RESQ FLOOD DETECTOR AND ALERT SYSTEM

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Computer Networking) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2024

DECLARATION

I hereby declare that this project report entitled

[**RESQ FLOOD DETECTOR AND ALERT SYSTEM]**

is written by me and is my own effort and that no part has been plagiarized

without citations.

STUDENT: ABYANA BATRISYIA BINTI MULYADI Date : September 29, 2024

I hereby declare that I have read this project report and found

this project report is sufficient in term of the scope and quality for the award

of Bachelor of Computer Science (Computer Networking) with Honours.

SUPERVISOR: TS. ERMAN BIN HAMID Date : September 29, 2024

DEDICATION

I would want to dedicate this report to everyone who helped make it happen by providing constant support, direction, and inspiration. To my beloved parents, who are taking care of me and always by my side to encourage and support me on every decision made. I want to acknowledge them because always served as my inspiration, pillar of support, and mentor. They also have instilled in me the values of individuality, perseverance, self-belief, and uniqueness. Having them as my family makes me incredibly grateful and honored. To my helpful supervisors, Ts.Erman bin Hamid, whose very expertise, helpful, and kind, and for spending the time and patience to guide me to complete this final year project. I also would like to express my gratitude to my fellow friends who, without any hesitation, helped me, shared some of their ideas, and rendered moral support to me in the process of completing this project. Without their valuable contributions, this report would not have been possible. Their ideas and thoughts have been the basis upon which this study is founded. Finally, I wish to express my gratitude to the members of the academic community and all who supported the general area of my study to which this report belongs. Your undivided attention and support were very instrumental in assisting me in this.

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I want to sincerely thank and show my gratitude to my parents, my brother, family and friends for their continuous love, support, and encouragement during my academic career. Their never-ended trust in me and their kindness have been the impetus behind my accomplishments. They have given me the will and fortitude to overcome obstacles and finish my report with their love and support. With the help of everyone that was mentioned above, I was able to overcome many problems and complete my project successfully on time.

ABSTRACT

Flood is considered as an unavoidable natural phenomenon. Besides, flood generates huge economic destruction and bring about great loss in human life. This proposed system aims to develop a prototype of an early flood detection and alert system in a residential area based on the level of water due to heavy rains. System has been designed and implemented based on two components which is hardware and software. The proposed system is designed with sensors incorporated into the microcontroller. Ultrasonic sensors are used by the system to measure the water level. After collecting and analyzing data, the model determines whether the water level is low, medium, or high. An Android application is used to convert the detected level into an alert message that is sent to the user. With the use of IoT technologies, It can save many life and property. It also offers an innovative and cost-effective solution that improves situational awareness, speeds up response times, and helps in preventing or helping us anticipate impending disasters.

ABSTRAK

Banjir dikategorikan sebagai fenomena alam yang tidak dapat dielakkan. Selain itu, banjir menyebabkan berlakunya kemusnahan ekonomi yang besar dan membawa kerugian besar dalam kehidupan manusia. Sistem yang dicadangkan ini bertujuan untuk membangunkan prototaip sistem pengesanan awal dan amaran banjir di kawasan perumahan berdasarkan paras air akibat hujan lebat. Sistem telah direka bentuk dan dilaksanakan berdasarkan dua komponen iaitu perkakasan dan perisian. Sistem yang dicadangkan direka bentuk menggunakan sensor yang digabungkan ke dalam mikrokontroler. Sensor ultrasonik digunakan oleh sistem untuk mengukur paras air. Selepas mengumpul dan menganalisis data,ianya dapat menentukan sama ada paras air berada di tahap yang rendah, sederhana atau tinggi. Aplikasi Android digunakan untuk menukar tahap yang dikesan menjadi mesej amaran yang dihantar kepada pengguna. Dengan penggunaan teknologi IoT, Ia boleh menyelamatkan banyak nyawa dan harta benda. Ia juga menawarkan penyelesaian yang inovatif dan kos efektif yang meningkatkan kesedaran situasi, mempercepatkan masa tindak balas dan membantu dalam mencegah atau menjangkakan bencana banjiryang bakal berlaku.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Every year, the east coast of Malaysia deals with heavy rain during the monsoon season, leading to unexpected floods, especially in Kelantan and Terengganu. Unfortunately, many people are caught off guard and worried due to the absence of a reliable early warning system. Through this project, we introduce an innovative IoT flood detection and alert, named ResQ Flood Detector and Alert. In this system, residents can see whether the water level is at low, medium or high levels. When residents are far from their home area, residents can remotely detect the water level using an android application that uses an internet connection. Therefore, they can access real-time data and receive alert everywhere and anywhere. Residents can respond and take early action to protect themselves and properties. For example, building a barrier, evacuating people to save their families, pets and valuables also managing resources before they are destroyed by floods that come suddenly without warning. This system is able for user to view previous date when the flood occurs, so they can take precautionary measures and early action, for example when they are planning on vacation in the region, they can check the specific dates to avoid potential date and months with a high risk of flooding. The ResQ Flood Detector is an example of a technological breakthrough as well as a skillfully integrated advanced system and community resilience. Its primary objective is to aid in keeping people safe and aware during the yearly monsoon season.

1.2 Problem Statement (PS)

Residents are not always at their home, they may return to their hometown, going outstation for work or going on vacation for a few days. They might not be aware if the

possibility of natural disaster will affect their home, for example flood and more. In monsoon season, the residents may not realise and aware if the water level is increasing due to heavy rain. It is difficult for the residents in flood-prone areas to remain informed and prepared for future disasters. This will lead to causing them difficulties to get early alert and take early action to protect themselves, families, pets and their properties if the flood occurs. Next, some people fail to plan the trip well when they want to go on vacation, for example to see natural disaster that happened before in that region. Furthermore, not all existing flood detection system provide feature to access previous data on flood events that occurred in the area. The lack of important information makes it more difficult for them to organise trips or vacations in these places, which may expose them to unanticipated risks. Table 1. 1 show the Summary of Problem Statement.

Table 1. 1: Summary of Problem Statement

PS	**Problem Statement**
PS1	When residents are far from home,they don't know if the water level is increasing due to heavy rain in their home area.
PS2	Residents can't take early action to protect themselves,family and properties when the flood suddenly comes.
PS3	Some of the flood detection systems do not provide a way to view the previous date when the flood occurred in that region,it can give difficulties to plan a trip or vacation in that region.

1.3 Project Question (PQ)

Project Research Question is used to identify the question of the existing flood detection and alert system.Based on the research,we can conclude that there are few weaknesses of the current flood detection and alert system. The problem statement for this project are shown in Table 1. 2 : Summary of Project Question.

Table 1. 2 : Summary of Project Question

PS	PQ	Project Question
PS1	PQ1	How user can understand the technique of flood detector and alert IoT applications system?
PS2	PQ2	How to design and develop the flood detector and alert IoT applications system?
PS3	PQ3	What is the usability of flood detector and alert IoT applications system?

1.4 Project Objective (PO)

Project objective defines the improvement that needs to be achieved at the end of the project.The improvement must be considered based on the problem statement and the project question of this project.The objectives for this project are shown in table 1.3: Summary Of Project Objectives below.

Table 1. 3: Summary Of Project Objectives

PS	PQ	PO	Project Objective
PS1	PQ1	PO1	To study and design the existing method and technique of flood detector and alert system IoT application system.
		PO2	To develop the flood detector and alert system IoT application system that could give early warning of floods, retrieve flood alert data for a specific time period, capture video, and monitor the residential area.
		PO3	To test the usability of the flood detector and alert system

			IoT application system.

1.5 Project Research Hypothesis

A research hypothesis is the statement created by researchers to improve the outcome of a research. Based on the research, the current flood detector and alert has insufficient features and is not very satisfying. Some of the hypotheses have been suggested to improve the current flood detector and alert. The Figure 1. 1: Project Research Hypothesis shows the problem of the flood detector and alert and the hypothesis to make an improvement.

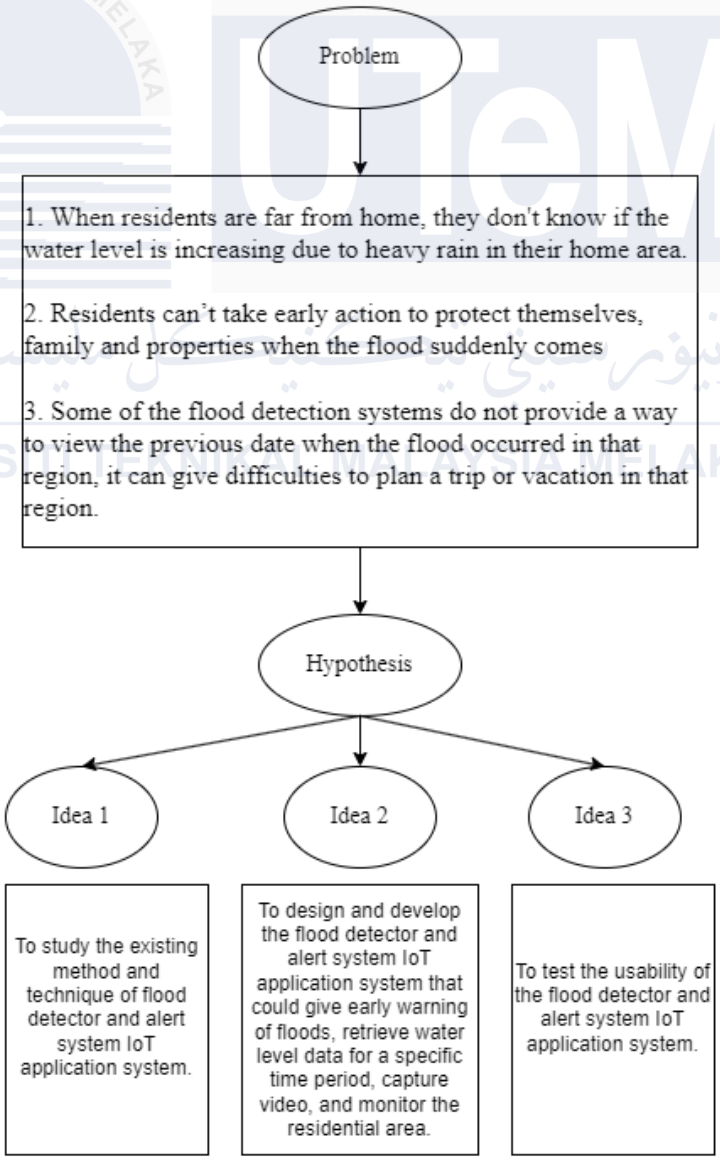

Figure 1. 1: Project Research Hypothesis

1.6 Project Scope

The main purpose for ResQ Flood Detector and Alert System is to perform a flood detector and alert system by using an android application. IoT flood detector and alert is one of the flood detectors that is controlled by a mobile application through the internet.The flood detector and alert can monitor water levels continuously and give an alert when the water level is high.The application can show water level data for the previous date, allowing users to analyse past flood occurrences.Last but not least the flood detector have a camera component (ESP32-CAM) that can enabling users to visually monitor their residential area remotely through the Android application.

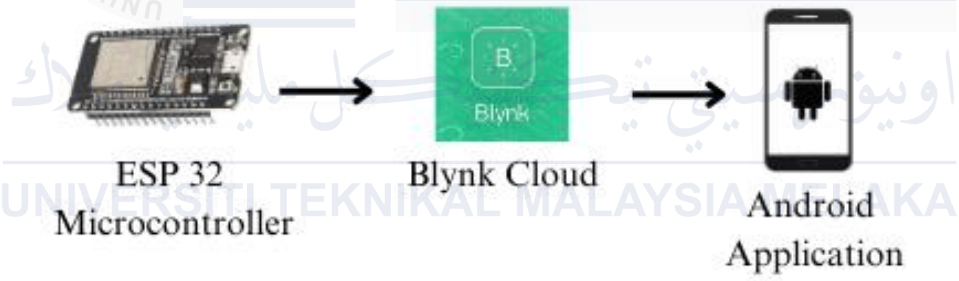

Figure 1. 2: Flow of the System

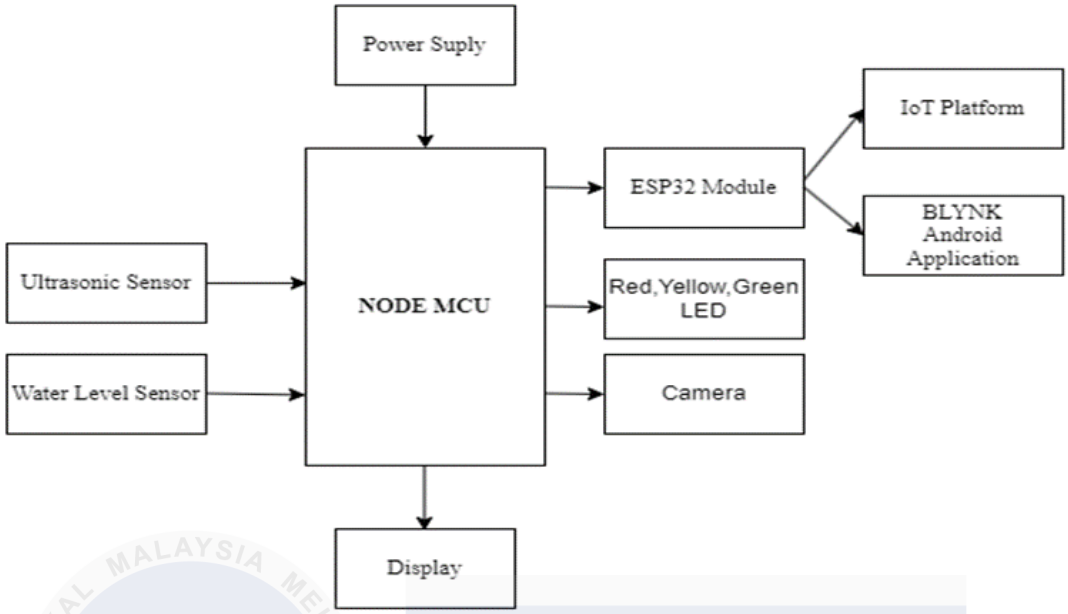

Figure 1. 3: Block Diagram of Flood Detector and Alert System

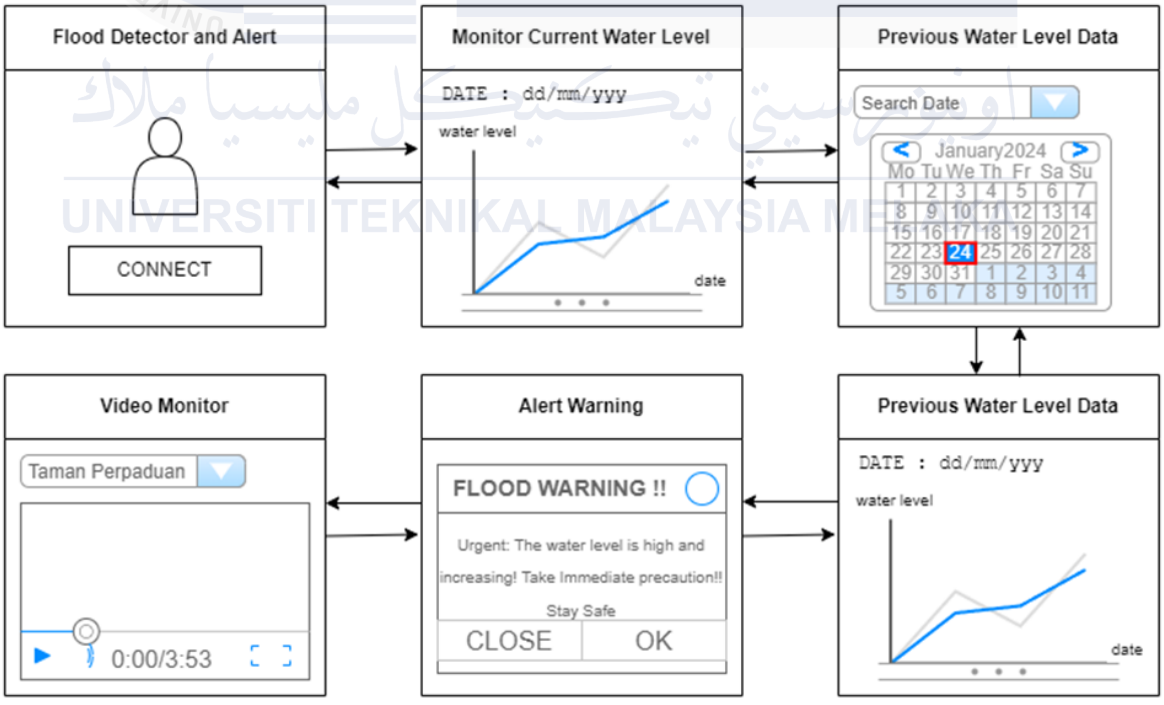

Figure 1. 4: Interface for Android Application

1.7 Project Contribution (PC)

Project contribution defines the expected output from this project. This part can be referred to the objectives of this project. The project contribution can be referring to the Table 1. 4: Table of Project Contribution below.

Table 1. 4: Table of Project Contribution

PS	PQ	PO	PC	Project Contribution
PS1	PQ1	PO1	PC1	Proposed an android application using Blynk Application to monitor flood detectors and alert by using smartphones.
PS2	PQ2	PO2	PC2	Proposed a hardware system using ESP32 that are able to connect to android application perform as an flood detector and alert.

1.8 Conclusion

As a conclusion, this chapter provides an overview of the project and its background, outlines the problem that the technology is currently facing in the problem statement subsection, and explains the project's objective, which is to create an android application and make it more effective and friendly. This chapter also outlines the project's execution approach and representation. System upgrades followed the criteria provided, allowing the project to accomplish its objectives and progress as planned, phase by phase. Next, the project's aims were met, and the flood detector and alert safety was increased. It is expected that by implementing the project's strategy and scope, the parties will be able to carry out their tasks more effectively.

CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

In this chapter,we will focus on the complication and solution of the flood detector and alert that already exist before.This will include previous research,current information, methodological, and theoretical on the study paper.Current problems and the rationale behind recommended solutions for upcoming projects will be discussed in this chapter. Additionally, This chapter will examine current difficulties and proposed solutions for future initiatives. The project flow will also be utilised to describe extra purpose and functions.

In Addition,This chapter can collect information about flood detectors and alert systems, evaluate the capabilities of the current system, compare the hardware and equipment that are most suitable for the project and discover its shortcomings.This project is primarily focus with developing hardware and software that can connect and communicates with Android application on smartphone and ESP32. Enhancements can be made to strengthen the project's ability to handle user complaints, starting with the weak point. Prior to selecting a better method for the task, compare all the data and information gathered from journals and other sources.

2.2 Research Problem

A literature review report basically starts with a research issue that serves as the question or concern the author aims to explore by studying existing literature. This issue sets the focus and boundaries of the review influencing how studies are chosen and analysed. It's important that the research issue is clearly defined, transparent and significant, aiming to identify a gap in knowledge that the review aims to address. The problem statement should be crafted to encourage evaluation and incorporation of existing literature to help readers grasp the purpose of the review.

i. Concept

In order to make our lives easier, the Internet of Things (IoT) is an emerging paradigm that allows connectivity between electronic devices and sensors.According to (Mihailovic, 2016; Neisse et al., 2016), IoT can be used to manage the physical world in various ways. It is essential to establish reliable and sustainable systems to pave the way, for innovation and growth in diverse sectors. Apart from cost savings and enhancing the efficiency of existing systems IoT offers opportunities for imaginative services that were previously inaccessible. ResQ Flood Detector and Alert System is was created to give early alert message to resident if the water level is increased due to heavy rain that can cause flood when they are away and far from home. This system can monitor the water level in the residential area whether the water level is low, medium or high. They can also virtually monitor their home area using surveillance camera that has been installed in their residential.

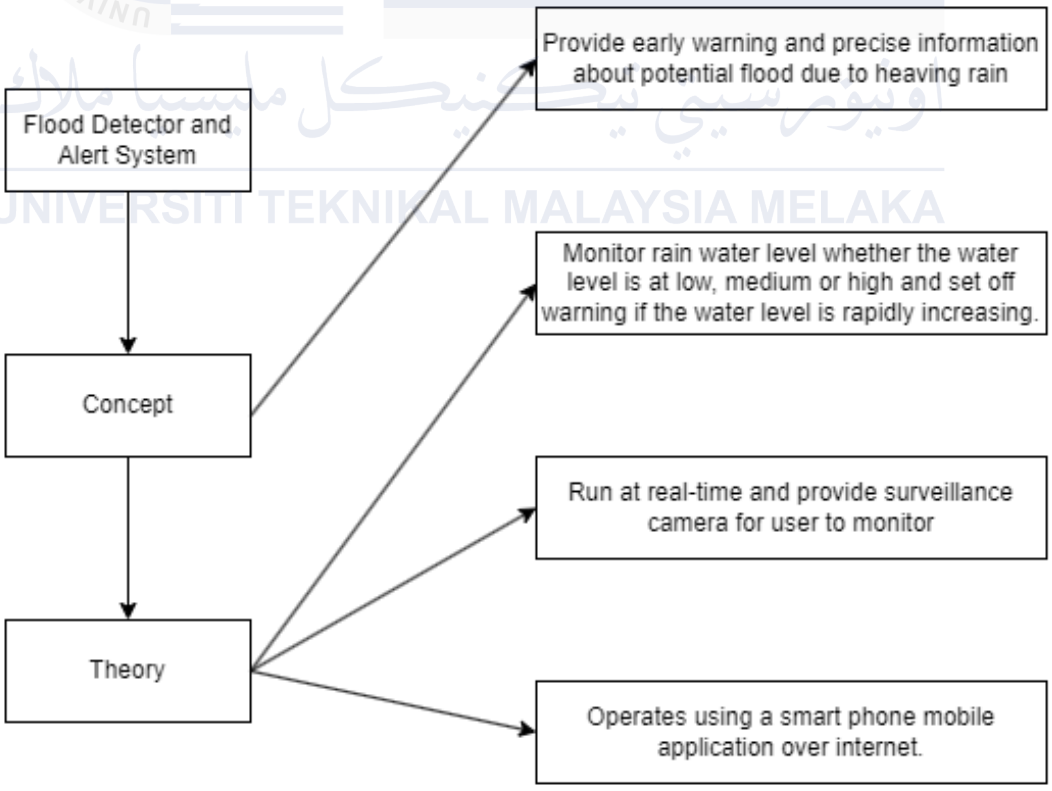

Figure 2. 1: Summary of Research Problem

ii. Theory

The function of the flood detector and alert system is to monitor the water level in residential are due to heavy rains that can cause flood and set off warning alert where it will be running at a real-time. This system can connect to a smart phone where the user can monitor the water level whether its low, medium or high at the residential area due to heavy rain on the android application. Resident can take precautionary measures and early action by monitor the water level before they become a victim of flood disaster. The aims is to monitor the water level and alert the authorities as well as notifying victims ("Flood Monitoring and Warning System",2015)

iii. Application

Numerous Flood Detector and Alert System varieties are being introduced to the market. The most prevalent and well-known are:

1. **Mobile Flood Detector Alert System (M. Z. Ayob and M. S. A. Rahim,2022).**

2. **LoRaWAN-based IoT flood monitoring and warning system in catchment areas(Muhammad Izzat Zakaria, Waheb A. Jabbar, Noorazliza Sulaiman,2023).**

3. **Flood Monitoring and Early Warning System Using Ultrasonic Sensor (J G Natividad and J M Mendez, 2018).**

4. **Internet of Things based Smart Flood forecasting and Early Warning System (B. M. Shankar, T. J. John, S. Karthick, B. Pattanaik, M. Pattnaik and S. Karthikeyan, 2021).**

5. **Flood disaster indicator of water level monitoring system (Wan Haszerila Wan Hassan, Aiman Zakwan Jidin, Siti Asma Che Aziz and Norain Rahim, 2019).**

6. **Flood Alert and Monitoring System (Niranjan P.Yadav , Priyanka P. Shinde, Ashwini A. Dhotre,Shraddha P.Sabale and Rutuja R. Girigosavi , 2022).**

7. **Early Warning of Impending Flash Flood Based on AIoT (Wen-Tsai Sung, Ihzany Vilia Devi and Sung Jung Hsiao, 2022).**

8. **Flood Detection and Early Warning System (R.Aishwariya Lakshmi, M.Muthu Lakshmi, P.Swetha and Thiru D.Prakash, 2020).**

9. **The Prototype Of The Flood Disaster Early Detection System and Its Security (Wahyu Susilo, Edi Mulyana, Lia Kamelia, 2019).**

10. **Techniques of Remote Sensing and GIS for flood monitoring and damage assessment (Mateeul Haq, Memon Akhtar, Sher Muhammad, Siddiqi Paras, Jillani Rahmatullah, 2012).**

2.3 Related Work

In this section the researchers delve into the existing body of work and studies following comprehensive research. They also outline the purpose of each tool, concept and theoretical framework to gain a grasp of the fundamental ideas necessary for undertaking this project. Lastly they highlight the advantages of the project/tool, in each research endeavour.

M. Z. Ayob and M. S. A. Rahim in their research of Mobile Flood Detector Alert System(2022). This system uses electronic sensors to gauge flood severity and send GPS based alerts to users. A context diagram outlines the systems interactions covering communication, between users and devices GPS data retrieval, flood level detection and vehicle power supply. In figure 2.2 a block diagram details the hardware and software components, such as waterproof ultrasonic sensors, ESP32 microcontroller and output interfaces for flood levels and GPS

data.The waterproof ultrasonic sensor employed in the prototype system's input component was used to trigger, detect, and measure the flood level. The GPS module's job is to provide latitude and longitude information about the FDAS device's present location as output data. The OLED display provides the driver's 4WD with the current task status, while the ESP32 serves as a platform for task distribution.Device setup process and user interactions emphasising connectivity with platforms like Blynk for real time monitoring and Telegram, for notifications.FDAS electronics and the sensor stabiliser tool, the latter of which is essential for precise flood level assessment, are developed into prototypes. The system intends to assist people and authorities in flood-prone areas by integrating these components into a 4WD vehicle and aiding quick decision-making for flood mitigation measures. It does this by giving immediate road safety information. Lastly, it can be said that the mobile FDAS device successfully improves flood danger awareness and response procedures.

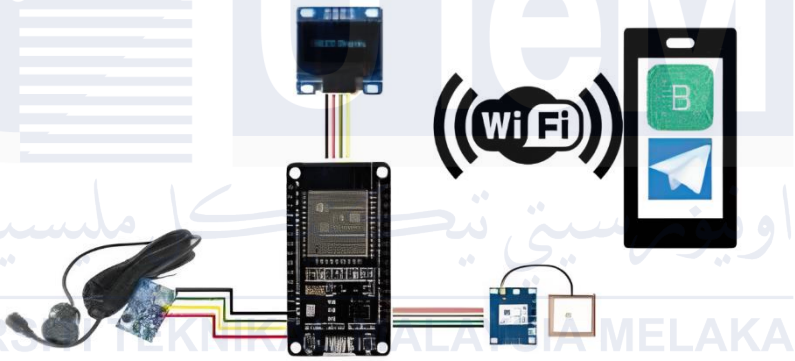

Figure 2. 2: Block diagram of mobile FDAS

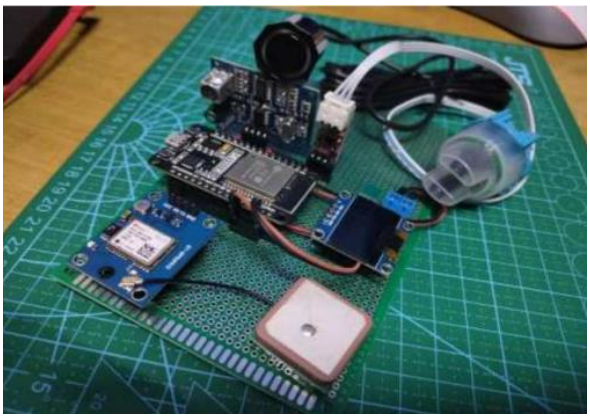

Figure 2. 3: Prototype of mobile FDAS

Muhammad Izzat Zakaria, Waheb A. Jabbar, Noorazliza Sulaiman in their research of LoRaWAN-based IoT flood monitoring and warning systems in catchment areas(2023). To monitor floods in catchment areas,the LoRaWAN FMWS system uses Raspberry Pi 3.0 acts as the LoRaWAN gateway, fitted with a LoRa Pi hat for operation at 915 MHz and connected to the TTN platform for data processing. An Arduino Uno MCU powers the LoRa shield and sensors providing versatility and energy efficiency making it suitable for deployment in areas. The LoRa shield uses LoRaWAN technology for distance low power communication featuring temperature sensing and low battery alerts. The LoRaWAN protocol ensures data transmission by utilising network level security with a 128 bit network session key and application level security with a 128 bit application session key. For contact liquid level measurement in flood monitoring ultrasonic sensors like the HC SR04 are chosen to ensure precise data gathering. Power is sourced from panels and rechargeable batteries managed by an Arduino based solar charger shield for functionality. The TTN platform provides an open source solution supported by the community for real time data monitoring on devices. Integration with TagoIO and ThingSpeak IoT platforms enables data handling, visualisation and analysis enhancing adaptability and scalability of the system, for flood monitoring and warning setups.

Figure 2. 4: LoRaWAN FMWS overall system architecture

J G Natividad and J M Mendez in their research of Flood Monitoring and Early Warning System Using Ultrasonic Sensor (2018). There are two monitoring devices in this suggested system.The first is an online real-time monitoring system with an interface based on the web. Secondly, an automated SMS notification system that initiates communication.A solar panel, regulator, and battery power source make up the two monitoring devices. An ultrasonic sensor measures the distance to the water level. An Arduino microcontroller processes the sensor's signal. A GSM module transmits data or information from the microcontroller to the computer server.When a sensor fires, an output signal is sent to a microcontroller, which then acts as a switch to cause the attached GSM module to transmit an alert message or a status report on the water level to a different GSM modem that is linked to a computer server. The created software that is installed on the computer server will then read and evaluate the message that is received before automatically sending a text message to the phone numbers of the relevant agencies that are kept in a database.Finally,the created application will post the alert message or status to the created website automatically.

Figure 2. 5: Prototype component connection of the research

B. M. Shankar, T. J. John, S. Karthick, B. Pattanaik, M. Pattnaik and S. Karthikeyan in their research of Internet of Things based Smart Flood forecasting and Early Warning System (2021). This research relies on developing an innovative flood detection system with ultrasonic sensors, Node MCU, and Blynk application. The results provide flexibility, efficiency, and low effort.The primary component of this project is the

Arduino UNO regulator, which sits at the centre of the square design and manages every function of the system.The microcontroller's internal operations are all displayed on an LCD. This framework uses a WSN framework architecture for flood determination that includes climate observation. Temperature (T), humidity level (H), snow dissolve (S), wind speed (W), rainfall (R), and air pressure (P) are just a few of the limits that are measured by distant sensors.With the help of the ESP8266 WiFi module, It can access any location via the Thing Talk website by transferring sensor data to the cloud.The BMP180 sensor measures absolute and relative pressure, whereas the DHT sensor measures temperature and humidity. These are the real-time values, which we dump into the cloud to identify flood predictions.

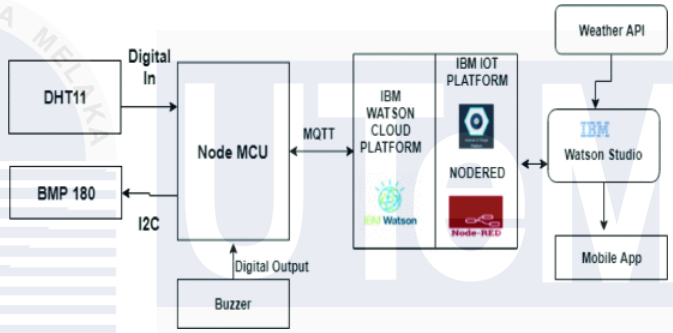

Figure 2. 6: Block Diagram for proposed method

Wan Haszerila Wan Hassan, Aiman Zakwan Jidin, Siti Asma Che Aziz and Norain Rahim in their research for Flood disaster indicator of water level monitoring system (2019). To monitor the flood prone area,the escalation level is distinguishable via three float switch sensors. The Arduino Uno controller processes the data sent by the sensors.The GSM module receives the output that the Arduino Uno controller transmits.Following that, the relevant user receives an SMS alarm. The SMS that the user receives varies based on the level of sensor detection.The flood monitoring is developed using Float switch sensors (RSF50 Series), an ATmega328 microcontroller board, a GSM modem, and an M1632 LCD screen are all components of the Arduino Uno microcontroller board. These sensors are used to measure the water level in safe conditions or high-risk areas as required. Five distinct circumstances can be recognized by the system as it is constructed. Upon detecting the presence of water, an electric pulse is produced. The microcontroller compares the predefined value to the real-time data analysis. The outputs are shown on the LCD screen in addition to being communicated

via SMS.The flood monitoring system prototype consists of a transmitter and a receiver. Data from the sensors is transmitted and displayed by the transmitter component.

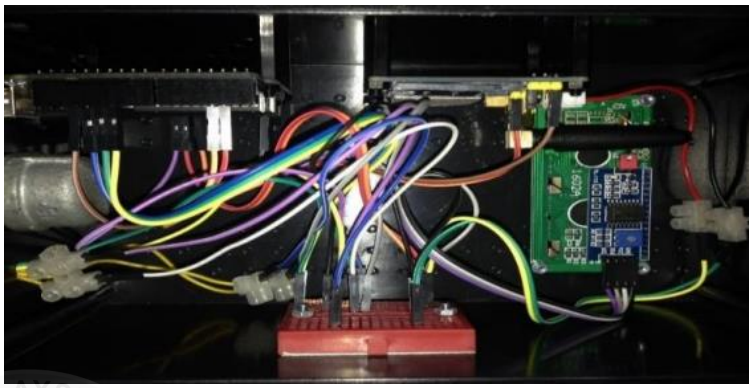

Figure 2. 7: Prototype of Flood monitoring system

Niranjan P.Yadav , Priyanka P. Shinde, Ashwini A. Dhotre,Shraddha P.Sabale and Rutuja R. Girigosavi in their study of Flood Alert and Monitoring System (2022). This system was created in response to the difficulties commuters and drivers faced during floods. This will prevent traffic congestion because user will have more time to locate an alternate route before becoming stranded in the flood area.This system's hardware is separated into three primary components, which are an ultrasonic sensor acting as the input system, a Raspberry Pi 3B with 2GB of RAM acting as the system's primary controller, controlling all inputs and output and a solar panel module acting as an interface that connects the battery to the application. For the software, coding is done in the meantime using the Jennie software IDE for software development. If the water level reaches the boundary, the sign will gradually be released to individuals. The raspberry pi-pico model was used in this system. The rain and water sensors provide the values, which are then computed. After being transferred to a Wi-Fi the data is forwarded to an Android device for display. Additionally, the user receives all detected information from the Wi-Fi via wireless connection and cloud storage will be used to record the rain and water level readings. Lastly, The data will be stored in the cloud and can be used to forecast the chances of flooding in the future.

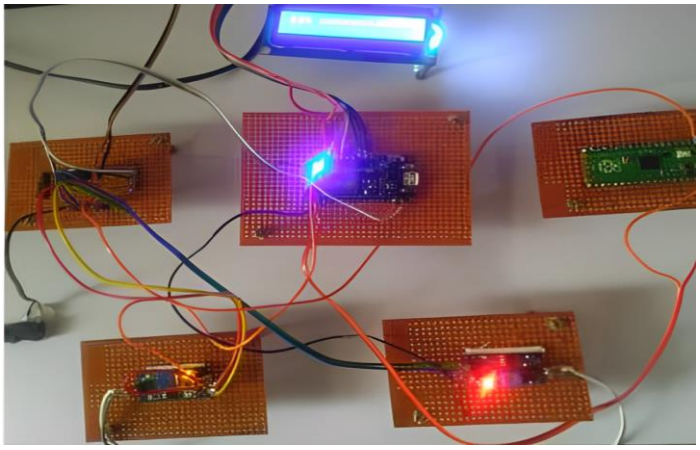

Figure 2. 8: System Setup for Flood Alert and Monitoring System

Wen-Tsai Sung, Ihzany Vilia Devi and Sung Jung Hsiao in the research of Early Warning of Impending Flash Flood Based on AIoT (2022).The purpose of this project was to monitor flooding on mountain slopes and to provide early warnings. Artificial Intelligence Internet of Things (AIoT) technology is used to measure the water's height and velocity as well as to periodically monitor the rain in order to analyse and monitor the data.The hardware used in this project are Heltec LoRa 32,GSM SIM900,Rain gauge sensor,Water flow metre sensor and Tilt (inclinometer) sensor. It functions via using long-range (LoRa) communication technology to coordinate several nodes.Each node also has sensors to analyse water velocity, water flow rate, and rainfall in order to estimate the chance of flooding in a LoRa-connected area.Through the internet, data is sent to a cloud server through the use of the LoRa and SIM900 communication between posts. Moreover, alerts are transmitted by short messaging service (SMS) and the app, and all sensor readings for every post are shown on the app.There are three early warning levels in the SMS notification: yellow, orange, and red. The orange indicator denotes severe rain and the risk of landslides, the red sign suggests the probability of flash flood, and the yellow sign signals approaching rains.The communication network used in this study completely realises wireless communication for monitoring and early warning by using the LoRa plus GSM mode to carry out effective and convenient data transfer even in the mobile network's signal blind zone.

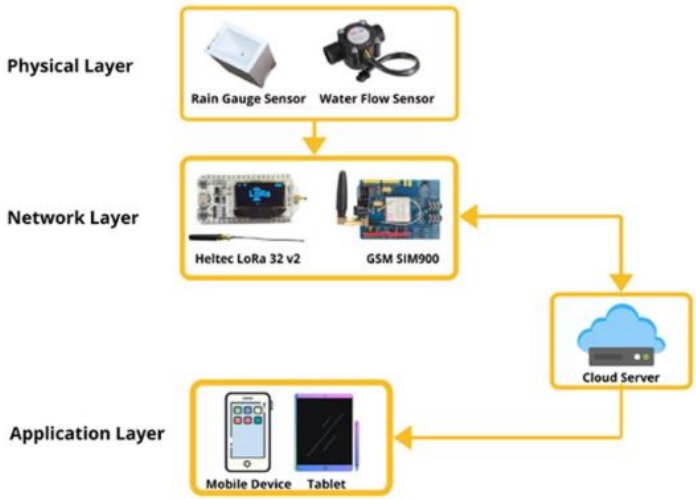

Figure 2. 9: System architecture of Early warning of impending flash flood based on AIot

R.Aishwariya Lakshmi,M.Muthu Lakshmi,P.Swetha and Thiru D.Prakash on their study of Flood Detection and Early Warning System (2020). The damages caused by flooding will be avoided by the proposed system. In order to provide the proper alerts to the public and authorities, the system is able to detect rising water levels.The public receives alert notifications in advance of the flood to allow them to evacuate to a safer location at the appropriate moment. Hardware that are used in this system are including the water flow sensor (YF-S201) for measuring the water's speed out the outlet, the ultrasonic sensor (HC-SR04) for measuring the water's height, and an RTC module for updating the sensor's changes on a periodic basis. The hardware and software are interfaced using the Arduino Uno microcontroller.The Arduino board, also known as the UNO ATMEGA 328, is a microcontroller that connects to hardware, stores information in the cloud, and retrieves it for additional processing. The data are made to be shown on the LCD and subsequently saved on the cloud when the values from the water flow and ultrasonic sensors are detected.Lastly, automation is applied in the dam field in this project without the need for human interaction. The procedure is quick and can notify people before the flood happens.

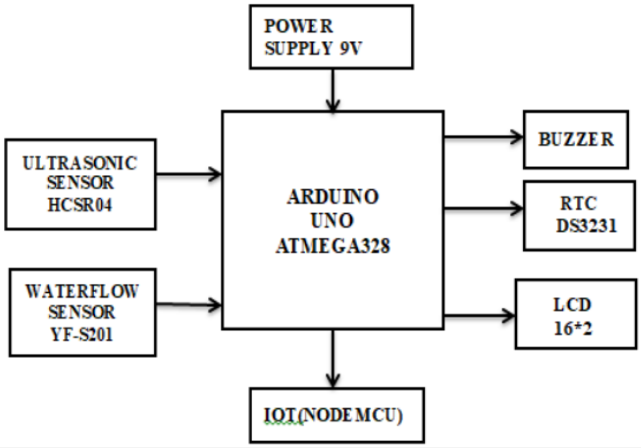

Figure 2. 10: Block Diagram of proposed system

Wahyu Susilo, Edi Mulyana, Lia Kamelia in their study of The Prototype Of The Flood Disaster Early Detection System and Its Security (2019).This proposed system is to build an early detection system on the dam that takes into account the water level inside the structure and integrates it into a security system to prevent theft of the system in the dam area. The parts of the system are Arduino Uno, ultrasonic sensors to control the water level of the dam, PIR sensors to detect human movement to prevent theft or damage caused by intruders, and a GSM SIM900a Module that sends information to the user via text message A. frequency signal is received through the sensor through the transceiver and then reflected back to the receiver upon reaching the water surface LCD 16X2 is used to display the flood data and the Arduino Uno microcontroller allows to control all the inputs and outputs of the system module. If the condition of the dam is alarm, critical or disaster, the system will send an alarm message to the registered phone number.

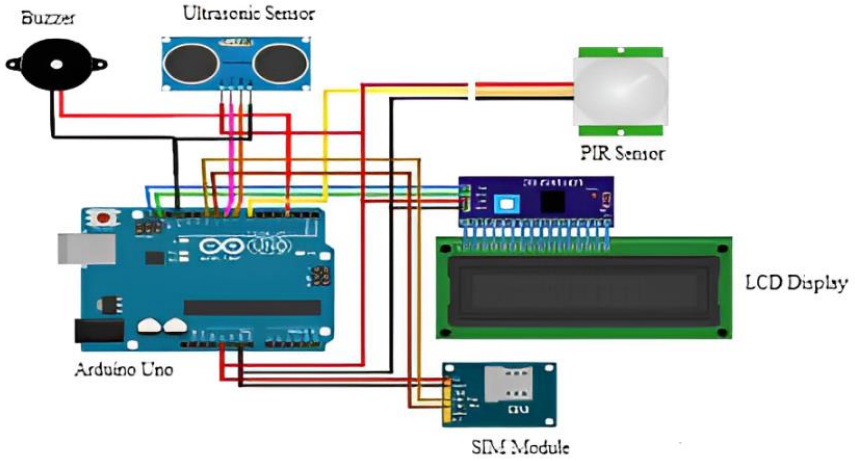

Figure 2. 11: System Design of the Prototype of the Flood Disaster Early Detection System and Its Security

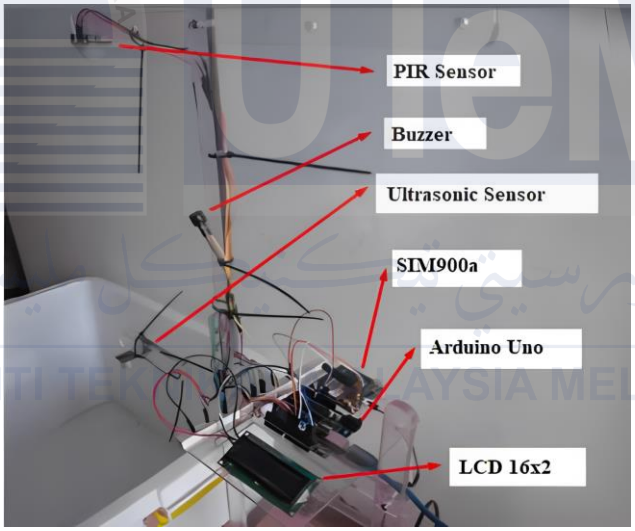

Figure 2. 12: Prototype of the System

Mateeul Haq, Memon Akhtar, Sher Muhammad, Siddiqi Paras, Jillani Rahmatullah in their research of Techniques of Remote Sensing and GIS for flood monitoring and damage assessment. This study paper deliver method for mapping flood extent and estimating damages with Remote Sensing (RS) and Geographical Information Systems (GIS) to improve flood disaster monitoring and management efficiency.Remote Sensing data with high temporal resolution is critical for monitoring floods under cloud

cover.MODIS Aqua and Terra pictures were utilised to estimate flood damage using GIS analysis techniques.Integrating GIS and Remote Sensing data with other datasets has significant potential for identifying, monitoring, and assessing flood disasters.Finally,satellite data can provide a quick and accurate assessment of flooded areas.

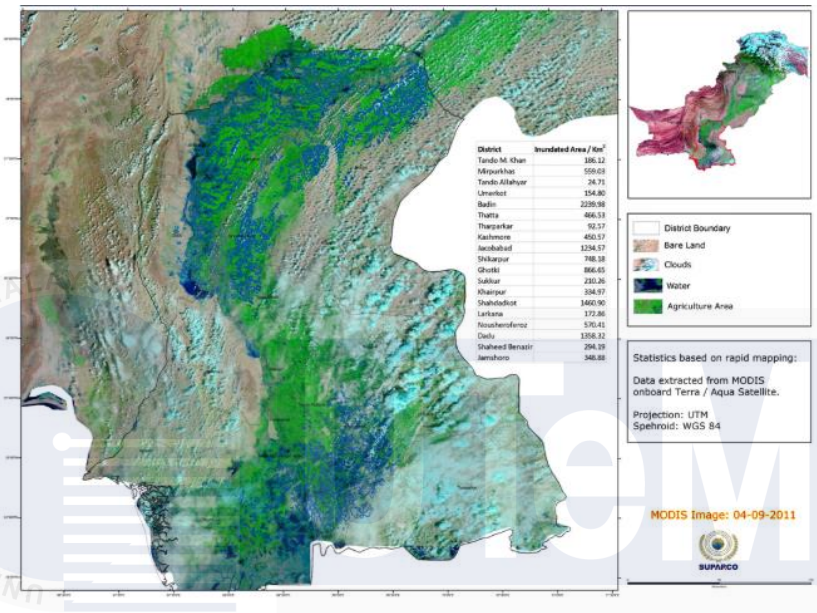

Figure 2. 13: MODIS image showing the inudated area

2.4 Critical review of current problem and justification

Table 2. 1: Summary of Critical Review

Research Title	Purpose	Description	Advantage
Mobile Flood Detector Alert System Author: M. Z. Ayob and M. S. A. Rahim	Detects flood events and notifies drivers with electronics installed on 4WD vehicles that can traverse flooded roadways.	The prototype system detected, measured, and triggered the flood level using a waterproof ultrasonic sensor.Through interaction with a satellite, the GPS NEO-6M and the device generate a location that represented by a precise latitude and longitude position.Dangerous levels are displayed with real GPS locations on a digital map.	Displays live data and provides accurate positioning of flood incidents.
LoRaWAN-based IoT flood monitoring and warning system in catchment areas Author:	Develop a new LoRaWAN gateway and sensors, and set up a LoRa network to track flood levels and update flood information on the IoT	Facilitate the concurrent and real-time reporting of data from several sensing units dispersed throughout catchment regions and uses	Cost effective, consume minimal power, utilise low data transmission rates.

Muhammad Izzat Zakaria, Waheb A. Jabbar, Noorazliza Sulaiman	platform.	long-range wide area networks' (LoRaWAN) capability to keep a large network connection in order to monitor flood levels and assess their status.	
Flood Monitoring and Early Warning System Using Ultrasonic Sensor Author: J G Natividad and J M Mendez	To measure water levels at the rivers in the province area and construct an early warning system using two monitoring devices,It will deliver vital information to concerned organisations and the local community.	The two monitoring devices measure the water level using ultrasonic sensors. A GSM module transmits data to a computer server in response to a change detected by a sensor and the application on the server analyses the data.	Low-cost,reliable
Internet of Things based Smart Flood forecasting and Early Warning System Author: B. M. Shankar, T. J. John, S. Karthick, B. Pattanaik, M.	Develop a monitoring system for essential events like flood, fire, gas and water leak and emphasises changes a flood's characteristics to reduce the highest points, spatial extents, and underlying safety precautions.	The DHT Sensor are utilise to observe the temperature and humidity values and BMP180 sensor detects the relative pressure and absolute pressure values.	Scalable approach for broader coverage and integration with existing weather forecasting systems.

Pattnaik and S. Karthikeyan			
Flood disaster indicator of water level monitoring system Author: Wan Haszerila Wan Hassan, Aiman Zakwan Jidin, Siti Asma Che Aziz and Norain Rahim	Build a water level predictor that will track the water level whether in a safe or high-risk zone.	Three float switch sensors are used to differentiate the escalation level such as “safe condition”, ”moderate risk level”,”high risk level” and more,then it will analyse the information and forward the alert message to the user.	Cost-effective and rapid alerting,users can take early action via the different alert messages when the water level increases.
Flood Alert and Monitoring System Author: Niranjan P.Yadav , Priyanka P. Shinde, Ashwini A. Dhotre,Shraddha P.Sabale and Rutuja R. Girigosavi	Develop the monitoring and alert system to prevent motorists and commuters from traffic jams and to find a possible route before they get stuck in a flooded area.	Using a wireless sensor network that sends data to an application server via mobile GPRS communication.Data transfer between the application server and remote sensors connected to GPRS data units (GDUs) is enabled VirtualCOM.	Provide early warning for users to avoid accidents and injury from flood areas, improve traffic flow.
Early Warning of Impending Flash Flood Based on AIoT	Monitor residents around flood-prone mountain slopes, measure rainfall, water	Utilising LoRa and Artificial Intelligence Internet of Things (AIoT) combination	Low-power consumption, Having a wide-coverage in

Author: Wen-Tsai Sung, Ihzany Vilia Devi and Sung Jung Hsiao	flow rate, and water velocity in determining the potential for flooding in an area connected to LoRa.	technologies to measure the water level and to regularly track the rain.This system assigns output control signals depending on input signals from environmental sensors, utilising fuzzy logic to perform intelligent control.	mountain terrain, time efficiency
Flood Detection and Early Warning System Author: R.Aishwariya Lakshmi, M.Muthu Lakshmi, P.Swetha and Thiru D.Prakash	Minimise flood damage and identify rising water levels so that the public and authorities can receive the real-time proper alert warnings.	Different sensors are used for calculating the height of the water, calculating the speed of outlet water and using RTC Module for updating the changes in sensor periodically.	Facilitating prompt updates and anticipatory reactions to fluctuating flood conditions.
The Prototype Of The Flood Disaster Early Detection System and Its Security Author: Wahyu Susilo, Edi	Develop an early flood detection system in dams based on water level and link it with security systems to prevent theft.	Utilising ultrasonic sensor circuits to continuously measure water level in dams, while the PIR sensor circuit identifies obstructions based on body temperature.The	Low-cost,enhance security by recognising human presence and preventing theft or damage to the system.

Mulyana, Lia Kamelia		PIR sensor has a maximum detection range of 2.5 metres.	
Techniques of Remote Sensing and GIS for flood monitoring and damage assessment Author: Mateeul Haq, Memon Akhtar, Sher Muhammad, Siddiqi Paras, Jillani Rahmatullah	Develop flood monitoring using a combination of statistical processes, geophysical modelling, forecasting and economic evaluation.	Operate using high-resolution synthetic aperture radar (SAR) and picture capture to scan extensive areas. Remote Sensing (RS) and Geographical Information System (GIS) technology, which uses satellites, are also used to monitor flood direction and predict flood damage.	Efficient resource allocation,SAR and satellite imaging offer wide coverage of large areas, allowing for a detailed evaluation of flood-prone areas.

2.5 Proposed Solution

Flooding is one of the major disasters occurring in various parts of the world (Klong , Klong Luang, Pathum Thani,. 2011). Previous research indicates a variety of development strategies and approaches. This section describes a proposed flood monitoring and alert system with the objective of early detection and warning systems to mitigate the potential flood dangers. The suggested approach uses various sensor technologies, data analysis, and communication networks to provide real-time monitoring and reaction to flood disasters. To summarise the various forms of flood monitoring and alert systems, I have picked three types of systems to develop my own.There are three type of different system which is Early Warning of Impending Flash Flood Based on AIoT (Wen-Tsai Sung, Ihzany Vilia Devi and Sung Jung Hsiao, 2022). The second one is The Prototype Of The Flood Disaster Early Detection System and Its Security (Wahyu Susilo, Edi Mulyana, Lia Kamelia, 2019) and the third one is Flood

disaster indicator of water level monitoring system (Wan Haszerila Wan Hassan, Aiman Zakwan Jidin, Siti Asma Che Aziz and Norain Rahim, 2019).The Table 2. 2: Comparison between the system below show summarises features selected from different systems.

Table 2. 2: Comparison between the system

Title **Aspect**	**Early Warning of Impending Flash Flood Based on AIoT**	**The Prototype Of The Flood Disaster Early Detection System and Its Security**	**Flood disaster indicator of water level monitoring system**
Cost	Cheap	Cheap	Cheap
Wifi connectivity	Yes	Yes	Yes
Power source type	Plug to socket	Plug to socket	Plug to socket
Real-time data input	Yes	Yes	Yes
Advantages	Low-power consumption and have a large-coverage in mountain terrain.	Ease of deployment and increase security by recognising human presence and preventing theft or damage to the system.	Ensuring reliable connection and communication even during congested phone lines.

Implementing a flood detection and alarm system can enhance the current system and reduce its shortcomings. This project involves the creation of a software system for tracking and monitoring the sensor in the system. Users can access the programme wirelessly and get weekly and monthly water level and flood status updates on their smartphone. In this project, the ESP32 is used to connect the processing unit to the internet, and the Blynk app is used to create the flood detector and alert application. The project will include components such as an ultrasonic sensor, power supply, and buzzer. Data will be transferred using Firebase's real-time database and made available to the user. The figure below shows the suggested system's functionality.

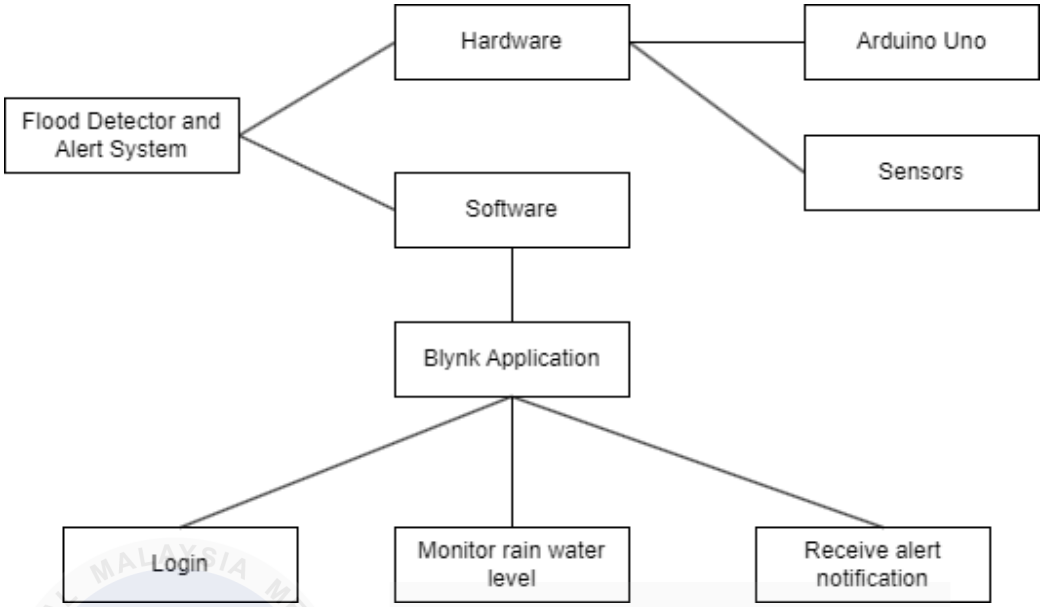

Figure 2. 14: Functionality of Flood Detector and Alert System

The proposed flood detector and alert system offer a comprehensive approach to early detecting and monitoring. Through the use of sensor technology, data analysis methods and a reliable communication network, early flood warning systems help protect the community by averting loss of life, emotional distress and damage to properties. Nevertheless, recent technological progress has led to the development of cost-effective tools that can address challenges. Further research, progress and cooperation with stakeholders are necessary to realise this idea and enhance flood risk management.

2.6 Conclusion

In conclusion, conducting literature review is an important chapter and it is a very crucial part to develop the project concept, it helps to understand the existing features of the system and to gain a clear picture to implement the system. Research and study can improve the project's flow and knowledge. Basically, this chapter is used to enhance the previous and current work and make the solution the problem to become better.

CHAPTER 3: METHODOLOGY

3.1 Introduction

In this chapter, we will discuss and explain about the methods used in this project.Methodology is a research strategy for conducting investigations on certain study subjects in an organised manner.It denotes a deep theoretical understanding of research procedures employed in a specific field and gives a framework for researchers to undertake systematic inquiries, ensuring that the research process is rigorous, transparent, and reproducible.Agile, Rapid Application Development (RAD), Waterfall, Object Oriented Methodology, and Prototyping are some of the approaches utilised in development.Each methodology has its own set of benefit and limitation.In this project, prototype model approaches are used. It is useful for collecting and validating the needs of users.The prototyping model is a software development life cycle (SDLC) model that entails generating a functional prototype of the system prior to developing the final product. The most suitable method can help the project progress efficiently and in the correct manner.The aim of methodologies is assisting to achieve the goal of a project to develop high-quality research and study.

3.2 Research Process

The product's progressive development is known as the research process,it consists of step-by-step development of the project. The method is separated into five stages such as data collection, analysis, design, implementation, and testing. Every stage is essential for completing the project. The following Figure 3.1: Flow of Research Process shows the flow of the research process.

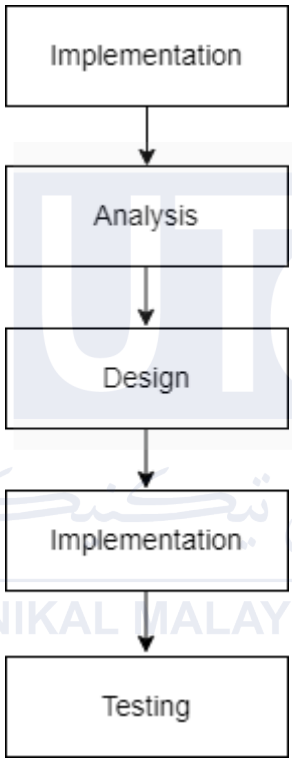

Figure 3.1: Flow of Research Process

3.2.1 Data Collection

Flood detectors and alert systems are one of a modern technology to monitor the flood event. Collecting data for a flood detector and alert system entails obtaining important information and measurements in order to understand the conditions that cause flooding. The beginning stage in collecting data for a flood detector and alert system is determining which data sources are useful. In this project, we collect data using an ultrasonic sensor before communicating it to the user. This system enable the residents to monitor their home when they are far from home and not aware if the water level is increasing due to heavy rain in their home

area and give them early alert if the flood is occur .It is difficult for the residents in flood-prone areas to remain informed and prepared for future disasters. User also can view the previous date when the flood occurred in that region, so they can easily plan a trip or vacation. The lack of important information makes it more difficult for them to organise trips or vacations in these places, which may expose them to unanticipated risks.

3.2.2 Analysis

Based on the findings of the research and analysis conducted in journals and on the internet, the flood detector and alert system currently on the market is not performing to their maximum capabilities .This is because some of current flood detector and alert systems do not provide any applications or interfaces to the residents and users. They also cannot view the previous and current date when the flood occurred in that area. Because of this, it can give difficulties for individuals to get early warnings and take immediate action in order to protect themselves, their families, pets, and their properties if a flood occurs. They also cannot make sufficient preparations to organise their trip there if there is an heavy rain and unexpected flood. As a result, residents of the local community and visitors from other areas feel they are at risk when the heavy rain is occur or when the weather is bad. This is a highly inefficient use of resources.

3.2.3 Design

a. System Architecture Design

The expected result for a flood detector and alert system is that it will come up with an Android application that will be internet-connected and able to detect the levels of water as well as possible floods that might be caused by a heavy downpour on this platform. The water level information will be sent through an ultrasonic sensor from an ESP32 board to the regions prone to floods . After transmitting the data, the data will be saved on the Firebase cloud. The app's main screen will display the most recent data as of the current date. The following Figure 3.2: System Architecture, depicts the system architecture of the flood detector and alert system, as well as the product flow.

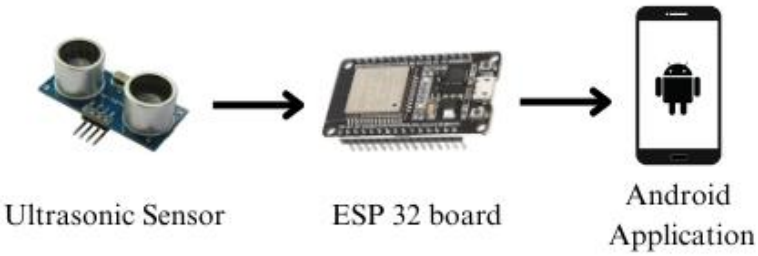

Figure 3.2: System Architecture

3.2.4 Implementation

Project implementation explains how to develop the system in reality from the version and plans. The execution consists of exactly two phases which are hardware connection and Blynk application accordingly. Every detail of the planned performance is explained in chapter 5.

a. Hardware connection

The figure below shows the connection of hardware that was implemented in this project. The sensor is attached to ESP-32 microcontroller to retrieve data to come out by using the male to male jumper wire. The Blynk application has to be programmed to ensure the connection with the ESP-32 is connected and functioning well. All the data that received from the ESP-32 has to be transmitted to Blynk Cloud to process the data.

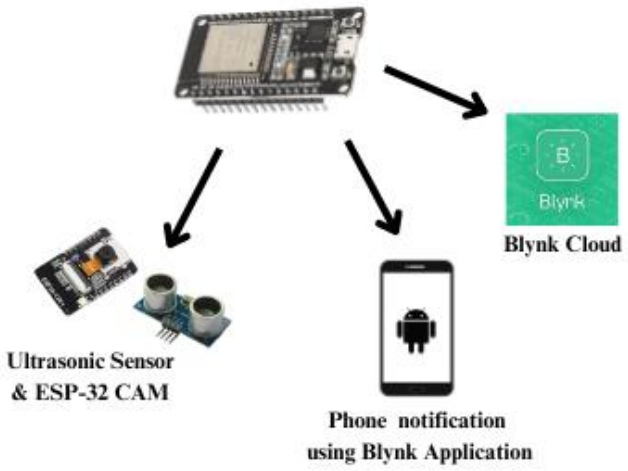

Figure 3. 3: Hardware Connection

b. Blynk Application

Blynk application is an application integrated development to monitor the flood detector and alert system.

3.2.5 Testing

Testing is the process of executing and operating a system application to ensure that it will perform well as expected. Hardware testing and software application testing have been prioritised for the flood detector and alert system testing procedure. Everything in the testing process must follow a proper procedure and is supposed to be done in the correct way in every part of the process. Chapter 6 provides a more detailed explanation.

Hardware testing - Hardware testing includes sensors and the ESP-32 microcontroller.

Software application testing – Each created function of the system is examined to ensure that it operates properly.

3.3 Prototyping Methodology

A prototype is a pre- final product that displays a tangible representation of the final product and thus, enables the stakeholders to visualise and interact with it before the full development. The degree of fidelity and functionality of a prototype is dependent on the aims and needs of the project. Therefore, it could vary from design to design. Prototyping is an activity that diminishes risks, allows for enhanced communication, and delivers a higher level of the project success.

The base model is perfectly suited for the project of flood detector and alert system for the following reasons. In a flood detector and alert system project, it is important to first understand what the users need and want, for example the type of data to be collected, the accuracy needed, and the response time. The feedback from the end-users and domain experts of a flood detector and alert system is of all importance as to figuring out the viability of the system. The given prototype project has incorporated six stages, which are requirement gathering, quick design, building prototype, customer evaluation, refining prototype, and engineer product. The figure below clearly depicts the prototyping model.

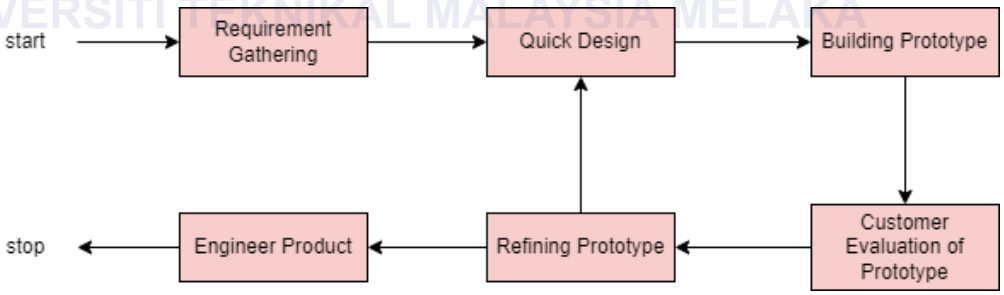

Figure 3. 4: Prototyping Model

3.3.1 Requirement Gathering

The fundamental point of starting the prototyping model is to collect project requirements.There are two particular requirements that are essential, it is hardware and software requirements. The following sections will provide a detailed explanation of these requirements.

3.3.1.1 Hardware Requirement

i. ESP32 microcontroller board
ii. LCD display
iii. Buzzer
iv. Ultrasonic sensor
v. Resistor 330Ohm
vi. Breadboard
vii. Battery and battery connector
viii. Jumper wire
ix. ESP- 32 CAM
x. Water Pump DC 3V-5V

For hardware connection, LCD display, ultrasonic, and buzzer will connect to a Wi-Fi module on ESP32 board. The 330 Ohm resistor will be used to limit the current flow through the LCDs, while the battery and battery connector will be used to power on the microcontroller without requiring a USB cable connection. All of the connection components for this project will be wired using breadboard and jumper wire.

3.3.1.2 Software Requirement

i. Arduino IDE
ii. Blynk Application
iii. Blynk Libraries

The Arduino IDE will serve as the programming interface for all hardware used in the implementation of the software described above. The Blynk application will start with the development of an Android app that will use Wi-Fi connectivity to gather water level and flood data from the Wi-Fi module. Multiple interfaces, such as water level data, current and previous status, notification, and report interfaces, will be designed for the Android application. Figure 3.5: Functionality Model below demonstrates the operation of a flood detection and alert system. The Blynk app will interface directly with Google Firebase to obtain water level and flood status data.

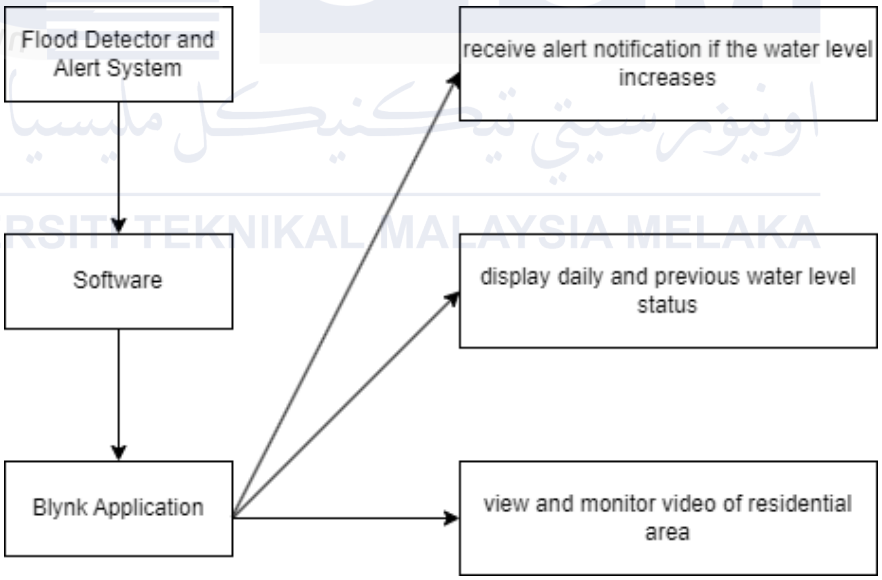

Figure 3. 5: Functionality Model

- Displays alert notifications when the water level rises, there are 3 types of alert notifications: low level, medium level and high level (high risk). Users also get information that displays steps to be on guard and safe.

- Display daily and previous details report of water level and flood status (user can search current or previous specific date to view the report of water level and flood status)
- View and monitor video of residential flood-prone areas.

3.3.2 Quick Design

The second phase might involve a preliminary design. During this stage, the system's basic design is developed. However, the design is not finalised. It offers the user with a brief description of the system. The quick design facilitates prototype creation.The design of a flood detector and alarm system will be implemented to provide a concept for project implementation, including a flowchart outlining how to build this project wisely. The design should consider both the physical and logical components of the project.

3.3.3 Building Prototype

During this phase,this stage features the more realistic prototyping which concretizes the learning from rapid design. It is a reduced scale reproduction of the final system.All hardware will be installed and configured using the previously implemented design. Additionally, the chosen software will be installed for this attempt. The first piece of software required is the Arduino IDE, which is used to write code for each piece of hardware that uses the ESP32 microcontroller. The Blynk application was then installed and used to create Android application interfaces. The programme retrieves notification status from Arduino data sent to a mobile phone via Wi-Fi connection. The third installed software, Firebase, will be utilised for storing all data and measurement information.

3.3.4 Customer Evaluation

During this step, the client receives the system for preliminary testing. It might be prudent to conduct some research into these areas of strength and weaknesses.They will evaluate the efficiency and usefulness of the system and application developed. To meet user

requirements and satisfaction, performance testing will analyse data transfer correctness and speed. For functionality testing, the prototype will be evaluated by asking the user to select a current or specific date and determining whether the data collected is performing as planned and succeeding or having difficulties. Any comments and ideas made by an evaluator will be gathered, revised, and analysed to help improve project implementation. A questionnaire on flood detector and alert system aims will be used to evaluate and verify the usability of the designed flood detector and alert system.

3.4 Project Milestone

The implementation plan for this attempt will be based on the project timetable and milestones. The project timeline and milestones are crucial because they make sure the project is completed effectively and within the timeframe specified, including the expected completion date. As a result, the project will not fall behind time, which is helpful. Table 3. 1: Project milestone below displays the project's anticipated milestones.

Table 3. 1: Project milestone

Method \ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Requirement Gathering																						
Quick Design																						
Building Prototype																						
Customer Evaluation																						
Refining Prototype																						
Engineer Product																						

3.5 Conclusion

As a conclusion, this chapter explains the methodology that will be used in this project.It is very important because it can control the structure of flow on this project. It also contains a specific chapter on the methodology being used. The developer should therefore not have any hard time building his prototype model suitably as it is a basic one and very practical. The prototype model can be used as the guide for the developer to construct the system and to improve the customer satisfaction. This is due to the fact that the end user is integral in the planning, implementation, and execution of the project.

CHAPTER 4: ANALYSIS AND DESIGN

4.1 Introduction

This chapter will thoroughly discuss the project design for implementation in the following chapter. The technique was discussed in the previous chapter and will be used for the development of this project.The analysis and design parts provide a comprehensive overview of the project's goals, needs, and suggested solution. To provide a thorough grasp of the project's objectives and suggested solution, material must be clear, concise, and well-structured. The project's software and hardware needs will be detailed. This chapter provides an overview of hardware prototypes and software interfaces.

4.2 Problem Analysis

The current flood detection and alert system in the market lacks comprehensive capability due to a lack of information-based applications. By implementing the RESQ Flood Detector and Alert System, users are able to monitor water levels in real time. The system helps to monitor the water level and alert the user if the water level rapidly increases. This project's monitoring tool is a Blynk app that tracks water environmental changes, checks water level status for the previous date, and provides reliable information After that, all the data will be stored in the cloud for reference.

4.3 Requirement Analysis

We will be deliberating about the Flood Detector and Alert System in this sub-chapter. It is crucial to understand the procedure and how it will operate. Thus, this chapter may provide us with more detailed information on the hardware and software needs.The methods and technology used in this project will also be implemented in further depth in this chapter. This approach might help the user keep a precise monitor on the flood water level.This chapter will also go into more detail on the technology and procedures that were implemented for this project. The user can efficiently perform the flood water level monitoring function by adhering to this step or process.

4.3.1 Data Requirement

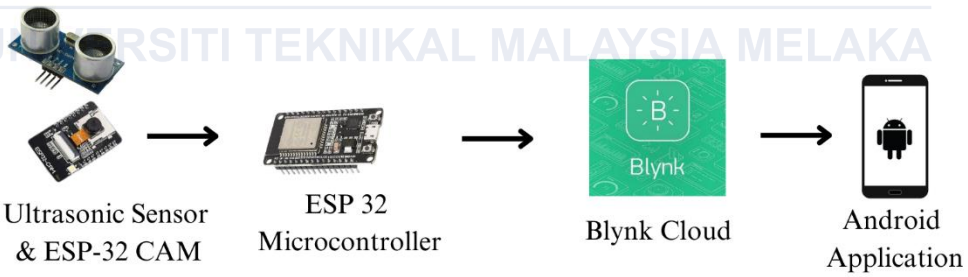

Figure 4. 1: Data Flow

Figure 4. 1: Data Flow above illustrates the system's data flow. An internet-connected Android application intended to monitor the water level caused by heavy rain and potential flooding is the expected result of a flood detector and alert system. Data on rainfall and water level will be reported by an ESP32 Wi-Fi module linked to ultrasonic sensors and ESP-32 CAM in flood-prone locations. It is recommended to take those readings frequently, for instance, once every minute, and to convert them into some kind of unit of measurement, such as centimetres or metres. According to predefined constraints, water levels can be categorised

into three basic categories: low, medium, and high. The ESP-32 CAM captures real-time video footage of flood conditions. After that, the data will be transmitted and kept on the Blynk application cloud. The most current reports and information from the last few days will be shown in the application's main interface.

4.3.2 Functional Requirement

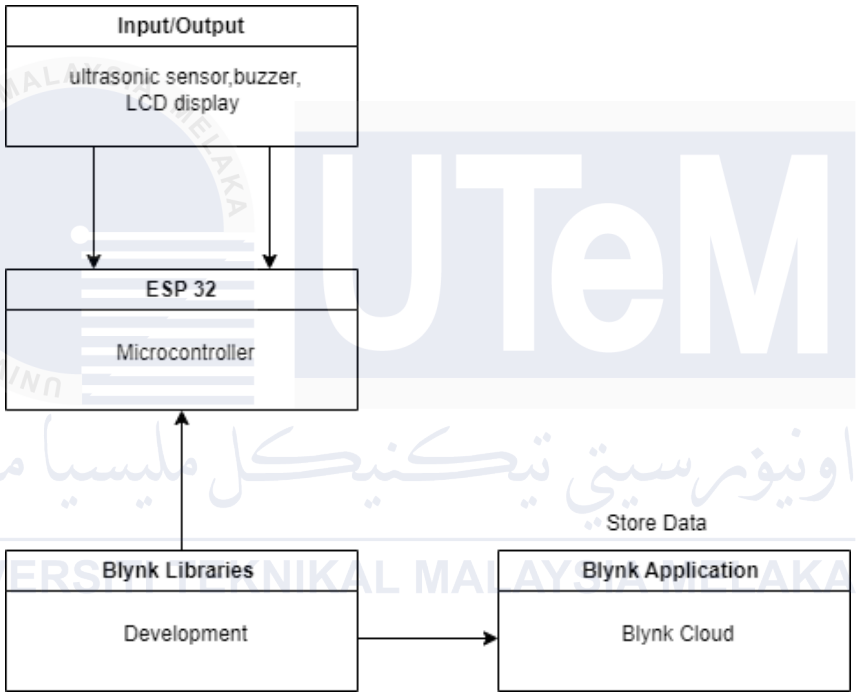

Figure 4. 2: Block Diagram of Functional Requirement

This project is divided into several sections namely microcontroller block, input/output block and development block. The Figure 4. 2: Block Diagram of Functional Requirement depicts the details of the block diagram for this project.

1) Blynk Library sent the command to the ESP32 microcontroller, which then sent the command to the sensors. This microcontroller's sensor control code is all programmed using an IDE.

2) Input/Output sensors will measure the water level and rainfall data. It must be linked directly to the ESP32 microcontroller.

3) Blynk Library: The primary operation is the Blynk Application platform and Blynk library are interconnected. It can manage how the Blynk cloud, through the Blynk library, is connected to the flood monitoring sensors and allows them to display real-time data transfer and reception. This also enables the hardware to perform user commands and read sensor readings sent to the Blynk app. The operation entails monitoring the ESP 32 to observe water level,rainfall data and detect flood possibility. The Blynk Library has the capability to exchange commands with the ESP 32 microcontroller, enabling communication both ways.

4.3.3 Non-Functional requirement

1) Performance: The performance of the system is important to make sure the system operates smoothly. The sensor must be able to capture data accurately to make sure that the data are able to be monitored.

2) Scalability: Scalability is an important factor since it determines how well the system can handle increasing data volumes, user demands, and functionalities without experiencing performance or stability issues. The measurement method used in this study is insufficient to control huge quantities of water level, so its scope is limited to certain residential areas prototypes.

3) Reliability: Reliability is the probability that a system will operate as planned for a certain period of time or will operate flawlessly in a predetermined environment. Based on the threshold, the system has previously been tested and is capable of recording sensor data.

4.4 Hardware Requirement

1) ESP32 microcontroller board

ESP32 is a low-cost, low-power system-on-a-chips (SoCs) that has dual-mode Bluetooth and WiFi capabilities. Its core is a Tensilica Xtensa LX6 microprocessor, which may run at up to 240 MHz and be either dual- or single-core.This the compact board operates at a voltage range of 2.5V to 3.6V.With filters, power management modules, RF balun, power amplifier, low-noise receive amplifier, and antenna switches integrated in, ESP32 is a highly integrated device. ESP32 is a power-saving technology that is designed for wearable electronics, mobile devices, and Internet of Things applications.It programmable using Arduino IDE, MicroPython and more.It achieves extremely low power consumption by using features like dynamic power scaling, numerous power modes, and fine resolution clock gating.

Figure 4. 3: ESP32 microcontroller board

2) LCD display

A flat-panel display called an LCD (Liquid Crystal Display) creates text and images using liquid crystals

Figure 4. 4: LCD Display

3) Buzzer

A piezo buzzer is an electronic device with sound-generating functionalities using the piezoelectric effect. It is widely employed in the construction of audible alerts, notifications, and tones for different electronic systems and devices

Figure 4. 5: Buzzer

4) LED

Green LED will turn on if the water level is low (safe),yellow LED will turn on if the water level is medium (medium risk) and lastly red LED will turn on if the water level is high (High Risk).

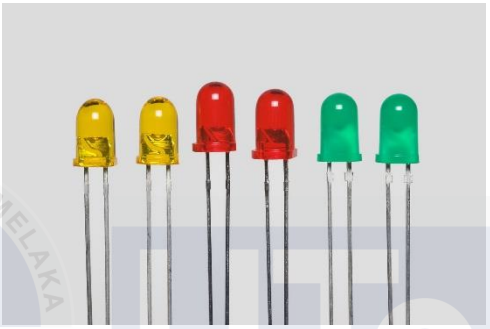

Figure 4. 6: LED

5) Ultrasonic sensor

Measurement of the flood water level is carried out using an ultrasonic sensor, which has the advantage of emitting ultrasonic sound waves and measuring the time of wave reflection. The sensor transmits a high-pitched sound pulse that travels down through the air to be reflected from the water before returning to the sensor. The time-lag in the sending and receiving of the pulse is directly proportional to the distance of the water surface from the sensor.That distance measurement is used in computing the amount of water. An ultrasonic sensor has high accuracy and is effective for the purpose of continuous monitoring of the water level and provides real-time data, which is of prime importance for the detection of floods and alarm systems.

Figure 4. 7: Ultrasonic Sensor

6) Resistor 330Ohm

Resistors are electrical devices that control or limit the passage of current in electronic circuits. The application of this resistor thereafter extends to interrupting transmission lines, splitting voltages, adjusting signal speeds, and reducing the running of current.

Figure 4. 8: Resistor 330 Ohm

7) Breadboard

A breadboard is a tool in electronics used for building and testing circuits without the need for soldering. It is constructed from a flat board with an easy-to-insert grid of holes for connecting parts. Strips of metal that join the.The temporary wiring of electrical connections is made possible via holes from below.Resistors, capacitors, and integrated circuits can all be connected to and plugged into the breadboard.

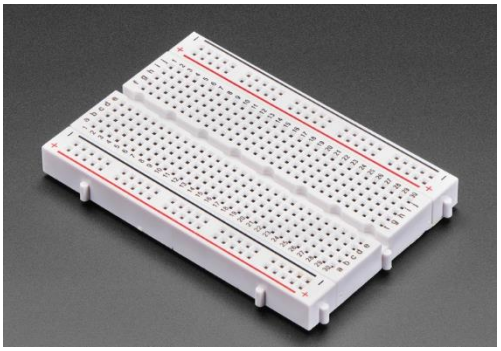

Figure 4. 9: Breadboard

8) Battery

A battery is an electric power source made up of one or more electrochemical cells that can power electrical devices through external connections.

Figure 4. 10: Battery

9) Battery connector

Battery holder is used to keep cells fixed safely and securely while conveying power from the batteries to the electric components.

Figure 4. 11: Battery connector

10) Jumper wire

A jumper wire is a wire that connects a microcontroller to other components so they can communicate with one another. There are three different kinds of jumper wire: male-to-female, male-to-male, and from female to female. In this project, an ESP32 microcontroller is connected to sensors and other electronic parts via jumper wire. A jumper wire example is shown in the above illustration.

Figure 4. 12: Jumper Wire

11) ESP- 32 CAM

ESP32 camera module is a multi-purpose low cost camera module, which can be effectively used for flood monitoring systems. It consists of a powerful microcontroller and a camera unit, which makes it possible to take images and record

videos in real-time. The Wi-Fi module of ESP32 camera module can broadcast data to a remote server for image analysis and user alerts. The small size and low power of ESP32 camera module allows it to be located in different places to monitor the water level and alert for the possible flood areas.

Figure 4. 13: ESP-32 CAM

12) Water Pump DC 3V-5V

The water suction mechanism used by this Micro Submersible Water Pump DC 3V-5V drains the water from the intake and releases it through the outlet.

Figure 4. 14: Water Pump DC 3V-5V

4.5 Software Requirement

The Arduino IDE is a cross-platform application that is used to write and upload programs for Arduino-compatible boards and other microcontrollers.This consists of a straightforward, user-friendly interface for authoring, compiling, and submitting code that supports Windows, macOS, and Linux operating systems. The Arduino IDE offers a clear way to set up projects integrating sensors and actuators to enable devices to communicate with each other and the environment, as well as to facilitate automation and data collecting in the context of Internet of Things applications. It works with a wide range of Arduino boards, from the most basic (Uno, Mega, Nano) to the newest (MKR and Nano 33 IoT), which are intended for Internet of Things applications that have built-in Bluetooth or Wi-Fi.

Figure 4. 15: Arduino IDE Interface

Blynk is a feature-rich Internet of Things platform designed to allow developers to easily create connected devices which can be controlled and monitored through an intuitive smartphone app. A wide range of widgets, such as buttons, sliders and graphs, can be used to create custom user interfaces for projects that allows to remotely monitor and control devices. Blynk can be used for industrial automation, smart homes and other Internet of things scenarios as it enables users to visualise readings and manage devices in real-time. Reliable IoT solutions can be created with minimal effort because Blynk supports popular hardware platforms including Arduino, Raspberry Pi and ESP8266,ESP32 and more.

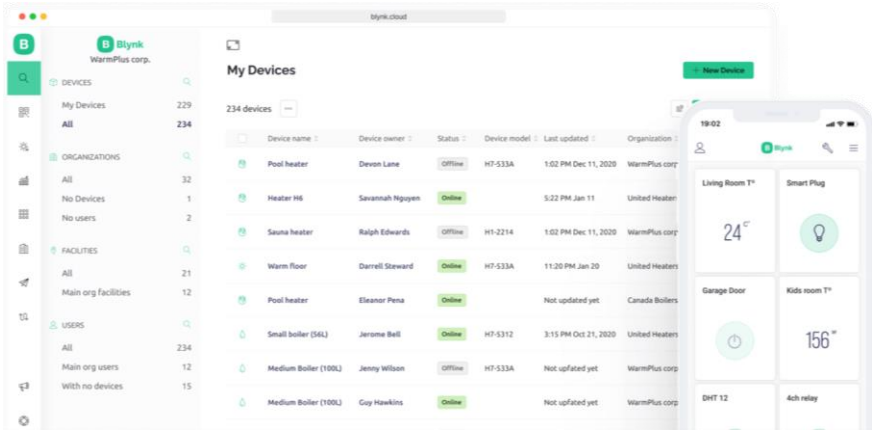

Figure 4. 16: Blynk Web and Mobie Interface

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Blynk library acts as a link between the hardware and the Blynk server. It provides users with a set of functions which establish communication between the IoT devices and Blynk servers. By incorporating Blynk library in the project, It can easily connect the device to the internet, transmit sensor readings, get commands from the app and notify the users about the changes. Different communication libraries allow using Wi-Fi, Ethernet and GSM modules, which makes it possible to connect almost any hardware configuration to the Internet.

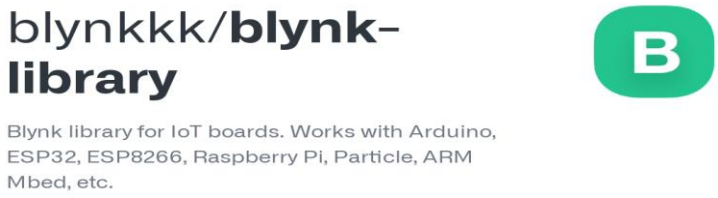

Figure 4. 17: Blynk Library

4.6 High Level Design

High level design (HLD) in a project can be the architectural design of the solution or system being developed. It outlines the overall structure, major components and interfaces of the project and its main functionalities. It ensures successful and well structured implementation of the project

4.6.1 System Architecture

System architecture is a software android-based system.This software enables users to put systems in place with minimal time used in the process. There are different system architectures which are important in the development of any system, since it gives a general framework with regard to the design, development and implementation phases. The goal of designing a system introduces structure that ensures all objectives must be met to improve the functionality of the system. For instance, the IoT architecture of a flood monitoring and alert assumes the structure of a system that consists of several sensors, data processing units, and communication modules responsible for monitoring the environmental conditions in real-time. It involves the utilisation of technology, especially cloud services for storage of data as well as applications for notifications using mobiles. Furthermore, the proposed system architecture has back up major components and high levels of reliability and accuracy built in for measure.

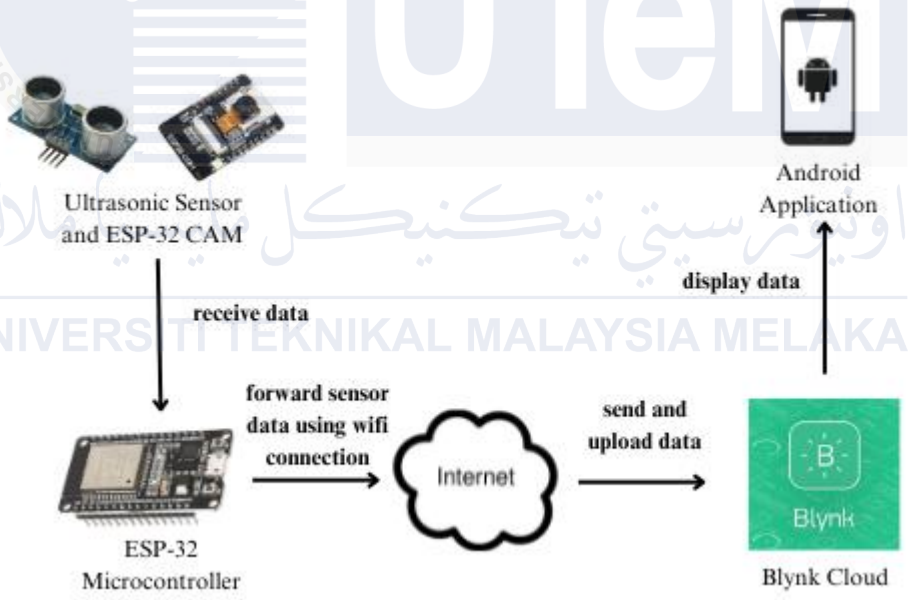

Figure 4. 18: System Architecture

4.6.2 Interface design

A proposed user interface will be part of the Internet of Things flood monitoring and alert system. User interface (UI) and user experience (UX) are terms that are used in human-computer interaction. UI involves the visual interaction between the user and computer system and applications while UX encompasses the whole of a user's experience with a product, including UI. Among other improvements in HCI, they have an impact on user engagement, accessibility, feedback systems, error management, usability, effectiveness, and learnability.

In selecting the colour schemes for HCI, including the use of green colour, the application's aims and objectives, and the feelings the application wants to instil in the users, must be taken into consideration. To prove that the chosen colour scheme improves the user experience and enhances the intended functionality and mood of the programme, there has to be a need to perform user testing and garner feedback. In this regard, there is the need to complete various research projects to select a good theme. The selection of a green color theme can have various psychological and human computer interaction effects on the users of the Flood Detector and Alert System.

i. Reduced Anxiety : Flood is a serious matter, and the use of green colour can help reduce user anxiety when using the application.Green is a calming and revitalising colour. It also indicates inexperience and progress. Compared to most other colours, it exudes more good energy.

ii.Trust and Safety: Green is generally considered a trustworthy tone and when used on a safety-critical application like a flood detector it might even make the user feel more relaxed. Green is a calm colour. Green lights are instinctively recognised by consumers as signals that there is no immediate danger, which might translate in the user's mind to a trustworthy system that is looking out for their welfare.

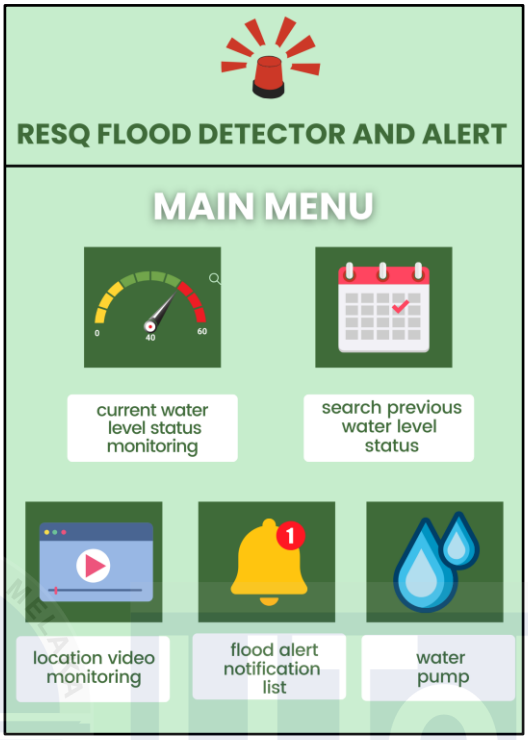

Figure 4. 19: Main Meny Interface

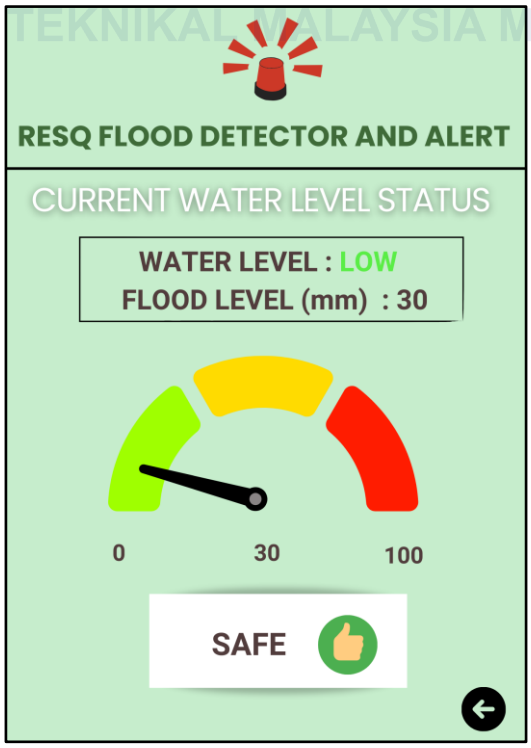

Figure 4. 20: Current Water Level Status Interface (Low)

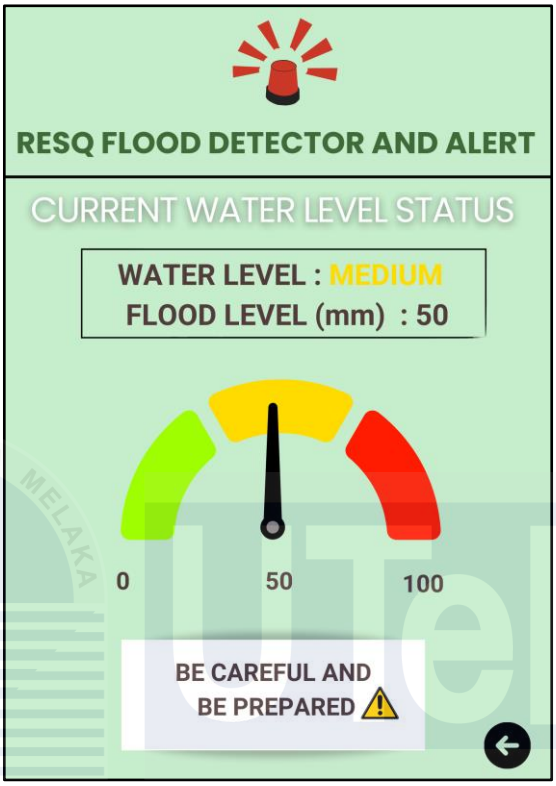

Figure 4. 21: Current Water Level Status Interface (Medium)

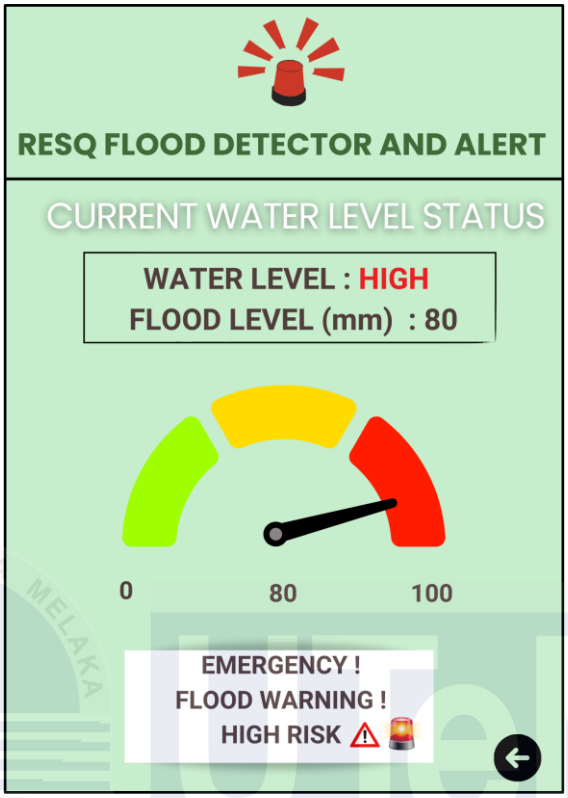

Figure 4. 22: Current Water Level Status Interface (High)

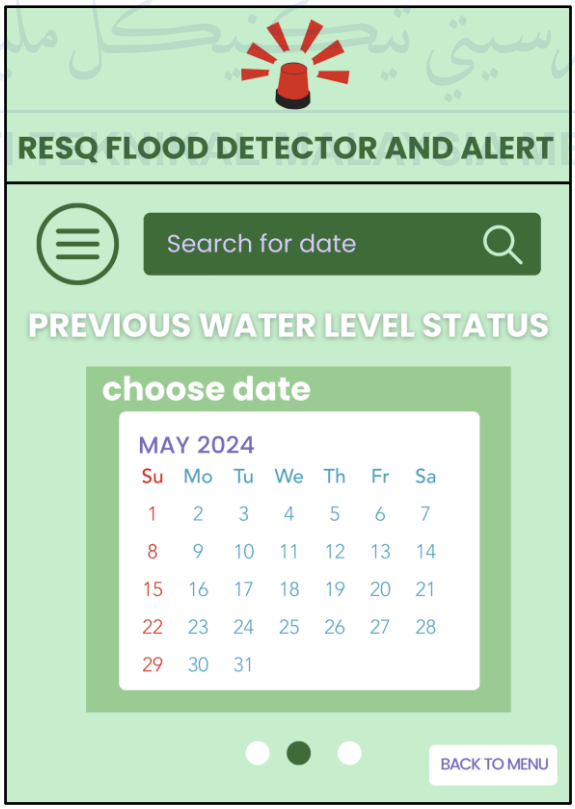

Figure 4. 23: Search Previous Date Interface

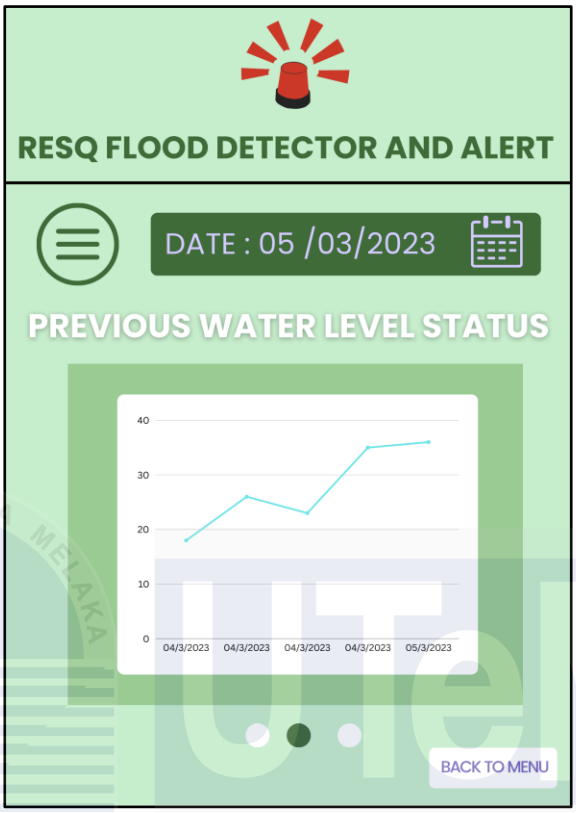

Figure 4. 24: Water Level Graph Statistic Interface

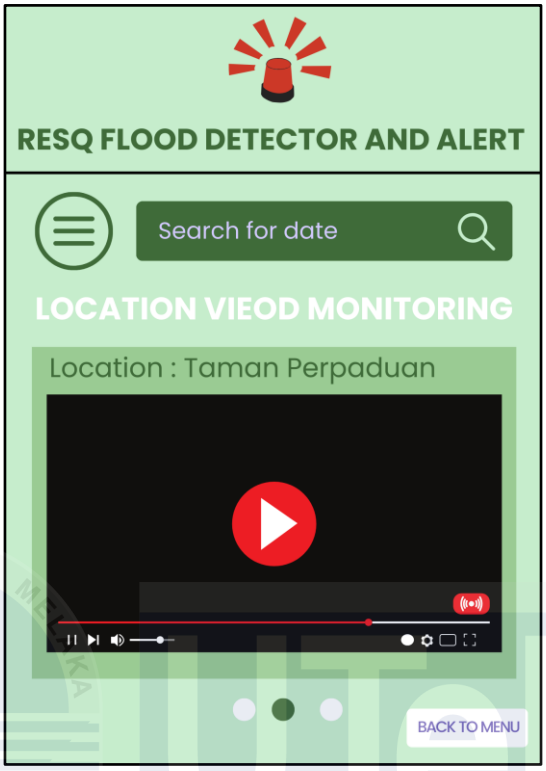

Figure 4. 25: Video Monitoring Interface

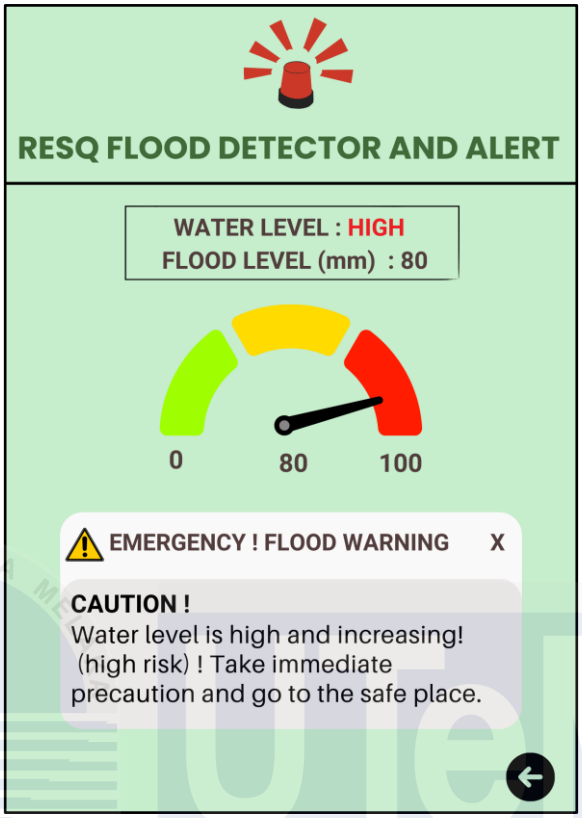

Figure 4. 26: Pop Up Alert Notification

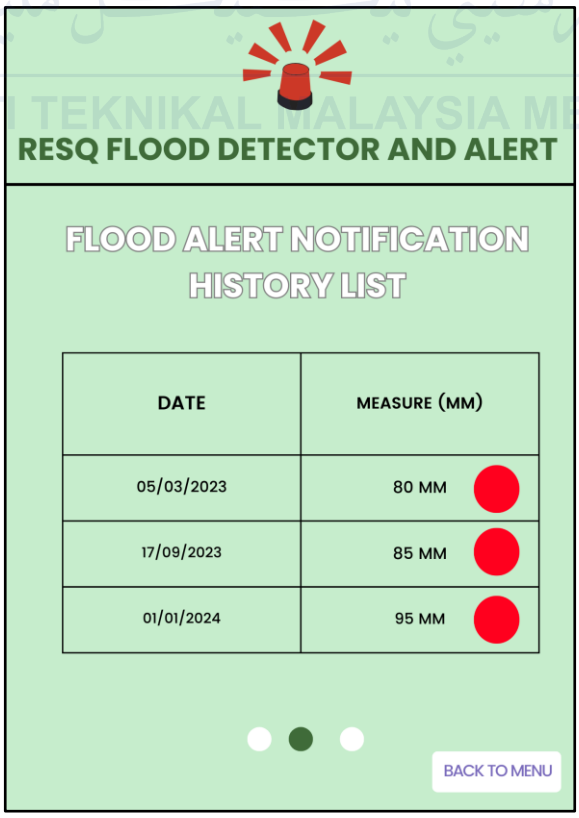

Figure 4. 27: Food Alert Notification History List

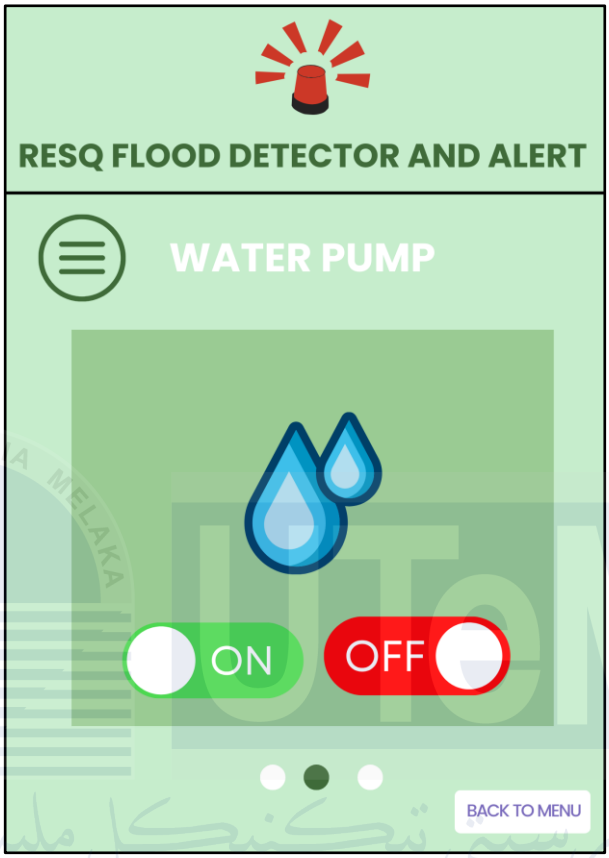

Figure 4. 28: Water Pump Control Interface

4.7 Flowchart Application Process

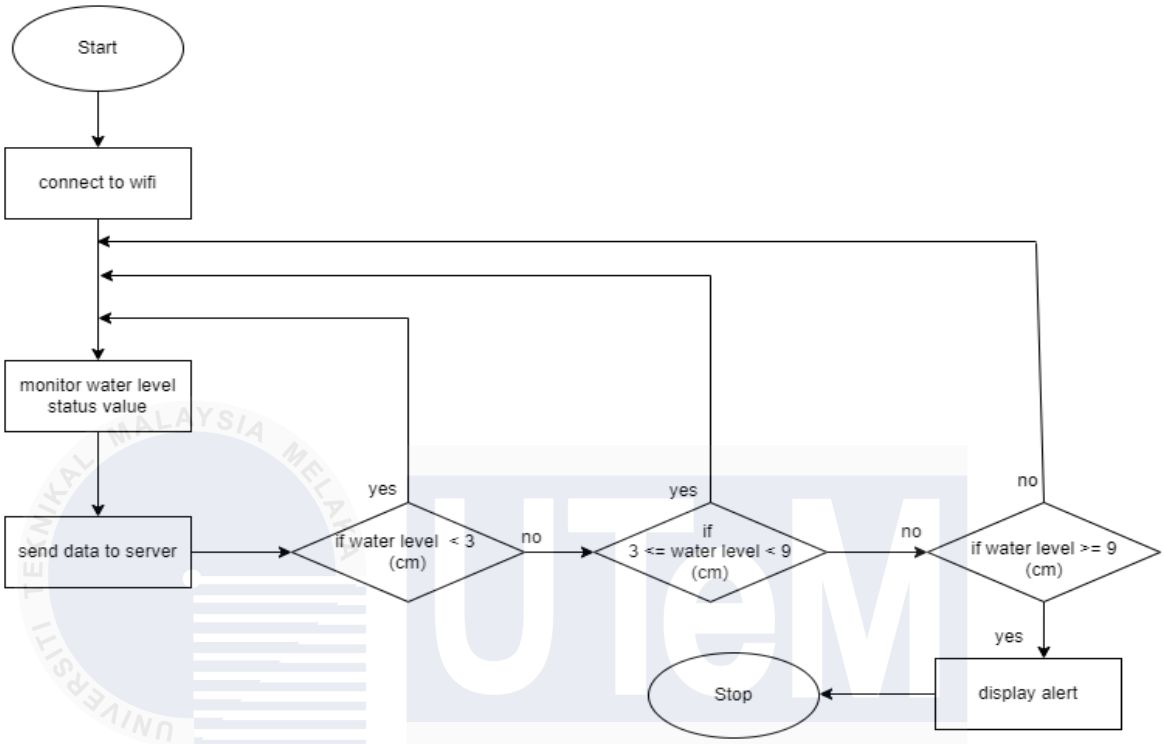

Figure 4. 29: Application Flowchart

4.8 Conclusion

Analysis and design are an important part to implement a project. All software and hardware requirements need to be identified and studied before carrying out a project. With the help of this design, users will be sure that the prototype is easy to install and work with. Therefore, it's important to understand the software and hardware that will be used. This chapter is the pre-preparation stage for the implementation, and it also includes the flow of the overall system so that one will be better understood before it was implemented. The next chapter will be discussed on how the project will be implemented and the output that is expected from this project. So, the analysis and design phase helps in the implementation process to be smooth.

CHAPTER 5: IMPLEMENTATION

5.1 Introduction

This chapter presents the integration with Android smartphone applications through ResQ Flood Detector and Alert System software and hardware development. Furthermore, it elaborates on how the management settings can be configured to ensure smooth and effective performance of the project. The process used the ESP-32 microcontroller in developing the ResQ Flood Detector and Alert System to enable it to identify the water level measure in assessing the level of flood risk and, in the event of detection and send out notifications to users. The result in this study shows that the prototype has been implemented successfully. The activities applicable here include setting up the software development environment, managing software configurations, configuring the development environment, outlining version control procedures, and detailing how the progress of implementation will be implemented.

5.2 Development Environment Setup

Hardware and software prerequisites are needed to set up a development environment for the ResQ Flood Detector and Alert System. It provides thorough instructions for configuring the ResQ Flood Detector and Alert System's development environment. The setup processes have been explained in a much systematic and clearly accessible manner. The hardware and software prerequisites are dealt with in chapter 4, while the next section explains them in greater detail and how they interconnect.

5.2.1 Hardware Development Setup

There are ESP-32 microcontroller, ultrasonic sensor, a relay,Lcd crystal and a water pump attached to the breadboard. It also have 3 LED and buzzer to prompt signal of the detection. All of the hardware are connected using jumper wire to receive and transmit the data. After being transmitted, the data will be next kept in the Blynk cloud for storage. The main interface of the application will show the most recent reports and statistics of the last seven days in real-time. The configuration of the hardware is shown in Figure 5.1: Setup Hardware Circuit below.

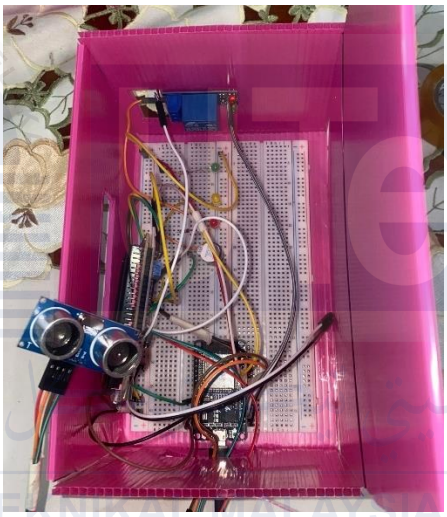

Figure 5. 1: Setup Hardware Circuit

5.2.1.1 Hardware Installation

Use male-to-female jumper wire to connect the ultrasonic sensor to ESP-32 microcontroller using trigger pin connect to D5 and echo pin connect to D18. Next attach buzzer to pin D14, red, yellow, green LED is connected to pin D4, D23, D19. Relay that are used as a switch to water pump is connected using pin D15 and so on. This step can be referring in figure 5.2 : Circuit Design For Hardware Setup below. Table 5.1: Details of each pin number shows the detail pins that is inserted by the hardware to the ESP-32 microcontroller. The GPIO pins on the ESP- 32 can be refer in figure 5.3: The GPIO pins of ESP-32 Microcontroller and the final product should look like in figure 5.4: The Final Product .

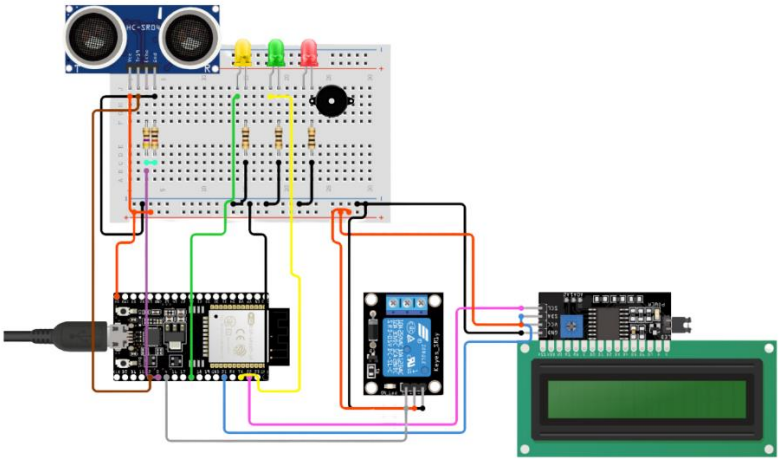

Figure 5. 2: Circuit Design For Hardware Setup

Table 5. 1: Details of each pin number

Hardware	Pin
Ultrasonic Sensor	D5 (trigger) , D18 (echo)
Relay	D15
Buzzer	D14
LED	D4, D19, D23

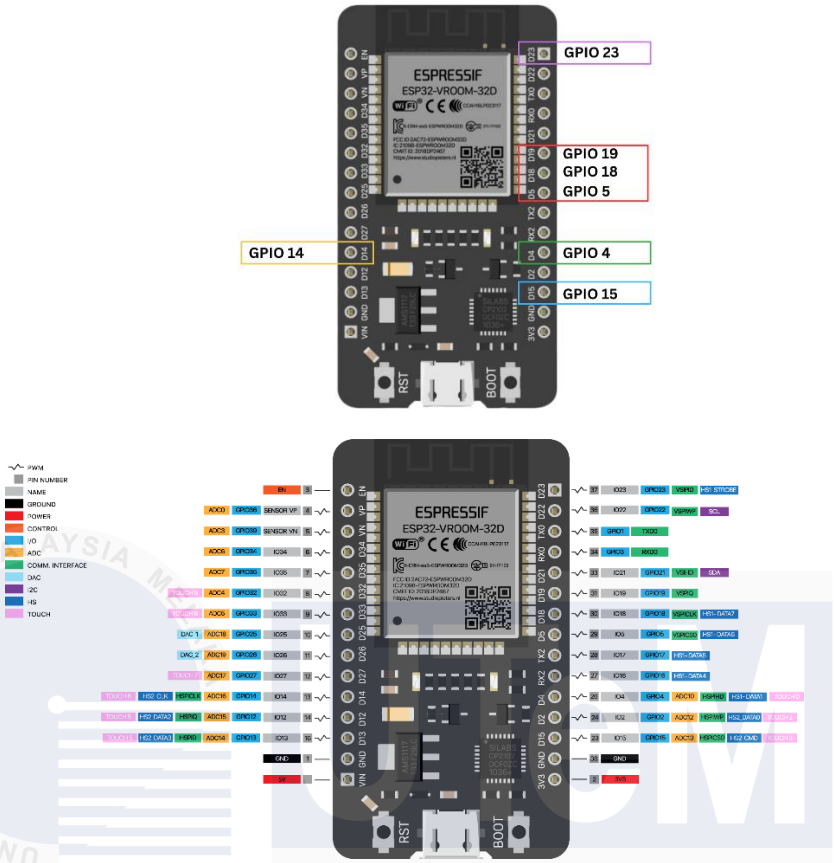

Figure 5. 3: The GPIO pins of ESP-32 Microcontroller

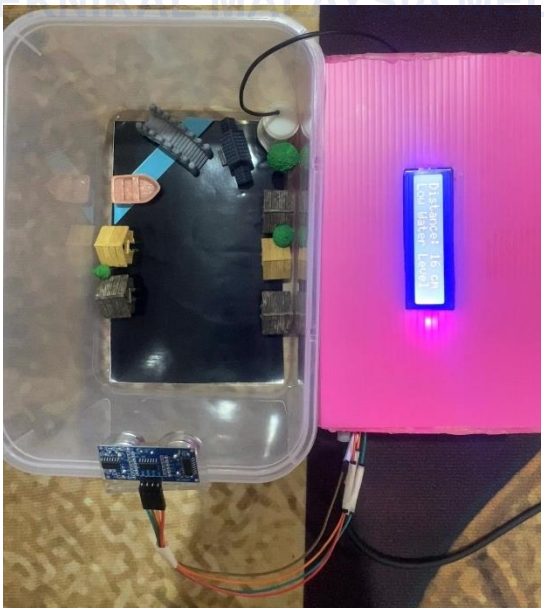

Figure 5. 4: The Final Product

5.3 Software Development Environment Setup

This section discusses the prerequisites of the developmental prototype within this project. These specifications are essential for the construction of both the hardware and software aspects of the project. Moreover, these components enable greater user engagement in the project's development process. The project's environment encompasses the subsequent elements:

i. ESP-32 Environment Setup

ESP-32 is one of the software environment settings used to develop this project. In addition, the Arduino IDE shows how the microcontroller was set to create the ResQ Flood Detector and Alert System using the ESP-32. This project requires the ESp-32 as the main board in order to operate as intended. After that, all the other parts will have to be discussed in connecting the microcontroller with other component parts. The setup of the ESP-32 environment for a ResQ Flood Detector and Alert System prototype involves configuring the necessary software and hardware components to create a functional prototype capable of detecting potential flood. The list below shows the hardware and software requirement for ESP-32 environment setup:

A. Hardware Requirement

- ESP-32 Microcontroller
- Ultrasonic Sensor
- Buzzer
- Led
- Relay
- Water Pump
- LCD Crystal
- Power Supply
- ESP-32 Cam

B. Software Requirement

- Arduino IDE
- Blynk Iot

Based on the hardware and software requirement information above, all of it are element of the development environment to setup ResQ Flood Detector and Alert System. ESP-32 provides connectivity to a user's mobile phone through its built-in Wi-Fi module and gives notifications to alert users in case of a flood event. Based on the Table 5. 2: ESP 32 Environment setup , the summary of the system configuration for ESP-32 environment setup in this project.

Table 5. 2: ESP 32 Environment setup

No.	Operating System	Specification
1.	Operating System	No real OS
2.	Hardware	Operating Voltage : 3.3 V Input Voltage: 5 – 12 V Flash Memory : 4MB 2.4 GHz Wi-Fi, supporting WPA/ WPA2 Support standards TCP/UDP Server and Client
3.	Software	Arduino IDE

ii. Blynk Environment Setup

Blynk, by Pavel Bayborodin and Dmitriy Derevyanyk, is used in the project for the ResQ Flood Detector and Alert System. The system leverages Blynk for real-time monitoring,

storage, and synchronization of efficiently gathered data from multiple sensors in real time. The biggest use of the Blynk cloud services is to allow frictionless saving of updates of the sensor data into a cloud database. Its infrastructure ensures real-time updates on any information, hence keeping end-users with the most recent and accurate data through flood detection. Blynk also supports the feature of customizable dashboards for the visualization of the data and management of devices remotely via the mobile or web app. The ability of the platform to provide orchestration of real-time notifications and management at remote locations delivers improvement in the performance and reliability of the system, and, in effect, makes one of the most important elements of the flood detection and alert system.

iii. ResQ Flood Detector and Alert System Environment Setup

The application should function seamlessly to ensure users can easily access water level measurement and potential flood information. Once the user open the application, the smartphone screen will display water level measure from the ultrasonic sensor. It is essential for this application to be well-crafted to enable users to receive alert notifications on their smartphones.

5.4 Software Configuration Management

The setup of the ResQ Flood Detector and Alert System is carried out in a systematic manner, with each of the flowcharts below providing detailed explanations of the process. This includes configuring the prototype to ensure it operates correctly and continues until the project is fully operational.

i. Development and Configuration (ESP-32 and Arduino IDE)

Table 5. 3: Show the Development and Configuration of the ESP-32 in Arduino IDE

Component Name	Software Implemented
NodeMCU ESP-32	Arduino IDE
	Port 3 COM
	Ultrasonic Sensor
	Port 3 COM

	Relay & Waterpump
	Port 3 COM
	Blynk Cloud

This section deals with the software applications applied to the ESP-32 microcontroller. The prototype was made based on the Arduino IDE and COM port 3. Without COM port 3, the prototype will fail to upload the code. Therefore, it will not work. Arduino IDE will provide a friendly, easy-to-use environment for writing, compiling, and uploading code to the ESP-32. Moreover, the different components in this project include an ultrasonic sensor, a water pump, a relay, and Blynk. Connections will be established with the ESP-32 microcontroller, which is very important in monitoring and hence controlling the components effectively. The ultrasonic sensor is used to measure water levels, water pump used to control the flow of water and the relay acts are a switch to control the pump. On the other hand, Blynk entails real-time data monitoring and control over the system by use of smartphone application. These components are incorporated into the project to ensure that the system of detecting floods and issuing an alert is functional and without any glitches.

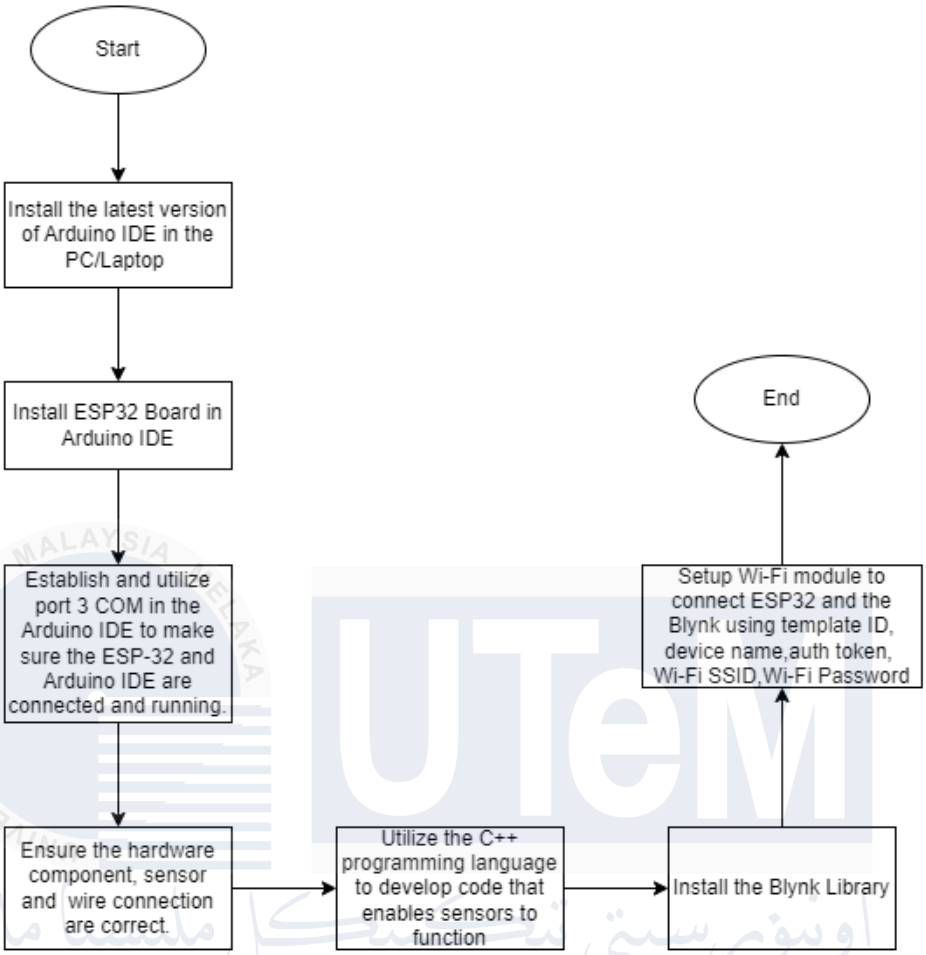

Figure 5. 5: Flowchart of the development and configuration of ESP-32.

The following steps will guide the setup of the environment of Arduino IDE with library configurations for ESP32 NodeMCU. This is a step-by-step guide to help users work more easily and efficiently.

Step 1: Download the latest Arduino IDE version from the official Arduino website and run the installer.

Figure 5. 6: Website for Arduino IDE installer

Step 2: Launch the Arduino IDE once the installation is finished

Figure 5. 7: Arduino IDE initializing

Step 3: First interface and begin by accessing and making alterations to the code.

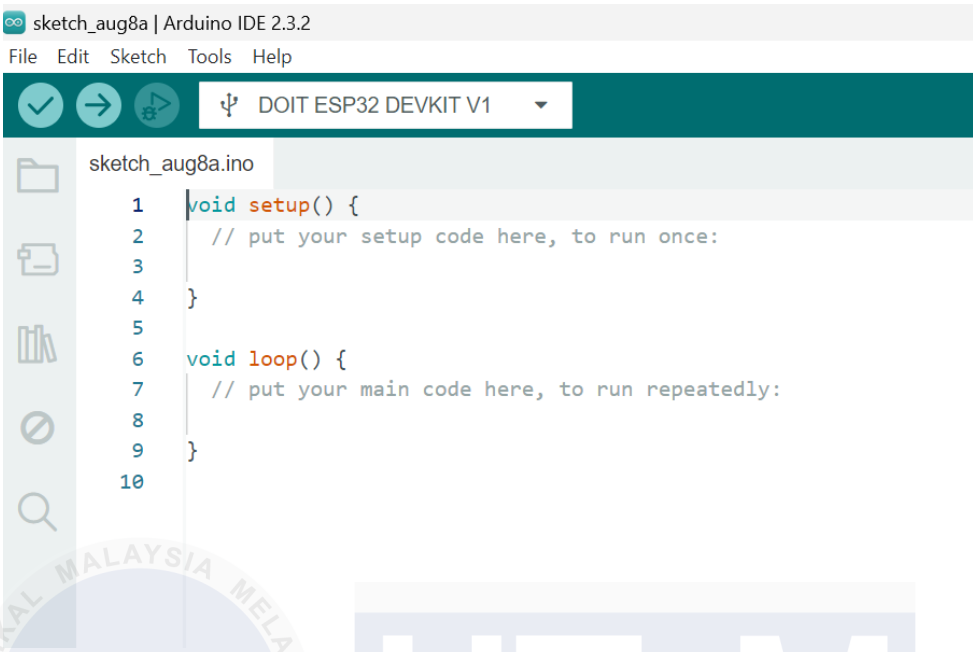

Figure 5. 8: Arduino IDE coding interface

Step 4: Setup the ESP32 Board in Arduino IDE. To install the ESP32 board libraries in the Arduino IDE, follow these : go to File> Preferences.

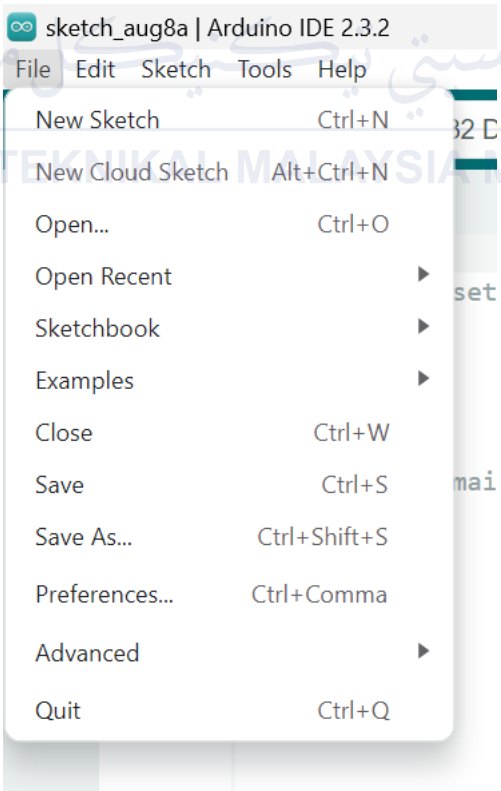

Figure 5. 9: Open preferences to enter library for ESP32

Step 5 : Enter https://dl.espressif.com/dl/package_esp32_index.jsoninto the “Additional Boards Manager URLs”. Then, click the “OK” button.

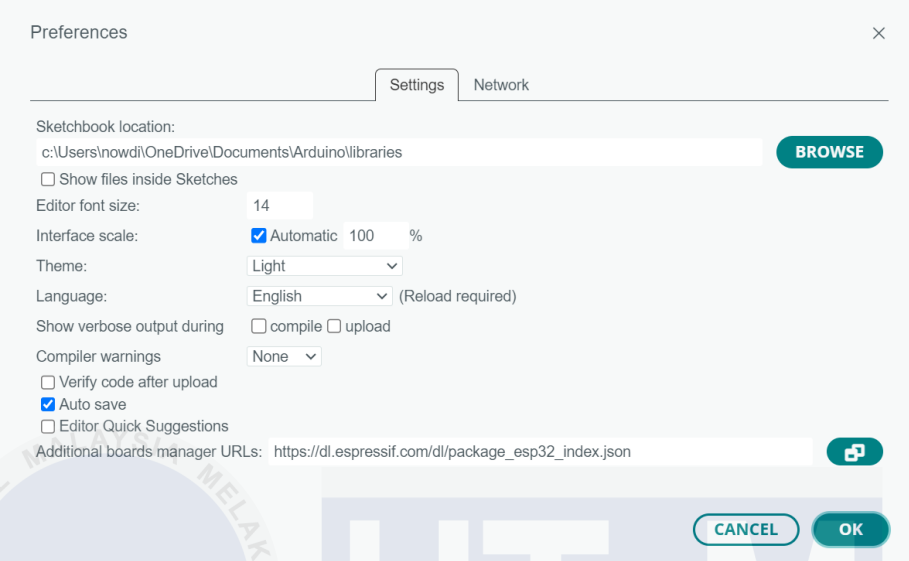

Figure 5. 10: Open preferences to enter library ESP32.

Step 6: Installing ESP32 by ESP32 Community. Go to Tools > Board > Boards Manager.

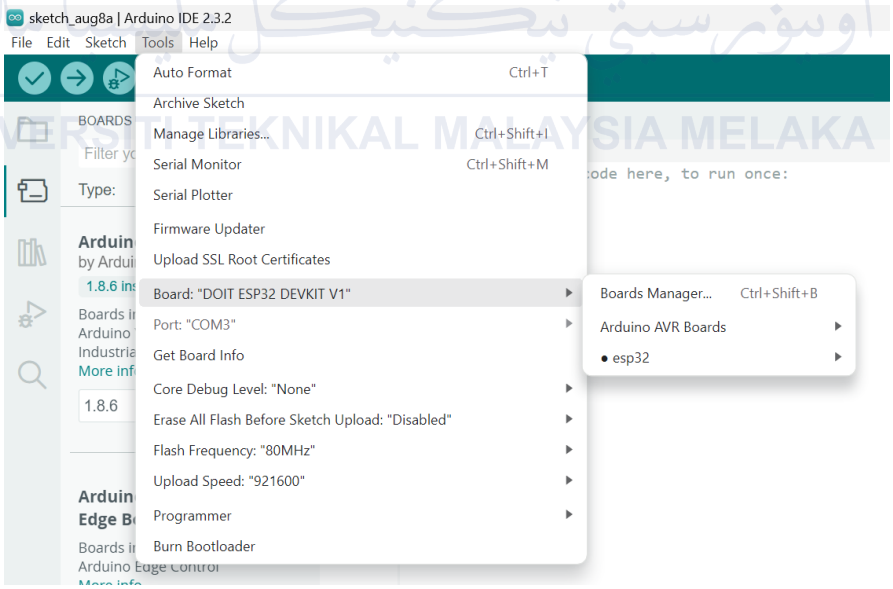

Figure 5. 11: Installing DOIT ESP32 DEVKIT V1

ii. Development and Configuration (Ultrasonic sensor)

Table 5.4: Show the Development and Configuration of the ultrasonic sensor

Table 5. 4: Show the Development and Configuration of the ultrasonic sensor

Component Name	Software Implemented
Ultrasonic Sensor	Arduino IDE
	Port 3 COM
	C++ Language

The setup and configuration of the ultrasonic sensor are detailed in Table 5. 4: Show the Development and Configuration of the ultrasonic sensor. To verify the functionality of the components, the ultrasonic sensor was tested using the Arduino IDE, Port 3 COM, and C++ language. The code for development and configuration was then utilized to construct the prototype.

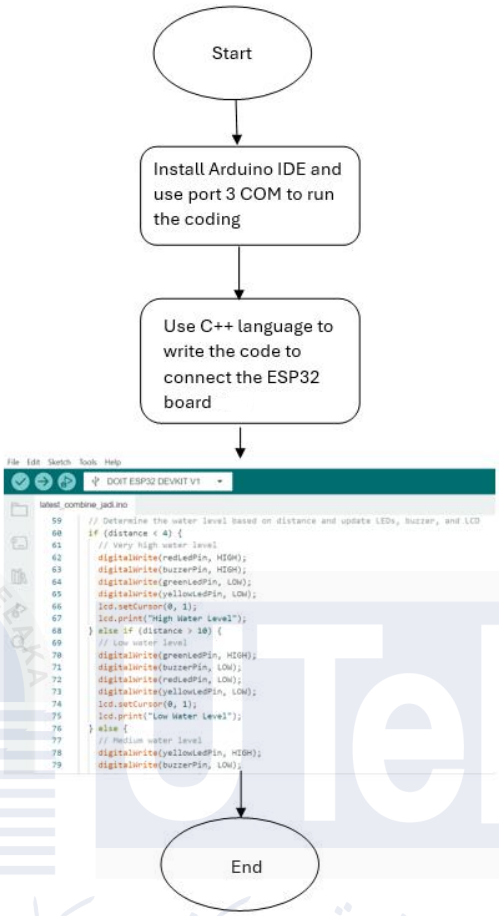

Figure 5. 12: Flowchart of the development and configuration ultrasonic sensor

Figure 5.12: Flowchart of the development and configuration ultrasonic sensor is a flowchart that depicts the steps to ensure that the modules are operational. To operate this prototype, the ultrasonic would have used the components and connected to the ESP 32.

Figure 5. 13: Ultrasonic sensor

Figure 5.13 show the ultrasonic sensor connected to the ESP32 microcontroller. This setup enables accurate management of measure precise distance measurement.

iii. Development and Configuration (Blynk)

Blynk is an all-in-one IoT platform powering the "ResQ Flood Detector and Alert System," connecting sensors seamlessly to the Blynk Cloud, where data is stored securely and managed in a runtime environment. Through the Blynk application, it provides real-time water level monitoring with the latest details and staying updated with instant alerts in the event that thresholds are exceeded. This integration ensures that the system is always informed, hence able to quickly respond to any possible flooding and hence smart and reliable.

Step 1 : Sign Up and Login to the Blynk account.

Figure 5. 14: Blynk Login Interface

Step 2: Create a new project (template), select the appropriate device, such as ESP32, with Wi-Fi as the connection type.

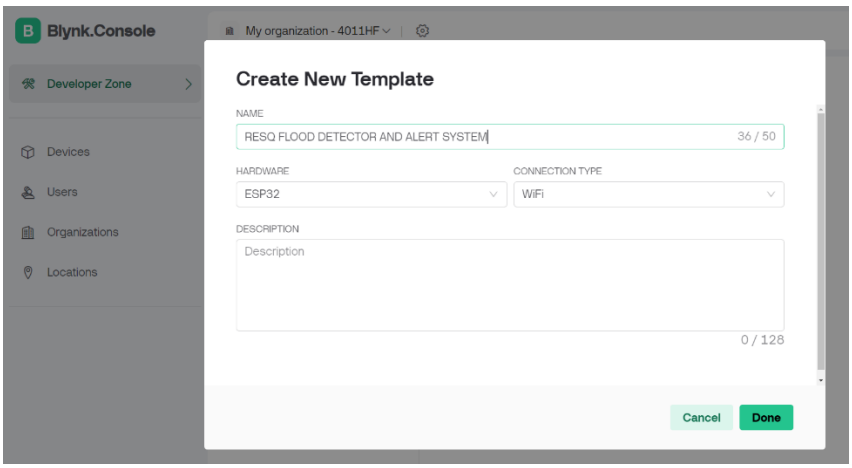

Figure 5. 15: Create new template Interface

Step 3 : Open the project area to access and design the dashboard then add the necessary widgets.

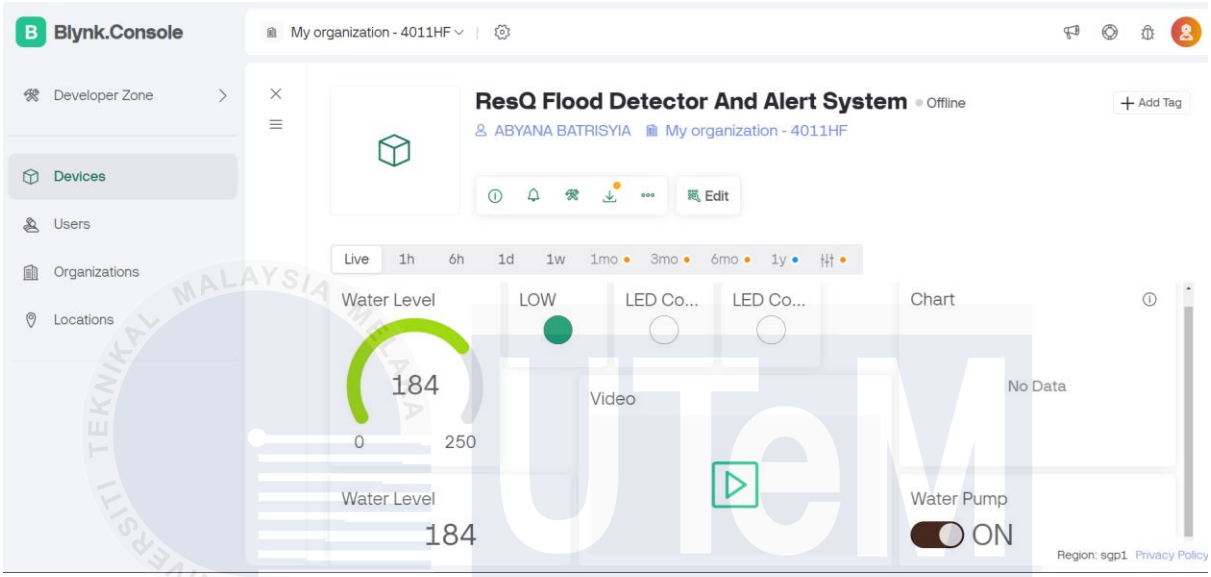

Figure 5. 16: Add necessary widget

Step 4 : Set up the datastreams to create virtual pins corresponding to each sensor or indicator in your system

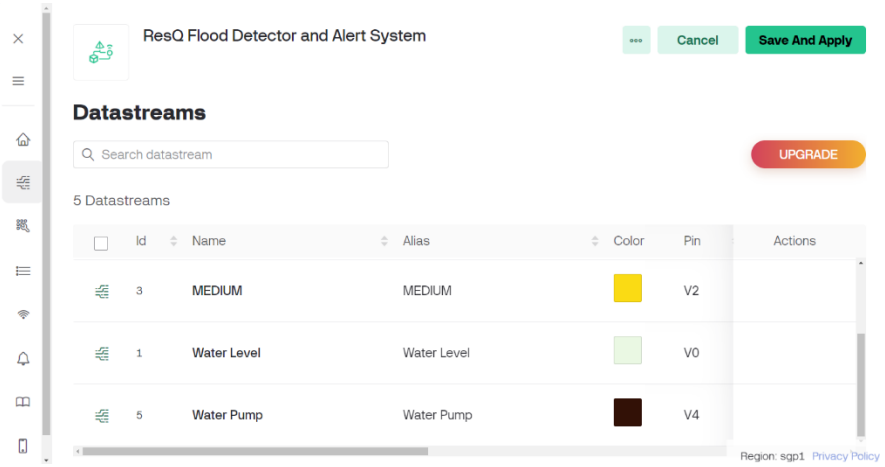

Figure 5. 17: Insert the datastreams

iv. Development and Configuration (Arduino IDE)

The table 5.5 shows the development and configuration of the Blynk application. The

application helps to monitor the prototype with receive the notification when the water level increases and reach high level.

Table 5. 5: Development and Configuration of the Blynk

Component Name	Software Implemented
ESP 32 Components	Arduino IDE
	Port COM 3
	C++ programming language

The following is a step-by-step display. These steps need to be followed to ensure that users can develop applications for monitoring. Therefore, when user login into the account, this software can provide input and output.

Step 1: Include and install the Blynk library for ESP32.

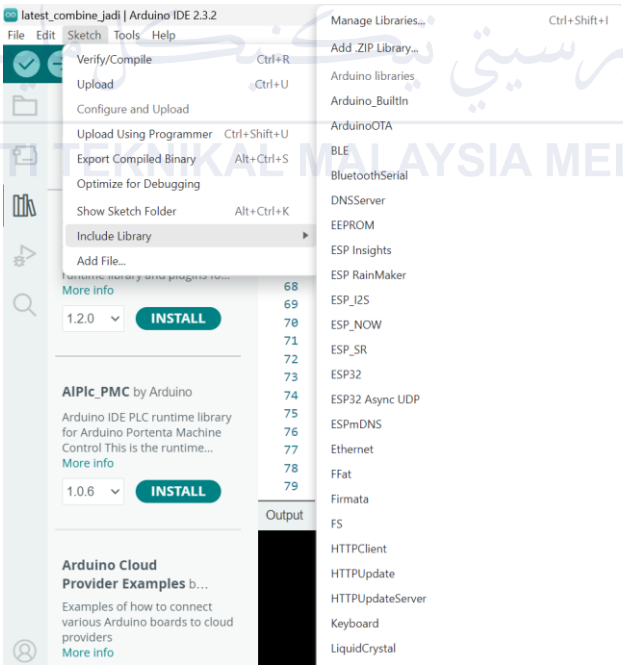

Figure 5. 18: Include Blynk Library

Step 2 : Find “BlynkESP32_BT_WF” by Khoi Hoang and install.

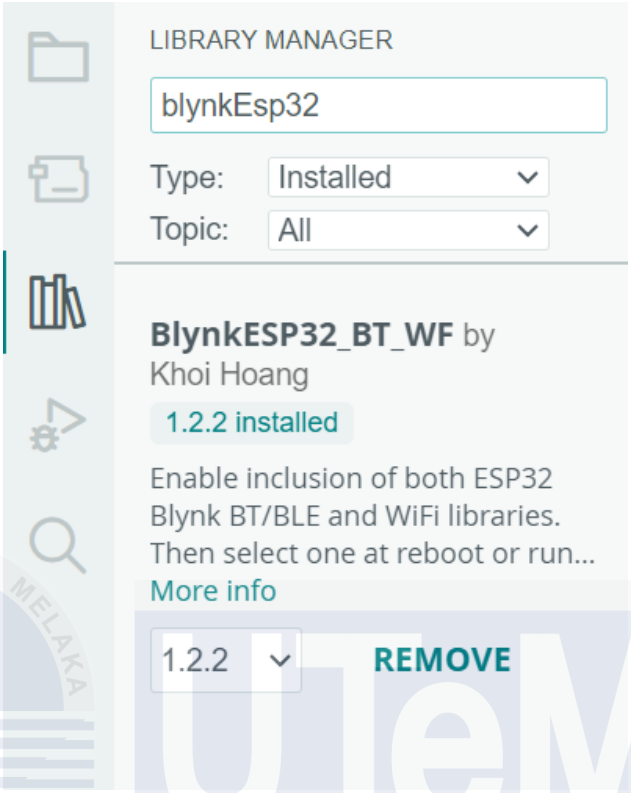

Figure 5. 19: Add Blynk Library

5.4.2 Version Control Procedure

This sub-topic will demonstrate how to set up a board in the Arduino IDE control procedure source code. The board used is ESP32 NodeMCU, and the port used is COM 3. Therefore, these procedures need to be followed to ensure that the source code runs successfully and smoothly. The next steps involve the user selecting the components using the board and the port. Figure below show the source code for connect Wi-Fi module microcontroller and blynk use to store data in cloud.

The Figure 5.20: Show the coding that use for connect component Wi-Fi module and Blynk in the Arduino IDE.shows how to connect component Wi-Fi module and Blynk in the Arduino IDE using template ID, Auth Token,Wi-Fi SSID and password.

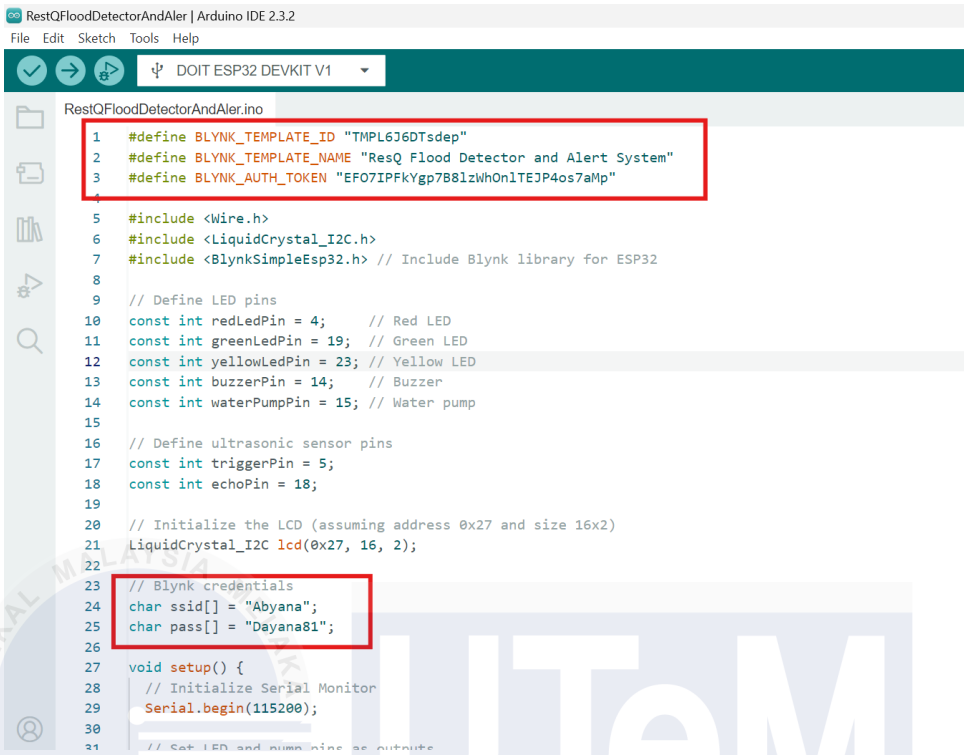

Figure 5. 20: Show the coding that use for connect component Wi-Fi module and Blynk in the Arduino IDE.

Figure 5.21:Show the coding for ultrasonic sensor to measure water level distance and give water level information.

Figure 5. 21: Show the coding for ultrasonic sensor

Figure 5.22: source code for water level information below show the source code for to decide and send water level information.

Figure 5. 22: source code for water level information.

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5.5 Implementation Status

ResQ Flood Detector and Alert System's implementation status is a part of the time and status. In the table 5.6: Show the implementation status project is explain about the status of the development of each component or module. In this explanation, it comprises of module name, description, duration to complete and date completed.

Table 5. 6: Show the implementation status project

No.	Module Name	Description	Duration
1.	Setup Installer	Installation and setting up the software Arduino IDE with the port COM and Blynk.	2 days
2.	Assemble Hardware	Setting up the ESP-32, WiFi module, sensors, wire, lcd, buzzer,water pump and led.	7 days
3.	Implement all source code	Implement code for all part which ss ESP-32, WiFi module, sensors, Blynk cloud, android application and notification	40 days
4.	Develop Application	This application is build the software and install it on the smartphone to 25 days 77 ensure that the updates are received by the user.	30 days
5.	Test the Prototype	Check to see if the prototype is functional.	5 days

5.6 Conclusion

In conclusion, the implementation phase elaborates on the detailed parts of the processes involved in developing the ResQ Flood Detector and Alert System. All activities and tasks are systematically performed in this phase to ensure that all parts of the project run smoothly and effectively. Careful planning and configuration of the environment are very important at this stage to enhance dependability. A comprehensive review of the hardware and software to be used in the setup is conducted, in which all relevant information shall be identified, compiled, sorted, and structured. This extensive collection of data forms the base that is needed to move into the next step, covered in Chapter 6, testing and analysis.

CHAPTER 6: TESTING

6.1 Introduction

In this chapter, we are going to discuss on testing phase, which purpose is to ensure that the product and development system meets the requirements of the project and functions properly as designed. Testing is performed on all aspects of the project and on the product in order to arrive at the anticipated outcome with the crucial significance of the project and its function as a means for the intended purpose. In more detail, the present project employs a NodeMCU ESP32 microcontroller, with the focus laid on the ResQ Flood Detector and Alert System that aims to predict possible flood occurrences and eliminate possible threats. The various trials are carried out to realize a number of goals. Furthermore, the regions to be tested, the overall strategy and setup of the test, the test design, the test results, and the justification for the results obtained are all covered in this chapter.

6.2 Test Plan

This section aims to explain the basics of each methodology and product and how the testing of the product is going to be done. It also presents the people engaged in conducting the research and explicates regarding the kind of activities that are done. The test plan is significant for considering possible operational issue occurrences. The main objectives of the projects are to make certain the whole product and system strategy fully satisfies user need. This test plan is useful prior to the usage of products and systems that were created in the project. However, it also afford a clear pattern to assess performance and to show directions for future plans and changes.

6.2.1 Test Organization

Two individuals in this section are in charge of carrying out the system's testing procedure. The system developer is the person who creates the system, and another on is the end user. Different role are played by each tester during the testing process.

i. Sistem Developer

The System Developer is tasked with performing thorough system testing, actively identifying any mistake or errors. They are also responsible for maintaining the system’s stability and ensuring its smooth operation. Additionally, they oversee the implementation of necessary fixes and optimizations to enhance system performance.

ii. End User

The End User is also actively involved in identifying areas of weakness with the systems, and in terms of the user interfaces and functions, and in suggesting ways that the systems can be improved. Because they offer unique insight into usability and practical performance, they help guarantee that the system is adequate for the world as is and its intended user. Also, they come in handy in ensuring that instances of repeated modification have better results in an overall design.

6.2.2 Test Environment

This project aims at proving the ability of the above prototype to receive alert notifications when connected through Wi-Fi from the ResQ Flood Detector and Alert System. The prototype can be operated from a 5V supply through an attached USB cable. The NodeMCU ESP32 as the main microcontroller that controls all the connected modules. The ultrasonic sensor is applied in measurement of water level. Data is saved through Blynk which is connected to clouds services. The system is expected to support provision of accurate as well as real time information. As a result, for the testing phase of the project test environments have been created and elaborated for better and more precise testing of the end product. Also, integration with Blynk cloud makes the system scalable and remotely controlled, which further increases the flexibility of the machinery.

6.2.3 Test Schedule

This testing phase tries to identify the time required to complete the project and create a test schedule. Several problems and issues arose during this stage, demanding additional time for resolution and verification throughout the implementation phase. The testing procedure is ongoing and will last until the system's functionality is completely realised. The assessment strategy is structured as follows: after creating the prototype, the user must upload the code to the hardware and test its functionality. As a result, the prototype has been successfully tested and works as anticipated.

i. Start the prototype

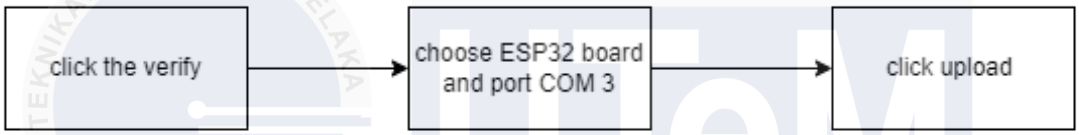

Figure 6. 1: Show the role of the prototype.

Figure 6.1: Show the role of the prototype and how the initiation procedure of the prototype. The "verify" button in the Arduino IDE lets users make sure the code is accurate and error-free. Customers must select their preferred board before they may view the prototype's operational state. In this case, the board is an ESP32, and the associated port is COM4. Selecting the appropriate board and port is crucial because the prototype cannot function in any other way. After accurately choosing the board and port, users can submit the code to the prototype by clicking the "upload" button.

ii. Functionally of the prototype

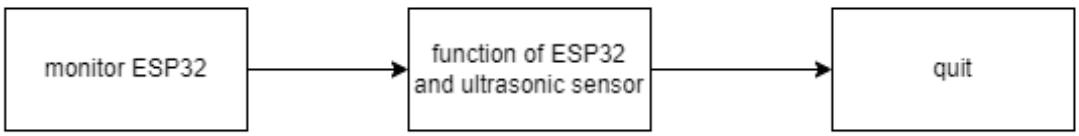

Figure 6. 2: Show the Functionally of the prototype.

Figure 6. 2: Show the Functionally of the prototype in operation. The NodeMCU ESP32, which controls the system, is one of the primary parts. It connects all components to enhance overall functionality. In addition, there is an ultrasonic sensor that will measure distances of

water levels. These functional elements contribute to warning users when the water level increases and reach high water level. All of the elements combined into the system will support real-time monitoring for instant alerting to the user endpoints so that users have real information to avoid possible flooding problems in a timely manner.

iii. Connect with the Blynk.

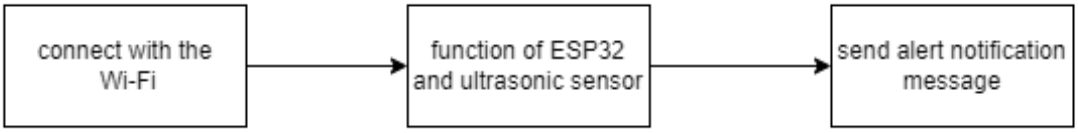

Figure 6. 3: : Show the Connection with the Blynk.

In order to complete the above process, as illustrated in Figure 6.3: Show the Connection with the Blynk, the user needs to be connected with the internet in order to access the Blynk application, which is integrated with cloud services and provides real-time data as well as send notifications to the user's smartphone. The sensor readings and corresponding timestamps are included in the data, which is safely kept in the Blynk.

iv. Start the ResQ Flood Detector and Alert System

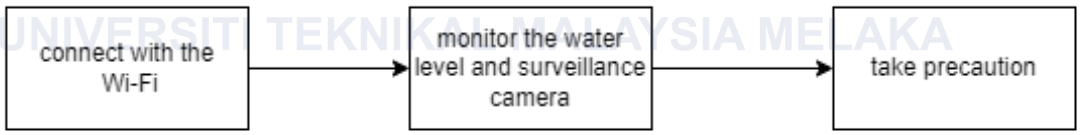

Figure 6. 4: Show how to use the Happy Pet application.

To use the money system application shown in Figure 6. 4: Show how to use the Happy Pet application, users must first connect to the internet. This connection is necessary to launch the application and receive up-to-the-minute updates from the water level sensors. Users will receive a notification in the event of a flood occurrence and take early precaution.

6.3 Test Strategy

This section describes the project's testing approach, which aims to make it easier for users to monitor the water level in residential areas. Users must install the Blynk Application, which includes the ResQ Flood Detector and Alert System, on their Android smartphones in

order to receive updates and view detailed information. The prototype used to test this aspect is shown in the Figure 6. 5: Show two step use in this category . To guarantee peak performance, the developed prototypes have undergone rigorous screening. The testing is divided into two categories: analysing the prototype itself and evaluating how well the Flood Detector and Alert System application receives information. Gaining understanding of prototype testing and information testing processes is the main goal of these tests.

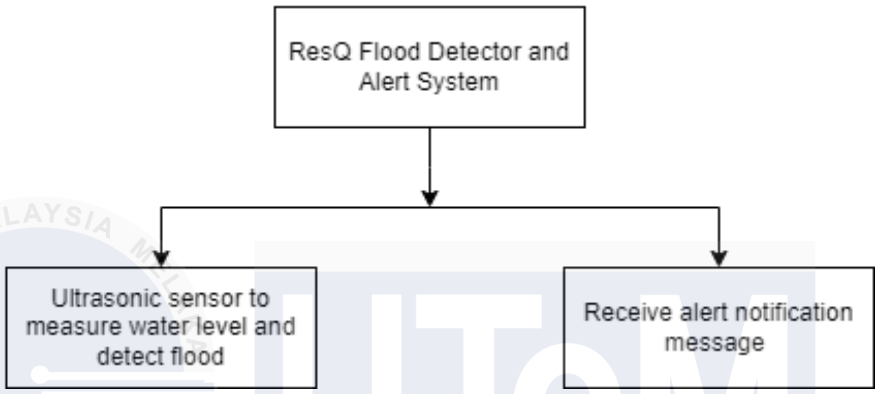

Figure 6. 5: Show two step use in this category

i. Feedback to the receipt of the information.

This testing means the information of the flood detection in the residential area is sent to the user's smartphone. The information can only be received on the smartphone if it is first connected to the internet. After connecting the smartphone with the internet, the system issues real-time alerts and works fine to notify the user.

ii. Testing the sensors detection.

For testing on the sensor detection, it will need to have internet connection and electric power to test it. The ultrasonic sensor will detect the water level and give alert to user if the water level reach high level.

6.3.1 Classes Test

i. Functionality Test

This is a function that tests the prototype ResQ Flood Detector and Alert System in association with the NodeMCU ESP32 and inquires about the performance of the sensors. It started from the ESP32 component to verify if the sensors could detect readings, then afterward able to transmit this information to the cloud. Not only that, but it is also possible to request data from applications and thus obtain a detailed overview of all information that is available, and real-time. This functionality not only checks on the effectiveness of the system but also provides real-time alerts to the user in case of a flood, hence making the system more reliable.

6.4 Test Design

This is a crucial phase of the testing process, where the designed components or modules are evaluated for accuracy and effectiveness within the system. Each of them is well observed through the validation and verification process. The device testing is of need to ensure that the device returns all the specifications to work out its operations correctly. The test will allow increasing the functionality of the project with it meeting the intended objectives. Moreover, testing is also responsible for the fine-tuning of system functionality toward meeting the overall system goals. The various components and modules are thus being checked fully in order to ensure perfection in each of them. Constant training and refining should be done in such a way that the system is reliable and works efficiently in real life.

6.4.1 Test Description

This is the section that points out the exact areas of the project to be tested. Enumerated in this project, test cases are provided in Tables 6.1 through 6.3. Among the components and modules used ensure that the results are accurate and successful. The prototype has all the components used that need to be understood for its proper functioning. It is important for the users to understand what procedures and expected performances the project will yield. Below is the table of all test cases that will test each and every single aspect to assure reliability and efficiency. At this part, it has tried to give the overview to users about how to understand and validate the overall functionality of the system by providing the detailed test cases.

i. Table 6. 1shows the results of the Wi-Fi module testing.

Table 6. 1: Table Wi-Fi module function

Test	Test of the Wi-Fi module's connectivity
Test Purpose	To test the Wi-Fi module has connection with the internet.
Test Environment	To run this pre situation test, Wi-Fi module must be set up. Installation and setup procedure.
Test Setup	i. Download the Arduino IDE and Install. ii. Connect to COM port and install library. iii. Create the source code for NodeMCU ESP32. iv. After running the code, the Wi-Fi module is function to test the internet connection.
Expected Result	After running the code, the Wi-Fi module is function to test the internet connection.
Error Message	None
Result	Pass


```
Connecting to Wi-Fi...Connected to Wi-Fi
IP Address: 192.168.38.130
Connected to Blynk
```

Figure 6. 6: Pass result to test Wi-Fi module's connectivity

ii. Table 6.2 shows the results of the ultrasonic sensor testing.

Table 6. 2: ultrasonic sensor function

Test	Test of the ultrasonic sensor connectivity
Test Purpose	To test the detection of water level distance.
Test Environment	To run this pre situation test, the ultrasonic sensor must have connection with NodeMCU ESP32 to be set up.
Test Setup	i. Download the Arduino IDE and Install ii. Connect the ultrasonic sensor to the NodeMCU ESP32 using jumper wire. iii. Create the source code for the ultrasonic sensor. iv. After running the code, ultrasonic sensor functions to detect and measure the distance to the water level. This capability is essential for accurately monitoring and responding to fluctuations in water levels.
Expected Result	After running the code, the ultrasonic sensor is function to detect measurement of the water level distance.
Error Message	None
Result	Pass

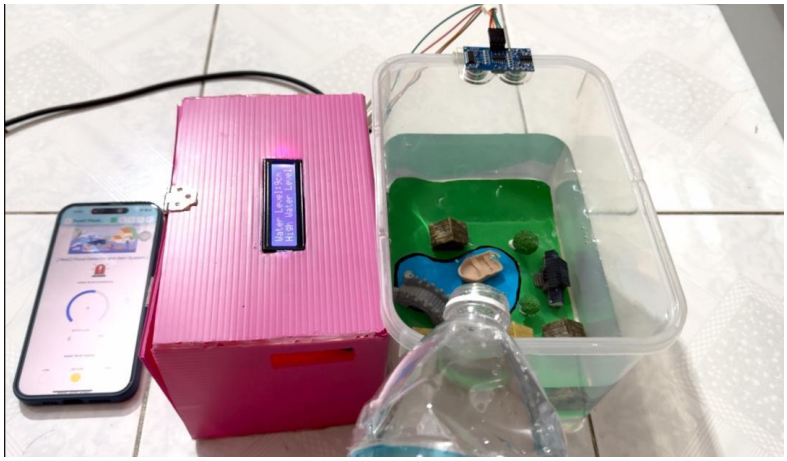

Figure 6. 7: Pass result to test ultrasonic sensor is function to detect measurement of the water level distance.

iii. Table 6.3 shows the results of the ESP32 CAM testing.

Table 6. 3: ESP32 CAM function

Test	Test of the ESP32 CAM connectivity for live video streaming monitoring.
Test Purpose	To test the streaming of live video using the ESP32 CAM.
Test Environment	To run this test, the ESP32 CAM must be connected and set up correctly.
Test Setup	i. Download the Arduino IDE and Install. ii. Connect the ESP32 CAM to the required peripherals using USB cable. iii. Create the source code for the ESP32 CAM to stream live video. iv. After running the code, ensure the ESP32 CAM streams live video as intended.

Expected Result	After running the code, the ESP32 CAM should stream live video successfully.
Error Message	None
Result	Pass

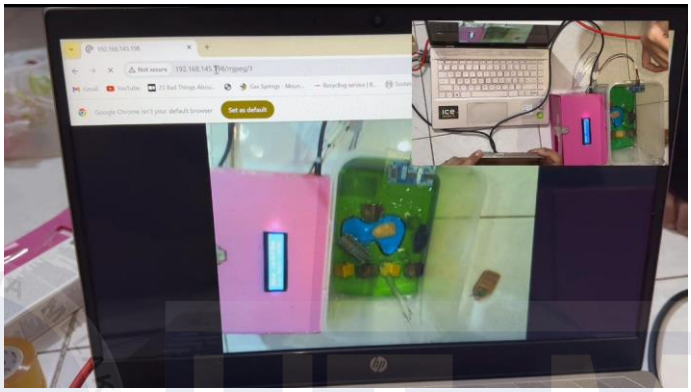

Figure 6. 8: Pass result to test the streaming of live video using the ESP32 CAM.

iv. Table 6.4 shows the results of the ResQ Flood Detector and Alert System application on smartphone testing.

Table 6. 4: ResQ Flood Detector and Alert System application function

Test	Test of the ResQ Flood Detector and Alert System application connectivity
Test Purpose	To test if user can check potential flood and water level update on mobile application.
Test Environment	To conduct this preliminary test, the smartphone must be connected to the internet to link with the flood detector device and receive notification alerts if the water level rises and reaches a critical point.
Test Setup	i. Download and install Blynk Application.

	ii. Create a new template and design the simple application for landslide detection system in web dashboard that will automatic connected with the cloud. iii. Install Blynk Application in App Store / Play Store. iv. Create the source code for the application and run it. v. After running the code, user can view the details using this application.
Expected Result	After running the code, user can monitor water level and get alert notification.
Error Message	None
Result	Pass

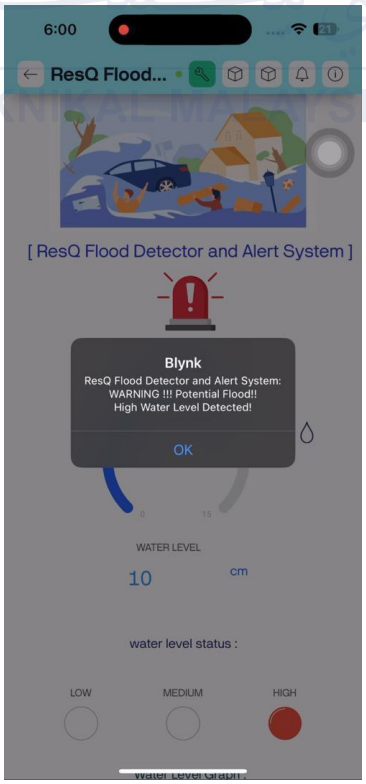

Figure 6. 9: Pass result to test user can monitor water level and get alert notification.

6.4.2 Test Data

i. NodeMCU ESP32 connectivity test

The ESP32 microcontroller board is connected to the laptop using a micro-USB cable as shown in Figure 6.6 : Show how to use the slide alert application .

Figure 6. 10: Show how to use the slide alert application

We can check the availability of the status of the connectivity in the tool menu of Arduino IDE, which depicts that the connection has been established. Now, to upload the program into the device NodeMCU ESP32, under the Tools menu, select the port as COM3, as of the diagram below. The diagram identifies the relationship between the Arduino board with the USB port, whose task is displaying the port during code upload. If there are no errors in the source code, the console window will display the uploaded source code as successful. This step is done to make sure when the system is very well set up and ready to run.

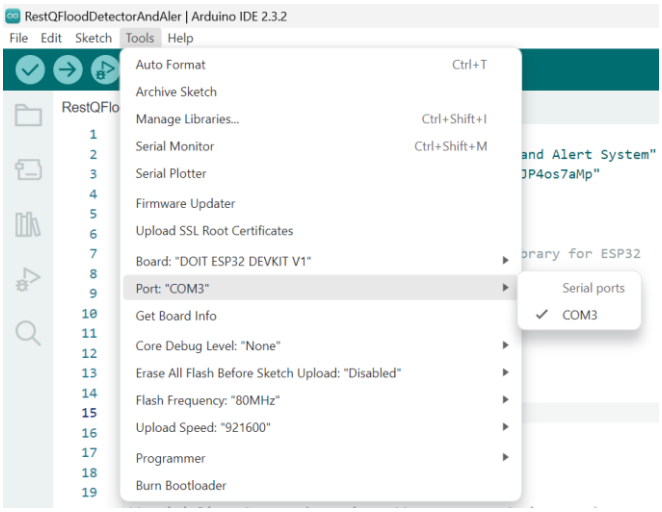

Figure 6. 11: Arduino IDE shows the detail of port uses

ii. Component connectivity test

The configuration of the ESP32 and sensor components, with jumper wires connecting them to one another.

iii. Application connectivity test

In this project, a ResQ flood detector and alert system were designed with the Blynk application. This application is developed to run the code in Arduino IDE where the Blynk library should be installed in Arduino IDE. Through this, it will establish perfect communication between the flood detection hardware and the user's smartphone in order to provide real-time updates on the water levels and any possible risks of flood. Integration of Blynk enables an interactive user interface so that users can stay updated with regard to flood warnings and act accordingly.

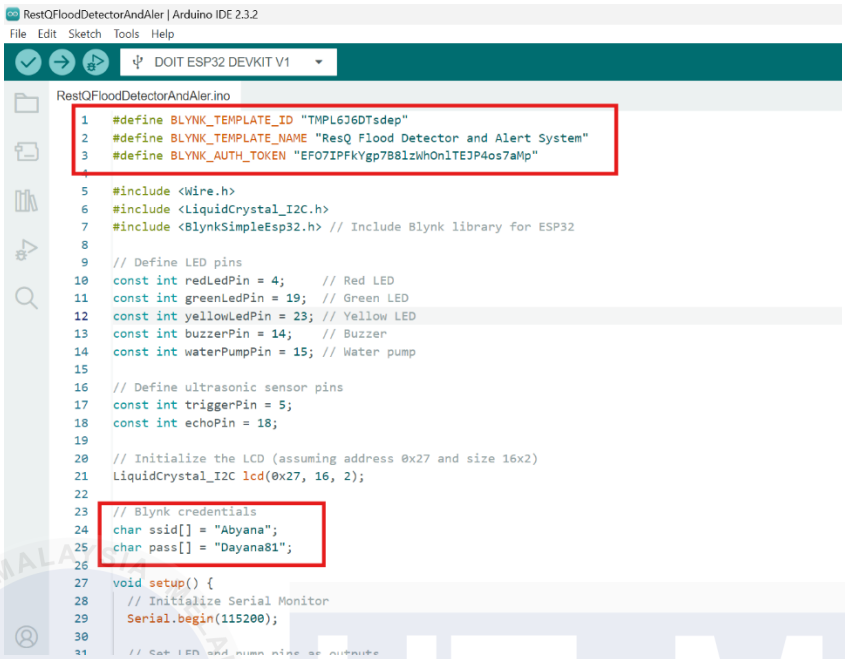

Figure 6. 12: Insert Blynk information in Arduino IDE.

The figure above shows the software used to create the application. It also connects with Blynk to monitor and manage the data in real-time.

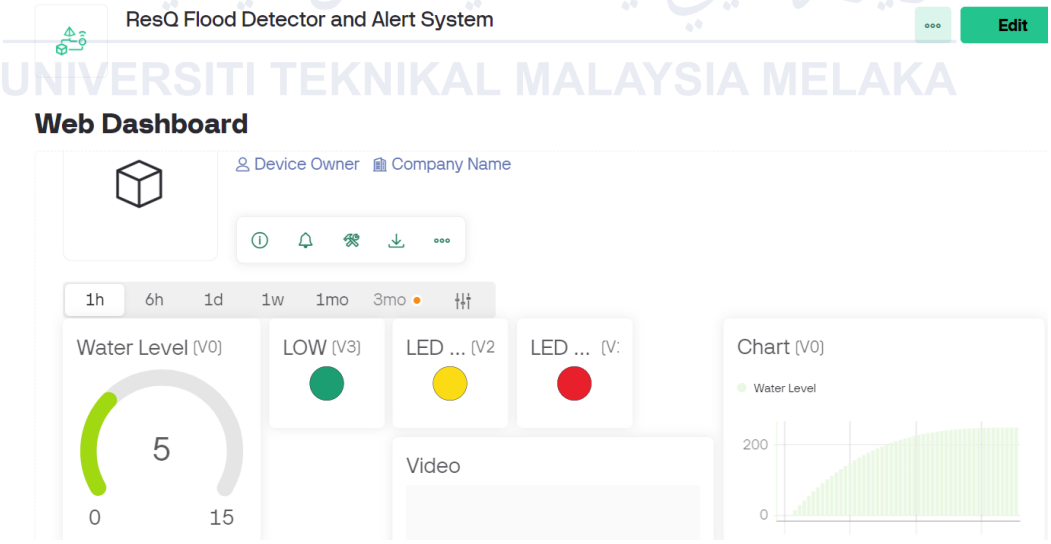

Figure 6. 13: Blynk application Web Dashboard

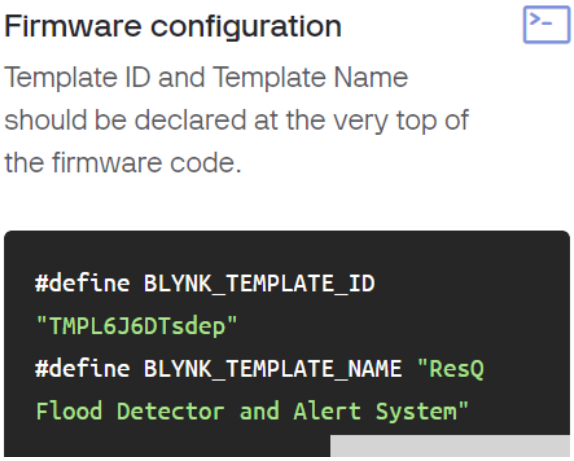

Figure 6. 14: Blynk Template ID and Name

6.5 Test Result and Analysis

This subsection focuses on the identification of the test cases and the evaluator, along with the result of that particular test case, whether it passed or failed, after detailing the test schedule, strategy, and design as mentioned above. Next is the section showing the research results for each and every component used for this project. These results are very important to determine whether the system developed is effective and reliable. The results also inform any necessary changes to be made, so that the delivery of the project serves its intended purpose.

6.5.1 Test Result on hardware

i. NodeMCU ESP32

Table 6. 5: ESP32 function result and analysis

Test Case Identification	Test Identification	Result Expectation	Success/Fail
1	Uploading the code and click run	The microcontroller is connect the internet connection that have set.	success
2	When the codes are not uploaded,and the run button is not clicked	The microcontroller have no internet connection.	success

The ESP32 Wi-Fi module is a very essential part in this project since it will ensure that the set-up information from the device is forward-leached and updated on the user's smartphone. If this module had been added, the users would never have a chance to receive updates from the ResQ Flood Detector and Alert System and, therefore, would not know if the floods were about to occur. Configuring it properly in the Arduino IDE is a must to make it work. Moreover, the ability to maintain a stable connection is the primary requirement needed to give timely and reliable alerts. Setting up the ESP32 allows the entire system to work fine in dispensing real-time flood warnings to the users.

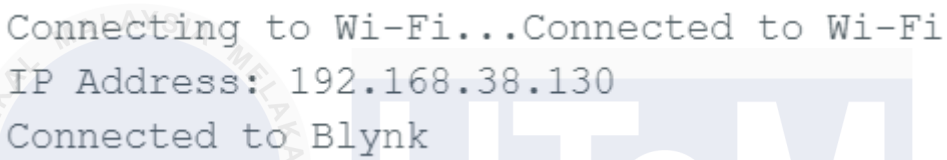

Figure 6. 15: ESP32 success to connect to internet.

Figure 6.11: ESP32 success to connect to internet show how the Wi-Fi module is successful to connect to internet. This component helps the user to get the updates of the potential flood.

ii. ultrasonic sensor & ESP32 CAM

Table 6. 6: Ultrasonic sensors and ESP32 CAM function result and analysis

Test Case Identification	Test Identifiaction	Result Expectation	Success/Fail
1	Uploading the codes and run	The ultrasonic sensor are able to read the water level measuremnet distance and ESP32 CAM are able to display video streaming.	success
2	When the coded	The ultrasonic	success

	are not upload,and the run button is not clicked.	sensor and the ESP32 CAM are not fuctioning.	

6.5.2 Test Result on application

i. ResQ Flood Detector and Alert System Application.

Table 6. 7: shows testing on the application

Test Case Identification	Test Identifiifaction	Result Expectation	Success/Fail
1	User can monitor the water level	Users can monitor the water level, tracking whether it is at a low, medium, or high level based on the preset distance thresholds.	success
2	User can receive alert message notification	When the water level is high, users will receive an alert notification about the water level.	success

The testing and implementation of this project are shown in Table 6.6. The ResQ Flood Detector and Alert System application provides users with the ability to quickly access and display data. The application is linked to the flood detection system, which alerts users with notifications when water levels rise, allowing them to take precautionary measures promptly.

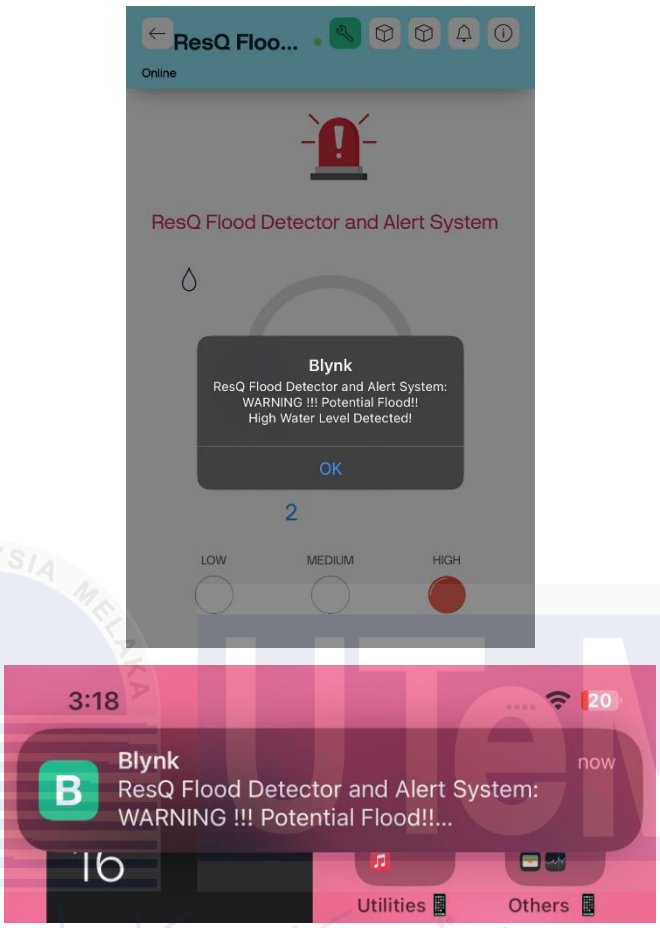

Figure 6. 16: Alert Notification from mobile application

6.6 Usability Test

John Brooke created the System Usability Scale in 1986 (Brooke, 1996), making it highly known method for determining usability. This scale could be used to give a fast and convenient way of assessing the design and utility of products in which the user takes a quick survey of 10 questions to give their rating. SUS is actually a usable method to quantify perceived usability and it can be used for any software, website and even mobile applications. It allows the programmers and developers to gauge whether a certain design meets a certain difficulty and whether users are capable to engage the product in the right way. SUS is for overall evaluation of usability in accordance with the ISO 9241-11 standards and embraces several aspects of a product, but it cannot be employed for diagnostic purpose. Furthermore, SUS scores are further

normalized to a percentile that can be used to compare usability of products and services across the different fields and industries for benchmarking purposes.

- Effectiveness: Are users able to successfully accomplish their objectives?
- Efficiency: How much time, money, and effort are needed to reach those objectives?
- Satisfaction: Was the user experience positive?

The respondents are provided with five option that includes Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree for each of the ten items of the SUS questionnaire. The purpose of designing these questions is to ensure that users can respond to them quickly and simply. Otherwise, their response may be inaccurate due to feelings of pressure or overload. The survey was done via google forms due to the following characteristics, easy to use interface and real time response tracking, real time chart generation, ease of organizing the data received. That not only makes the gathering of feedback easier and efficient but also analysis and reporting as well. The questionnaire comprises the following ten well-developed questions, including several questions relating to the user experience of the product:

1. I think that i would like to use this ResQ Flood Detector and Alert System frequently.
2. I found the ResQ Flood Detector and Alert System application unnecessarily complex.
3. I thought ResQ Flood Detector and Alert System application was easy to use.
4. I think that i would need the support of a technical person to be able to use this ResQ Flood Detector and Alert System application.
5. I found the various function in this ResQ Flood Detector and Alert System application were well integrated.
6. I thought there were too much inconsistency in this ResQ Flood Detector and Alert System application.
7. I imagine that this application would bring the benefits to the flood prone area resident and community.
8. I found that the ResQ Flood Detector and Alert System application very cumbersome to use.
9. How visually appealing do you find the application design?
10. I need to learn a lot of thing before using the application.

6.6.1 Result

Similar to the study by (Symk, 2020) which was conducted in 2020, it has been ascertained that to achieve deserving results, it is imperative to collect at least five responses from users. Therefore, this questionnaire was completed by six respondents. The questionnaires were administered in the form of a Google Form and each respondent was given 1-2 minutes to respond after the usability testing session with the actual ResQ Flood Detector and Alert System device. As for the results of the test, they are given below.

Name

6 responses

Nur Syadiah Bin Mokhtar

Muhammad Nawfal Bin Kamarudin

Nur Asyikin Binti Khairi

Lee Poh Kian

Nurul Athirah Binti Abdul Rahim

Danial Syahim Bin Zubair Ahksan

Figure 6. 17: Name of the responden

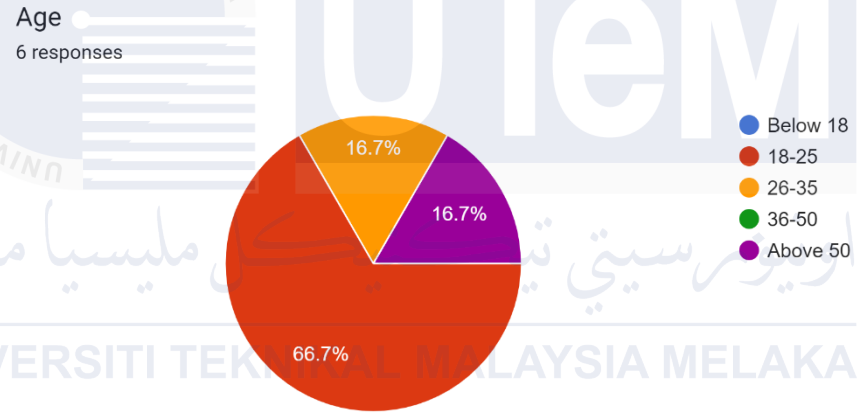

Figure 6. 18: Age of the respondent

User Scalability Scale (1 = Strongly Disagree , 2 = Disagree , 3 = Neutral , 4 = Agree , 5 = Strongly Agree**)**

1. I think that i would like to use this ResQ Flood Detector and Alert System frequently.

6 responses

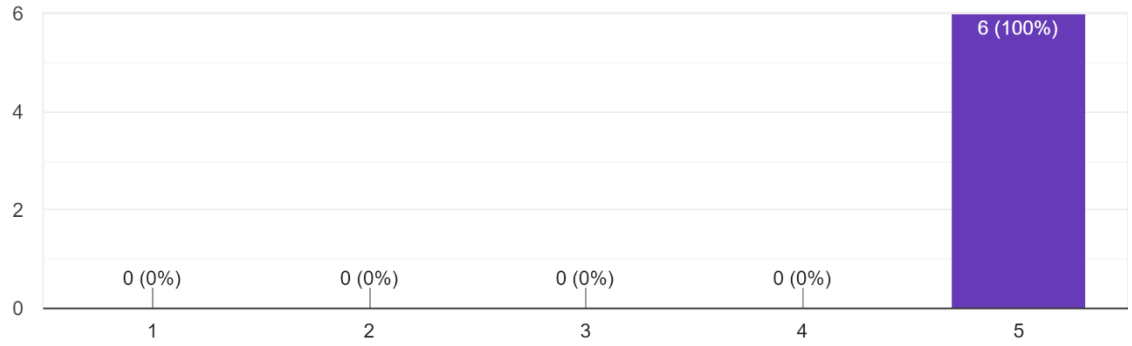

Figure 6. 19: Answer of question 1 from the respondent

2. I found the ResQ Flood Detector and Alert System application unnecessarily complex

6 responses

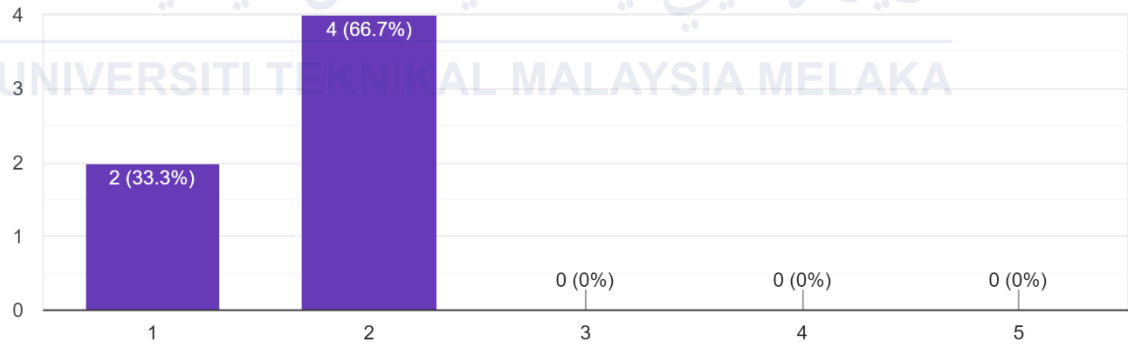

Figure 6. 20: Answer of question 2 from the respondent

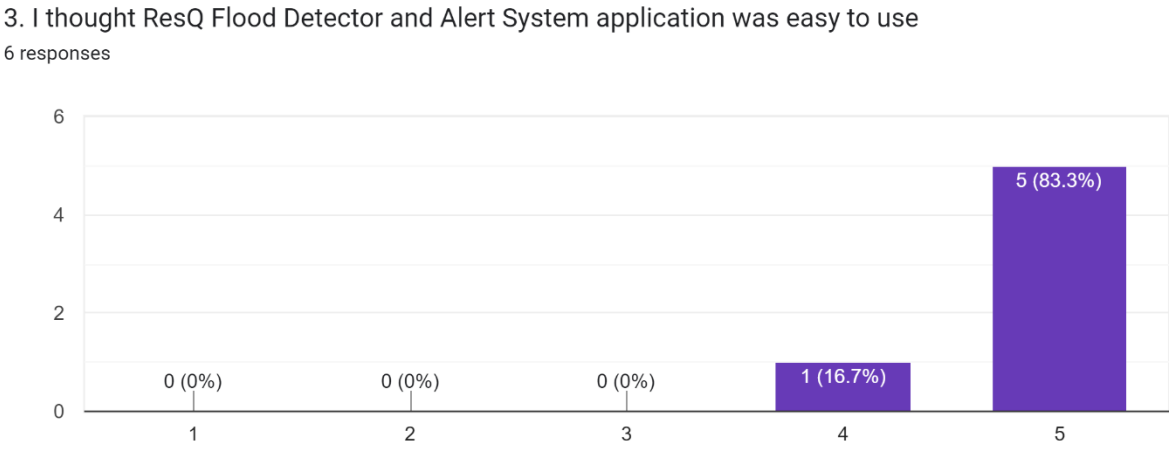

Figure 6. 21: Answer of question 3 from the respondent

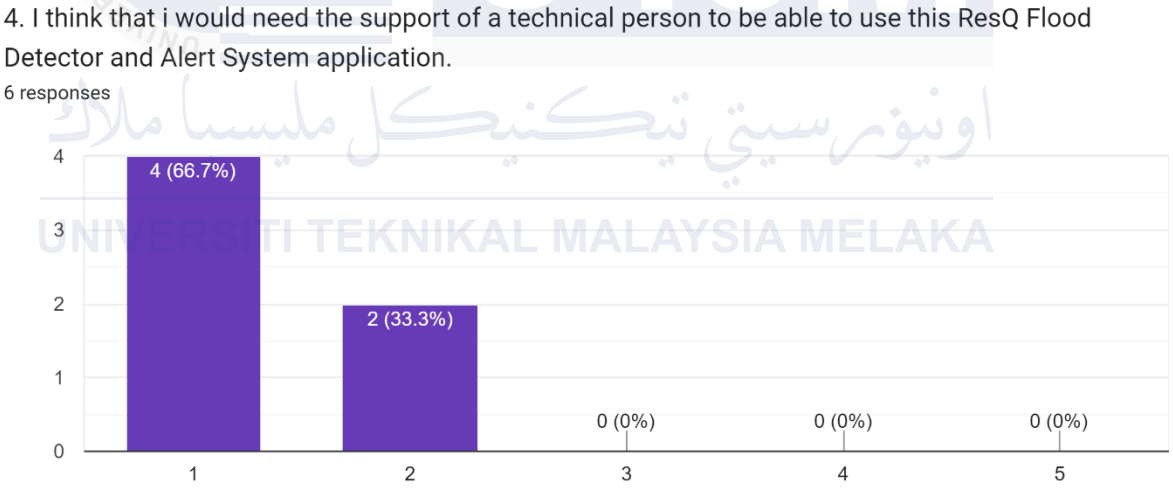

Figure 6. 22: Answer of question 4 from the respondent

5. I found the various function in this ResQ Flood Detector and Alert System application were well integrated

6 responses

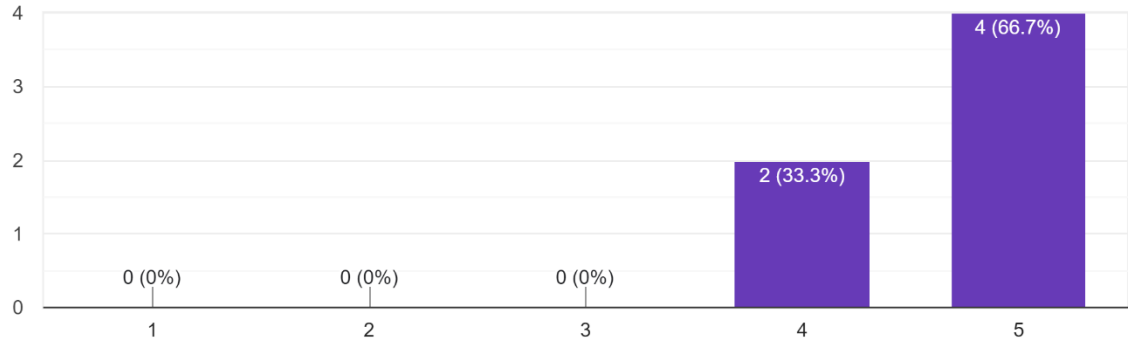

Figure 6. 23: Answer of question 5 from the respondent

6. I thought there were too much inconsistency in this ResQ Flood Detector and Alert System application

6 responses

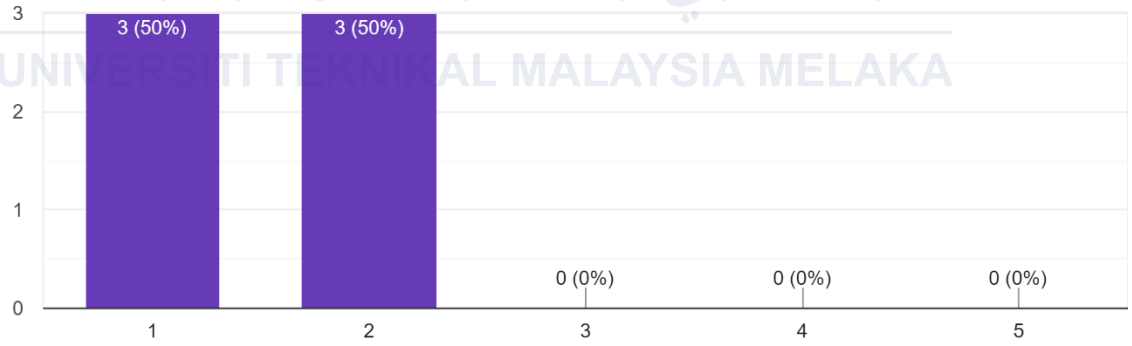

Figure 6. 24: Answer of question 6 from the respondent

7. I imagine that this application would bring the benefits to the flood prone area resident and community.

6 responses

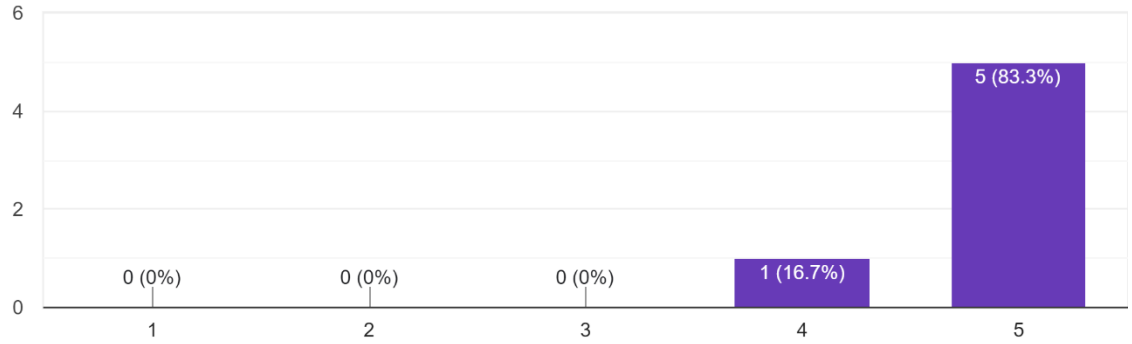

Figure 6. 25: Answer of question 7 from the respondent

8. I found that the ResQ Flood Detector and Alert System application very cumbersome to use.

6 responses

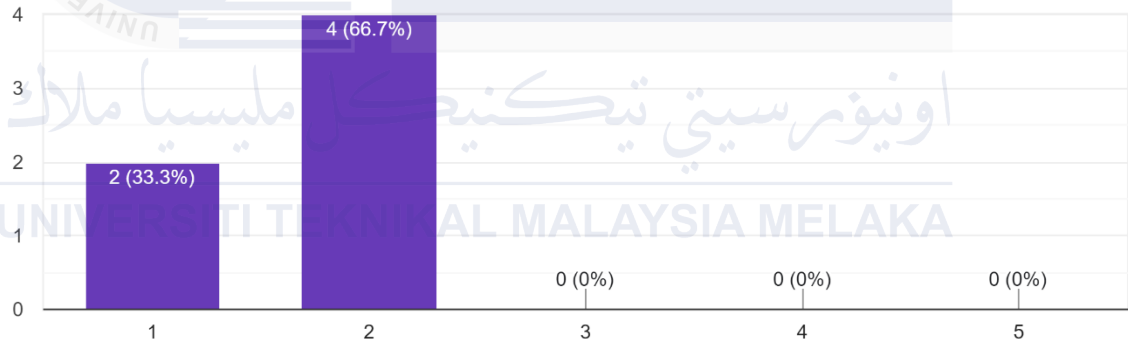

Figure 6. 26: Answer of question 8 from the respondent

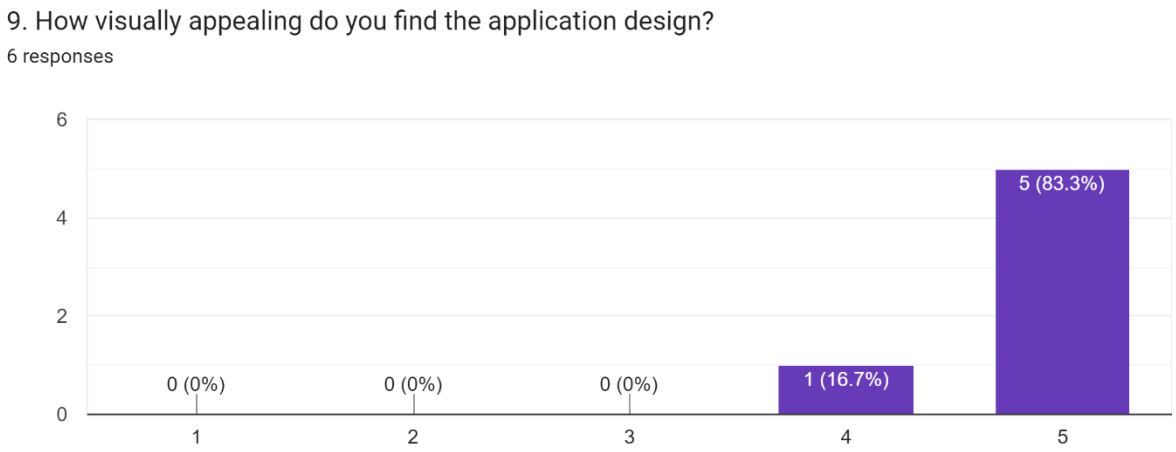

Figure 6. 27: Answer of question 9 from the respondent

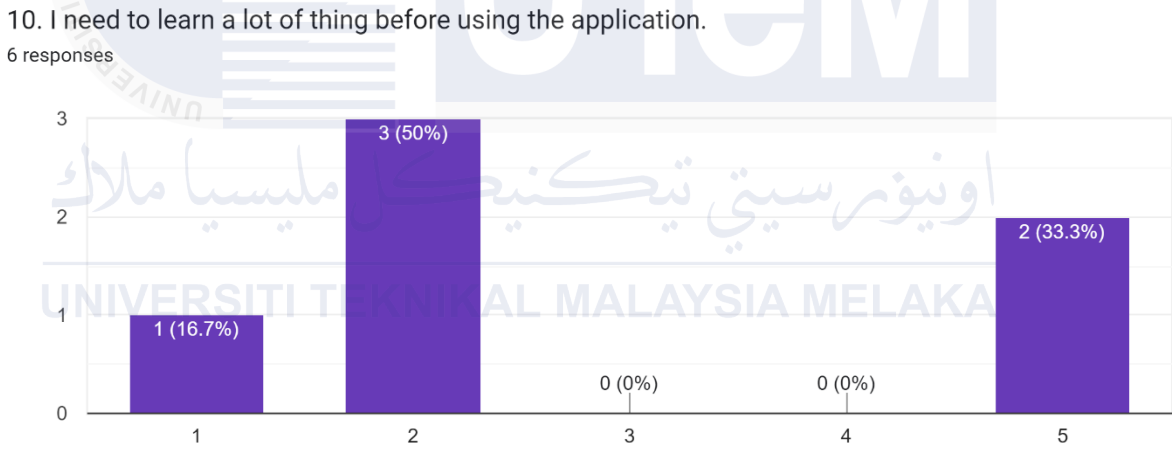

Figure 6. 28: Answer of question 10 from the respondent

6.6.2 Interpreting Score

To determine the SUS score, a response scale with a range of 1 to 5 is utilized.Since the odd-numbered questions indicate positive sentiments and the even-numbered ones convey negative ones, add up the scores for all six respondents' odd-numbered questions (1, 3, 5, 7, and 9) and deduct 30 from the total to obtain (X). Subtract 1 from every answer to an odd statement to determine the SUS score. As there are five odd-numbered questions for every six

responses in this instance, the total score for odd-numbered questions is subtracted by thirty. Then, add up the total score for all even-numbered questions (2,4,6,8,10), then subtract that total from 150 to get (Y). This explains by subtract corresponding values from 5 in every even-numbered statements. In this case, there are 5 even-numbered questions for each 6 respondents, overall 150 is subtracted by the total of even-numbered questions. Lastly, Add up the total score of the new values (X+Y) and multiply by 2.5

X = Total odd - Numbered Questions – 30
= (30+29+28+29+29) – 30
= 145 – 30
= 115

Y = 150 - Total even-numbered Questions
= 150 – (10+8+9+10+17)
= 150 – 54
= 96

Total Score = $\frac{(X+Y)XX\ 2.5}{600} \times 100$

$= \frac{(115+96)\times 2.5}{600} \times 100$

$= \frac{211\times 2.5}{600} \times 100$

$= \frac{527.5}{600} \times 100$

= 87.92

When following the above technique of scoring tabulation, the SUS score is a score out of 100 which is (87.92/100). This is not a percentage score. According to (usabiliTEST, 2011), It is important to remember that to generate a percentile ranking, raw scores are not expressed as percentages and need to be normalized. SUS scores can be converted into letter grades, which helps convey outcomes.

Table 6. 8: SUS Score Grading

SUS SCORE	Letter Grade	Adjective Rating
Above 80.3	A	Excellent
Between 68 – 80.3	B	Good
68	C	OK
Between 51 and 67	D	Poor
Below 51	E	Awful

The SUS score for the ResQ Flood Detector and Alert System is above 80.3. This shows that the flood detector and alert device got an A which is an excellent rating.

6.7 Conclusion

In conclusion, the testing phase in the development of the ResQ Flood Detector and Alert System is important because it determines the extent to which the system is ready for practical use. By conducting this process of testing and validating, we are able to pinpoint as well as mitigate possible issues as well as flaws of the network of sensors that includes the NodeMCU ESP32 and the ultrasonic sensor. This stage assures that the system works properly, is fast and reliable in monitoring and transmitting reports on amounts of water level and flood information in nearly real time. Hence, by employing traditional techniques for testing and adopting standard and protocol, developers can control risk factors, improve on security and gain on efficiency of the system. This is achieved because of the cautious approach in the development of ResQ Flood Detector and Alert System and enables the system to be highly reliable in offering important information and support in the management of risks associated with floods. However, another important advantage of the proposed system is that, through continuing testing a giving feedback, modifications can be made regularly and when new issues appear, the system will still be usable to address them.

CHAPTER 7: CONCLUSION

7.1 Introduction

This chapter summarizes the project, contributions, limitations, and future activities. It opens with a brief description of the project's objectives and further provides a detailed insight into the development and testing processes. Moreover, one is able to see the constraints faced and opens up opportunities for future enhancements in order to make the project more reliable, efficient, and effective. In the view of these, the chapter intends to provide a deeper understanding of the result of the project and its further evolution and optimization.

7.2 Project Summarization

The section focuses on some of the key elements, including a project summary, contributions, limitations, and future work planned. It relates to an overview of the project, which was successfully carried out to meet its objectives and offers views on the development and testing phases. Besides the challenges described in this chapter, it also puts forward possible future improvements for making the system more reliable, efficient, and effective in performance. In this chapter, it is going to be indicated how these factors have been taken to present a complete perception of the overall impact that results from a project and at the same time allows for continuous improvement and innovation.

The ResQ Flood Detector and Alert System Project integrates NodeMCU ESP32, ultrasonic sensors, ESP32 CAM, and a water pump in ensuring that its objectives are met. Some of the primary objectives include examining the outputs and data from the flood detection system, ensuring effective communication and visualization to the concerned local communities, creating a system that would give early alert, reduce injuries and losses during floods, and testing the acceptance of the system by its users. The following objectives have been fully met since the ESP32 NodeMCU has served very well as the central microcontroller in charge of monitoring and controlling the various involved devices, including the ultrasonic

sensor. Therefore, the coherent system is very effective in detecting the slightest possibility of a flood and making relevant information available to concerned communities, thus minimizing the impacts of such disasters. Further, the project has relied on the methods of monitoring and feedback with the aim of making sure that the system will always adapt to the changing environmental aspects thus it can be said to be rather useful tool in disaster preparedness especially in the long run.

i. Project Weakness

Sensor Sensitivity to Water Exposure: This system is equipped with a non-waterproof standard ultrasonic sensor. Therefore, the sensor is susceptible to water exposure through a splash or direct contact with it. This will result in malfunction of the sensor or reception of wrong readings, meaning that the sensor will not be as effective in informing of a rising water level.

Connectivity: It utilizes wireless connection, Wi-Fi, to transmit data and notifications toresident. If it is implemented in some far or rural locality, this could raise issues of connectivity and therefore communication with the system, reducing the overall reliability and operability in emergency instances.

Power Supply Limitation: This system is built to monitor floods in real-time continuously but the system is powered by a power bank that has a small capacity. This therefore directly connects the actual operational time of the system to the hours of Battery charge of the power bank. Hence, when the power bank runs out of power and has not been charged on time, it will not be able to detect and give out an alert in the case of critical floods hence most probably developing gaps in the coverage and effectiveness of the project.

ii. Project Strengtness

Real-Time Monitoring: The system provides real-time monitoring of water level, enabling timely data collection and analysis.

User-Friendly Interface: This system is designed to obtain control over the real time data and alerts in simpler way with the help of a graphical user interface. User who lacks

technical skills will be able to manage the operation of the system fully hence enhancing usage of the device by the resident and communities.

Mitigation of Flood Impact: Early detection and alerting of a potential flood event, can reduce the environmental and economic impacts of the floods. Provided in advance, it allows communities to prepare and take precaution, hence reducing potential damages and building resiliency to flood-related challenges.

Table 7. 1: Project Objective Reference

PS	PQ	PO	Project Objective	Reference (Chapter)
PS1	PQ1	PO1	To study and design the existing method and technique of flood detector and alert system IoT application system.	Chapter 2
		PO2	To develop the flood detector and alert system IoT application system that could give early warning of floods, retrieve flood alert data for a specific time period, capture video, and monitor the residential area.	Chapter 4
		PO3	To test the usability of the flood detector and alert system IoT application system.	Chapter 6

7.3 Project Contribution

The project indicates that contributions have a positive impact and add value to many stakeholders, flood detection, and the wider community. In that regard, ResQ Flood Detector and Alert System can take some very critical strides in matters of safety, awareness, and disaster management for the benefit of local communities and the larger field of flood prevention and response.

i. Improved Safety: This system entails early warning systems and efficient risk mitigation measures making the system to increase on the safety of the communities in the area that is most affected by floods. With timely information concerning the disasters to be expected, the at-risk residents can always be compelled to act thus reducing causalities while at the same time minimizing on the amount of property that can be destroyed.

ii. Technological Advancement: The system utilize different innovations and technologies in an attempt to boost the monitoring and detection and flood alert. This advancement enhance the accuracy and timeliness of flood warnings and can be used as best practice for other development.

7.4 Project Limitation

There are limitation in every project, and in order to control expectations and make progress on system improvement, it's critical to understand these limitations. Comprehending these constraints is vital for proficient project handling and evaluation of risks. Over time, some of these limitations can be addressed by the implementation of mitigation techniques and ongoing improvement initiative.

Some of the possible limitations to a ResQ Flood Detector and Alert System project are:

Data Connectivity: Dependency upon Wi-Fi or internet connectivity can be a problem in remote or rugged terrains with limited network access, thus affecting the transmission of data.

Power Supply Constraints: This may be limited in terms of power supply, especially when all sensors and equipment have been turned on simultaneously. If the power supply is insufficient, these sensors can malfunction or even fail to detect the flood conditions as expected.

Sensor Accuracy Interference: Implementation of ultrasonic sensor with a water pump will cause the accuracy of this device to drop lower. The vibrations and noise produced by the water pump may interfere with the waves of the ultrasonic device, producing erratic readings.

7.5 Future Work

In the future, this project will expand its functionality by adding a new implementation or enhancing the one that already exists. Some possible possibilities for implementation or improvement to think about are as follows:

i. Firstly, A mobile chat forum would go perfectly well within the mobile application, allowing residents to share real-time information about the local flooding situation and let each other know that they are safe. This module has the potential to build community collaboration and better preparedness during emergencies.

ii. Next, allowing users to view graphical representations of past date water levels. Insights on flood patterns over time would result from this, enabling resident, tourist and authorities to spot patterns of flood and take early action.

iii. Finally ,add the functionality to the smartphone app that could access and view previous videos from the surveillance camera. Post-event analysis, insurance claim and other things could all benefit greatly from this capability.

7.6 Conclusion

In conclusion, design and development of the ResQ Flood Detector and Alert System reflect considerably improved safety, reduced risk of flooding, and increased community resilience in areas subject to flooding. This will be driven by advanced sensor technology, real-time data analysis, and community engagement to set a good base for establishing better systems of early warning and response. The project has limitations that need to be addressed in order to be further improved upon, even while its strengths such as its ability to raise community awareness and provide early warnings must also be acknowledged. Developing technology, and conducting more research will surely help to make the system better and eventually more expansive in order to achieve the goal of protecting people, property, and the environment from the destructive consequences of flooding. The result of this continual commitment means that, in the face of any future flood event, communities will be more prepared and resilient to create a clear path toward flood management and disaster response. Besides, responding to new challenges, users' feedback, or constant changes, the system still remains relevant to go on solving the evolving needs of flood-prone regions.

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APPENDICES A

i. Source code for ESP32

REAL_RESQ_FLOOD_DETECTOR | Arduino IDE 2.3.2

File Edit Sketch Tools Help

AI Thinker ESP32-CAM

REAL_RESQ_FLOOD_DETECTOR.ino

```
#define BLYNK_TEMPLATE_ID "TMPL6J6DTsdep"
#define BLYNK_TEMPLATE_NAME "ResQ Flood Detector and Alert System"
#define BLYNK_AUTH_TOKEN "EFO7IPFkYgp7B8lzWhOnlTEJP4os7aMp"

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <BlynkSimpleEsp32.h> // Include Blynk library for ESP32

// Define LED pins
const int redLedPin = 4;     // Red LED
const int greenLedPin = 19;  // Green LED
const int yellowLedPin = 23; // Yellow LED
const int buzzerPin = 14;    // Buzzer

// Define ultrasonic sensor pins
const int triggerPin = 5;
const int echoPin = 18;

// Initialize the LCD (assuming address 0x27 and size 16x2)
LiquidCrystal_I2C lcd(0x27, 16, 2);

// Blynk credentials
char ssid[] = "Abyana";
char pass[] = "Dayana81";

void setup() {
  // Initialize Serial Monitor
  Serial.begin(115200);
```

ii. Source code for ESP32 CAM

esp32_camera_mjpeg | Arduino IDE 2.3.2

File Edit Sketch Tools Help

AI Thinker ESP32-CAM

esp32_camera_mjpeg.ino camera_pins.h

```
#include "src/OV2640.h"
#include <WiFi.h>
#include <WebServer.h>
#include <WiFiClient.h>

#define CAMERA_MODEL_AI_THINKER

#include "camera_pins.h"

char ssid[] = "Abyana";
char pass[] = "Dayana81";

OV2640 cam;

WebServer server(80);
const char HEADER[] = "HTTP/1.1 200 OK\r\n" \
                      "Access-Control-Allow-Origin: *\r\n" \
                      "Content-Type: multipart/x-mixed-replace; boundary=12345678900000000000987654321\r\n";
const char BOUNDARY[] = "\r\n--12345678900000000000987654321\r\n";
const char CTNTTYPE[] = "Content-Type: image/jpeg\r\nContent-Length: ";
const int hdrLen = strlen(HEADER);
const int bdrLen = strlen(BOUNDARY);
const int cntLen = strlen(CTNTTYPE);

void handle_jpg_stream(void)
{
  char buf[32];
```

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iii. Source code for Water Pump