, 2015)

This research aimed of development of innovations to help the authorities to able in handling the incoming flood and to recover from it (Rahaman, 2015). The current system is focusing on the SCADA systems. This model is a flash flood warning system that controlled by SCADA system. It is developed and implemented in CoDeSys platform. PLC are completely very usual with CoDeSys (Controlled Development System) (Rahaman, 2015)**.** They are using PLC to perform the logical operation in which to notify the peoples that are live in flood effected area to well-prepared to save their properties and life. SCADA is system that acts as a main unit. The HMI will show the result as the interest area on the contour map.

2.8 Flood Detection using Sensor Network and Notification via SMS and Public Network

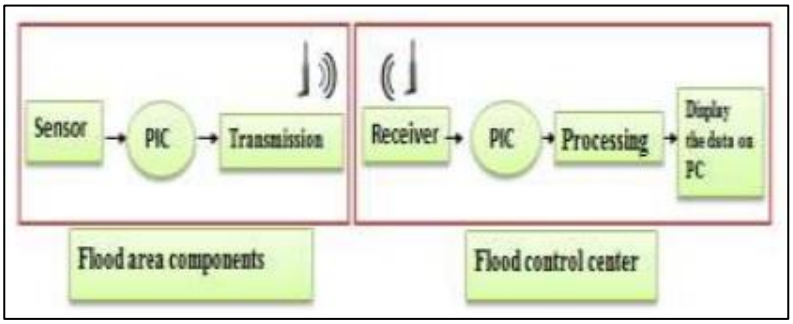


Figure 2.9 Block Diagram shows the system's process

(Source : Alfahadiwy & Suliman, 2011)

In this system, the authors are using wireless sensor network in advance way. The main part of the system divided by two consists of hardware and software development. The figure 7 show the process of the system's process. PIC16F877A as main unit conduct as a controller to control all of the devices interfaced to it. Programmed codes will be installed inside PIC in C language form (Alfahadiwy & Suliman, 2011). Components consist of water level sensor, PIC16F877A, radio frequency and Global System Communication Mobile (GSM) are the main part in this system. At the first stage, the system will detect the water level by using water level sensor, then PIC will read the data to transmit it by using radio module to the receiver. If the receiver receives the transmitted data, then in will be analyze data and display the result on monitor. After that, GSM will be triggered to send a SMS to the user to inform about the current water level situation. At the same time, system will send the details information to the flood management via Facebook and Twitter to give a warning to the communities.

2.9 Previous Studies

Authors	J C Pagatpat, AC Arellano and OJ Gerasta (2015)	Allu Venkateswara Rao, Ch. Drakshayini, R. Naveen Kumar, K.Abhishek G. Sharmila, M.Surendra Sai (2020)	Aishwarya Jadhav, Harshvardhan Jadhav, Snehal Jalkote, Prof. Mr. V.B. Deokamble (2020)	Mr. Vimmigari Karthik & Syed Ateequr Rahaman (2015)	Mohamed Ibrahim Khalaf alfahadiwy & Azizah Suliman (2011)
Title	"GSM & Web-based Flood Monitoring System"	"LabVIEW Based Flood Monitoring System."	"Flood Detection and Alert System Based On IoT"	"Flash Flood Warning System Using SCADA Systems"	"Flood Detection using Sensor Network and Notification via SMS and Public Network"
Method	This system using GSM module as their connection platforms.	Every code will be programmed graphically using LabVIEW software.	Raspberry used in this project as a microcontroller. This system using water level sensor, humidity sensor and temperature sensor.	The research comes out with SCADA technology.	This flood detection system is using PIC as their controller. Also using radio wave and GSM module.

Results	The system will send an SMS message to the users via GSM when the water level reached every sensor.	The result of this research is the system will trigger the buzzer and will display the result on the monitor	Users will get notified when the system detect the dangerous water level via SMS and live feed camera.	System will display the result on the monitor with contour map at interest area.	Communities will get notified via SMS and also the system will report to the flood department if the flood happen. It will also be posted on social media to alert residences around the area.

2.10 Overall View of the System

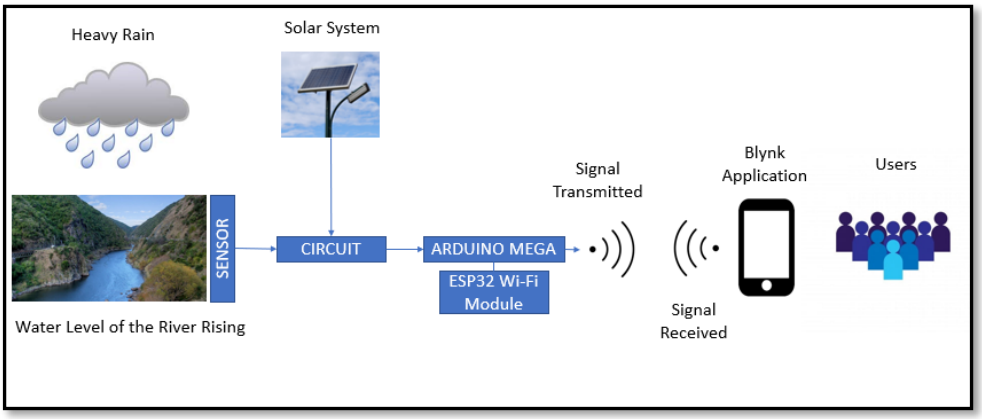


Figure 2.10 Overview of Flood Monitoring & Detection System.

Figure 2.10 illustrate on how the system will operate at some areas such as a river. This system device incorporates software and hardware, and each component has its own purpose. The river water level will be determined by the sensor that was place at the riverbank. The Ultrasonic sensor are basically used to calculate the various range of water level. The Ultrasonic sensor will transmit the signal to the ESP8266 NodeMCU, and the Microcontroller will interpret the signal and identify the measurement of the water level. The solar system is applied as backup power supply based. This technique will help this system to operate properly even though the main power supply is running out. ESP8266 NodeMCU microcontroller will send the data by using IoT communication system that connected to Blynk application. The users will be notified from the application and they can be prepared to face flood otherwise they can move to the safer place.

Flash floods usually take place 6 to 7 hours after heavy rainfall, but river floods are lengthier and last a week or more (Ramizu & Halim, n.d.). Flash flooding does not occur seasonally, but they are still possible and have some drawbacks in comparison to river floods. This flood can harm peoples that are living nearby river area. System for Flood Monitoring is one of the initiatives that can be made to prepare ourself to face river flooding and also can reduce the damage because of the flood.

2.11 Water Level

The height to which water in a reservoir or a water tank may rise is determined by its level. Depending on the appropriate scale, it may be graded as low to high water level. It is important to understand each depth of water in order to avoid a safety issue as a result of the flooding. The rising water level increases the potential of extreme floods, which can cause serious problems. Same goes as the river, it can monitor due to rising of the water level. Every rising of the river's water level can be measured and monitor. Developing a water level device that can track and provide warnings at each point is critical in allowing for early intervention and ensuring safety. A precise water level forecast is thus crucial to warn the public of a possible rise in water level and need required preparations. (Reeves et al., 2007).

2.12 Hardware

For this project, hardware is needed to guarantee efficient development and the proper functioning of the system (prototype). This included the materials and the microcontroller applied. Arduino microcontroller will act as a controller that will conduct the system according to the encoded program. Ultrasonic sensor is the input of the system that it will transmit the signal to the ESP8266 NodeMCU microcontroller. ESP8266 NodeMCU will send the signal via Internet of Thing (IoT) to the Blynk application. The Blynk will give the notification if there have an input from the system. In addition, solar power system is added, it will act as a backup power source to make sure the system is always in power supply in order to give the warning notification to the user. The purpose is to make sure the user will ready and well prepared before the flood happen.

2.13 ESP8266 NodeMCU

Arduino is one of the microcontroller board innovations, as well as an open-source platform for designing immersive computerized interfaces. It has a microcontroller which can associate with a large variety of circuits and boards. The world used this type of board as the brain for tens of thousands of fascinating projects. There are some other microcontroller architectures available for physical devices. Similarly, the ESP8266 NodeMCU is the most basic board and comes with everything you need. Arduino is not only ready to use, but it is also lightweight and cheap.

In this project, ESP8266 NodeMCU microcontroller applied. First, it had firmware that ran on the ESP8266 Wi-Fi SoC from Espressif Systems, as well as ESP-12-based hardware that was used to test the software (*Espressif - WikiDevi*, n.d.). It was generally used to write and upload programming code to the physical board. The ESP8266 NodeMCU has a range of device, Arduino or other microcontrollers to communicate with. The Arduino programme contains a serial monitor which can be sent to and from the board with simple text data. The ESP8266 NodeMCU is designed to reset it in software running on a connected device instead of having a physical press on the reset button before the upload is made. The reset line falls long enough to reset the chip when that line is asserted (turned down). You can download code using this Arduino programme by simply pressing the upload button in the Arduino environment.

The ESP-12E module has a 32-bit LX106 RISC CPU with a configurable clock frequency of 80 to 160 MHz and RTOS compatibility, and the development board is equipped with the ESP-12E module (*Insight Into ESP8266 NodeMCU Features & Using It With Arduino IDE (Easy Steps)*, n.d.). All is built into the board already, which provides this system effectively. This board can operate with 3V to 3.6V operating voltage range. This device assembled with LDO which is a voltage regulator device that can keep a constant voltage at 3.3V (*Insight Into ESP8266 NodeMCU Features & Using It With Arduino IDE (Easy Steps)*, n.d.).

The Figure 2.11 below shows the ESP8266 NodeMCU microcontroller architecture board. It contains everything needed to operate the microcontroller.

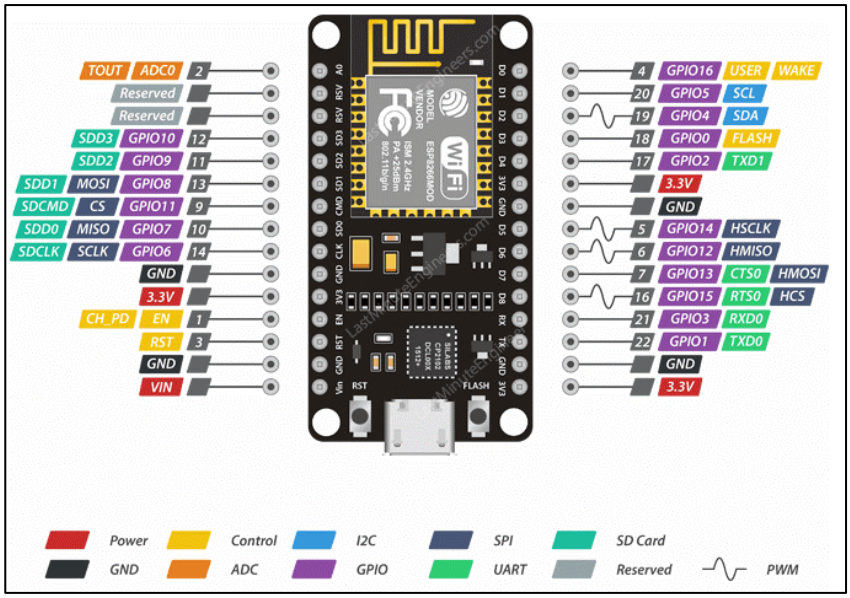


Figure 2.11 ESP8266 NodeMCU Architecture

(Source : *Insight Into ESP8266 NodeMCU Features & Using It With Arduino IDE (Easy Steps)*, n.d.)

2.13.1 Advantages of Arduino IDE

Major advantages of using Arduino are ready to use. As Arduino is available in a comprehensive packet form including a 5V control system, burner, oscillator, microcontroller, serial communication interface, LED and connecting connectors. (*Advantages and Disadvantages of Using Arduino – Engineer Experiences*, n.d.). It also comes with the open source software system that allows harsh software system developers to utilise the Arduino code to merge and extend and update the existing programming language libraries (*Arduino Technology Architecture and Its Applications*, n.d.). Also, in operating systems such as Linux, Windows and Macintosh. The Arduino programme is well-suited. In addition, It includes an open hardware supply feature allowing users to build their own kit. The Automatic Unit Conversion is another benefit of Arduino because you don't have to think about converting units during debugging. Last but not least, Arduino got large communities. In the internet there are various forums in which people debate about the Arduino. The Arduino is used to develop engineers, hobbyists and professionals (*Advantages and Disadvantages of Using Arduino – Engineer Experiences*, n.d.).

2.13.2 Disadvantages of Arduino IDE

Arduino also got some weakness instead of more advantages. Arduino structure is one of them. You have to do as tiny as possible while constructing a project yet we have to stick with large PCB's with the large structures of Arduino (*Advantages and Disadvantages of Using Arduino – Engineer Experiences*, n.d.). After that, they got no script checking debugger included in Arduino. In addition, they also leak of no AVR microcontroller comprehension. Also, the performance of Arduino is less powerful compared to Raspberry Pi. The speed of Raspberry Pi is faster than Arduino. To be added, Arduino couldn't run multitask activity.

2.14 Calculation System

The distance of water level at the river is measured using an ultrasonic sensor in this device. The ultrasonic sensor measurement data is fed into the microcontrollers, which perform the processing. In this case, the ESP8266 NodeMCU was used as a controller. A microcontroller is a device that allows you to monitor two transducers are used in ultrasonic. Each transducer serves a specific purpose. The transducer, also known as a sound transducer, generates pulse of sound waves high frequency. Detect reflected sound waves that have an effect on a surface, such as the level of water. Ultrasonic distance can be measured by calculating the time difference between transmitting the pulse and receiving the reflection or echo and translating the distance to the speed of sound. The signal transmitted at 40Hz by the Ultrasonic transmitter and processed via the transmitter circuit. The transmitter has a transmission rate of 340 m/s with sound speed. The signal is reflected by the ultrasound receiver, the receiver signal is analyzed for wavelength determination. Distance is calculated by the formulation S = 340t/2, where S is the distance from the ultrasonic fields, and t is the time differential between transmitter and receiver (From et al., 1998).

2.15 Internet of Things (IoT)

The internet of things or IoT is a system of interconnected computing equipment, electronic and digital machinery, items, animals or people with unique identity (UIDs) and the capacity to transmit information across a network without interaction between peoples or human to computer. (*What Is IoT (Internet of Things) and How Does It Work?*, n.d.). A human with a heart monitor implant, a farm animal with a biochip transponder,

an automobile that incorporated sensors to warn the driver at the low pneumatic pressure or any other natural or man-made item that is able to be allocated an Internet Protocol (IP) address and can transmit data through a network can be part of the Internet. Cloud computing is encountering growing challenges in meeting many new requirements in the Internet of Things (IoT) (Chiang & Zhang, 2016). The IoT has been acknowledged by numerous industries and is one of the major areas of future technology (Lee & Lee, 2015). Organizations across a range of branches are increasingly using IoT to work more effectively, to better understand customer experience, to improve decision-making, and to maximise market value. An IoT ecosystem is composed of web-enabled smart devices that gather, transmit and react to data they collect from their environment using embedding systems, such as processors, sensors and communication devices. A radical evolution of the current Internet into a Network of interconnected objects that not only harvests information from the environment (sensing) and interacts with the physical world (actuation/command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications and communications (Reeve et al., 2001).

The Internet of Things allows people to live and work more smartly and to take full control of their lives. IoT is important for companies as well as smart devices for home automation. In real time, IoT gives firms an examination of how their processes function, providing insight into everything from computer efficiency to supply chain and logistics. IoT is one of the most relevant daily technologies and will continue to gain momentum as more companies understand the importance of connected devices for competitiveness. IoT's most abundant use of sensors and other IoT devices in manufacturing, transport and utility organisations. However, it has also found useful applications for agricultural, infrastructure and home automation organisations leading several organisations into digital transformation. By facilitating their job IoT may help farmers in agriculture. Sensors can gather information on precipitation, moisture, soil content and temperature as well as other variables to automate agricultural techniques. Also, , the electrical appliances including washing machines, and refrigerators can be controlled remotely through IoT (Khan & Salah, 2018).

2.15.1 Advantages of IoT

IoT got some of advantages which is capability of accessing information on any computer from anywhere. This application is universal and can be use anytime and anywhere since there have an internet connection. Enhanced communication between electronic devices linked. Also, data packets switch over a linked network saving time and resources and tasks automation to further increase a company's service quality and reduce the need to respond to human needs. It drives devices and sensors more granular levels and permits new, economically impossible uses, new applications, services and new business models (Yadav et al., 2018).

2.15.2 Disadvantages of IoT

Instead of having an advantage, IoT also some weaknesses. First, the data can be breach. The data and the information that stored in the system are more exposed. Our private data will be easily collected by the theft if it is not been well-protected. The statistic told that 12.7 million American has been victim of identity theft (*Identity Monitoring - IDStrong*, n.d.). One of the biggest data breaches is credit card and debit card number. This is very extremely cruel. Most of the companies also fear about this and they can lose their clients trust if data breach came attack them. Furthermore, IoT is a dependent technology. This can't be argued because it is dependent with internet connection. When there is no internet connection, so it can't be used. In addition, complexity also one of the IoT weakness. Beside of the great technology, a lot of complex operation behind the scene. If there got some error on the software, it will affect all of the process. In conclusion, IoT will bring more amazing and great technology but it also has to be aware and make sure all this technology is under control in order to protect the private data and information.

2.16 Summary of this Chapter

In this chapter explained the definition of flood and also its types. The type of flood has been explained with three types of floods and two of them are frequently happen in our country. This chapter also explain the responsibility of Department of Irrigation and Drainage in Malaysia. In addition, Arduino and IoT concept are explained with details including their supporting device and software development. All of the previous

journal and research are explained and also get compared each of the research with variety of methods. With this method, the difference between of the journal can be well-analyse.

CHAPTER 3

METHODOLOGY

3.1 Project Methodology

Monitoring of the water level in flood-prone areas could provide early warning of the type of floods which devastated various regions in ASEAN (Association of the Southeast Asian Nations) in recent times (Kuang et al., 2008). Many potential users are located in impoverished nations and do not usually have remote sensing or software to handle data sets in forms easily ingestible into their models (Asante et al., 2007). This system's project use IoT communication technology and ultrasonic sensor detects the water level and transmits data to the user as an alert. This strategy acts to improve the responsibility and collaboration of the floods between the competent authorities and the experts (Sunkpho & Ootamakorn, 2011). The users can get the data processing based on data produced by the sensor to give a warning. The warning will pop-up in the Blynk application. For the alert device, an ultrasonic sensor will be used as a marker or detector of the river's water level and the system will send an alert via IoT system. Then, the users may know about the water level of a river that is prone to floods.

A network of ultrasonic sensors will be used in this project to track water levels in large, flood-prone rivers. The Ultrasonic sensors device will be installed in containers such as PVC pipe with a 120mm diameter. The pipe shaft's length is 5 meters. The pipe would be installed on the surface of the river's natural condition. The water level is indicated on the PVC pipe by three separate levels. Level 1 represents a mild situation, level 2 represents a prudent situation, and level 3 represents a dangerous situation.

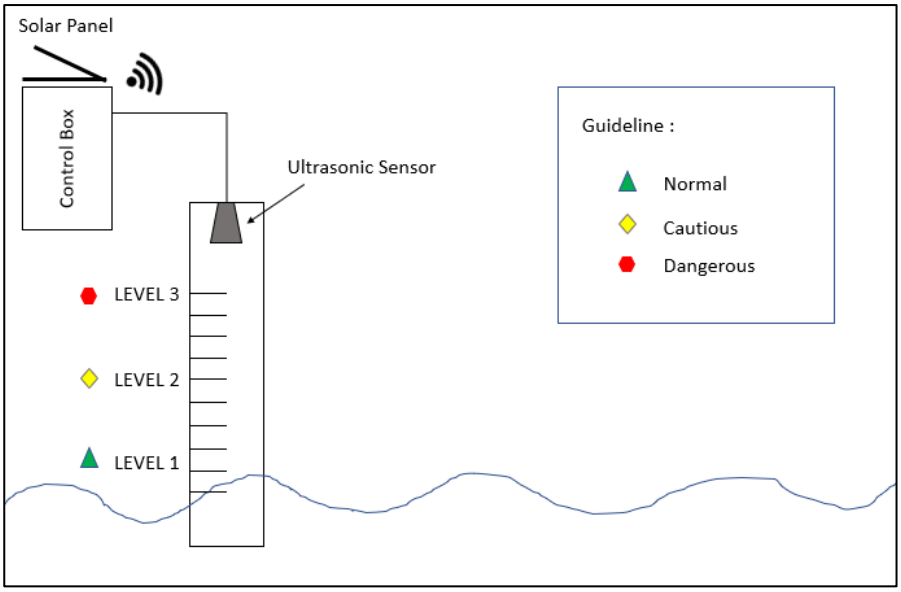


Figure 3.1 Overall System Structure

Table 2 shows that ultrasonic measurements are classified into three levels: normal, cautious, and dangerous level. Normal level is indicated that the level of the water is in safe level. The middle stage, on the contrary, indicates that the river is coming in or out and authorities or persons should warn against the risk of flooding. Residents have to be prepared to evacuate to safer place or a safe location, such as over the hill, if the situation becomes dangerous.

Table 3.1 Indicator of every water level.

Levels	Ultrasonic Sensor Measuring Between Water Levels
Normal	>>4 Meters
Cautious	2 to 4 Meters
Dangerous	2cm to 2 Meters

3.2 System Architecture

This system is using Ultrasonic sensor to measure the water level of the river. The sensor will transmit a signal to Arduino and ESP8266 WIFI module, then ESP8266 will process the signal data and send it with IoT communication system to the Blynk application. The Ultrasonic sensor will act as an input of the system and Arduino and ESP8266 WIFI module as microcontroller. Figure 4 will show the overall system architecture.

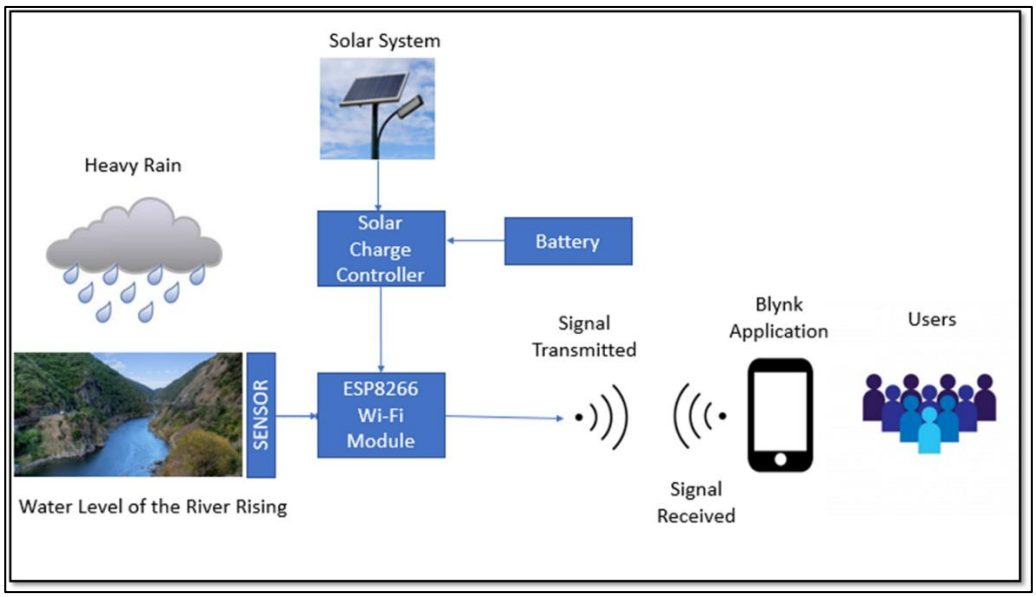


Figure 3.2 Overall System's Architecture

3.3 Block Diagram

A block diagram is a scheme where blocks connected by lines display the relationships of blocks display the principal parts or functions. This part will explain on how the system working generally.

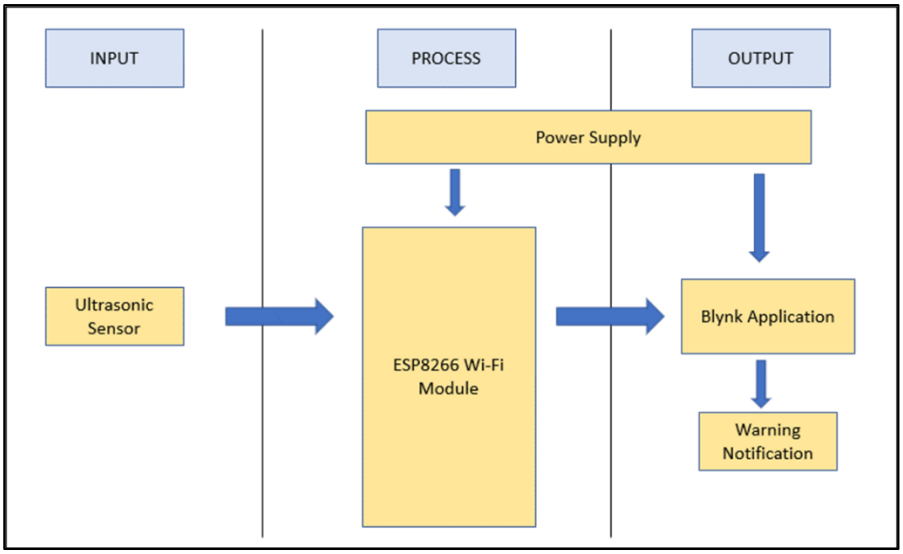


Figure 3.3 System Block Diagram

The figure show that the ultrasonic sensor which is HC-SR04 will send the signal to the Arduino & ESP8266 Wi-Fi Module motherboard. Then, the motherboard will interpret the signal and send it to the Blynk application where the user will get a warning notification if the water level of the river is exceeding the safe level and flood will happen.

3.4 Flowchart

A flowchart is a diagram that representing a workflow or process. In this flowchart, it will explain the process and the workflow of this flood monitoring system.

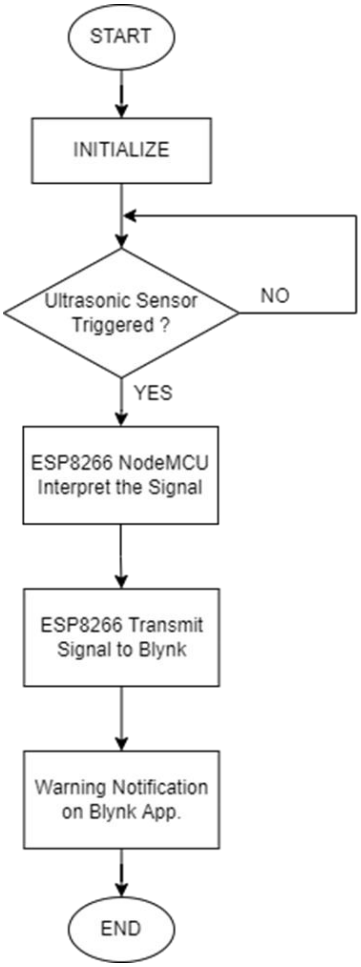


Figure 3.4 The flowchart of the system.

The figure above shows the process of the system. This system will interpret the signal from the Ultrasonic sensor if the sensor triggered. The sensor will be triggered if it detects the water level of the river is exceeding the safe level. Then, it will send the signal to the Arduino. The motherboard will read the signal and transmit it via ESP8266 Wi-Fi Module to the Blynk Application. From there, the user will get the warning notification about incoming flood.

3.5 Sensing System

For instance, the system employs ultrasonic sensors in conjunction with a microcontroller board. The ultrasonic sensor's primary function is to measure the distance between the water surface and the sensor. HC-SR04 is a ultrasonic sensor that can transmit and receive the wave signal. With an overall range of precision of up to 3 mm, this low-cost sensor gives non-contact measures between 2cm and 400cm. Each HC-SR04 module has an ultrasonic transmitter, recipient and control circuit. It all begins with

at least 10 microseconds of trigger pins. In response, a sonic burst of 8 pulses at 40 kHz transmits the sensor. This 8-pulse pattern uniqueness makes the "ultrasonic signature" special in the system such that the transmitted pattern can be distinguished from the ambient ultrasonic noise.

If those pulses are reflected back the Echo pin goes low as soon as the signal is received (*How HC-SR04 Ultrasonic Sensor Works & How to Interface It With Arduino*, n.d.). This results in a pulse with a range ranging from 150 µS to 25 mS, according to the time it takes to get the signal.

In order to determine the distance from the reflecting object, the width of the received pulse is calculated. Figure 6 shows the formula triangle that can be calculated by distance, time and speed. To measure the distance, the formula shown describe to multiply the value of speed and the time take. Then, the result will show the value of the distance.

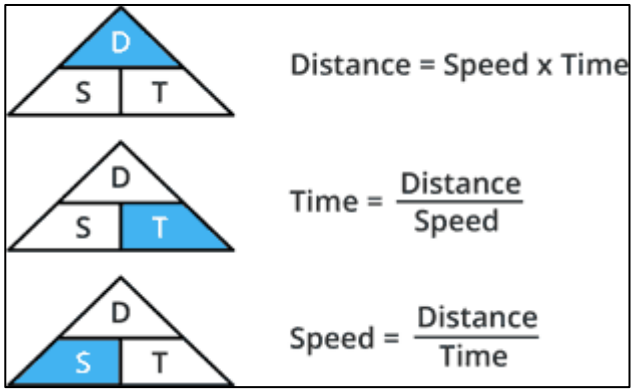


Figure 3.5 Formula Triangle for Distance, Time & Speed (*How HC-SR04 Ultrasonic Sensor Works & How to Interface It With Arduino*, n.d.)

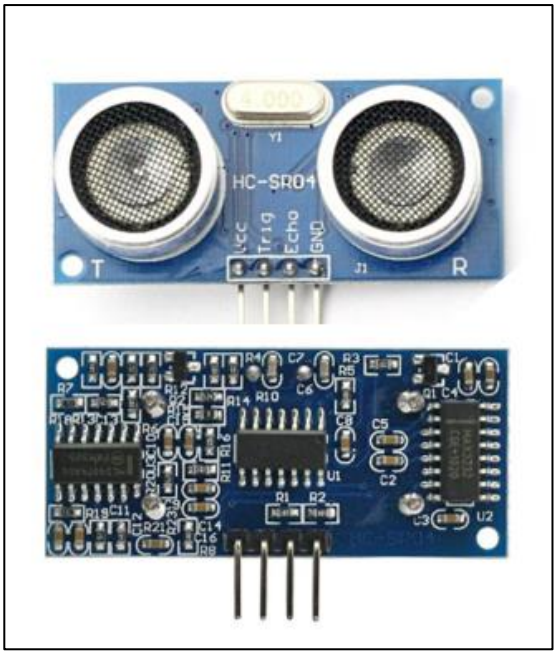


Figure 3.6 HC-SR04 Ultrasonic Sensor (*Complete Guide for Ultrasonic Sensor HC-SR04 with Arduino | Random Nerd Tutorials*, n.d.)

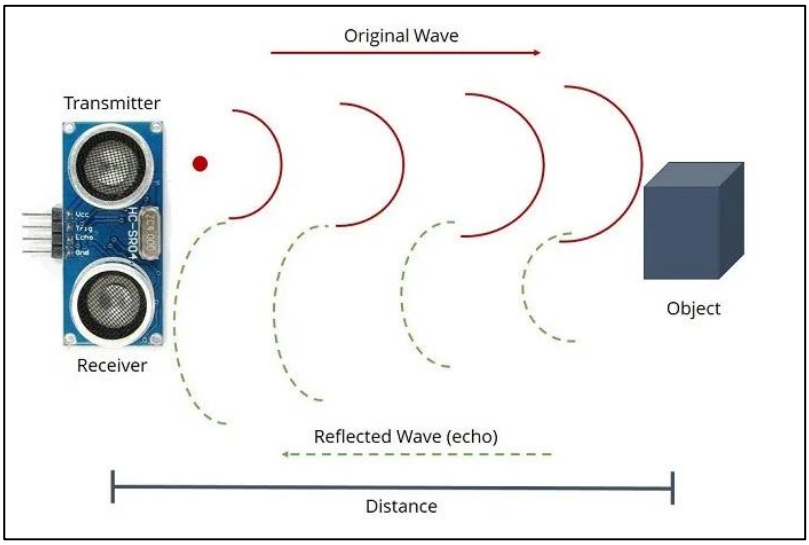


Figure 3.7 The operation of HC-SR04 Ultrasonic Sensor (*Complete Guide for Ultrasonic Sensor HC-SR04 with Arduino | Random Nerd Tutorials*, n.d.)

The Figure 7 shows the operation of HC-SR04 Ultrasonic Sensor, the sensor is actually transmitting the signal and the signal got bounce back to the receiver due to the obstacle such as an object. The time taken reflected wave will be interpret as the distance between the sensor and the object.

3.6 ESP8266 Wi-Fi Module

ESP8266 is a low-cost system-on-a-chip family of micro-controllers with integrated Wi-Fi and Bluetooth dual-mode. This ESP8266 Series has a Tensilica Xtensa LX6 microprocessor, a dual-core and single-core system, as well as integrated antenna switches, RF baluns, amplifiers, low-noise amplifiers, filters and module power management. Figure 3.8 shows the architecture of ESP8266 Wi-Fi Module.

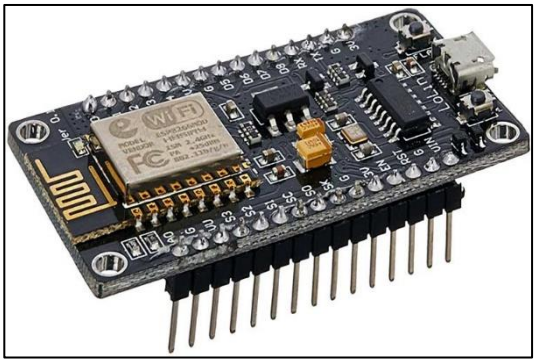


Figure 3.8 NodeMCU ESP8266 W-Fi Module (*NodeMCU ESP8266 Pinout, Specifications, Features & Datasheet*, n.d.)

This module will be use in this project as a medium to connect with Internet of Thing (IoT) communication system.

3.7 Solar Panel

The solar panel is an environmentally friendly instrument. The solar panel's duty is to generate battery power and current voltage and charge electricity. Currently this investigation uses solar panel that will supply 18Volt and 10Watt for this project. But, in this case, we have to use Solar Charge Controller (SCC) to control the output voltage supply to the battery in order to protect the battery. The solar output will be delivered to the battery in order to charge it. The sunlight will be a supply as a solar input. The solar panels are usually turned on in the afternoon.

For solar panel system, applying a suitable power rating solar panel is mandatory. The suitable power rating solar panel will provide a proficient supply without any wasting. The right solar panel with make the system working in excellent. In this system. 18V and 10W solar panel applied. The system is fully powered by solar panel source, the

system needs a storage to store an energy. In this case, 12V 7AH Sealed Lead Acid Battery used in this system.

3.7.1 NodeMcu Power Consumption

$$P = (IV) \times 24h \quad (1)$$

3.7.2 10A Solar Charge Controller

$$Current = \frac{(80\%\ of\ solar\ power\ rating)}{V} \quad (2)$$

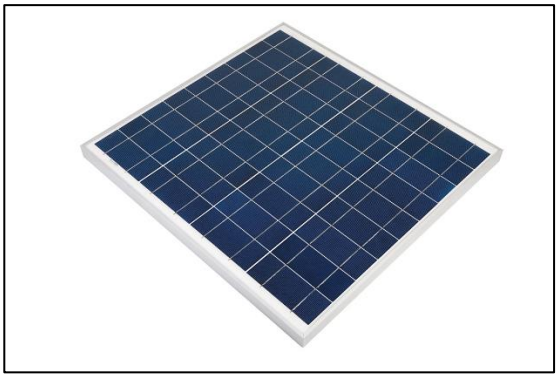


Figure 3.9 Solar Panel

(Source : *Solar Panel Sub System Building Blocks - Philips*, n.d.)

3.8 Project Diagram

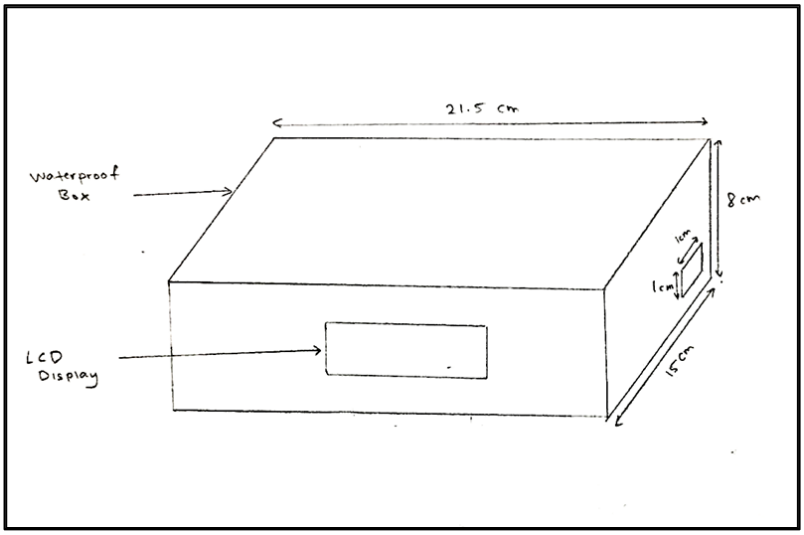


Figure 3.10 Main view of the product

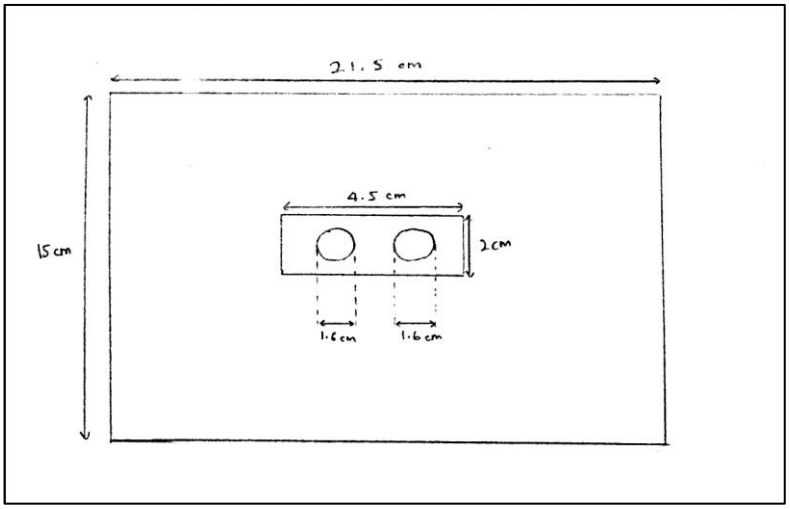


Figure 3.11 Bottom view of the product

Dimension of the product are decided based on the need. It combined all the related dimension needed to install the components and the circuit inside the case. The case dimension measurement based on height, distance and width. LCD Display are located at the front of the case. It will show all of the information and measurement of the water level. On the side of the case, there are hole with 1cm radius to located the wire connection to the power source. On the bottom side view, the ultrasonic sensor is installed at the center of the case to measure the water level of the river. The bottom of the case will be facing to the water's surface. To avoid any splash of water to the ultrasonic sensor,

a PVC pipeline will be used in this project. This pipeline will reduce the water splash to the ultrasonic and will provide an accurate measurement at a moment since no object can be passed through the bottom of the case. In addition, the project will use a waterproof case to protect the circuit from damage due to the water splash.

3.9 Circuit Diagram

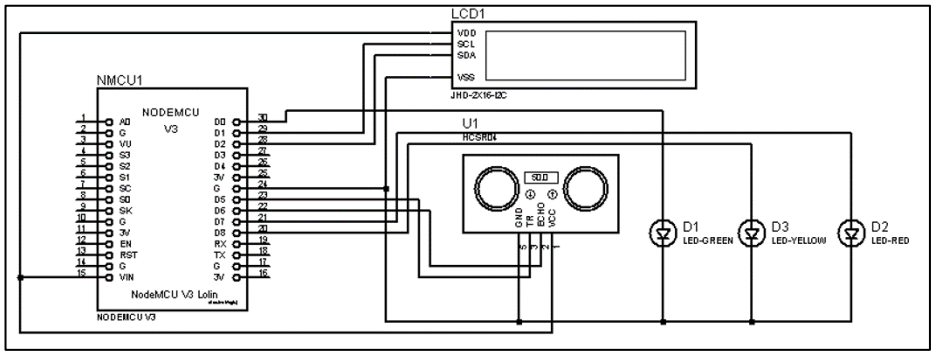


Figure 3.12 Circuit Diagram in 2D

This circuit diagram will indicate the connection of the system. The main component is Arduino Mega 2560 as a controller. The sensor is connected to the ESP8266 NodeMCU pin while the others connected to the Ground and Voltage Source pin. LCD Display will show all of the information needed such as current water's level and percentage of the water's level to indicate the current situation whether in a safe or danger situation. The pin of the LCD Display will connect to the SCR and SDA pin since it is an I2C LCD Display, rest of the pin will be connected to the VCC and GND pin. The diagram also shows a ESP8266 Wi-Fi Module used to connected the system with Internet of Things (IoT).

3.10 List of the Components

Table 3.2 List of the component

No	Material	Quantity
1	ESP8266 NodeMCU	1
2	Ultrasonic Sensor (HC-SR04)	1
3	Waterproof Case	1
4	18V 10W Solar Panel	1
5	12V 7AH Sealed Lead Acid Battery	1
6	Serial IIC I2C 1602 LCD Display	1
7	10A Solar Charge Controller	1
8	AWG26 Wires 4 Metres	1
9	Solderless Breadboard	1
10	LED	3
11	5x7 Strip Board	1
	TOTAL	**13**

3.11 Simulation Software

In this part, all of the software that related to this investigation are included in this section. The circuit diagram also generated from the software and the simulation process software that related.

3.11.1 Arduino

Figure 3.10 Arduino Software (Source : *Arduino - Home*, n.d.)

Arduino is a platform for open-source electronics focused on simple hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online(*Arduino - Introduction*, n.d.). Many other microcontrollers

and platforms for physical computing are available. Parallax Basic Stamp, MIT Handy board, BX-24 of Netmedia, Phidgets, etc. provide similar features. All these tools take on microcontroller programming specifics and bundle them into a kit that is simple to use.

3.11.2 Proteus

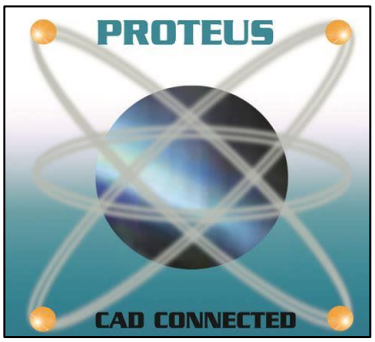


Figure 3.11 Proteus Software

(Source : *PCB Design and Circuit Simulator Software - Proteus*, n.d.)

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation (*Proteus Design Suite - Wikipedia*, n.d.). The primary objective of this programme is to give diagrams and electronic prints for electronic design engineers and technicians to produce printed circuit boards. In this project, this software is mainly used to create the circuit diagram and also to run the simulation.

3.11.3 Blynk

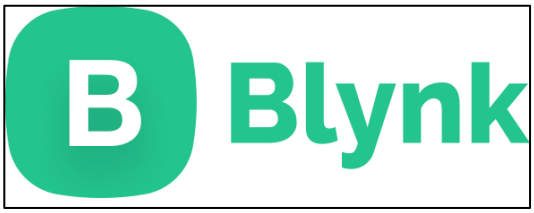


Figure 3.12 Blynk Application

(Source : *Blynk IoT Platform: For Businesses and Developers*, n.d.-a)

Blynk is a tech company that develops infrastructure for the internet of Things. Businesses of any size, from new start-ups to big enterprises, use our software to build and manage connected products (*Blynk IoT Platform: For Businesses and Developers*,

n.d.-b). For Internet of Things, Blynk was created. It can remotely monitor hardware, show data sensor, store data, view it, and do much more.

3.12 Software Development

Most important thing to build the system is the software. This topic will cover all of the configuration related to the software in this project. It will include Arduino and Blynk software.

3.12.1 Configuration of ESP8266 NodeMCU

Initialize the ESP8266 NodeMCU before proceed to the hardware installation. First thing needs to do is to install the Arduino Desktop IDE in the computer. This version will allow programmer to program an Arduino in offline mode. After that, connect the ESP8266 NodeMCU to the computer. This microcontroller, it can be connected to computer is by using printer USB. To configure the board, the setting can be set by clicking on Tools option and choose the ESP8266 NodeMCU board. This setting must synchronously to the applied board.

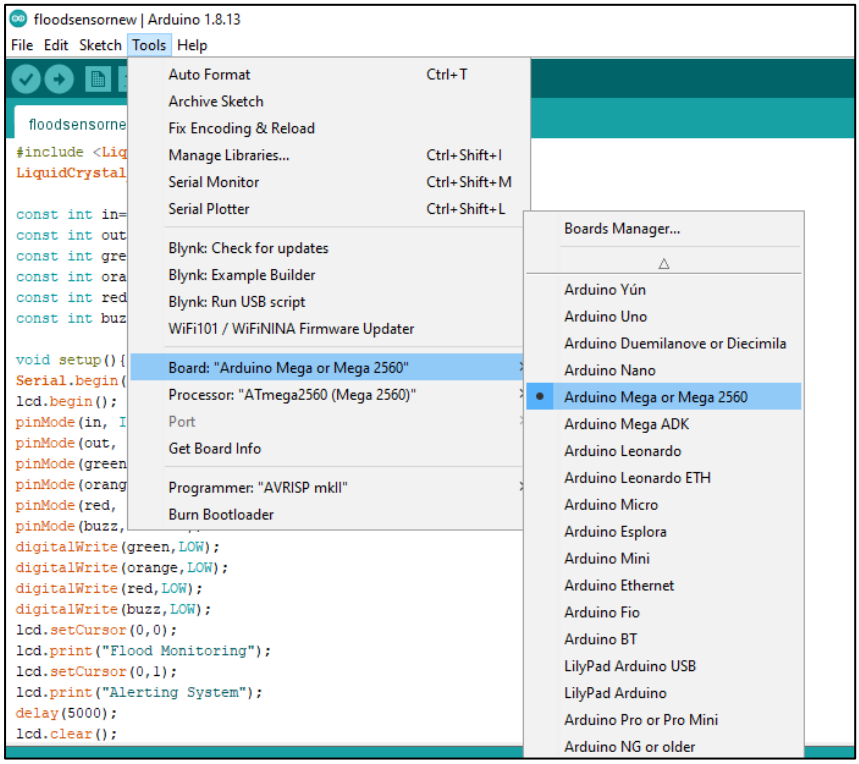


Figure 3.13 Board Configuration

After that, the port needs to be initialized in Arduino Desktop IDE. This step is important in order to configure the serial device with the serial port. If the configuration failed to match both of the serial device and serial port, the program couldn't be uploaded to the board and will occur an error. At this stage, need to assure that the board are already connect to the computer.

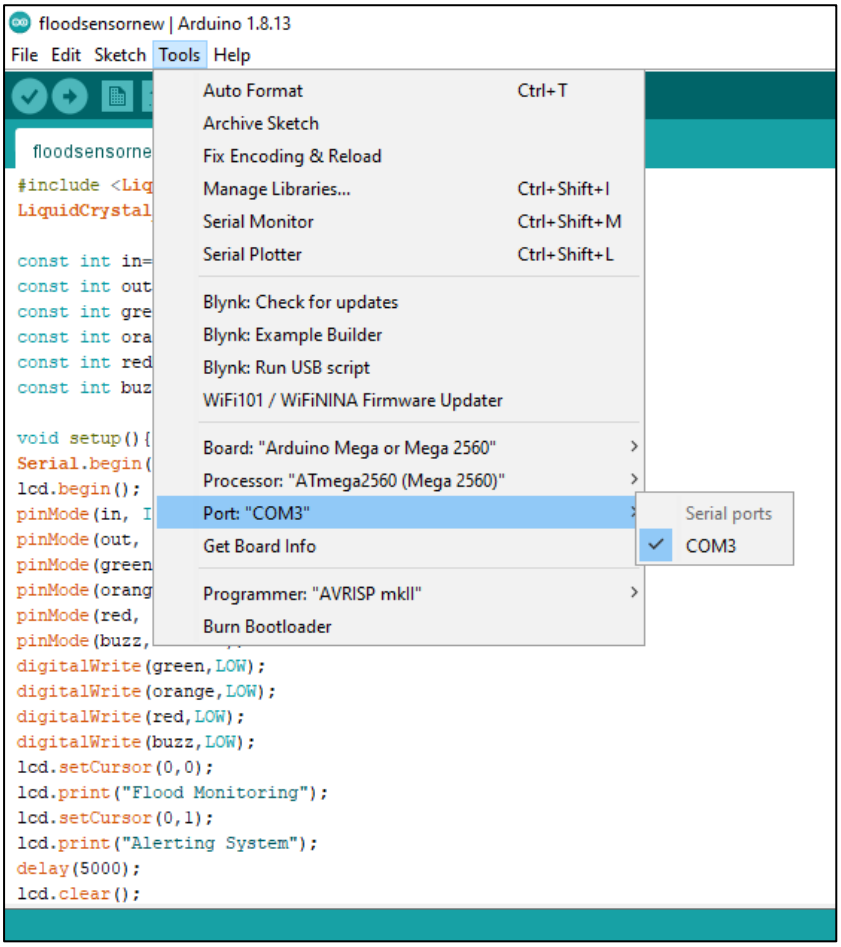


Figure 3.14 Serial Port Configuration

Programmer can upload the program by clicking the upload button in Arduino platform and the program will be stored and installed in ESP8266 NodeMCU board.

3.12.2 Additional Arduino Library Installation

Library is a bundle of coding that can make it easier to connect to the device. It can easily connect the module, display, motor or etc. (*Arduino - Libraries*, n.d.). This configuration is essential since the LCD Display in this project was applied I2C LCD

Display and it's not already installed in the Arduino IDE. So, it needs to be installed manually in the Arduino IDE software. If this step skipped, then it occurs an error and couldn't deliver the output. After the installation is done, the display can produce an output from the system.

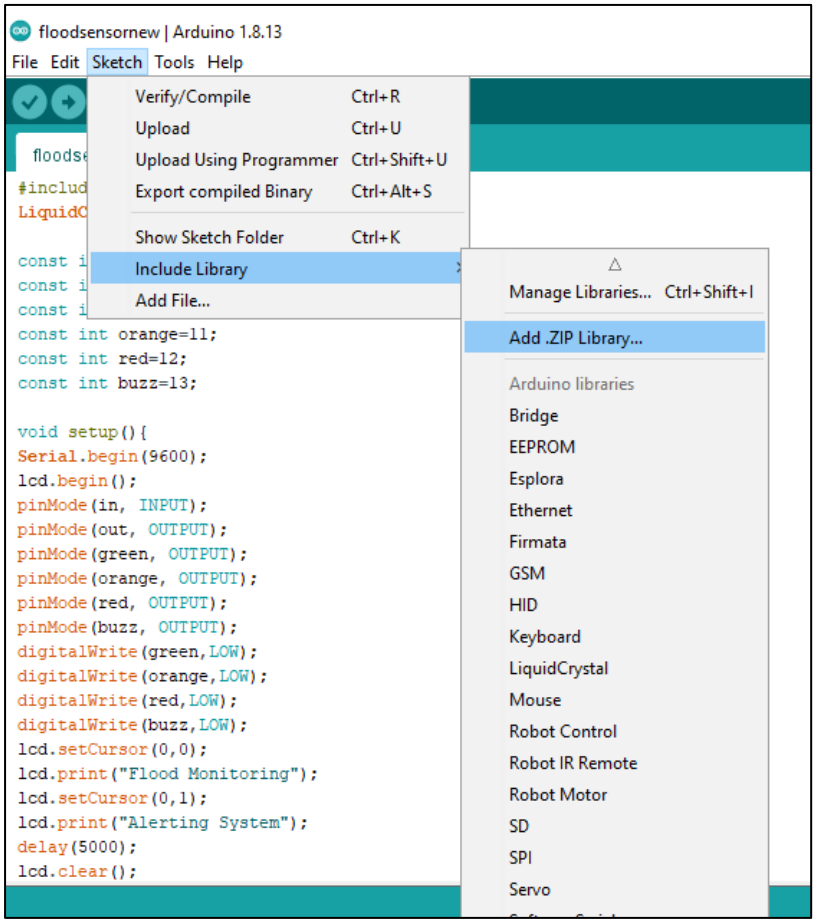


Figure 3.15 Additional Libraries Installation

3.12.3 Arduino Software Coding

Arduino Desktop IDE is a platform that used to write a program and comply it to the board. This platform act as a backstage that allow programmer to write a function in order to build a system. All of codes are included in this software where it can control the system. Then it will be uploaded to the microcontroller for hardware development.

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);

const int in=8;
const int out=9;
const int green=10;
const int orange=11;
const int red=12;
const int buzz=13;

void setup(){
Serial.begin(9600);
lcd.begin();
pinMode(in, INPUT);
pinMode(out, OUTPUT);
pinMode(green, OUTPUT);
pinMode(orange, OUTPUT);
pinMode(red, OUTPUT);
pinMode(buzz, OUTPUT);
digitalWrite(green,LOW);
digitalWrite(orange,LOW);
digitalWrite(red,LOW);
digitalWrite(buzz,LOW);
lcd.setCursor(0,0);
lcd.print("Flood Monitoring");
lcd.setCursor(0,1);
lcd.print("Alerting System");
delay(5000);
lcd.clear();
```

Figure 3.16 Arduino Codes Part 1

At this part, all the library must be declared in this part. It must be declared on the top of the coding in order to run the system smoothly without any errors. At the same time, all of the input or output pin must be declared at this part. LED are declared since it will turn on and indicate the water level situation. The green LED will turn on if the water level is in the safe situation. The orange LED will indicate the medium situation but must take precaution any time that flood can happen. RED light will indicate that it already in the dangerous level and residents need to be evocated from that area. Also, the system will also send them notification to evacuate their belongings to the safe area.

```
void loop()
{
long dur;
long dist;
long per;
digitalWrite(out,LOW);
delayMicroseconds(2);
digitalWrite(out,HIGH);
delayMicroseconds(10);
digitalWrite(out,LOW);
dur=pulseIn(in,HIGH);
dist=(dur*0.034)/2;
per=map(dist,10.5,2,0,100);
//map function is used to convert the distance into percentage.
if(per<0)
{
  per=0;
}
if(per>100)
{
  per=100;
}
Serial.println(String(per));
lcd.setCursor(0,0);
lcd.print("Water Level:");
lcd.print(String(per));
lcd.print("%  ");
if(per>=80)       //#MAX Level of Water--Red Alert!
```

Figure 3.17 Arduino Codes Part 2

This part will explain on the loop function. This part included the ultrasonic sensor functions and calculations. The map function will used to convert the distance to the percentage form in order the make it easy to read. Then, the percentage value will appear on the LCD Display and also appear on the Blynk application. And the bottom of the part 2 coding will explain about how the system will indicate the situation of the water level based on the measurement from the Ultrasonic sensor.

```
if(per>=80)       //#MAX Level of Water--Red Alert!
{
  lcd.setCursor(0,1);
  lcd.print("Red Alert!   ");
  digitalWrite(red,HIGH);
  digitalWrite(green,LOW);
  digitalWrite(orange,LOW);
  digitalWrite(buzz,HIGH);
  delay(2000);
  digitalWrite(buzz,LOW);
  delay(2000);
  digitalWrite(buzz,HIGH);
  delay(2000);
  digitalWrite(buzz,LOW);
  delay(2000);

}
else if(per>=55)   // #Intermedite Level of Water--Orange Alert!
{
  lcd.setCursor(0,1);
  lcd.print("Orange Alert!  ");
  digitalWrite(orange,HIGH);
  digitalWrite(red,LOW);
  digitalWrite(green,LOW);
  digitalWrite(buzz,HIGH);
  delay(3000);
  digitalWrite(buzz,LOW);
  delay(3000);
```

Figure 3.18 Arduino Codes Part 3

This part is the continuation from the previous part. If the measurement of the ultrasonic sensor will equal or more than 80, it will indicate the situation as danger situation. The red LED will turn on and LCD will display “Red Alert” warning. At the same time, it will appear in the Blynk as warning to warn the residents at that area. If the value is equal or more than 55, the system will declare it as intermediate level. The orange LED will turn on and the “Orange Alert” warning will appear both on display and in the Blynk application.

```
}
else if(per>=55)   // #Intermedite Level of Water--Orange Alert!
{
  lcd.setCursor(0,1);
  lcd.print("Orange Alert!  ");
  digitalWrite(orange,HIGH);
  digitalWrite(red,LOW);
  digitalWrite(green,LOW);
  digitalWrite(buzz,HIGH);
  delay(3000);
  digitalWrite(buzz,LOW);
  delay(3000);

}else          //MIN/NORMAL level of Water--Green Alert!
{
 lcd.setCursor(0,1);
 lcd.print("Green Alert!  ");
 digitalWrite(green,HIGH);
 digitalWrite(orange,LOW);
 digitalWrite(red,LOW);
 digitalWrite(buzz,LOW);
}

delay(15000);
}
```

Figure 3.19 Arduino Codes Part 4

The last part of the coding will see the intermediate level of the water level. The system will indicate the situation if the water's level is equal or same to 55. The orange LED will turn on and notification will deliver to the Blynk application.

3.13 Hardware Development

The progress in hardware development demonstrates the system's physical development. The entire process was logged and tracked using this subtopic. Physical development is easier and less time-consuming than developing software because there are fewer components.

3.13.1 HC-SR04 Ultrasonic Sensor

Ultrasonic sensor is the main component in this system. It will measure the level of the water. So, the connection of this sensor must be perfectly connected so it can avoid any error happen in future. If the sensor broke down, the whole of the system will affect since all of the data came from the sensor. The VCC connected to the 5V port, and GND

pin connected to the ground port on the ESP8266 NodeMCU board. The echo pin will connect to the one of the PWM pin port and same goes with the trig point. These two pins are the main character in order to transmit and receive the data from the sensor.

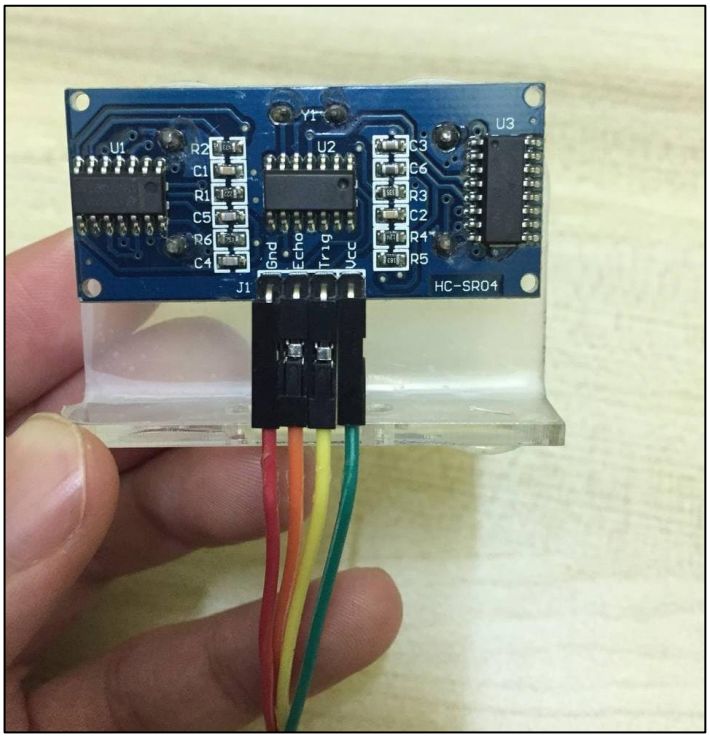


Figure 3.20 Ultrasonic Sensor Installation

3.13.2 I2C 16x2 LCD Display

The display will deliver the information related to the system. It will show the information on it and act as a main interface of the system. The adapter is powered by a PCF8574 8-Bit I/O Expander chip and the I2C data from the Arduino is converted to the parallel data required by the LCD display using this chip (*In-Depth: Interfacing an I2C LCD with Arduino*, n.d.). Serial Data (SDA) is a pin. This line is used for transmitting and receiving data. Connect to the Arduino's SDA pin. The SCL pin is the Serial Clock pin. This is a bus master device-supplied timing signal.

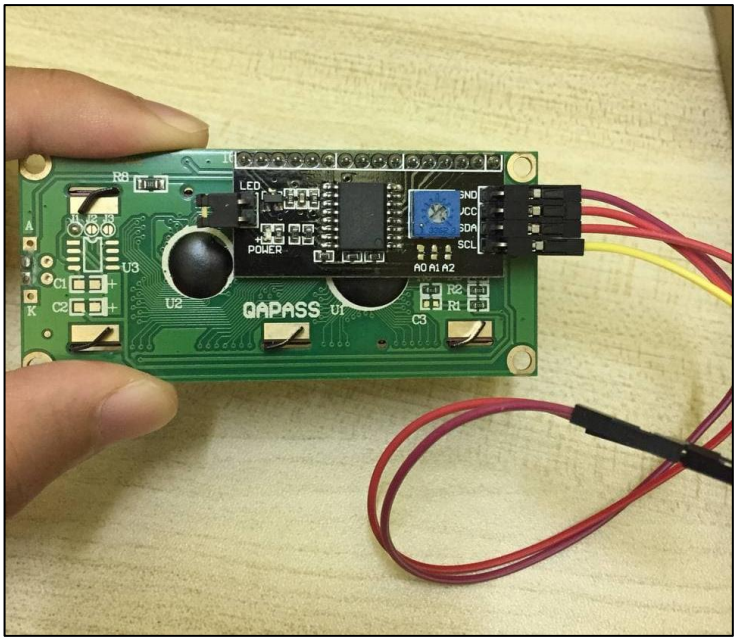


Figure 3.21 I2C LCD Display Installation

3.14 Estimated Cost

Table 3.3 Overall Estimated Cost

Equipment	**Estimated Cost**
HC-SR04 Ultrasonic Sensor	RM 14.90
NODEMCU ESP8266	RM 29.90
18V 10W Solar Panel	RM 99.00
IP56 Waterproof Casing	RM 49.00
12V 7AH Lead Acid Battery	RM 40.00
10A Solar Charge Controller	RM 29.90
AWG26 Wires 4M	RM 18.00
5x7 Strip Board	RM 8.00
LED	RM 2.00
TOTAL	**RM 290.70**

Table 3.3 shows the estimated cost applied for this project. All of the main equipment are included in the table. The actual cost will be declared since when the prototype is done.

3.15 Gantt Chart

This Gantt chart explains the flow of the progress of this semester. A Gantt chart is a bar chart that shows a project plan, this project is working on the progress based on the Gantt chart.

NO.	DESCRIPTION	2021															
		MARCH				APRIL				MAY				JUNE			
		WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4
	SCHEDULE FYP	FYP Briefing Session	Selection of FYP Title and Supervisor					1st General Evalution	Mid Term Break				FYP Progress Presentation		Report and Logbook submission		
	1.0 LITERATURE REVIEW																
1.1	Research for Paper/Journal																
1.2	LogBook Process																
	2.0 ACTIVITY WITH SUPERVISOR																
2.1	Choosing Topic																
2.2	First Draft of Project Chosen																
2.3	Presenting the Process to Supervisor																
2.4	Preparation for Presentation																
	3.0 SKETCHING AND DESIGNING																
3.1	Listing of Components																
3.2	Sketching Block Diagram																
3.3	Flowchart																

Figure 3.23 FYP 1 Gantt Chart

NO.	DESCRIPTION	2021/2022														
		OCTOBER				NOVEMBER				DECEMBER				JANUARY		
		WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7		WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14
	SCHEDULE FYP 2	Continue Research							Mid Term Break	1st General Evalution					FYP2 Seminar (EXSELEN)	Report and Logbook submission
	4.0 LOGBOOK PROGRESS															
4.1	LogBook Process															
	5.0 ARDUINO AND BLYNK WORK															
5.1	Components Equipment															
5.2	Arduino Coding															
5.3	IoT Progress															
	6.0 REALIBILITY TEST															
6.1	Data Analysis															
	7.0 THESIS DRAFT															
7.1	Thesis Draft															

Figure 3.24 FYP 2 Gantt Chart

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter show the research work that was done in order to achieve the objectives. All of the result of the project will be attached and explain in this chapter. The outputs and the data gain from the investigation will be recorded in this section. This topic focusing on to ensure the system can runs smoothly without any errors occur, it must be installed with proper execution approach. This topic also focusing on troubleshooting the problem and comes out with the solution. All of the problem must be diagnosed in order to ensure the system can runs in excellent execution.

4.2 Prototype Testing

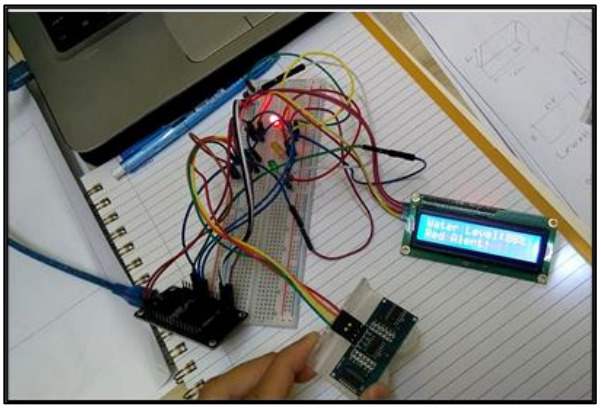


Figure 4.1 Hardware Installation Process

In this part all of the components will be installed with a proper execution. It will be assembled in order to test the system whether it can run smoothly or got some errors. The ultrasonic sensor will be test frequently either it can transmit the data to microcontroller. This issue are essential since the sensor is the main component and very important to this system

in order to achieve the objective of this prototype. The first thing needs to do is to make sure that the system can be turn on.

Figure 4.2 Completed Prototype

After that, the testing begins with the ultrasonic sensor measurement. Then, the information will be converted to the percentage form and display it on the I2C LCD Display. The testing will start with three stages of the measurement. The first situation, the sensor can indicate the safe situation if the water level is below or at the normal level. This situation stated that the flood are rarely can be happen with that level of water. Then, it followed by the awareness situation is when the citizens at that area must precaution and alert because the level of the water showing increasing. This situation indicate that the water level can reach the dangerous level anytime and can prepare their self. The last situation is danger situation where the system indicate that flood will happen and peoples who lived at the area must be evacuated immediately before the it happens.

Figure 4.3 The LCD shows the Safe Situation

Figure 4.4 The LCD Display shows the Awareness Situation

Figure 4.5 The LCD Display shows the Danger Situation

The system will notify the authorities by using Blynk application. The users will aware about the water level and gets a warning notification to evacuate from that area as soon as possible. This system able to save life and also can save their precious stuff. At the same time, authorities can monitor the level of water by percentages of dangerous level in Blynk app. The app interface will show the data information in real data form and users also can monitor the behaviors of the current water levels.

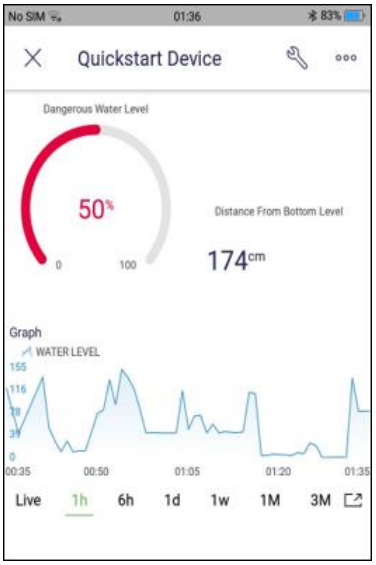


Figure 4.6 Blynk App Interface

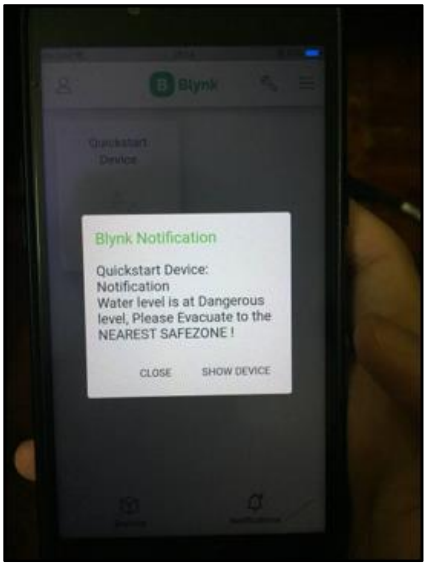


Figure 4.7 Warning Notification Appear

Figure 4.8 Solar Panel Connection

4.3 In-house Testing

This result is taken from the testing that can be done with Ultrasonic sensor to detect the water level. The level of the water level will be indicated as safe level which is the normal level of the water, then the others are indicate as level 1, level 2 and level 3 where it will be a warning. This method can monitor the rise of the water level at the river.

Table 4.1 Data Collection In-house Testing

LEVEL	DISTANCE	NOTICE	ACTION
LEVEL 1	19cm > 15cm	Normal!	Safe Level
LEVEL 2	14cm > 9cm	Cautious!	Awareness
LEVEL 3	8cm > 0cm	Dangerous!	Evacuate

4.4 Field Testing Result

Figure 4.9 Data collection at Titiwangsa's Lake

This result is gain from the outside field to gather the data. This data collection was achieved from the testing at the Titiwangsa’s Lake. This testing was held in 6 hours to gain the data collection.

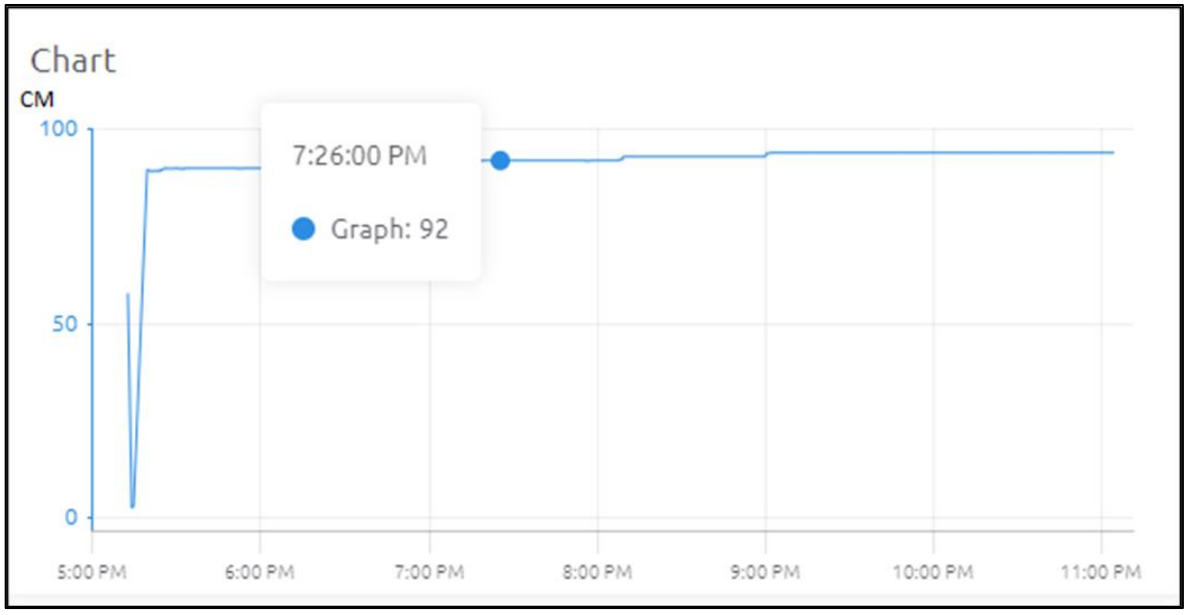


Figure 4.10 Data Collection from Field Testing

CHAPTER 5

CONCLUSION AND RECOMENDATION

5.1 Introduction

All of the conclusion of this study will be addressed in this chapter. Furthermore, some future recommendations are explained in this section to make an improvement for the system's better performance. Also, on this chapter will conclude all of the research either the objectives are achieved. The recommendations in this chapter will explained the improvement and additional solution that suit for this system in order to give an excellent output. But the recommendation will be explained as this investigation is completed.

5.2 Conclusion

Flood is a natural disaster that can kills peoples and also can make a major damage if it happened. Every year this issue is frequently can be heard from the television, media social etc. It will make the government losses and have to expand the budget in order to redevelop the city or area. Development of flood detection system is an alternative solution to reduce the value of people's death and also to reduce the value of losses. This system can give a warning notification to the users to prepare and save the important things before the flood happened. This system can give a warning to the users in order to prepare for the flood. This system also act as a monitoring system so the users can easily monitor the current water's level situation. So, they can prepare their belongings and evacuate themselves to the safest areas. To conclude the project is success since all of the objectives of this project are to develop a flood detector prototype system using the specified hardware and software. The second objective is to create a system that can reduces the flood risk effects and expense by delivering local a flood warning, detection and monitoring system. At the same time, all of the implementation of the hardware and software fundamental can be learned from this

project. A quick examination of trials and experiments in order to make sure the system runs smoothly and flawlessly. As a final conclusion, this project met and achieved all of the objectives stated.

5.3 Recommendations

Future recommendation is essential for the next developer in order to identify the problem and the weakness from the existing project in the future. This project seems to be very useful since flood disaster is frequently happen in our country for every year. There are some of the possibilities that can be improve in the future. The first step is to make sure the ultrasonic sensor that can deliver an accurate data and measurement by avoiding the stuff or something that can pass through below the sensor. This sensor will indicate a wrongly information when it happens. So, the application of the others sensor is also recommended such as float sensor. The float sensor can measurement the level of water if it exceeding the limits. This application also can reduce an accurate data and also can perform with excellent performance. Next possibility is to develop a solar power source system that can support the system when there is no power source at that area. This can help the system operate simultaneously all time with any disturbance. So, the users always can be notified by the system even there is no power sources at that time. This can help the system improve and give an excellent performance.

REFERENCES

Malaysia: risk index for natural disasters 2020 | Statista. (n.d.). Retrieved May 22, 2021, from https://www.statista.com/statistics/920888/malaysia-risk-index-for-natural-disasters/

Advantages and Disadvantages of Using Arduino – Engineer Experiences. (n.d.). Retrieved May 20, 2021, from https://engineerexperiences.com/advantages-and-disadvatages.html

Alfahadiwy, M. I. K., & Suliman, A. (2011). Flood Detection using Sensor Network and Notification via SMS and Public Network. *Student Conference On Research And Development (SCOReD 2011), June*, 1–7.

Arduino - Home. (n.d.). Retrieved May 23, 2021, from https://www.arduino.cc/

Arduino - Introduction. (n.d.). Retrieved May 18, 2021, from https://www.arduino.cc/en/guide/introduction

Arduino - Libraries. (n.d.). Retrieved December 18, 2021, from https://www.arduino.cc/en/guide/libraries

Arduino Technology Architecture and its Applications. (n.d.). Retrieved May 20, 2021, from https://www.watelectronics.com/arduino-technology-architecture-and-applications/

Asante, K. O., Macuacua, R. D., Artan, G. A., Lietzow, R. W., & Verdin, J. P. (2007). Developing a flood monitoring system from remotely sensed data for the Limpopo basin. *IEEE Transactions on Geoscience and Remote Sensing*, *45*(6), 1709–1714. https://doi.org/10.1109/TGRS.2006.883147

Blynk IoT platform: for businesses and developers. (n.d.-a). Retrieved May 23, 2021, from https://blynk.io/

Blynk IoT platform: for businesses and developers. (n.d.-b). Retrieved May 19, 2021, from https://blynk.io/

Chiang, M., & Zhang, T. (2016). Fog and IoT: An Overview of Research Opportunities.

IEEE Internet of Things Journal, *3*(6), 854–864. https://doi.org/10.1109/JIOT.2016.2584538

Coastal flooding. (n.d.). Retrieved May 22, 2021, from http://www.floodsite.net/juniorfloodsite/html/en/teacher/thingstoknow/hydrology/coastalfloods.html

Complete Guide for Ultrasonic Sensor HC-SR04 with Arduino | Random Nerd Tutorials. (n.d.). Retrieved May 23, 2021, from https://randomnerdtutorials.com/complete-guide-for-ultrasonic-sensor-hc-sr04/

Dano, U. L., Balogun, A. L., Matori, A. N., Yusouf, K. W., Abubakar, I. R., Mohamed, M. A. S., Aina, Y. A., & Pradhan, B. (2019). Flood susceptibility mapping using GIS-based analytic network process: A case study of Perlis, Malaysia. *Water (Switzerland)*, *11*(3). https://doi.org/10.3390/w11030615

Deokamble, P. V. B. (2020). *FLOOD DETECTION AND ALERT SYSTEM BASED ON IOT*. *09*, 1084–1090.

Department of Irrigation and Drainage. (n.d.). Retrieved May 19, 2021, from https://www.water.gov.my/index.php/pages/view/349?mid=220

Episode 141: The 5 Stages of Flooding. (n.d.). Retrieved May 19, 2021, from https://www.floodinsuranceguru.com/floodgurupodcast/episode-140-the-5-stages-of-flooding

Espressif - WikiDevi. (n.d.). Retrieved January 12, 2022, from https://web.archive.org/web/20171201034024/https://wikidevi.com/wiki/Espressif

Flood and flash flood definitions. (n.d.). Retrieved May 19, 2021, from https://www.weather.gov/mrx/flood_and_flash

Floods. (n.d.). Retrieved May 22, 2021, from https://www.who.int/health-topics/floods#tab=tab_1

From, R. E., Ednesti, T. H. E. B., & Reparation, S. I. T. E. P. (1998). E Ffect of S Ite P Reparation on. *Journal of Computer Science*, *1*(2), 1–3.

How HC-SR04 Ultrasonic Sensor Works & How to Interface It With Arduino. (n.d.). Retrieved May 18, 2021, from https://lastminuteengineers.com/arduino-sr04-ultrasonic-sensor-tutorial/

Identity Monitoring - IDStrong. (n.d.). Retrieved May 22, 2021, from https://www.idstrong.com/

In-Depth: Interfacing an I2C LCD with Arduino. (n.d.). Retrieved December 20, 2021, from https://lastminuteengineers.com/i2c-lcd-arduino-tutorial/

Insight Into ESP8266 NodeMCU Features & Using It With Arduino IDE (Easy Steps). (n.d.). Retrieved January 12, 2022, from https://lastminuteengineers.com/esp8266-nodemcu-arduino-tutorial/

Journal, M. S. (2020). *LabVIEW Based Flood Monitoring System*. *April*, 254–260.

Katuk, N., Ku-Mahamud, K. R., Norwawi, N., & Deris, S. (2009). Web-based support system for flood response operation in Malaysia. *Disaster Prevention and Management: An International Journal*, *18*(3), 327–337. https://doi.org/10.1108/09653560910965673

Khalid, M. S. Bin, & Shafiai, S. B. (2015). Flood Disaster Management in Malaysia: An Evaluation of the Effectiveness Flood Delivery System. *International Journal of Social Science and Humanity*, *5*(4), 398–402. https://doi.org/10.7763/ijssh.2015.v5.488

Khan, M. A., & Salah, K. (2018). IoT security: Review, blockchain solutions, and open challenges. *Future Generation Computer Systems*, *82*, 395–411. https://doi.org/10.1016/j.future.2017.11.022

Kuang, K. S. C., Quek, S. T., & Maalej, M. (2008). Remote flood monitoring system based on plastic optical fibres and wireless motes. *Sensors and Actuators, A: Physical*, *147*(2), 449–455. https://doi.org/10.1016/j.sna.2008.05.030

Lee, I., & Lee, K. (2015). The Internet of Things (IoT): Applications, investments, and challenges for enterprises. *Business Horizons*, *58*(4), 431–440. https://doi.org/10.1016/j.bushor.2015.03.008

Lopez-Fuentes, L., Rossi, C., & Skinnemoen, H. (2017). River segmentation for flood monitoring. *Proceedings - 2017 IEEE International Conference on Big Data, Big Data 2017*, *2018-Janua*, 3746–3749. https://doi.org/10.1109/BigData.2017.8258373

Mai Syaheera, M. S., Abd Karim, M. Z., & Basri, B. H. (2016). Flood disaster and GDP growth in Malaysia. *European Law Review*, *8*(2), 01–01. https://doi.org/10.21859/eulawrev-08023

Mohd Taib, Z., Jaharuddin, N. S., & Mansor, Z. (2016). A Review of Flood Disaster and Disaster Management in Malaysia. *International Journal of Accounting and Business Management*, *4*(2), 98–106. https://doi.org/10.24924/ijabm/2016.11/v4.iss2/98.106

Muqtada, M., Khan, A., Ashikin, N., Shaari, B., Muchtar, A., Bahar, A., Adriansyah, D., & Nazaruddin, B. (2014). *Flood Impact Assessment in Kota Bharu , Malaysia : A Statistical Analysis Faculty of Earth Science , Universiti Malaysia Kelantan , Jeli Campus , School of Quantitative Sciences , Universiti Utara Malaysia ,*. *32*(100), 626–634. https://doi.org/10.5829/idosi.wasj.2014.32.04.422

NodeMCU ESP8266 Pinout, Specifications, Features & Datasheet. (n.d.). Retrieved January 12, 2022, from https://components101.com/development-boards/nodemcu-esp8266-pinout-features-and-datasheet

Number of disasters by type 1998-2017 | Economic losses, pov… | Flickr. (n.d.). Retrieved May 21, 2021, from https://www.flickr.com/photos/isdr/45154655574

PCB Design and Circuit Simulator Software - Proteus. (n.d.). Retrieved May 23, 2021, from https://www.labcenter.com/

Proteus Design Suite - Wikipedia. (n.d.). Retrieved May 18, 2021, from https://en.wikipedia.org/wiki/Proteus_Design_Suite

Rahaman, S. A. (2015). *ISSN No : 2348-4845 Flash Flood Warning System Using Scada Systems ISSN No : 2348-4845*. *2*(August), 68–75.

Ramizu, M., & Halim, A. (n.d.). *Flood Monitoring and Warning System by Universiti Teknologi PETRONAS Bandar Seri Iskandar 31750 Tronoh Perak Darul Ridzuan Flood Monitoring and Warning System*.

Reeve, H. M., Mescher, A. M., & Emery, A. F. (2001). Experimental and numerical investigation of polymer preform heating. *American Society of Mechanical Engineers, Heat Transfer Division, (Publication) HTD*, *369*(6), 321–332.

Reeves, B., Nabil, A., Al-suhili, R., Bustami, R., Bessaih, N., Bong, C., & Suhaili, S. (2007). Artificial Neural Network for Precipitation and Water Level Predictions of Bedup River. *IAENG International Journal of Computer Science*, *34*(2), 228–233.

Shokova, Y. A., Di, G., Yang-jian, C., & Qiang, L. (2015). *GSM & web-based flood monitoring system*. https://doi.org/10.1088/1757-899X/79/1/012023

Solar Panel Sub System Building Blocks - Philips. (n.d.). Retrieved May 23, 2021, from https://www.lighting.philips.com.my/prof/outdoor-luminaires/solar/building-blocks/solar-panel-sub-system

Sunkpho, J., & Ootamakorn, C. (2011). Real-time flood monitoring and warning system. *Songklanakarin Journal of Science and Technology*, *33*(2), 227–235.

The process of floods - Tweed River Flooding. (n.d.). Retrieved May 22, 2021, from https://tweedriverflooding.weebly.com/the-process-of-floods.html

Three common types of flood explained | Zurich Insurance. (n.d.). Retrieved May 22, 2021, from https://www.zurich.com/en/knowledge/topics/flood-and-water-damage/three-common-types-of-flood

Tingsanchali, T. (2012). Urban flood disaster management. *Procedia Engineering*, *32*, 25–37. https://doi.org/10.1016/j.proeng.2012.01.1233

Toriman, M. E., Gazim, M. B., Mokhtar, M., Mastura, S. a. S., Karim, O., & Aziz, N. A. A. (2009). Integration of 1-d Hydrodynamic Model and GIS Approach in Flood Management Study in Malaysia. *Research Journal of Earth Sciences*, *1*(1), 22–27.

US Department of Commerce, N. N. W. S. (n.d.). *Flood and flash flood definitions*.

What are the two types of floods? (n.d.). Retrieved May 19, 2021, from https://www.usgs.gov/faqs/what-are-two-types-floods?qt-news_science_products=0#qt-news_science_products

What is a Flood? | What Causes a Flood? | Flooding | Earth Networks. (n.d.). Retrieved May 19, 2021, from https://www.earthnetworks.com/flooding/#river-flood

What Is a River Flood? (n.d.). Retrieved May 19, 2021, from https://sciencing.com/about-6310709-river-flood-.html

What is IoT (Internet of Things) and How Does it Work? (n.d.). Retrieved May 17, 2021, from https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT

Yadav, E. P., Mittal, E. A., & Yadav, H. (2018, November 1). IoT: Challenges and Issues in Indian Perspective. *Proceedings - 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages, IoT-SIU 2018*. https://doi.org/10.1109/IoT-SIU.2018.8519869

APPENDIX A

```
#define BLYNK_TEMPLATE_ID "TMPLiZ5tiJYB"
#define BLYNK_DEVICE_NAME "Quickstart Template"
#define BLYNK_AUTH_TOKEN "tGUGKQoPzasobhVrX4ROiCn1zuWLSSuN"

#include <Arduino.h>
#include <LiquidCrystal_I2C.h>
#include <BlynkSimpleEsp8266.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

const int in = 12; //D6
const int out = 14; //D5
const int green = 16; //D0
const int orange = 15; //D8
const int red = 13; //D7


char auth[] = BLYNK_AUTH_TOKEN;

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "HUAWEI-B315-0FD0";
char pass[] = "12651635";
```

```
void runProgram(){
  long dur;
  long dist;
  long per;
  int height;

  digitalWrite(out, LOW);
  delayMicroseconds(2);
  digitalWrite(out, HIGH);
  delayMicroseconds(10);
  digitalWrite(out, LOW);

  dur = pulseIn( in , HIGH);
  dist = (dur * 0.034) / 2;
  per = map(dist, 20, 2, 0, 100);
  height = 180 - dist;
  //map function is used to convert the distance into percentage.
  Blynk.virtualWrite(V4,per);
  Blynk.virtualWrite(V5,height);
  Blynk.virtualWrite(V6,height);
  if (per < 0) {
    per = 0;
  }
  if (per > 100) {
    per = 100;
  }
```

```
Serial.println(String(per));
lcd.setCursor(0, 0);
lcd.print("Water Level:");
lcd.print(String(per));
lcd.print("%  ");
if (per >= 60) //#MAX Level of Water--Red Alert!
{
  lcd.setCursor(0, 1);
  lcd.print("Dangerous !  ");
  digitalWrite(red, HIGH);
  digitalWrite(green, LOW);
  digitalWrite(orange, LOW);
  Blynk.logEvent("notification", "Water level is at Dangerous level, Please Evacuate to the NEAREST SAFEZONE !");

} else if (per >= 40) // #Intermedite Level of Water--Orange Alert!
{
  lcd.setCursor(0, 1);
  lcd.print("Cautious  ");
  digitalWrite(orange, HIGH);
  digitalWrite(red, LOW);
  digitalWrite(green, LOW);
```

```
    lcd.setCursor(0, 1);
    lcd.print("Normal  ");
    digitalWrite(green, HIGH);
    digitalWrite(orange, LOW);
    digitalWrite(red, LOW);
    digitalWrite(buzz, LOW);
  }
}

void setup() {
  Serial.begin(9600);
  Serial.println("Starting setup");
  lcd.init();
  lcd.backlight();

  pinMode( in , INPUT);
  pinMode(out, OUTPUT);
  pinMode(green, OUTPUT);
  pinMode(orange, OUTPUT);
  pinMode(red, OUTPUT);
  pinMode(buzz, OUTPUT);
  digitalWrite(green, LOW);
  digitalWrite(orange, LOW);
  digitalWrite(red, LOW);
  digitalWrite(buzz, LOW);

  lcd.setCursor(0, 0);
  lcd.print("Flood Monitoring");
  lcd.setCursor(0, 1);
```

```
  pinMode( in , INPUT);
  pinMode(out, OUTPUT);
  pinMode(green, OUTPUT);
  pinMode(orange, OUTPUT);
  pinMode(red, OUTPUT);
  pinMode(buzz, OUTPUT);
  digitalWrite(green, LOW);
  digitalWrite(orange, LOW);
  digitalWrite(red, LOW);
  digitalWrite(buzz, LOW);

  lcd.setCursor(0, 0);
  lcd.print("Flood Monitoring");
  lcd.setCursor(0, 1);
  lcd.print("Alerting System");
  delay(5000);
  lcd.clear();

  Blynk.begin(auth, ssid, pass);
  Serial.println("Connected");
  timer.setInterval(10L,runProgram);
}

void loop() {
  Blynk.run();
  timer.run();
}
```

APPENDIX B

Tech Support: services@elecfreaks.com

Ultrasonic Ranging Module HC - SR04

Product features:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:
(1) Using IO trigger for at least 10us high level signal,
(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.
Test distance = (high level time×velocity of sound (340M/S) / 2,

Wire connecting direct as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- 0V Ground

Electric Parameter

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
MeasuringAngle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**
Dimension	**45*20*15mm**