Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT FLASH FLOOD DETECTION BASED ON IOT

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Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours

Faculty of Electrical and Electronic Engineering Technology

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2021

DECLARATION

I declare that this project report entitled "Development Flash Flood Based on IOT" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Student Name : MOHAMAD FARHAN ADZRI BIN MAZMAN

Date : 9 JANUARI 2022

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

Signature : ....

Supervisor Name : NURBAHIRAH BINTI NORDDIN

Date : 9 JANUARI 2022

Signature : ....

Co-Supervisor Name (if any) : ....

Date : ....

DEDICATION

To my father Mazman Bin Mansor and to my mother Haryani Binti Mat Sahid. Thank you for your trust and support you give to me. All my hardwork and my struggle I do for both of you. Thank you to mu classmate for help me to finish the project and finally for my housemate thank you for your concern, encouragement, knowledge sharing and understanding.

ABSTRACT

Flood is a natural phenomenon, and it is one of the largest natural disasters often occurring worldwide and can cause a negative impact towards the society. The flood may happen without warning and the after effect can causes significant harm to the surrounding ecosystem and put citizen lives in danger. Therefore. “Flash Flood Detection Based on IOT” is proposed to reduce the damage and risk caused by the flood. The aim for this project is give the users information of current water level in a drain. A warning notification sentto the users indicating three types of water level which are safe, warning and danger. The flood detection based on IOT includes an ultrasonic sensor that detects the current water level while also allowing users to view the duration of the water level from their phone and makingthem more aware of when flooding is likely to occur. This system can provide plenty of time to prepare against predicted flood occurrence and they can be rescued from the aftermath of a flood catastrophe.

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ABSTRAK

Banjir adalah fenomena semula jadi dan merupakan salah satu bencana alam terbesar yang sering berlaku di seluruh dunia dan boleh memberi kesan negatif kepada masyarakat. Bencana banjir boleh berlaku tanpa amaran dan akibatnya boleh menyebabkan bahaya besarterhadap ekosistem sekitarnya dan membahayakan nyawa penduduk setempat. Oleh itu. "Pengesanan Banjir Kilat Berdasarkan IOT" diusulkan untuk mengurangi kerosakan dan risiko yang disebabkan oleh banjir. Tujuan projek ini adalah memberi maklumat kepada pengguna mengenai tahap air semasa di longkang. Pemberitahuan amaran akan dikirimkan kepada pengguna yang menunjukkan tiga jenis permukaan air yang aman, amaran dan bahaya. Pengesanan banjir berdasarkan iot merangkumi sensor ultrasonik yang mengesan paras air semasa dan juga membolehkan pengguna melihat jangka masa paras air dari telefon mereka dan membuat mereka lebih mengetahui bila banjir kemungkinan akan berlaku. Sistem ini akan menyediakan banyak masa untuk bersiap sedia menghadapi kejadian banjir yang diramalkan dan mereka dapat diselamatkan dari bencana banjir selepas kejadian

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My highest appreciation goes to my father, Mazman Bin Mansor and my mother, Haryani Binti Mat Sahid for their love, support, encouragement, and prayer during the period of my study.

Throughout my university studies, I am grateful to my friend such Nur Qamarina Binti Sulaini, Nursyafikah binti Kamaruddin my housemate for their help and moral support, knowledge, sharing, and encouragement. Thank you once again for your friendship and memories.

Finally, I would like to thank all who have helped and contributed to our study endeavours in whether way, your generosity means a lot to me and will never be forgotten. Thank you so much for everything.

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V	-	Voltage
℃	-	Celsius
%	-	Percentage

LIST OF ABBREVIATIONS

LCD	-	Voltage
IOT	-	Internet of Things
WSN	-	Wireless Sensor Network
V	-	Voltage
HZ	-	Hertz
Wi-Fi	-	Wireless Fidelity

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CHAPTER 1

INTRODUCTION

1.1 Background

In Malaysia flooding is natural disaster that occurs every year. A flood occurs when a water overflows terrain which is usually dry. There are several kinds of floods such as river floods, urban floods, flash floods and pluvial floods.

Flood disasters can be large-scale and strong enough to cause significant damage in specific areas. The loss is important in terms of human lives lost, assets and food supply disruption, and government infrastructure destruction.

There are two types can be classified for monitoring and alerting flood, which are local sensing data and remote sensing data. The flood parameters are measured through the installation of sensor nodes along the river on local sensing data meanwhile for the satellite generally uses remote sensing data to estimate the rain information and capture the cloud image.

Water level inspection in rivers, temperature and water velocity in certain location are extremely crucial to proving whether the flood will occur due the degree of cloud formation will change from time to time simply depending on how powerful the wind is.

This project is design to monitoring system for river that use local sensing data via microcontroller system for monitoring and the system also can measure various flood parameters such as temperature, water level and water velocity. The user receives an alert.

when the reading of the when one or more parameters reach the threshold values, it indicates a hazardous flood situation.

1.2 Problem Statement

In 1926 the heaviest flood occurred at Perak. This phenomenon known as “Bah Besar”. The flood affecting Sungai Perak, Sungai Kinta, and Sungai Batang Padang. The government has set up a temporary housing and disaster relief movement to help all the victims.

Majority of the flood victims are not fully aware of the upcoming flood calamity because in Perak does not have a flood monitoring and warning system. In certain situation, the authority has warned to the victims, but due the lack of information, the time flood begins and fully flooded, and the victims ignore the information.

In Malaysia, the flood monitoring system uses a telemetry system that continuously monitor water level measurement and uploads them to a specific web page. This procedure needs Internet connection to upload the values and not suitable for Malaysiadue to expensive cost.

Flood monitoring and alert system is an affordable design and able to measure manycharacteristics of the flood such as water velocity, temperature in real time and water level. Furthermore, this project will predict the flood calamity and give an alert to the user.

1.3 Project Objective

The aim of this research is to propose a systematic and effective methodology of the development research for Flash flood based on iot. The main objectives are as follows:

a) To obtain the flooding data parameters such as water level, temperature, and rainfall

b) To construct flash flood prototype

c) To analyze the performance of the built system

1.4 Scope of Project

The scope of this project are as follows:

a) Accuracy of temperature and water level to detect flood

b) This project is focusing on developing Internet of Things (IOT) by using Blynk and Arduino Uno

CHAPTER 2

LITERATURE REVIEW

2.1 What is flooding?

Flooding occurs when water from a river or rain floods a wide area of land. Flood is also known as a temporary rise of the water level as in a lake or river or along seacoast. As a result, it spills over and out of its natural or artificial boundaries onto usually dry land.In Malaysia, flooding is normal phenomena happen every year. It usually happens exposed to the river and in low surface area. It may happen in cities or metropolitan areas such as Kuala Lumpur, Pulau Pinang and Johor Bharu because of the inadequate drainage system that cannot handle the excessive rainwater. Figure 2.1 show floods happened in Kuala Lumpur, Malaysia.

Figure 2.1: Flood Effect in Kuala Lumpur, Malaysia

2.2 Type of Flooding

There are several types of floods that can be occurs in our country Malaysia suchas flash flooding, river flooding, urban flooding, and pluvial flooding. This flood disaster can cause a lot of property destruction which can cause a lot of losses occur.

2.2.1 Flash Flooding

In flash flood can happen in minutes or an hour because of heavy rain, a sudden release of water previously held by ice or a dam or levee failure. A huge debris can be carried by flash flood which can destroy the bridges and building, mud slide, trigger catastrophic and scrape out new channels. Slow-moving thunderstorms, heavy rainfall from hurricanes or thunderstorms repeatedly moving over the same location and other topical are the most common causes of flash flooding. This figure 2.2 show flash flood occur.(R.S.Davis, 2001)

Figure 2.2: How Flash Flood Occurs

2.2.2 River Flooding

Flooding is a common occurrence in our world. The usually occurs when the river's catchment receives more water than normal. The river cannot handle the extra waterin its river and causes the river's water level to rise and the water to flow out of streams, resulting in a flood. This flooding could occur anywhere along the river's course and not just where the extra water has entered. (S.A.Bande, 2017)

Furthermore, floods happen when soil becomes saturated and its capacity for infiltration is zero. Runoffs are unable to be contained in stream channels, constructed. reservoirs, natural ponds, and the land surface is submerged, washing away all its content. Periodic floods, resulting during heavy rains, happened naturally mostly river, and forming an area known as flood plain. River floods often cause rivers to overflow their banks, often with tremendous velocity and devastation. (Ezemonve, 2011)

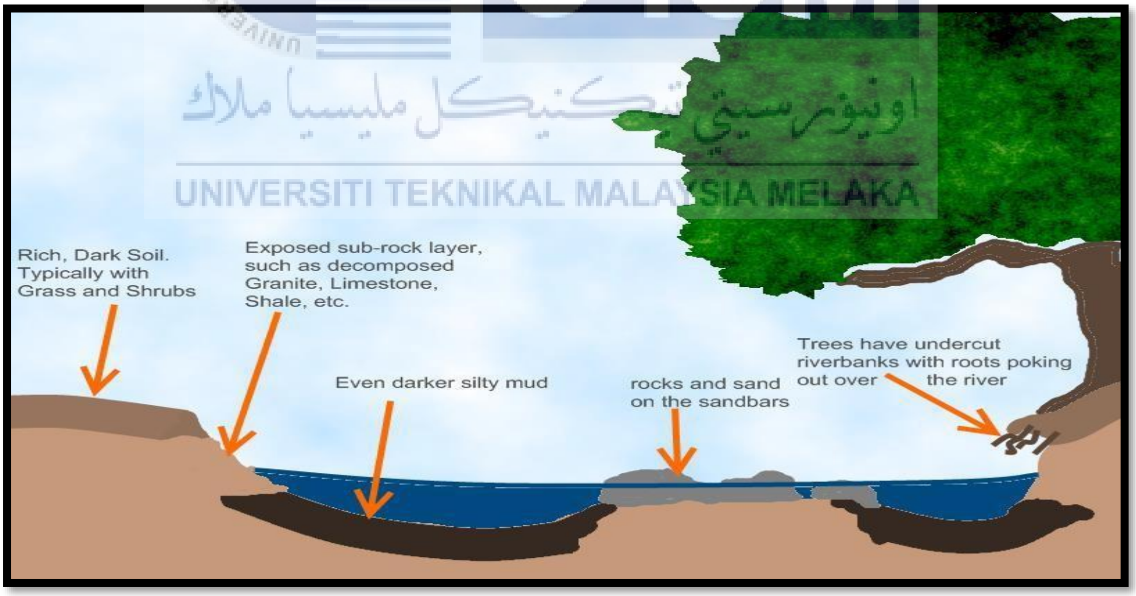

Figure 2.3: How River Flood Occurs

2.3 Review Paper on IOT Based Flood Prediction Model

A Natural can causes damage of property and even worse can cause loss of life. Floods are one of the most common natural disasters can many significant damages to life such as infrastructure, economy, and agriculture. This project use IOT and machine learning based embedded system is to measure different atmospheric conditions and to predict the weather information such as pressure, temperature, humidity, wind speed and direction and rainfall. Next, they also analyzing the trend of climate change to predict the upcoming natural disaster. The method that has been proposed is use a mesh network linkover ZigBee for the WSN to collect data and a Wi-Fi module to transmit the data over theinternet while using very little power. Using a cloud database, data sets from a variety of sensors are recorded and tracked. To forecast various weather events and predict future disasters, data was processed using an artificial neural network model. Wireless sensor network-based environmental monitoring systems have been found to be cost effective, compact, and extremely dependable, but the weakness of this system it cannot use for the large area because typically, each node is powered by an energy-limited battery. (S.A.Bande, 2017)

2.4 Flood Warning and Monitoring System Utilizing Internet of Things Technology

This project is to build wireless sensor node at high susceptibility area by developsan early warning and flood monitoring system in real time. Node MCU based technology integrated is the base of the system and they use Blynk application. The function of wireless sensor node is detecting the water level and rain intensity, when there is an inundation or severe rain, an early warning is given. Node MCU as the microcontroller of the system control rain sensor and ultrasonic sensor. Node MCU will put in the flood zone that has been identified. The buzzer and LED will be started to trigger and alert the victimwhen the flood had reached a certain level of danger.

Figure 2.4: Blynk IOT Based Architecture

The sensor will detect the data and transmitted to the Blynk application via wireless connection. Blynk application via IOS or android smartphone can access the interface and receiving a push notification, so the victim knows the current situation with theflood and rain. The flood level data transmitted by email may be useful to a variety of organizations for system development and flood forecasting. (Mohamad Syafiq Mohd Sabre, Shahrum Shah Abdullah, & Amirul Faruq, 2019)

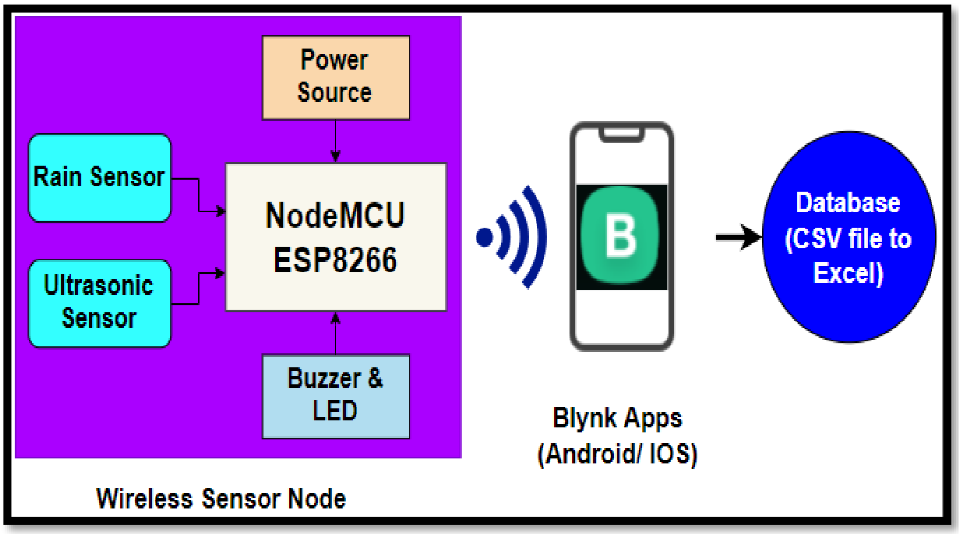

Figure 2.5: Schematic Diagram

2.5 Design of Early Warning Flood Detection System

This purpose of this project is to detect a river's rising water level from a suitable distance from rail track or roadways and alert authorities via SMS so that they can take appropriate action. Water level sensor will connect at different level for this project. Electrodes will be connected with microcontroller. The microcontroller will be connected to a GSM modem with a SIM card. The microcontroller coding will be stored to mobile number of users. SMS will be sent to the registered mobile number once the water level reaches its maximum level. (B.Kanaka Durga, M.Bala Moulika, K. Pradeep Kumar, & L. Karthik Varma, 2018)

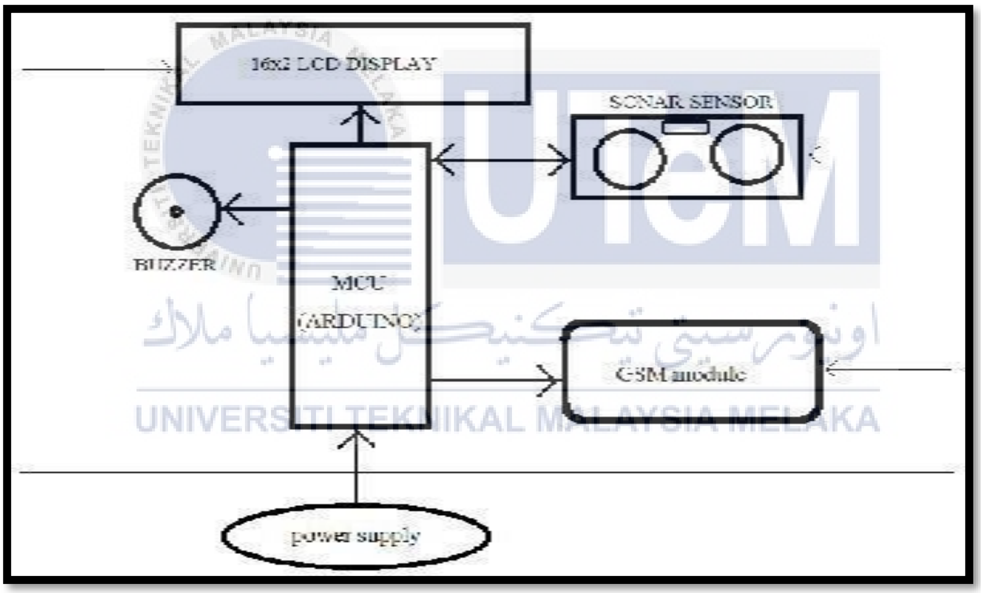

Figure 2.6: Block Diagram of The System

2.6 Real-Time WSN Based Early Flood Detection and Control Monitoring System

The benefit of this project is low cost. This device uses wireless sensor nodes to capture data as images from CMOS image sensors, which are then transmitted to a remote monitoring centre through the Zigbee and GSM networks. The data will be processed by the remote centre, which will analyze it and provide necessary notification to clients. The result of simulation shows the system is low cost and reliable for flood detection in the early stages. (Thekkil & Dr.N.Prabakaran, , 2017)

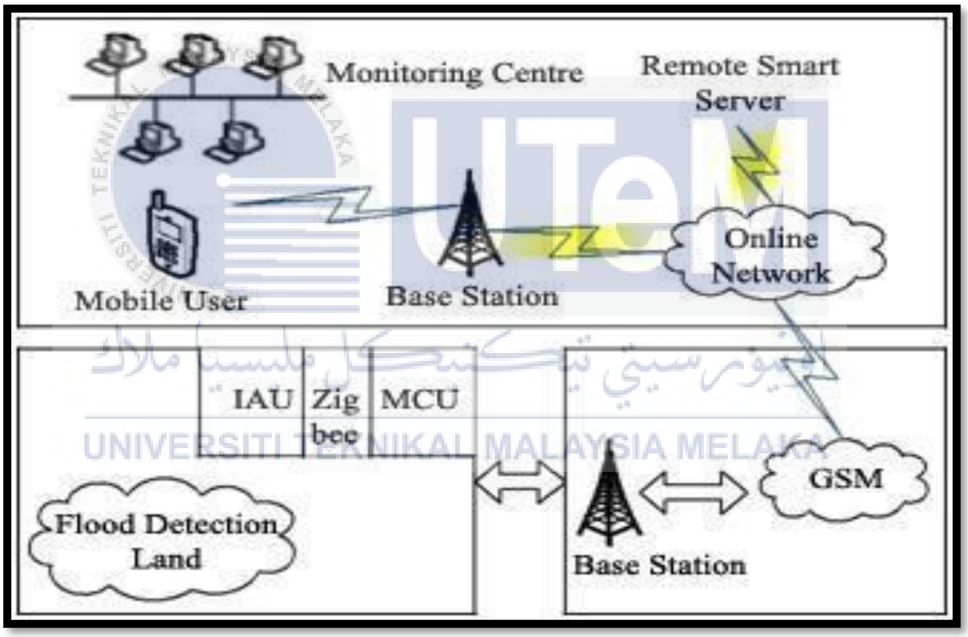

Figure 2.7: Block Diagram of System

2.7 The Implementation of an IOT-Based Flood Alert System

The project entitled the implementation of an IOT-Based Flood Alert System is purposed to detect water level. This project can also monitor the water level rising speedand alert the residents. The waterfall model is the methodology for this project.

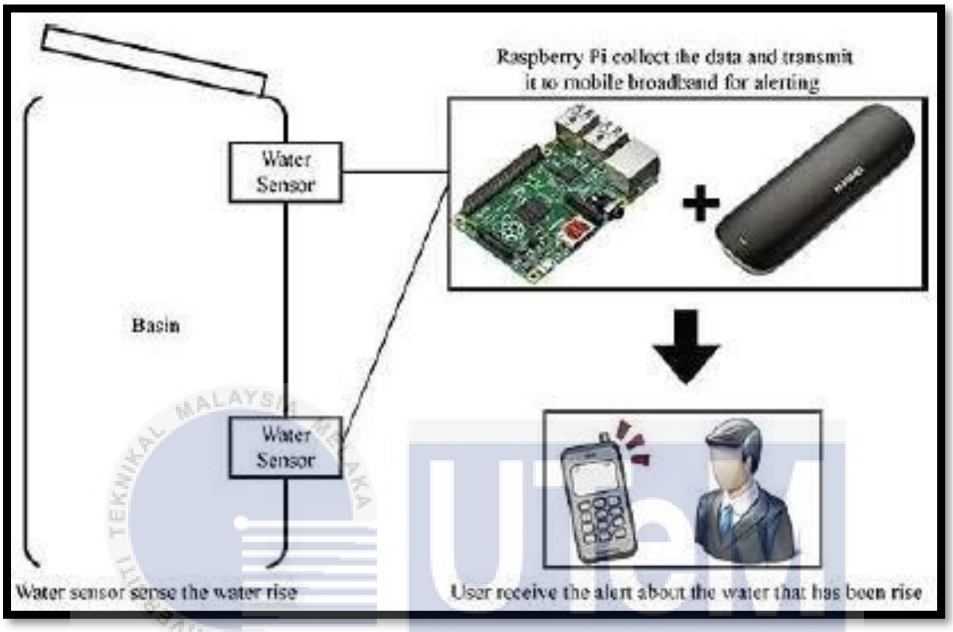

Figure 2.8: Flood Alarm System Design

The data from the water sensor is collected using a Raspberry Pi and sent to GSM module, which generates an SMS warning. There are two different environments in the system to ensure thatthe data provided by the system is correct and reliable.

(Wahidah Md. Shah, 2018)

2.8 Smart IOT Flood Monitoring System

The purpose of this research paper is this project is suitable for cities and village area. Next, they can monitor the situation and predict upcoming flood at the web server if they have an internet access. This system is easy for maintenance and low cost. The systemsfunctions by updating the water level at the web server and the technology will send out an evacuation alert to citizens, allowing them to take the appropriate action quickly.

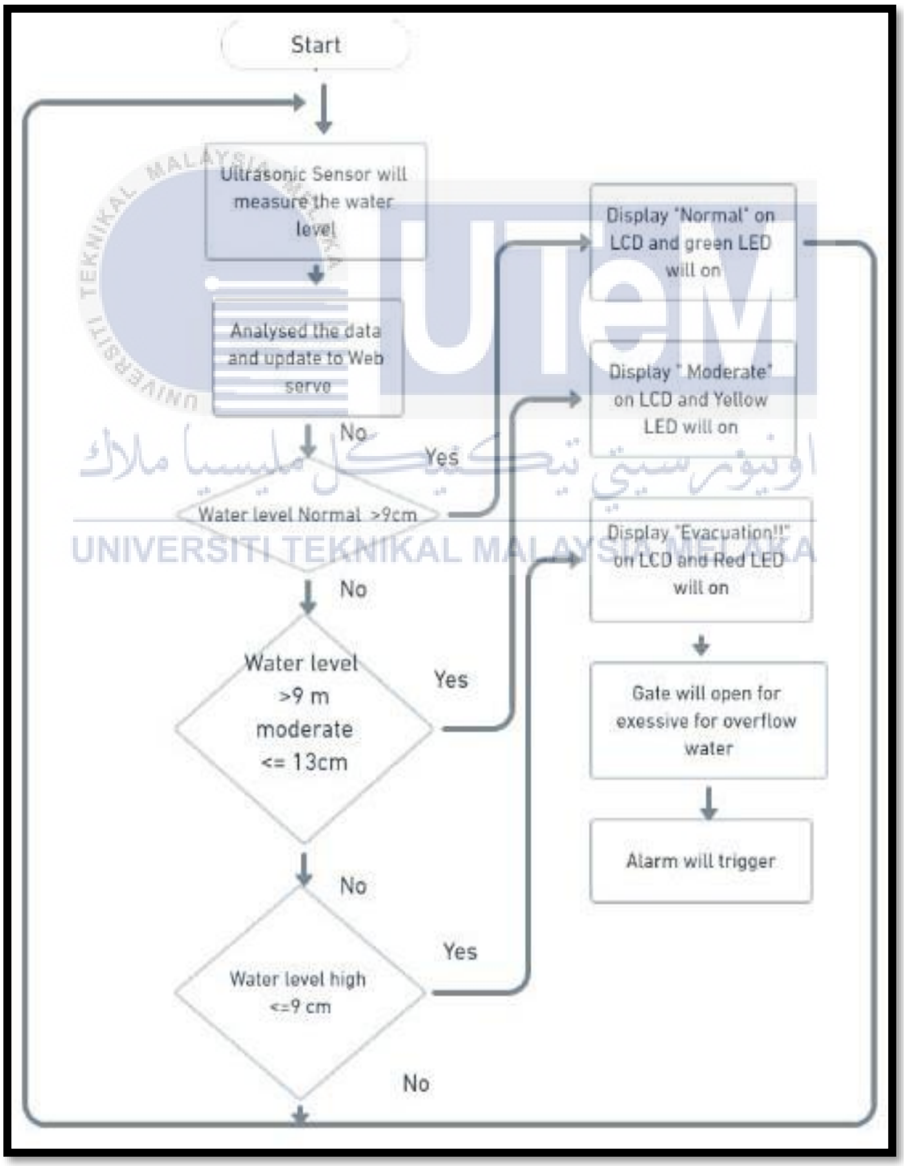

Figure 2.9: Flowchart of The System

Internet Of things (IoT) is widely used all around the world. The user can monitor the water level through mobile or laptop if there is continuous heavy rain as long as there have internet connection. This smart system technology can also wirelessly adjust the alert signal and the gate, allowing excessive water to flow. (Zahir, 2019)

2.9 Flood Detection and Avoidance Using IOT

This article is all about seeking to make Flood Detection and Avoidance using IoT. The function of this system can monitor the water level at dams, river and reservoirs. The sensor technology values are continually monitored and saved in the cloud server, which is help for visualizing flood and alert to the corresponding authorities with the help of IFTTT. The data visualization and KNN algorithm can help to find the suitableplace to place the device. There will update complete data to their web page that developing for this project. Next, they use sensor and automatically lift the dam gates. The model was created to monitor and regulate the disaster in this intelligent system that will oversee water management in general. (Mallangi Surya Prakash Reddy, 2021)

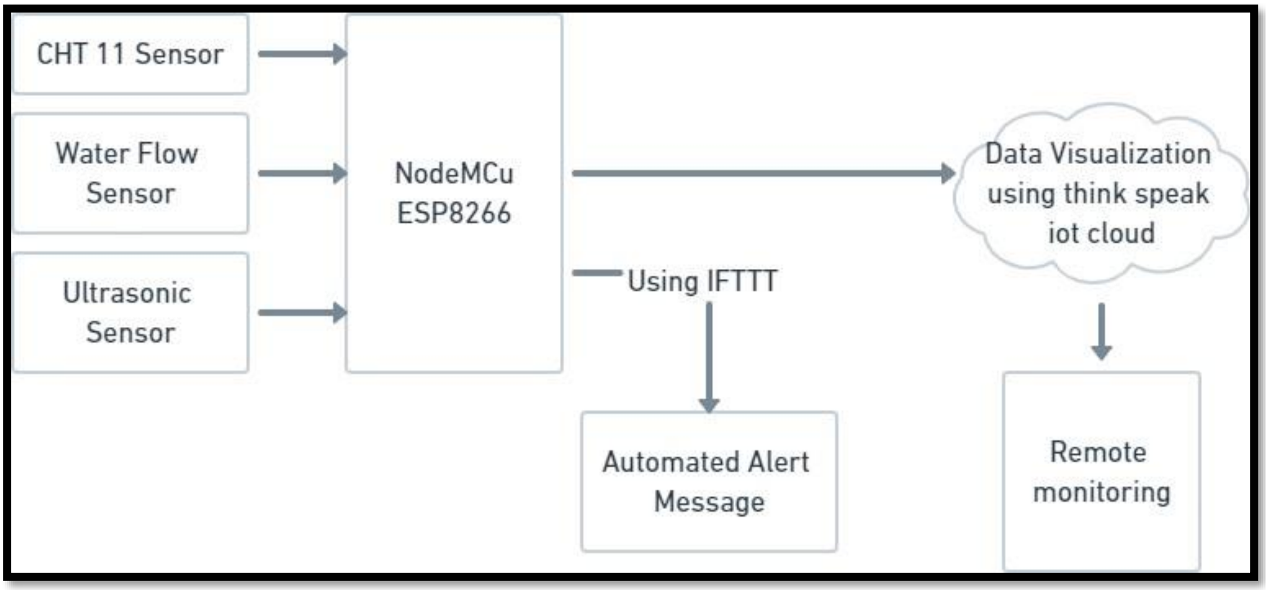

Figure 2.10: General architecture flow diagram of the model

2.10 Flood Monitoring and Early Warning System Using Ultrasonic Sensor

The proposed system provides a real-time flood monitoring and early system in the northern portion of the province of Isabela. The benefit of ultrasonic sensing can spread through any medium as solid, liquid and gasses, it has an exception ability to probe inside objective nondestructively. This project is focused only on water level detection and early warning system that can notify individuals in the event of a potential flood. The alert is sent via SMS or website. The aim of this project is help people to prepare for the floods they will face this project use Arduino, GSM module, ultrasonic sensor, and SMS early warning system for helping stakeholers to reduce flood losses. ((Mohamad Syafiq Mohd Sabre, 2019)

CHAPTER 3

METHODOLOGY

3.1 Introduction

In general, accuracy and effectiveness are considered the two conflicting requirements. Therefore, in this chapter provided the descriptions and explanations for the methodology for the project, which consists of four parts. The first part is the research design for the project. It is a refer to the overall approach that chosen to combine the various components of the study in a consistent and rational manner. Then, ensuring that the researcher issue is effectively addressed which is it constituted a road map or flowchart for data collection, calculation, and analysis. Next, for the proposed methodology is the suggested technique that use both qualitative and quantitative viewpoints and involves a wide variety of approaches, such as literature review, expect opinion, focus groups and material validation. It also required a sophisticated evaluation of the validity of the hardware and structural aspects.

3.2 Flowchart for Project Methodology

This project flowchart will be showing the procedure of this project development.The main purpose is to make sure this project is planned and act accordingly to the plan. Most information will be showing in flow chart experimental, which utilizes empirical modelling and statistical approach. Subsequently, Figure 3.1 shows the research design of this thesis.

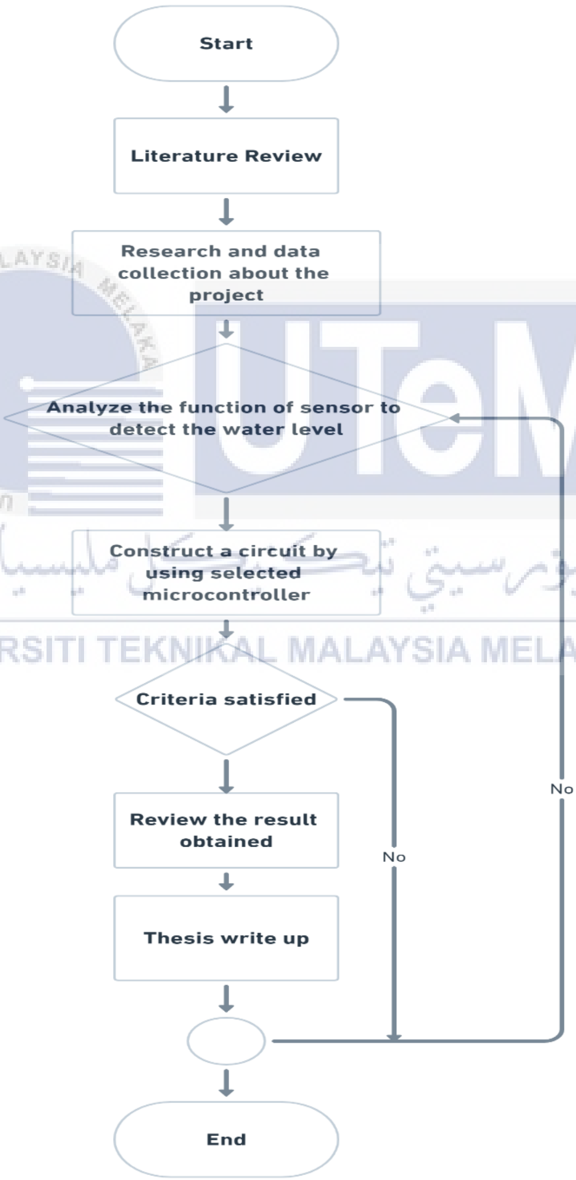

Figure 3.1: Project Methodology Flowchart

3.3 Process Block Diagram

Based on this figure 3.3, the project block diagram includes of three operation which is input, process, and output. For the input there are 3 sensor which is temperature sensor, ultrasonic sensor, and water flow sensor. Meanwhile for the output for this projectthere have a buzzer, LED, wireless module.

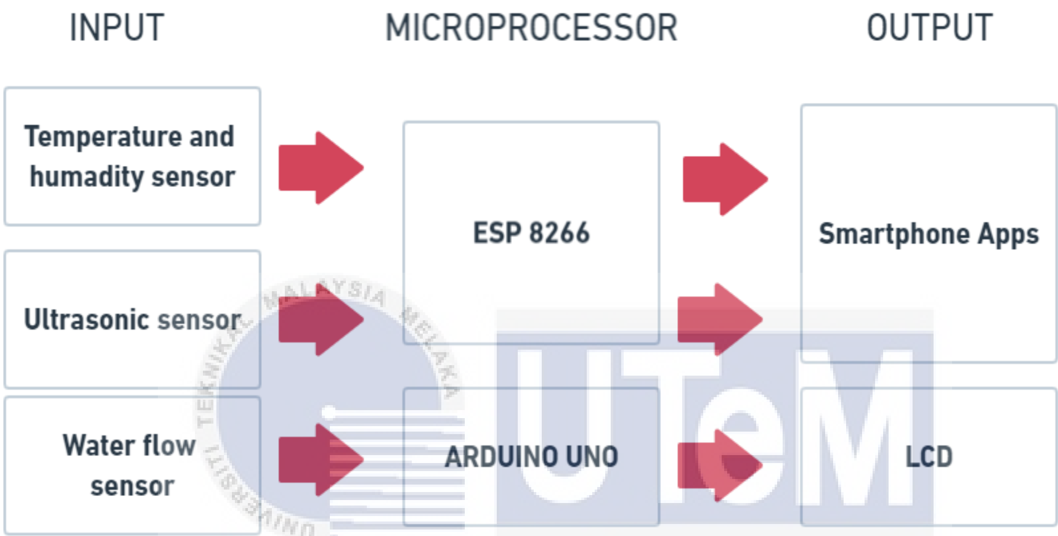

Figure 3.2: Block Diagram

3.4 Project Flowchart

For the proposed methodology, flow chart is the best figure to show the methodology of the project. The flowchart for this project shown in figure 3.3. At first the rain sensor detects the rain and inform the user by display at Blynk. Then if the speed of water flow sensor is high then water flow sensor will detect and will be display at LCD. There are 3 level of water level that have been programmed in the Arduino. First at safe level, secondly at warning and lastly the danger level. Then, if the ultrasonic sensor detects danger level it will show the user at Blynk and will notify user by SMS. At Blynk system can be monitor by phone which show water level, temperature, and humidity.

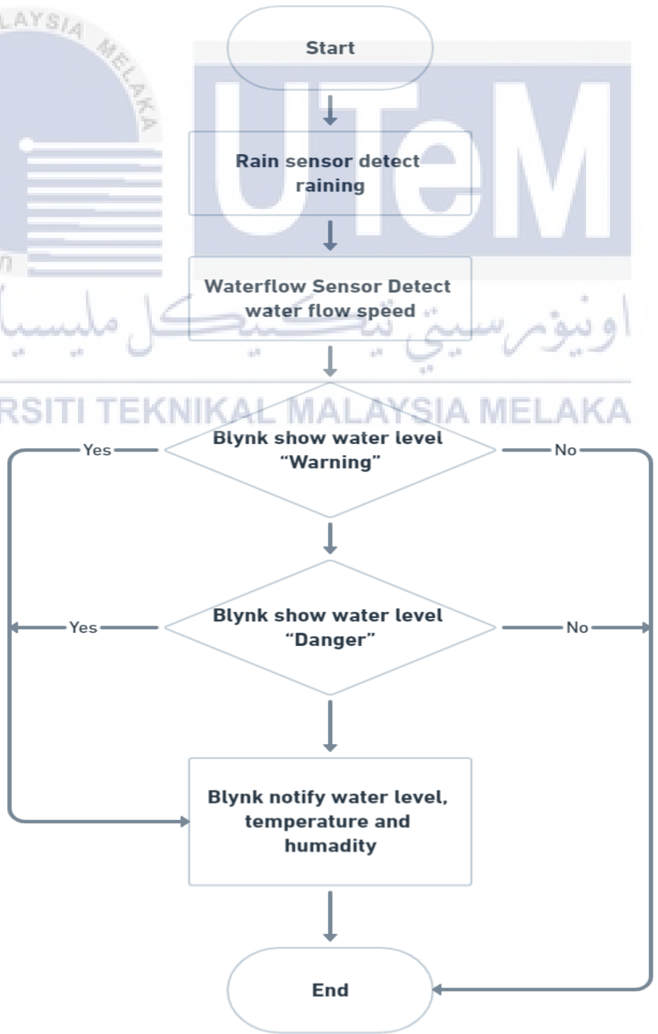

Figure 3.3: Process Flowchart Project

3.5 Equipment

Some hardware and software in this section were selected to achieve the desiredproject outcome. The system comprises of the following components.

3.6 Arduino Uno (AT MEGA UNO 328)

Arduino uno board is a microcontroller with ATmega328 base and it has 14 digital input/output pins (6 pins can be used as PWM outputs), 6 analog inputs. 16 MHz quartz crystal, USB connection, a power jack, ICSP header and a reset button which easy to use. The Arduino uno (ATmega328) work as brain of the entire project and manage the whole systems. The advantages using this Arduino is Arduino have a complete package form which includes the 5V regulator, an oscillator, serial communication interface, a burner, microcontroller, LED, and headers for the connections. This Arduino is commonly used for any type of project because the ATmega328 is simple, low powered and low -cost microcontroller.

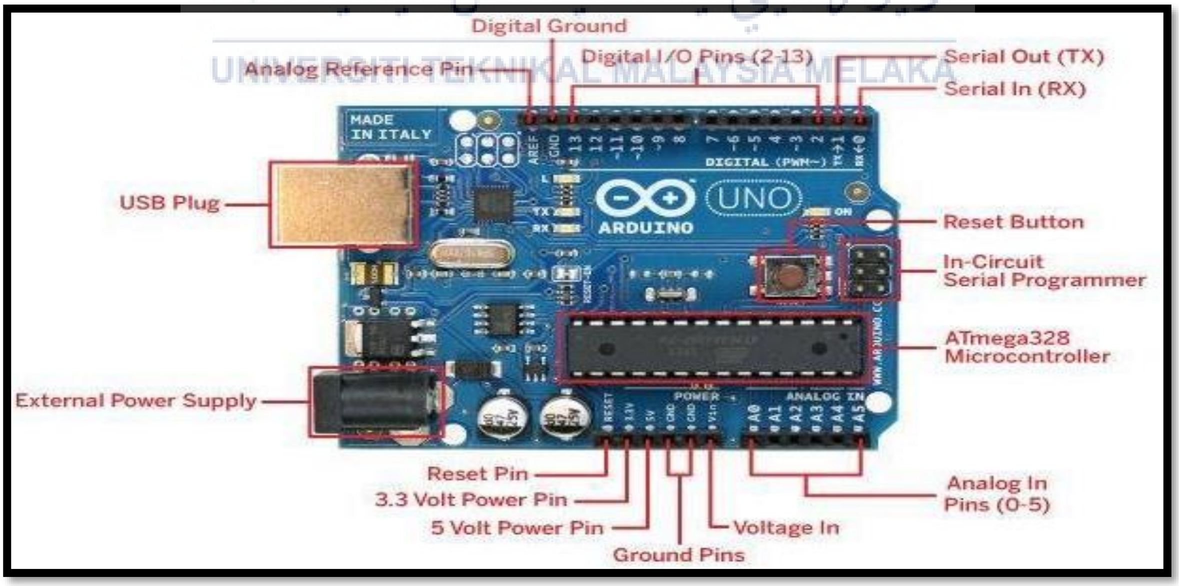

Figure 3.4: Arduino Uno

Table 3.1: Arduino Uno Specification

Parameter	Specification
Microcontroller	ATmega328P
Operating voltage	5V
Input voltage	6 – 20V
Number of analog input pin	6 (A0-A5)
Number of digital I/O pin	14
Flash memory	32KB
Frequency	16MHz

3.7 Sensor

Sensors are vital when measuring the flood parameters. In this project, the parameters are the water level, temperature, and water flow sensor. The sensor used are Ultrasonic sensor, temperature sensor and water flow sensor.

3.7.1 Ultrasonic Sensor

This device is an electronic device that uses for measuring the distance of a target object by using ultrasonic sound waves and transform the reflected sound into an electricalsignal. It works like a simple communication. Ultrasonic sensors consist of two units, namely the transmitter units and the unit recipient. The distance can be calculated using this formula:

Distance = time x velocity

The sensor's detection range start at 2cm to 400cm and accuracy the sensor will reach is 3mm. This figure shows the ultrasonic sensor.

Figure 3.5: Ultrasonic Sensor

3.7.2 Temperature Sensor (DHT 11)

The temperature measurement sensor selected is DHT 11. The DHT11 is basic digital temperature and humidity and very affordable. The air is measured using a capacitive humidity sensor and a thermistor and spits out a digital signal on the data pin(no analog input pins needed). This sensor is utilized in numerous applications, for example in heating, ventilation, and climate measurement, and temperature values. Weather stations also anticipate weather conditions by using these sensors. The operating voltage for this sensor is 3.5V to 5.5V and temperature range is 0 Celsius to 50 Celsius. Next humidity ranges this sensor is 20% to 90%. The resolution for DHT 11 is 16-bits for temperature and humidity.

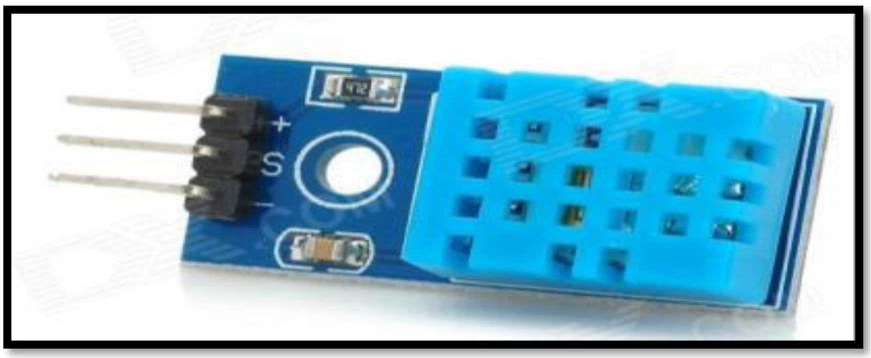

Figure 3.6: Temperature Sensor

3.7.3 Water Flow Sensor

Water flow sensor is a device to measure the rate flow water and measure the amount of water flowed through the pipe. The water flow sensor is usually installed at thewater source or pipe. The sensor has a rotating pinwheel sensor that measures the amount of liquid flowing through the sensor.

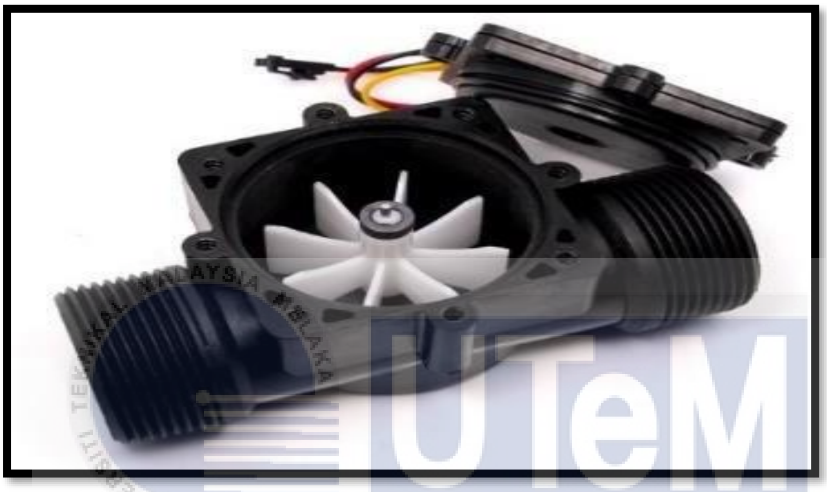

Figure 3.7: Water Flow Sensor

3.7.4 Rain Sensor

A rain sensor is made up of a rain sensing plate and a comparator that controls intelligence. The rain sensor detects water that comes short circuiting the tape of the printed circuits. The sensor functions as a variable resistance that changes depending on its state: resistance increases when the sensor is wet, and resistance decreases when the sensor is dry.

Figure 3.8: Rain Sensor

3.8 ESP 8266

The objective of this project is to alert the people towards upcoming catastrophe of flood. ESP8266 is the mechanism selected for this project to be used. The ESP8266 modules allow microcontrollers to connect to 2.4 GHz Wi-Fi, by using IEEE 802.11 bgn. Itcan be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK. The ESP8266 is an affordable wireless internet microchip.

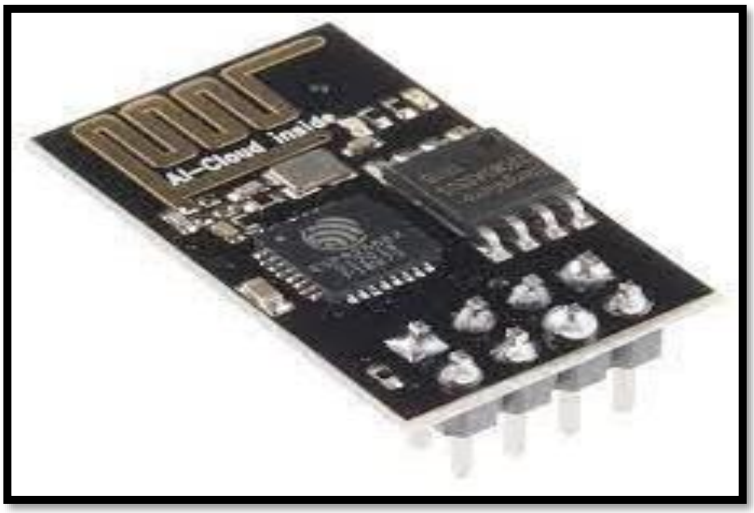

Figure 3.9: ESP 8266

3.9 LCD

LCD is flat panel display technology and usually used to display data from the usedsensor in this project. The LCD consist of 16 pins with the ground connection. The VCC port connects to the Arduino Board with 5 volts.

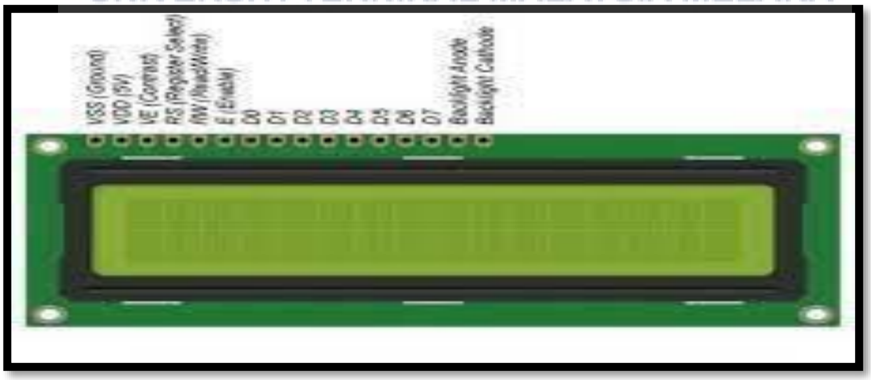

Figure 3.10: Liquid Crystal Display

3.10 Simulation in Proteus

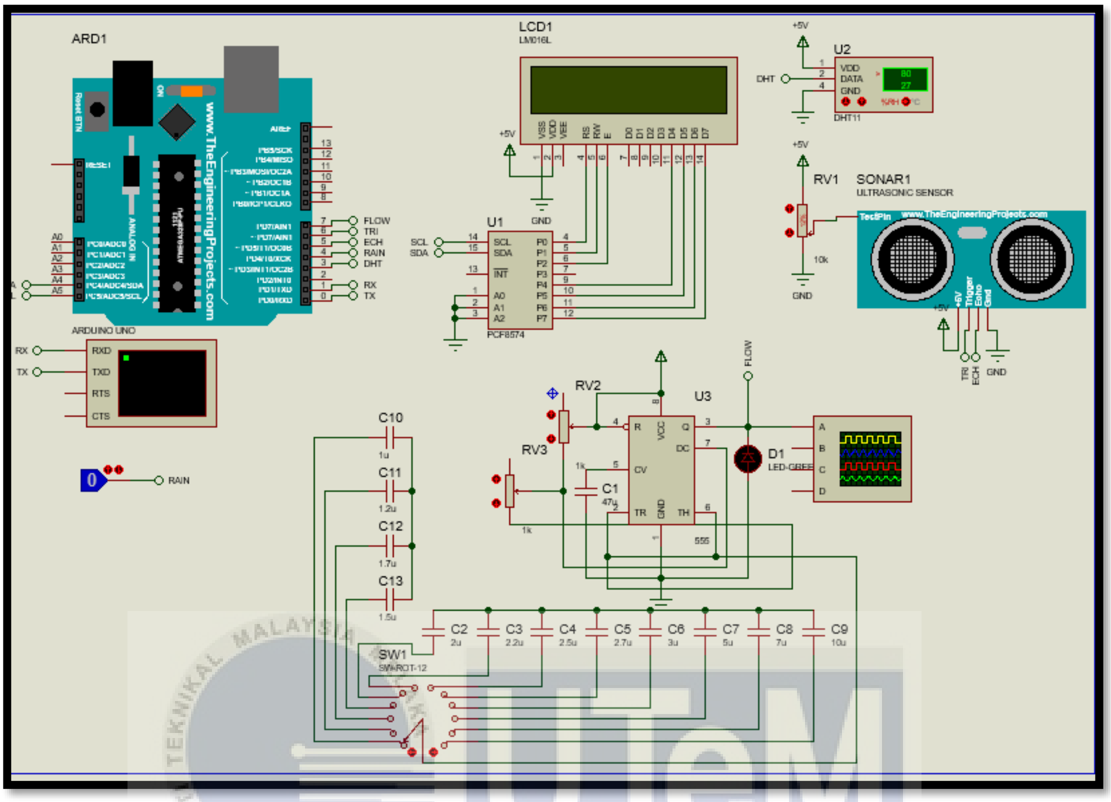

Figure 3.11: Simulation of the circuit

The simulation in proteus used Arduino, LCD, ultrasonic sensor and waterflow sensor. The simulation for the test run before upload at the hardware

3.11 Project Design Prototype

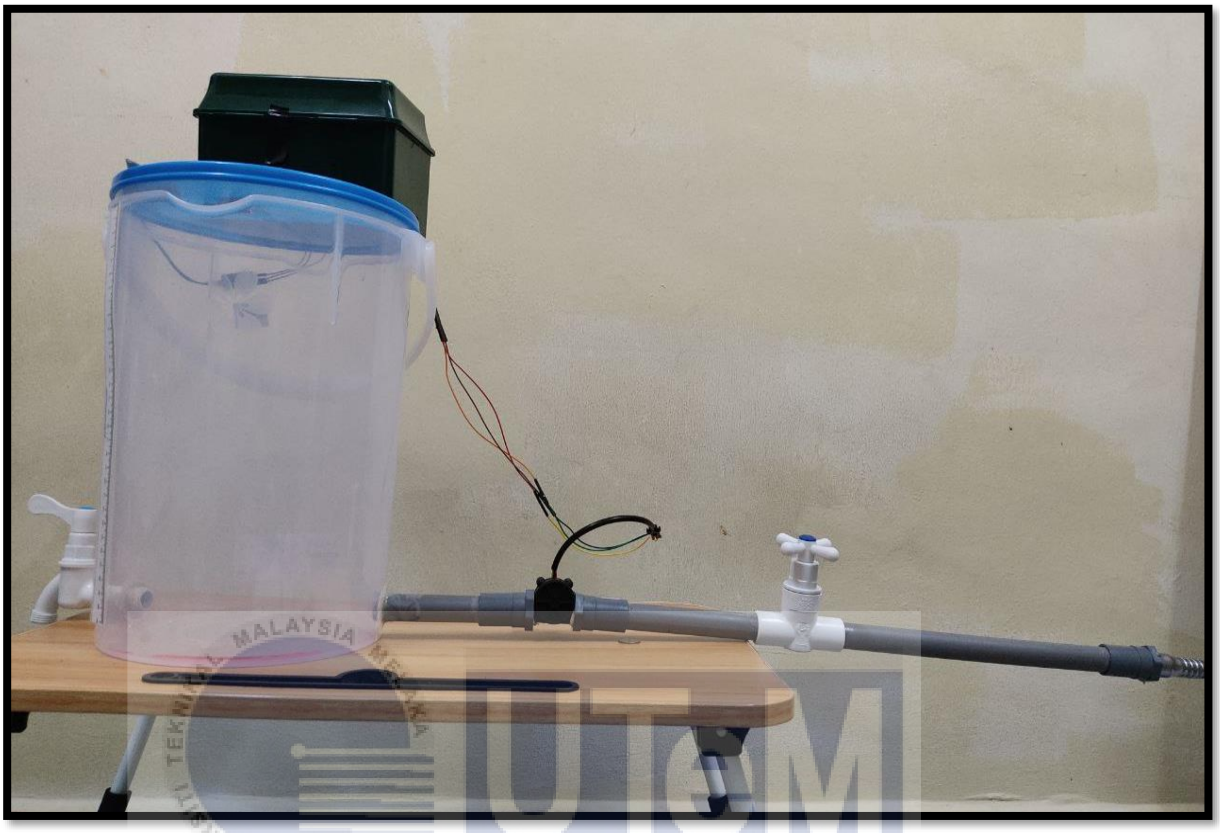

Figure 3.12: Project Prototype

3.12 Coding of the project

```
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

#include "DHT.h"
//#include <LiquidCrystal_I2C.h>

#define BLYNK_AUTH_TOKEN            "xjNevDKAMQpq7bBThW-6clkcncgVELmf"
#define DHTPIN D2
#define DHTTYPE DHT11   // DHT 11
#define TRIGGER  D6  // Arduino pin tied to trigger pin on the ultrasonic sensor
#define ECHO     D5
#define rainPin D4
#define flowPin D7
#define BLYNK_PRINT Serial

//LiquidCrystal_I2C lcd(0x27, 16, 2);
DHT dht(DHTPIN, DHTTYPE);

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Shokubutsu Clan";
char pass[] = "Modular600w";
int distance = 0;
int rainSensor = 0;
float h;
float t;
bool rain = false;

float water = 0;
```



```
BlynkTimer timer;

void sensorValue(){
  h = dht.readHumidity();
  t = dht.readTemperature();

  ultrasonic();
  rainSensor = digitalRead(rainPin);

  Serial.print("Humidity: ");
  Serial.print(h);
  Serial.print(" %\t");
  Serial.print("Temperature: ");
  Serial.print(t);
  Serial.println(" *C ");

  Serial.println(distance);
  Serial.println(rainSensor);
Serial.println(water);
  Blynk.virtualWrite(V0, h);
  Blynk.virtualWrite(V1, t);
  Blynk.virtualWrite(V2, distance);
  Blynk.virtualWrite(V3, water);
}

void setup() {
  Serial.begin(9600);
  while (!Serial) {
;
```

```
;
}

  Blynk.begin(auth, ssid, pass);
  timer.setInterval(1000L, sensorValue);

  //lcd.init();
  //lcd.backlight();

  dht.begin();

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

  pinMode(ECHO, INPUT);
  pinMode(TRIGGER, OUTPUT);
  pinMode(rainPin, INPUT);
  pinMode(flowPin, INPUT_PULLUP);



  //attachInterrupt(digitalPinToInterrupt(flowPin), pulseCounter, FALLING);
}

void loop() {
  Blynk.run();
  timer.run();
  /*
  currentMillis = millis();
```

```
  if (currentMillis - previousMillis > interval)
  {
    pulse1Sec = pulseCount;
    pulseCount = 0;

    flowRate = ((1000.0 / (millis() - previousMillis)) * pulse1Sec) / calibrationFactor;
    previousMillis = millis();

    flowMilliLitres = (flowRate / 60) * 1000;
    flowLitres = (flowRate / 60);

    totalMilliLitres += flowMilliLitres;
    totalLitres += flowLitres;
  }*/

 // lcd.setCursor(0, 0);
  //lcd.print("Temp:" +String(h)+ "oC");

  //lcd.setCursor(0, 1);
 // lcd.print("Level:" +String(distance)+ "cm");

  if (rainSensor == 0){
    //Serial.println("Raining");
    Blynk.notify("Raining");
  }

  if (distance <= 10){
   // Serial.println("Danger");
    Blynk.notify("Danger");
```

```
  }

  if (distance <= 10){
   // Serial.println("Danger");
    Blynk.notify("Danger");
  }
  else if (distance <= 20){
    //Serial.println("Warning");
    Blynk.notify("Warning");
  }
  else {
    //Serial.println("Low level");
  }
  if (Serial.available()) {
water = Serial.read();

}
}

void ultrasonic() {
  digitalWrite(TRIGGER, LOW);
  delayMicroseconds(5);
  digitalWrite(TRIGGER, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIGGER, LOW);

  long duration = pulseIn(ECHO, HIGH);
  distance = (duration / 2) * 0.0343;
}
```

3.13 GANT CHART FOR PSM 1

PROJECT ACTIVITY	ACADEMIC WEEK OF SEMESTER 1																
	STATUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Purchase of Project Component	PLAN								S								
	ACTUAL																
Revise and alternation based on panel's comment	PLAN								E								
	ACTUAL																
Troubleshoot the coding and circuit	PLAN								M								
	ACTUAL																
Construction of software and hardware	PLAN								B								
	ACTUAL																
Setup hardware	PLAN								R								
	ACTUAL																
Collecting Data	PLAN								E								
	ACTUAL																
Transfer PSM1 report to new format	PLAN								A								
	ACTUAL																
Implementation of Chapter 4 and Chapter 5	PLAN								K								
	ACTUAL																
Draft report submission	PLAN																
	ACTUAL																
Presentation PSM 2 to panel	PLAN																
	ACTUAL																
Improvement and modify the Report	PLAN																
	ACTUAL																
PSM 2 Report submission	PLAN																
	ACTUAL																

Figure 3.13 : Gant Chart PSM 1

3.14 GANT CHART FOR PSM 2

PROJECT ACTIVITY	Academic Week of Semester 1														
	STATUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Purchasing of Project Component	PLAN														
	ACTUAL														
Revise and alteration based on panel's comment	PLAN								S						
	ACTUAL														
Brainstorm and troubleshoot the coding for all circuit	PLAN								E						
	ACTUAL														
Construction of software and hardware	PLAN								M						
	ACTUAL														
Improve hardware	PLAN								B						
	ACTUAL														
Collecting data	PLAN								R						
	ACTUAL														
Implementation of Chapter 4 and 5	PLAN								E						
	ACTUAL														
Presentation PSM2 to panel	PLAN								A						
	ACTUAL														
Improvement and modify the Report	PLAN								K						
	ACTUAL														
PSM 2 Report submission	PLAN														
	ACTUAL														

Figure 3.14 :Gant chart PSM 2

3.15 Summary

This chapter brief emphasizes the need of using the most effective research and regulator preparation procedure feasible during the materialization process. The proposed structure is followed by a series of process that ensure the project success.

In this methodology, there are stage that create clearly. At the first stage development of the project structure and system. Then, the stage two is determination of project method and finally for the stage three is develop prototype hardware. Allthe three stage already explain the detail how the project needs to be done.

To ensure that all development work runs smoothly, there are several results that need to be done as also to achieve the objective of this project. Lastly the resultcan compare with real product and the simulation product.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and analysis of this experiment. There experiment was conducted. The experiment was done in indoor environment. The main of the experiment is to integrate all sensors and create a wired flood monitoring system.

4.2 Sensor testing

The experiment is to test the functionality and accuracy of the sensors such as ultrasonic sensor, temperature sensor, water flow sensor and rain sensor.

4.2.1 Measurement of Ultrasonic sensor

Ultrasonic technology can be used to determine the water level by detecting the rise in the water level. When the water level rises, the ultrasound sends a signal. Typically, an ultrasonic measurement can be made, with a range of 10cm to 400cm for water. However, for the time being, this project will only take measurements below 30cm because the prototype is required for this project. This project developed an algorithm to ensure that the ultrasonic works properly. The table 4.1 below illustrates the ultrasonic sensor's measurement from water to air.

Table 4.1 :Measurement of ultrasonic sensor

LEVEL	DISTANCE	NOTICE	ACTION
SAFE	>21 cm	-	Relocation is not required.
LEVEL 1	20cm>11cm	Warning	Relocation is not required.
LEVEL 2	10cm>0cm	Danger	Relocation

4.2.2 Water level via Ultrasonic sensor

The aim of this experiment is to verify that the coding and to evaluate the sensor's operation. The sensor is used to detect an object. The code runs smoothly on the hardware.

The Ultrasonic Sensor is put on the surface of the water as shown in Figure 4.1. This is how the sensor is then tested. The experiment is show whether the sensor can detect the water level or not.

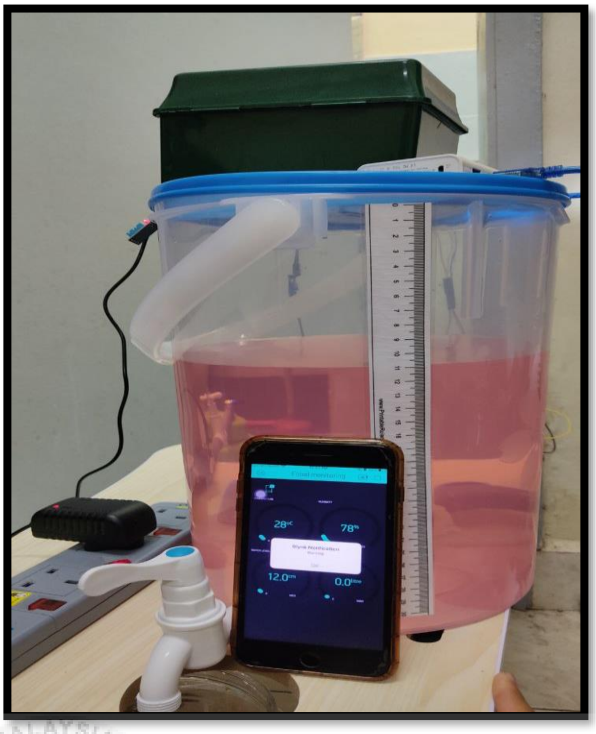

Figure 4.1. Ultrasonic sensor with water surface

The test is repeated with different amounts of water, as illustrated in Figure 4.2. The same container is filled with water to determine the Ultrasonic sensor's sensitivity to the water surface.

Figure 4.2. Tests on different levels of water

4.3 Result and analysis

They are two different water level were chosen in this experiment which 10cm and 20cm. The experiment was repeated four times, and the results are summarized in Tables 4.2 and 4.3. Measured value is the value recorded using the Ultrasonic sensor where Actual value is the value measured using ruler from the sensor to the water surface.

Table 4.2: water level sensor testing for 20 cm

Water surface	Actual (cm)	Measured (cm)
Reading 1	20	21
Reading 2	20	20
Reading 3	20	20
Reading 4	20	21

$$mean = \frac{sum\ of\ observation}{Total\ number\ of\ observation}$$

$$mean = \frac{82}{4}$$

$$mean = 20.5$$

$$percentage\ of\ error = \frac{mean\ measured\ value - actual}{actual} \times 100$$

$$percentage\ of\ error = \frac{20.5cm - 20cm}{20cm} \times 100$$

$$percentage\ of\ error = 2.5$$

Percentage error for 20cm is 5%.

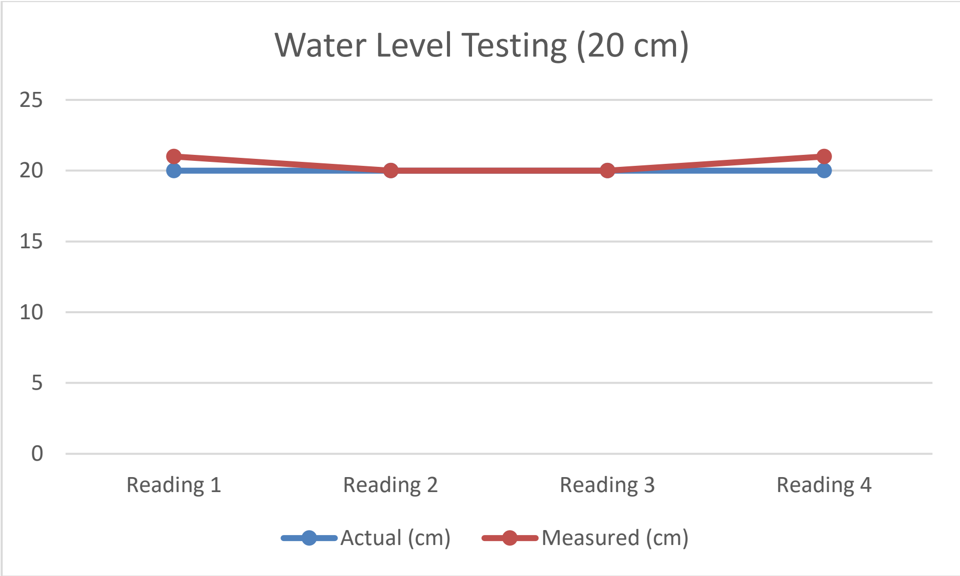

Figure 4.3: graph of analysis for 20cm

Table 4.3: Water level testing for 10 cm

Water surface	Actual (cm)	Measured (cm)
Reading 1	10	10
Reading 2	10	11
Reading 3	10	12
Reading 4	10	10

$$mean = \frac{sum\ of\ observation}{Total\ number\ of\ observation}$$

$$mean = \frac{43}{4}$$

$$mean = 10.75$$

$$percentage\ of\ error = \frac{mean\ measured\ value - actual}{actual} \times 100$$

$$percentage\ of\ error = \frac{10.75cm - 10cm}{10cm} \times 100$$

$$percentage\ of\ error = 7.5$$

Percentage error for 10cm is 7.5 %

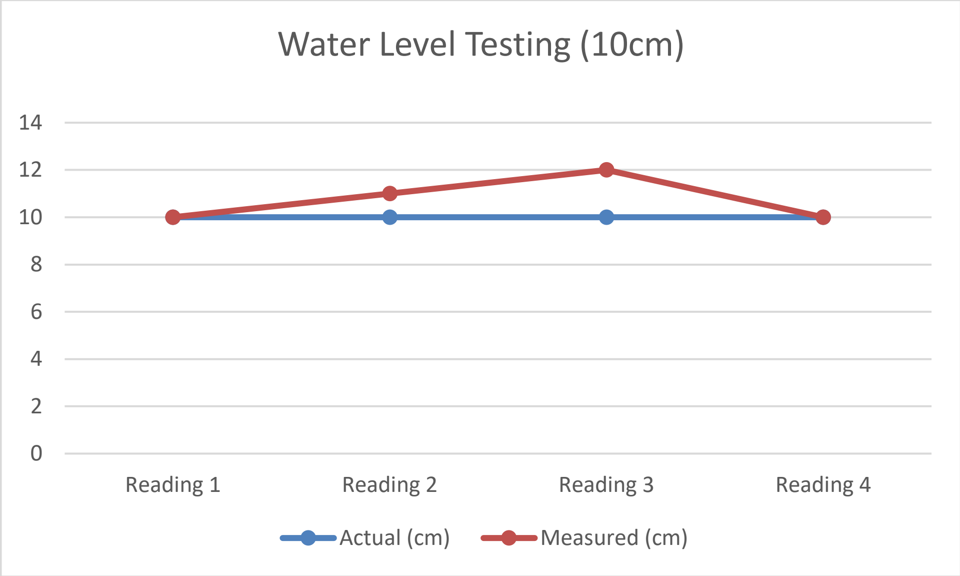

Figure 4.4: graph of analysis for 10 cm

According to the small error calculated for water levels of 10 cm and 20 cm, the ultrasonic sensor is reliable due to its percentage error of less than 10%.

4.3.1 Temperature via Temperature Sensor

As shown in Figure 4.5, the temperature sensor was coded to generate an output. The experiment was conducted to determine whether the sensor and the code are compatible. As shown in Figure 4.6, the output was displayed as temperature on the Serial Monitor. The measured values were then compared to the Google forecast values to determine the temperature sensor's accuracy.

4.3.2 Result

The temperature data from the sensor was compared to the data from an online source that was made by google, as shown in Figure 4.5. The experiment was done, and the results are shown in the Table 4.4.

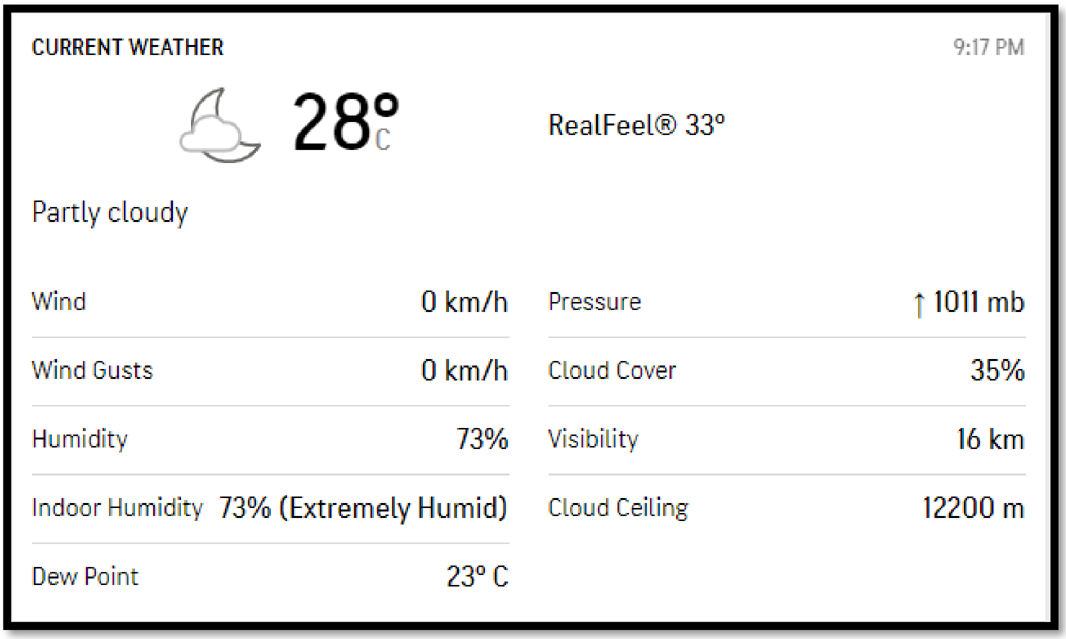

Figure 4.5: Weather forecast by google

Measured value is the value that was recorded by the temperature sensor, and Actual value is the value that wheather.com came up with.

Table 4.4: temperature testing

Temperature	Actual (°C)	Measured (°C)
Reading 1	28	29
Reading 2	28	29
Reading 3	28	29
Reading 4	28	29
Mean	28	29

$$\text{percentage of error} = \frac{\text{mean measured value} - \text{actual}}{\text{actual}} \times 100$$

$$\text{percentage of error} = \frac{29 - 28}{28} \times 100$$

$$\text{percentage of error} = 3.57\%$$

Based on the small error calculated for temperature, the temperature sensor is reliable due to its percentage error of less than 10%.

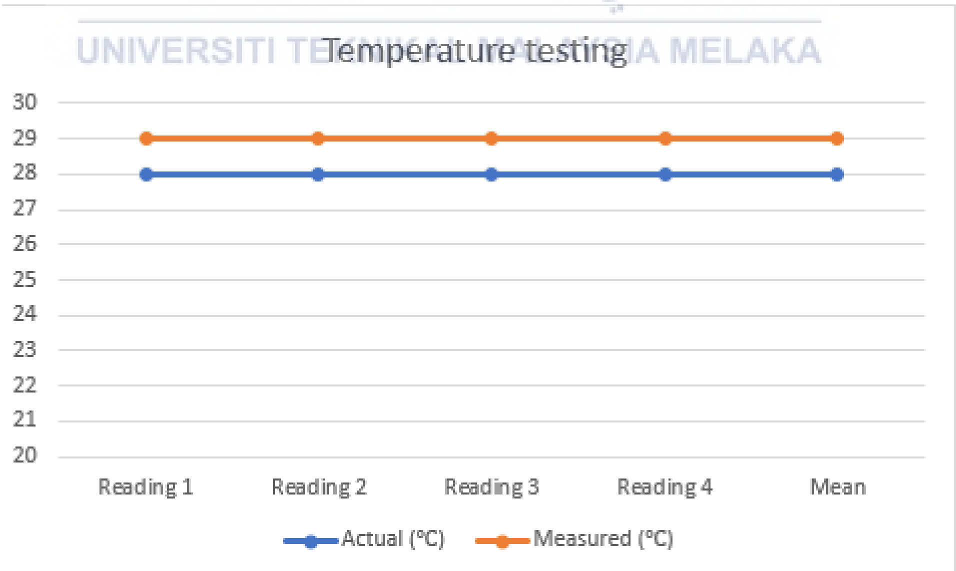

Figure 4.6: Graph analysis for temperature

4.3.3 Water Flow Sensor Testing

In Figure 4.6, the water flow sensor was functional, and water was passing through the sensor via the tube. As shown in Figure 4.7, the reading is then recorded and displayed on the LCD..

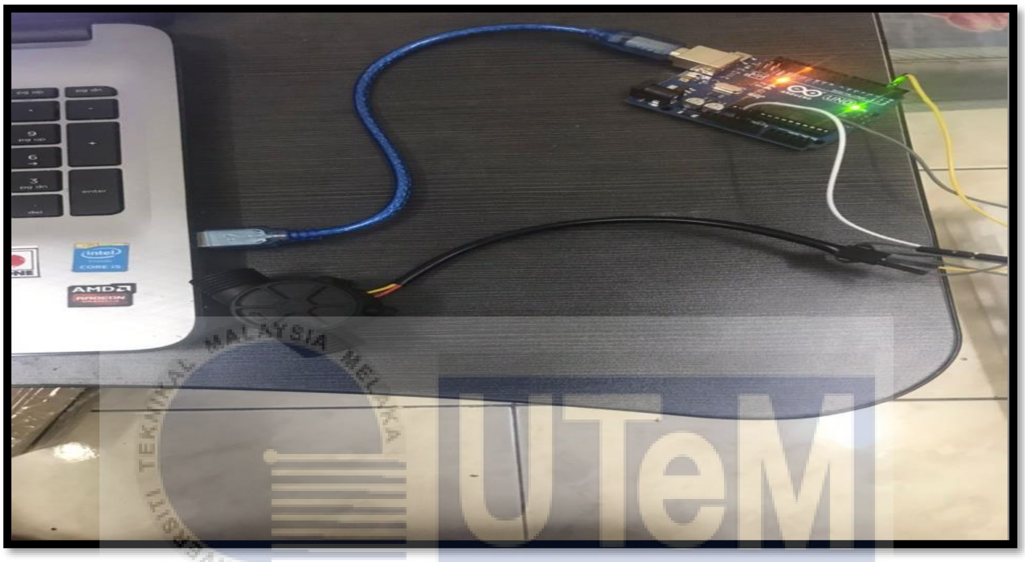

Figure 4.7 : Water flow sensor testing

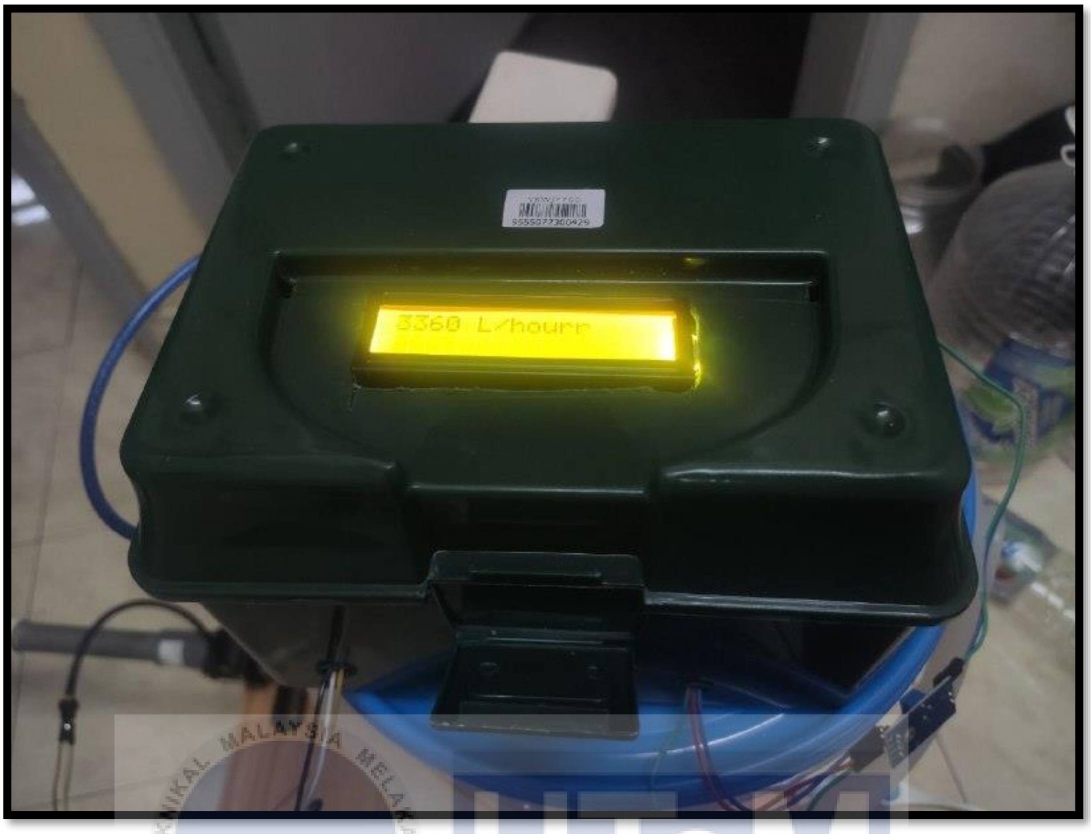

Figure 4.8: LCD display water flow result

4.4 Summary

This chapter summarized the project's data collection from all samples. The results from all the samples are compared. After comparing all the results, the analysis is conducted. Finally, after conducting the analysis, the conclusion was made.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The use of wireless sensor networks for flood monitoring and alerting is important because it deals with the flood disaster that occurs every year in Malaysia. The flood monitoring and alerting system is important in assisting residents in becoming aware of impending disasters. Flood information would be obtained in real time and actions such as relocating residents and their belongings could be planned more earlier. The prototype of the proposed design was built and tested in-house, and it worked well.

5.2 Future Works

For future improvements, the variety of results could be obtained as follow:

i) Added more parameters such as barometric pressure, wind direction and speed of the wind increase the accuracy and sensitivity of the project

ii) Install more sensor to obtain more data and more accurate result

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APPENDICES

Appendix A   Example of Appendix A

No.	Parameters
1.	$$mean = \frac{sum\ of\ observation}{Total\ number\ of\ observation}$$
2.	$$percentage\ of\ error = \frac{mean\ measured\ value - actual}{actual} \times 100$$