



Faculty of Electrical and Electronic Engineering Technology

**DEVELOPMENT OF SMART WATER QUALITY & FLOOD
MONITORING SYSTEM USING MICROCONTROLLER AND
CLOUD SERVER**

MUHAMMAD AFWAN BIN MUHAMAD ZAMRI

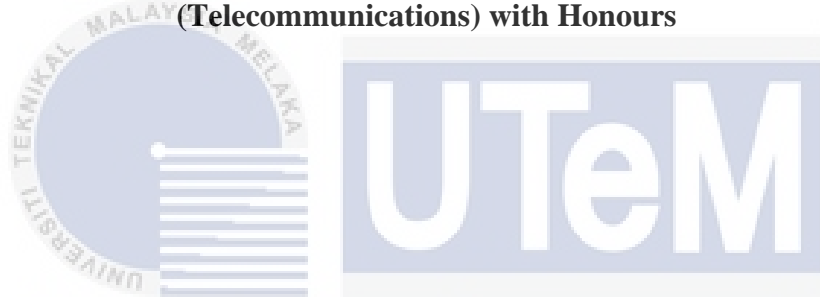
**Bachelor of Electronics Engineering Technology (Telecommunications)
with Honours**

2023

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SYSTEM USING MICROCONTROLLER AND CLOUD SERVER**

MUHAMMAD AFWAN BIN MUHAMAD ZAMRI

**A project report submitted
in partial fulfilment of the requirements for the degree of
Bachelor of Electronics Engineering Technology
(Telecommunications) with Honours**



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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APPROVAL

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

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DEDICATIONS

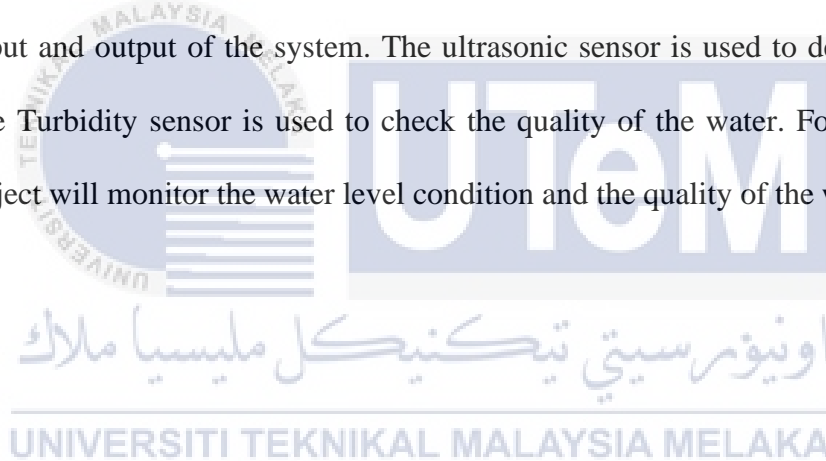
Special dedication to my parents
MUHAMAD ZAMRI BIN MAT YUSOP
and
NORIZA BINTI BAHAROM

My supportive and kind supervisor,
FAUZI BIN HJ ABDUL WAHAB



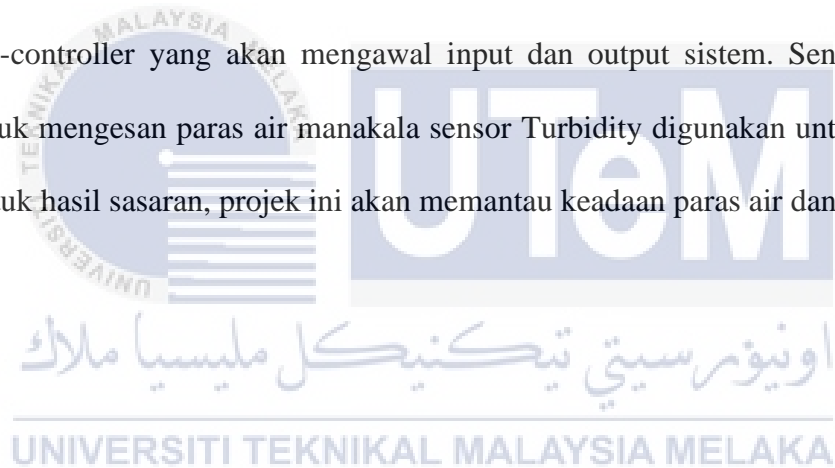
ABSTRACT

Water is an essential natural resource that is very important to humankind. Malaysia is a tropical country with an almost unlimited supply of fresh water. A good ecosystem requires water to be of good quality. When it rains heavily, a flood may hit the surrounding areas of the river. Many properties will be destroyed, or people's lives may be threatened. This project will focus on developing flood and water quality monitoring systems in the rivers. With the convenience of IoT Technology, an intelligent system can deliver valuable warning alerting information for both quality and flood hazards to respective personnel or the public. This flood and water quality monitoring system used an Arduino as a microcontroller that will control the input and output of the system. The ultrasonic sensor is used to detect the water level while the Turbidity sensor is used to check the quality of the water. For the expected result, this project will monitor the water level condition and the quality of the water.



ABSTRAK

Air merupakan salah satu sumber semula jadi yang penting kepada manusia. Malaysia adalah sebuah negara tropika dengan bekalan air tawar yang banyak. Ekosistem yang baik memerlukan air di dalam kualiti yang baik. Apabila hujan lebat, banjir mungkin melanda di kawasan sekitar sungai. Banyak harta benda akan musnah, atau nyawa orang ramai akan terancam. Projek ini akan tertumpu kepada pembangunan pemantauan banjir dan sistem pemantauan kualiti air di sungai. Dengan kemudahan Teknologi IoT, sistem pintar boleh menyampaikan maklumat amaran yang berharga untuk kedua-dua kualiti dan bahaya banjir kepada orang ramai. Sistem pemantauan kualiti banjir dan air ini menggunakan Arduino sebagai mikro-controller yang akan mengawal input dan output sistem. Sensor ultrasonik digunakan untuk mengesan paras air manakala sensor Turbidity digunakan untuk memeriksa kualiti air. Untuk hasil sasaran, projek ini akan memantau keadaan paras air dan kualiti air.



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CHAPTER 1

INTRODUCTION

1.1 Background

Floods are natural disasters that can happen when heavy rain is non-stop pouring. Floods are one of the natural disasters that always happen in Malaysia during the rainy season which happens at the end of the year. There are many types of flooding, but very common in Malaysia is river flood and flash flood. Some floods can happen when it rains heavily non-stop. Recently massive floods hit an unexpected area in Selangor that had rarely flooded before this [1].

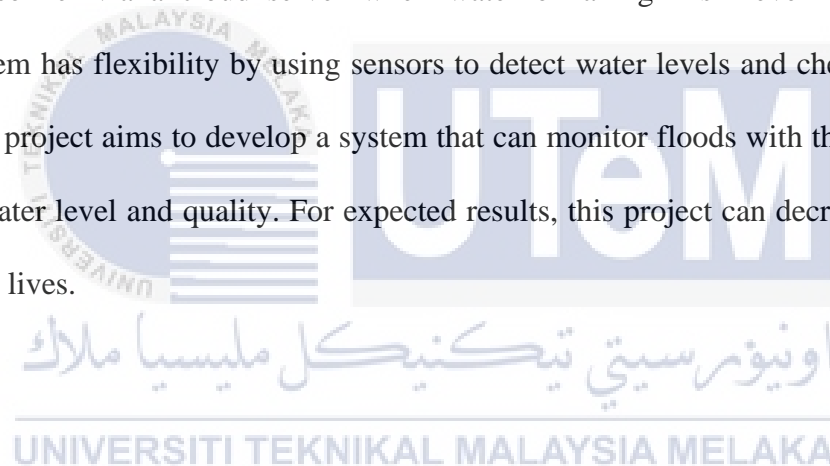
Water is one of the main sources for all living things, many plants and animals need water to survive. Humans also need water to survive, that is because water is used by our bodies to assist control the body's temperature and used by other physical processes. Moreover, the water that is used by humans needs good quality for safe drinking. Water quality refers to the water condition it's good to drink. However, the impacts of the flood will damage the water sources and affect water quality. It happens when mud carried by rain goes into the river water, affecting the quality of river water or water sources [2]. Poor water quality can cause health risks.

That's why a monitoring system for flood and water quality is needed. Firstly, Flood Monitoring System is a technology that is used to monitor the water level in dams or rivers. While some areas are more vulnerable to flooding than other places, installing flood warning systems near a dam or river provides important data that can save property and more lives. In Malaysia problem happened when some of the flood alerting systems had a technical issue. It happened in some places in Negeri Sembilan when the flood's siren does not work to

warn the nearest resident [3]. A good Flood Monitoring System is needed to avoid these incidents happening.

Secondly, the Water Quality Monitoring System is a technology that is used to monitor the quality of water in rivers. It can be assessed by collecting some of the water samples for laboratory examination or by utilising Turbidity sensors that can capture data at a single point in time or regular intervals over a long period. Monitoring water quality is critical for determining whether the water is clean. It displays the quality of water in a single moment as well as over weeks, months, and years [4].

This project's purpose is to solve the problems that occurred. By giving alerts to the public or personnel via a cloud server when water on a high-risk level happened. The proposed system has flexibility by using sensors to detect water levels and check the quality of water. This project aims to develop a system that can monitor floods with the capability to monitor the water level and quality. For expected results, this project can decrease casualties and save more lives.



1.2 Problem Statement

A flood may hit the surrounding areas of a dam or river when rains heavily and the quality of water on the rivers will also affect when the floods happen. The impact of floods is they can destroy many properties. According to the Department of Statistics, damage to public assets and infrastructure cost RM2 billion followed by house damage costing RM1.6 billion, the report from the government about the flood that happen in early January this year in Malaysia [5]. Other than that, people's lives also can be threatened by floods. Anxiety, fear, rage, frustration, sadness, and loss are some of the feelings that flood victims may experience. It's common for people who have been through traumatic events like floods to have trouble sleeping, lose their appetite, have melancholy or angry moods, and feel anxious. Besides that, floods also can damage water sources and affect the quality of water. For example, floods may change the terrain by destroying riverbanks and causing them to collapse. Sediment becomes trapped in the water as floods bring debris from eroding banks, lowering water quality, and causing hazardous algae blooms [6]. Therefore, in this project, a system of flood monitoring and water quality monitoring system will be made. The system also will give a notification about the water level and quality of water to the user's phone so they can know about the real-time situation.

1.3 Project Objective

To make a project an objective is needed. Below is the objective for this project:

- 1) To identify the effect of flood and water quality.
- 2) To develop a Flood and Water Quality Monitoring System in the river.
- 3) To develop an alerting system that can deliver valuable warnings alerting flood hazards to the respective user.
- 4) To analyse and optimize system performance.

1.4 Scope of Project

To accomplish the objectives of this project, several things should be considered which is:

- a) Identify the effect of flood and water quality on people.
- b) Develop a monitoring system for flood and water quality that monitors water level and the turbidity of water.
- c) Develop an alerting message in Blynk to alert users about the water level and turbidity of water.
- d) Measure and analyse complete system performance.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Flood Monitoring System is a technology that uses to monitor the water level such as in dams or rivers. Some areas are more vulnerable to flooding than others, installing flood warning systems near a dam or river provides important data that can protect property and save lives. Water Quality Monitoring System is a technology that uses to monitor the quality of water in the river. The turbidity of the water will be measured to know if it is good or not. This chapter will look at what has been established based on previous studies. The flood and water quality monitoring system, as well as associated work on this project and development methods to be used to build the system, will be described.

2.2 Related Work

2.2.1 Flood Monitoring and Alerting System Using Arduino in IoT

The paper “Flood Monitoring and Alerting System Using Arduino in IoT” [7] developed a flood monitoring and alerting system. The mechanism for this project is the water level sensor to track the water level and the temperature sensor to detect the humidity level connected to Arduino, the water limit sensor to maintain the level of water. The sensor that is connected to the microcontroller will analyse the real-time data if there is a changeover Waterflow or humidity level and send the data to the application. By using an IoT (ESP8266) connected to Arduino as a module for sending the alert message to the nearby surrounding.

2.2.2 Flood Monitoring and Alerting System

The author of “Flood Monitoring and Alerting System” [8], is using Arduino as a microcontroller connected by the ultrasonic sensor to read the distance between water and the sensor. The water was measured, and the water level was calculated then it will compare to the set threshold if the water level is more than the threshold value it will make a voice call to a residence to alert them via GSM SIM 900A and update the web page. When the water level is lower than the threshold value it will update the web page only. This paper uses APR33A3, this component is a device to record voice it will interface d with GSM and the recorded voice will play when the call happens.

2.2.3 IoT Based Water Flood Detection and Early Warning System

In the paper “IoT Based Water Flood Detection and Early Warning System” [9], the author uses an Android application for monitoring the data. Firstly, Water Level Detection Sensors, Temperature Sensors and Humidity sensors are placed near the river to detect the flood in water bodies. Next, the water level detection sensor function as a transmitting unit that is used to detect the water level at the time of the floods. Temperature Sensors and Humidity Sensors are used to measure the live temperature and humidity of the water bodies. Then, the data is displayed on an LCD for the end user to see the data. When the sensor detects water level increases at a certain level in the water body, it will send an alert SMS via a GSM modem to the people who are nearby the water body. The collected data from the sensors will transmit to the Android application, Thingview. The application will display the flow graph level of the water level in the river, temperature, and humidity values. It also can send SMS to the registered contact mobile numbers.

2.2.4 IoT Based Smart Water Quality Monitoring System

The paper “IoT based smart water quality monitoring system” [10] focused on a water quality monitoring system that uses ATMEGA328 as a microcontroller that will convert the analogue data to digital and LCD will display the output value. The sensors are connected to a microcontroller that will measure the real-time values and the values will upload to the cloud. If the values are more than the threshold value, it will communicate to the concerned end user. A Wi-Fi module is a wireless module to connect software and hardware part.

2.2.5 Smart Water Quality Monitoring System Using IoT Technology

The paper “Smart Water Quality Monitoring System Using IoT Technology” [11], This project is about a smart water quality monitoring system using IoT. The mechanism for this project is that WQM chooses water parameters such as temperature, pH level, water level, and CO₂ using various device nodes. The data is sent to the web server using this way. The data updated at regular intervals on the server may be obtained or viewed from anywhere around the globe. If the sensors fail or enter abnormal circumstances, a buzzer will sound.

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2.2.6 Smart IoT Flood Monitoring System

The paper “Smart IoT Flood Monitoring System” [12] is an IoT flood monitoring system that uses a web server to display the data and alert the public. The HC-SR04 module sensor will be used to detect the water level of the river. The mbed NXP LPC1768 is a microcontroller that will collect the data for this system. A buzzer will act as an alarm to alert the public and authorities when there is an upcoming flood. The data will be uploaded to the web server. This project uses LCD and LED that function to display and will indicate the level of water.

2.2.7 Smart Monitoring System of Najran Dam

The project “Smart Monitoring System of Najran Dam” [13] was focused on the flood warning system and monitoring Dam system of Najran Dam. The mechanism for a flood early warning system is the water level sensors and water flow sensor will measure the flow and level of water and the Arduino as a microcontroller read the data from the sensor then alerting messages will send to people via GSM shield based on the data collected.

2.2.8 Smart Water Quality Monitoring System with Cost-Effective Using IoT

The paper “Smart Water Quality Monitoring System with Cost-Effective Using IoT” [14] uses four sensors which are a pH sensor, turbidity sensor, ultrasonic sensor, and DHT-11 sensor. The sensors will collect real-time data and then the data will process by Arduino which is a microcontroller for this project. Then all the data upload to the ThingSpeak server via a Wi-Fi module. Users can log in to the server to access the data by using the user ID and password.

2.2.9 Implementation of GSM Communication on Flood Monitoring Systems Based on Multiple Locations Visualization

This project “Implementation of GSM Communication on Flood Monitoring Systems Based on Multiple Locations Visualization” [15] has two systems flood detection system and a flood monitoring system server. For flood detection systems they use Arduino as a microcontroller, then connected to several sensors as input including ultrasonic sensors to measure water levels, rain sensors to determine the rain conditions and temperature sensors. For flood monitoring system servers, they use a GSM modem, web server application, MySQL database, PHP engine and Gammu. The data from sensors will send to the flood monitoring

system server using SMS via the GSM transmitter module. Then the flood monitoring system server that has a GSM receiver module will display the output on the server application.

2.2.10 Flood Warning and Monitoring System (FWMS) using GSM Technology

On the other hand, the paper “Flood Warning and Monitoring System (FWMS) using GSM Technology” [16] uses the GSM SIM900A module embedded in Arduino as the microcontroller. Sensors were monitoring and collect real-time data and are then connected to a microcontroller which is work as a processor. This project system has three different levels of flood warning “normal”, “Warning” and “danger”. This project is also capable to give alerts by sending a warning SMS or call to users and the Fire and Rescue Department via the GSM module. When the levels are on “warning” or “danger” a buzzer will be turned on as a warning notification to users. Users also can monitor the level of water status by sending an SMS to the system.

2.2.11 IoT Based Early Warning System for Torrential Floods

For “IoT Based Early Warning System for Torrential Floods” [17] the system is based on a network of automated meteorological stations (AMS) that send data to a central server at regular intervals, where it is processed and shown to users with the necessary authorisation level. Data is collected using an Arduino as a microcontroller. Water levels are measured using ultrasonic sensors, while temperature, relative humidity, and ambient pressure are measured using a combination sensor. A soil vibration sensor is an optional feature that may be used to identify potential landslides and to acquire extra data for the production of a larger meteorological image. The data collection, processing, and alerting web application is developed in the PHP programming language and hosted on the Apache webserver. The information is saved in a MySQL database. The software is available on a separate web domain

and may be used on a variety of platforms, including PCs, laptops, and smartphones. AMS also features an internal alert system that sends SMS messages to selected mobile phone numbers in the event of a substantial change in sensor data.

2.2.12 Flood Detection and Water Monitoring System Using IoT

The project “Flood Detection and Water Monitoring System Using IoT” [18] was focused on IoT while Arduino is used as a microcontroller for this system. All the sensors are connected to the Arduino. The sensors detect their surroundings and provide real-time data to the cloud which users may view and access via their mobile platform. When the water level reaches a certain height, the system issues a warning. The volume of water or the distance between the sensor and the water level is measured using an ultrasonic sensor. Meanwhile, the flow and amount of water transported are measured using a flow sensor. DHT11 sensor for measuring temperature and humidity. When the water level reaches the float sensor, it causes the float sensor to move higher, completing the circuit and sending a stress signal to the user, alerting them of a probable rise in water level. Data is uploaded and modified in the cloud with accuracy to the sensor, allowing for real-time modifications in the mobile app.

2.2.13 Designing Early Warning Flood Detection and Monitoring System via IoT

The author “Designing Early Warning Flood Detection and Monitoring System via IoT” [19] uses the Blynk app as a platform. NodeMCU was used to connect the system to Wi-Fi. The ultrasonic sensor has been used for detects the water level. This project also allows users to view the duration of the water level from their smartphone. A solenoid valve was used for water excess to flow out to suitable places. In this project, a GPS has been used to provide the exact location of the flood area. Users can get an alert message on the Blynk app when the level of water is at a WARNING or CRITICAL level.

2.2.14 Flood Disaster Indicator of Water Level Monitoring System

The paper “Flood Disaster Indicator of Water Level Monitoring System” [20] used GSM to deliver data and an Arduino board is used to operate the entire system. This project uses float switch sensors to assess the water level and then analyses the data to identify the sort of hazard present. An alarm message is issued to the user based on the observed level. The GSM is utilised to send SMS messages between the various system components. The output will be presented in SMS messages to users and also displayed on LCD.

2.2.15 A GSM Based Water Quality Monitoring System using Arduino

The author of “A GSM Based Water Quality Monitoring System using Arduino” [21] focused on GSM based water monitoring system it uses three sensors is pH sensor, a conductivity sensor, and temperature sensor, an Arduino processing module, and two data transmission modules (Arduino and GSM) are used in this system. The data is captured as analogue signals by the three sensors. Then the data obtained from the sensors is accepted and processed by Arduino and sent to the Web page through the GSM module. The microcontroller will process and analyse the digital data, and the GSM module will send an SMS including the water quality parameters to the smartphone or PC, which will also be shown on the Arduino's LCD.

2.2.16 Internet of Things Enabled Real-Time Water Quality Monitoring System

The project from “Internet of Things Enabled Real-Time Water Quality Monitoring System” [22] uses TI CC3200 as a controller, it is a single-chip microcontroller with an in-built Wi-Fi module and ARM Cortex M4 core. Then the sensors were connected to the controller for the data processor. The real data has been collected by the sensor by placing the sensors into different solutions of water. the value can be viewed by using LCD. Then the data will