Faculty of Electrical and Electronic Engineering Technology

IOT BASED RIVER FLOOD DETECTION SYSTEM USING MICROCONTROLLER

MUHAMMAD HAZMAN BIN MOHD HIDIR

Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

2021

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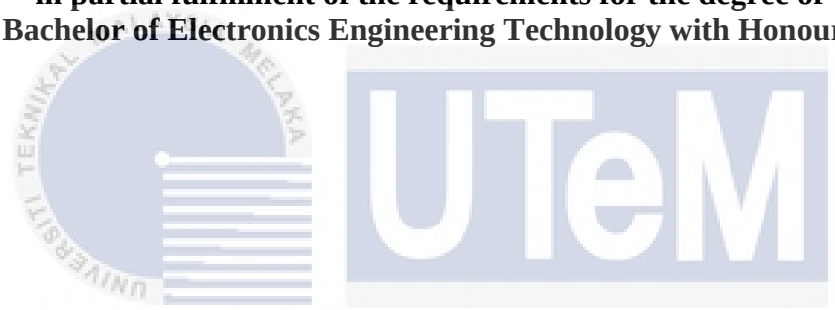
A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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Tajuk Projek : IOT BASED RIVER FLOOD DETECTION SYSTEM USING MICROCONTROLLER

Sesi Pengajian : 2021

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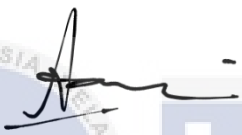
I declare that this project report entitled “IOT BASED RIVER FLOOD DETECTION SYSTEM USING MICROCONTROLLER” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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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 (Industrial Electronics) with Honours.

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Date : 11 Jan. 2022

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

This study wholeheartedly dedicated to my beloved parents
Rasidah Binti Othman and Mohd Hidir Bin Hamzah
who have been the source of inspiration and strength to push me forward one step closer toward success and continually provide moral, spiritual, emotional, and financial support.

And next we dedicated this study to the Almighty God Allah S.W.T. for the knowledge and wisdom provided that made this possible.

ABSTRACT

Nowadays, natural disaster is quite common because of global warming. Incident such as flood will happen almost every year when there is a heavy raining season. This is always the case when the river is overflown by the rainwater. Since rain cannot be stopped, it is important to have a certain mechanism that is able to predict ocurence of flood . Therefore, the objective of this project is to develop a system that can detect early sign of flooding. This system must be able to warn user about the incoming flood that is likely to occur based on the river water level. In addition, the system must be able to store the data for easy access and future analysis. This flood detection system uses an NodeMCU as a microcontroller to control input and output of the system with a built-in Wi-Fi module to transmit the data wirelessly to a web application. "ThingSpeak" web application is used to monitor and store all the data of the sensor. Ultrasonic sensor is used to measure the water level in the river and the rate of water rising. In addition, a cylinder tube is used as a stilling well in order to reduce the error during water level measurement. From the implementation, it is shown that the system works well to measure the water level and the data has been succesfully transfered to the cloud storage. A few output in the form of graphs are directly produced after the data has been transfered. Then, a Twitter status update based on the condition of the river will be performed in the specified twitter page. As a conclusion the system for detecting and predicting approching flood has been succefullly developed and tested.

ABSTRAK

Masa kini, bencana alam sering berlaku disebabkan oleh pemanasan global. Situasi seperti banjir akan terjadi hampir setiap tahun apabila adanya musim hujan lebat. Hal ini sering berlaku oleh kerana air sungai yang melimpah akibat daripada air hujan. Memandangkan hujan tidak dapat dihentikan, adalah penting untuk mempunyai alatan tertentu yang mampu meramalkan kejadian banjir. Oleh itu, objektif projek ini adalah untuk membangunkan satu sistem yang dapat mengesan tanda-tanda awal banjir. Sistem ini mesti dapat memberi amaran kepada pengguna tentang banjir yang akan datang yang mungkin berlaku berdasarkan paras air sungai. Di samping itu, sistem mesti boleh menyimpan data yang mudah dicapai dan dianalisis pada masa hadapan.Sistem ini menggunakan NodeMCU sebagai mikropengawal untuk mengawal keluaran dan kemasukan sistem berserta modul Wi-Fi yang terbina digunakan untuk menghantar data secara tanpa wayar kepada satu aplikasi sesawang. Aplikasi sesawang "*ThingSpeak*" digunakan untuk memantau dan menyimpan semua data daripada pengesan. pengesan ultrasonik akan digunakan untuk menyukat paras and sungai dan juga tahap kenaikan air sungai tersebut. Selain itu, tiub silinder digunakan sebagai telaga pegun bagi mengurangkan ralat semasa pengukuran aras air. Hasil daripada pelaksanaan sistem ini, ia menunjukkan bahawa sistem ini berfungsi dengan baik untuk mengukur paras air dan data telah berjaya dipindahkan ke storan atas talian. Beberapa bacaan dalam bentuk graf dihasilkan secara langsung selepas data telah dipindahkan. Kemudian, status "*Twitter*" akan dikemaskini berdasarkan keadaan sungai akan dilakukan dalam laman "*Twitter*" yang ditetapkan. Sebagai kesimpulan, sistem untuk mengesan dan meramalkan banjir telah berjaya dibangunkan dan diuji.

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First and foremost, I would like to express my gratitude to my supervisor, Dr. Nor Azlan Bin Mohd Aris for his precious guidance, words of wisdom and patient throughout this project.

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My gratitude is extended to my parents and family members for their love and prayers during my studies.

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LIST OF ABBREVIATIONS

V	-	Voltage
cm	-	Centimeter
s	-	Second
m	-	Meter
A	-	Ampere
mA	-	Milli Amp
mAh	-	Milli Amp Hour
W	-	Watt

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Flooding is a natural phenomenon when water settles on a land due to overflow that exceed nearby bodies of water. This is due to excessive rainfall, melting snow, or the inability of the river to accommodate and distribute the water it receives. Floods could also happen when citizens are unaware or during their sleep. During this time, they are unable to prepare for evacuation. It is no doubt that flood will damage all buildings, property and takes lives. However, we could prevent the lots of live when we are prepared. For this reason, it is necessary to design a remote flood detection tool, not only to increase the accuracy of the detection in the flood but can be monitored in real time to provide flood warning at the precise moment.

A flood detection tools could be improvised from a liquid level sensor. Ultrasonic sensor has been commonly used as to measure the level of a liquid. For example, a chemical factory with a dangerous chemical will have a sensor inside the storage tank to help the workers monitor the current liquid level at a further distance. It is also equipped with an indicator to warn the operator about the liquid level. Same concept could be applied to a flood detection tools. As a river is usually located at a rural area, monitoring them constantly is quite challenging. Therefore, with the help of a system, we could both monitor the river level and warn nearby citizens remotely.

1.2 Problem Statement

During monsoon season in Malaysia, heavy and long rain will cause water to accumulate in the low ground area. Usually, a drainage system is built to transfer the water to nearby river so it can flow back into the sea. However, this method will cause the river itself to overflow if there is too much water. This is because in some places, only a few rivers are presence, and some rivers are small is size. So, usually in these places, a sensor is installed to monitor the river level in real time. It consists of an ultrasonic sensor which is pointed downward and installed at a bridge. One of the problems with this system are the readings are not accurate because the sensor may detect debris as the current water level. Therefore, in this project, a new design for the river water level sensor is developed. The sensor will be encased in a cylinder to prevent the debris from interrupting the sensor. This new system will notify people about incoming flood through a web application to help the evacuation process.

1.3 Project Objective

The objectives of this research are:

a) To develop a system that measure the water level and the rate of water rising using ultrasonic sensor.

b) To develop a system that able to warn users about incoming flood.

c) To store data of water level, rate of water rising and rain status to cloud storage for future study.

1.4 Scope of Project

For the microcontroller, an NodeMCU is used as the main control for the sensors and other module. A built-in Wi-Fi module enable the NodeMCU to connect to a Wi-Fi network. On the web browser, an application called ThingSpeak is used to receive data from the NodeMCU. The ThingSpeak allow its user to fully customize the variable shown on its interface such as graph, meter, indicator light and many more. For the sensor, an ultrasonic sensor is used to monitor the water level while a rain sensor is used to detect rain. To power the NodeMCU remotely, a rechargeable lithium battery is used along with a charging circuit powered with a solar panel. This prototype is built to be tested at a controlled environment and not at the real river. All component used are picked based on the cheapest price and availability to save cost and time.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter shows the previous research done mainly on IoT projects. The methods and hardware used is compared to find the most efficient in terms of functionality and cost. Most common method of creating this system is by integrating three major system which is, a sensing system, data processing and transmitting system and lastly an alerting system.

2.2 Internet of Things (IoT)

IoT refers to a network of devices connected to each other. IoT devices does not require a human interaction to perform. It able to communicate wirelessly to send real time data through the internet. The devices available are from just a household items up to an industrial equipment. The advantages of IoT are such as ability to access information from anywhere, easily communicates with the devices, saving time and money by sending the data over a network connection and minimize human interactions with the devices.

2.3 Previous Flood Monitoring and Alert System

The old method of determining river stage was to place pipelines in rivers, dig stilling wells, and build the necessary brick-and-mortar infrastructure. Because of the high cost of this method, it can only be used on major rivers.

A group of researcher from Iowa City has developed a flood detection system called Bridge-Mounted River Stage Sensors (BMRSS) [1]. BMRSS units incorporate an ultrasonic distance- measuring module, a solar panel/battery/charge controller, and a GPS receiver.

Internet connection via commercial cellphone networks has grown commonplace in recent years, even in most remote locations. BMRSS units have cell modems and provide data to the Iowa Flood Center's servers through the Internet.

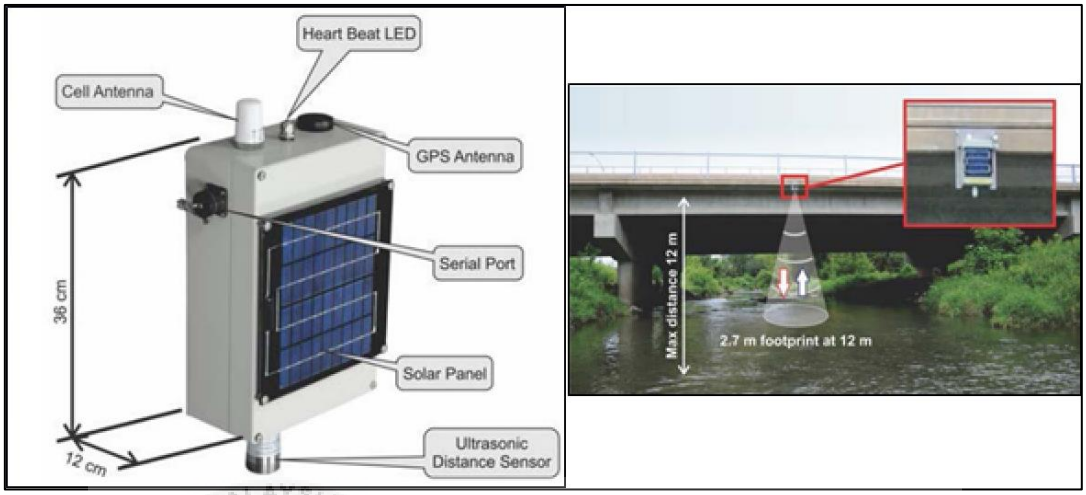

Figure 2.1 Bridge-Mounted River Stage Sensors (BMRSS)

Currently in Malaysia, a telemetry system being deployed to monitor and predict the impending flood calamity. Water level and rain level are the only flood characteristics measured by the existing system. The sensor is remotely installed at selected places with high flood risk. The data then been uploaded to a certain database and can be seen through a website.

For example, the website from Jabatan Pengairan Dan Saliran Negeri Perak (JPS), shows the status of many rivers in Perak. The information provided by this website includes the rain level, water level and the time it is taken.

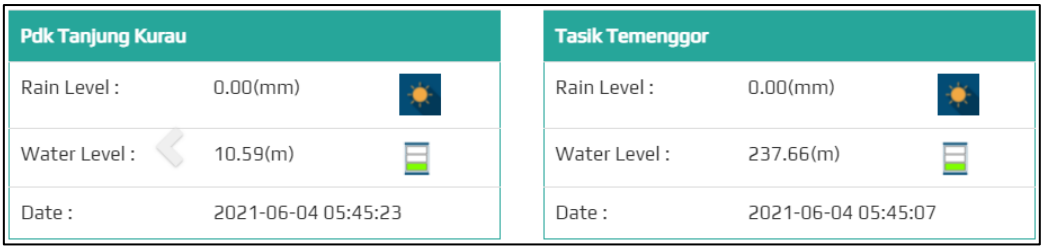

Figure 2.2 JPS website interface

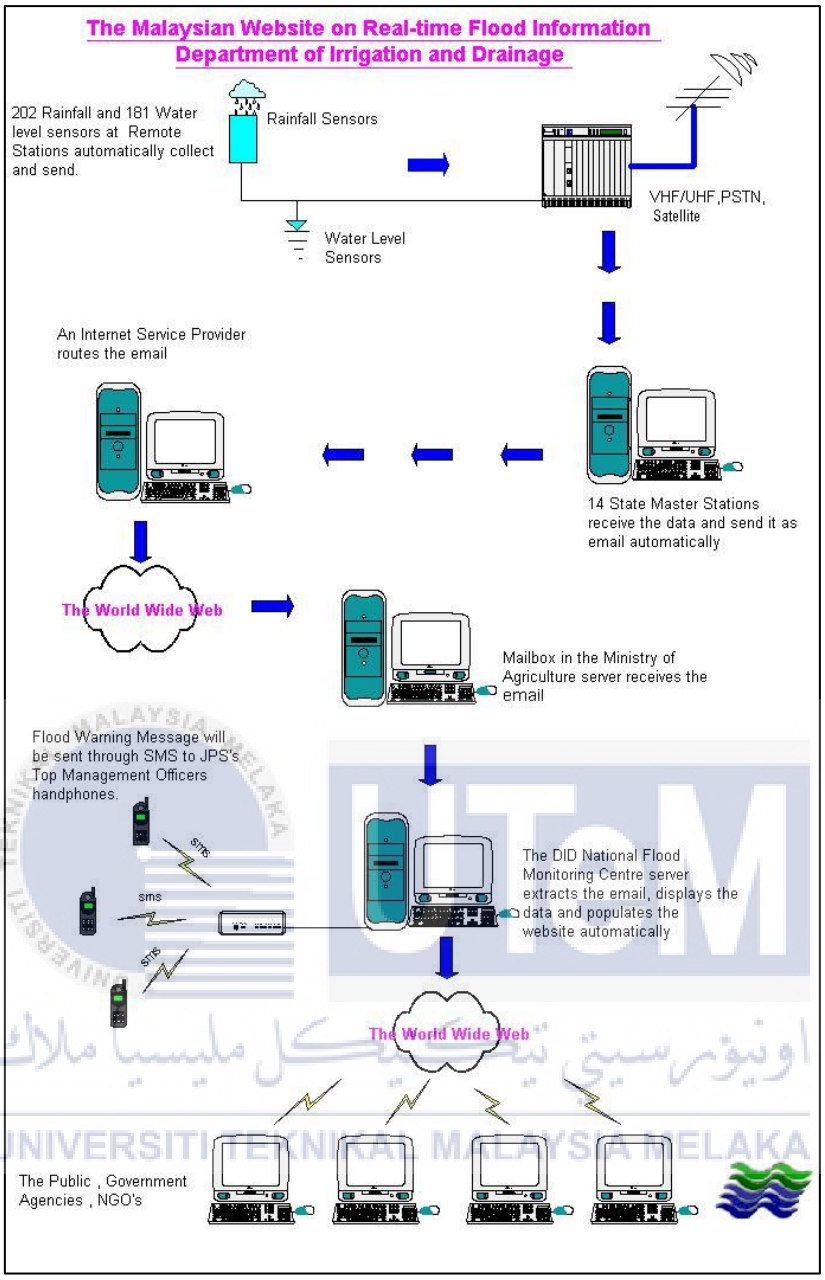

Figure 2.3 Malaysia real-time flood information system

2.3.1 Sensor

The sensor is an important component needed to monitor a flood. Many sensors can be used to monitor the water level in a river. However, some sensors are more efficient and more reliable than the other.

2.3.1.1 Ultrasonic Sensor

An ultrasonic sensor would be a cheap and reliable component to be used. An example from (G. Singh, N. Bisht, P. Bisht, and P. Singh) [2]. They employed ultrasonic sensors to measure the water level. This sensor will be used for sound ranging and navigation. It will function by transmitting a wave of short and high frequencies, which will be echoed, and the level will be assessed based on these. The distance between sensor and water level will be calculated as below.

Distance L = ½×T×C
Where L=Distance
C=Sonic speed
T=Time between transmission and reception

Figure 2.4 Distance calculation

(T. Perumal, M. N. Sulaiman, and C. Y. Leong) [3] predicted that, in the future, the ultrasonic sensor could be replaced by precise water level sensor, so that the system can perform more reliably and gives higher accuracy of water level detection reading.

2.3.1.2 Flow Rate Sensor

When water flows through the rotor, the rotor spins. The rotation speed of the rotor changes along the speed of the water flow. The output hall sensor is a pulse signal. A system developed by (Garima Singh, Nishita Bisht, Pravesh Bisht, Prajjwal Singh) [2], used a flow rate sensor to monitor a sudden change in the water flow rate. However, flow rate sensor has limitation of how much water can pass through the sensor due to its size. So, in a river, it is impossible to record the flow rate of the whole river.

2.3.1.3 Rain Sensor

Other than only detecting the water level, a system created by (Dedi Satria, Syaifuddin Yana, Elin Yusibani, Saumi Syahreza, Zulfan) [4], used a rain sensor to indicate whether it is raining or not. But it does not give any information on the intensity of the rain. Rain sensor could be useful to minimize the battery usage of the system. It helps by sensing the rain and only activates the whole system when it is raining because that is when there is a flood risk.

2.3.1.4 Water Level Sensor

A water level sensor able to detect the liquid level based on where the water touches the sensor. It works like a potentiometer because as the water rises the water contact with the exposed PCB changes the resistance. According to a research done by (P. Yellamma, C. Nagaraju, R. Anitha, A. Yeswanth, K. Karthik, and P. Surendra) [5], a water level sensor could be simply created by using exposed wires as the contact point for the water. They used three contact point with different height in the water to distinguish between low, medium and high water level. This method could be very cheap but not very reliable.

2.3.2 Data Transmission

To transmit the data from a remote sensor to another system, a transmission system is used. Many wireless technologies are available nowadays and the most common are such as Bluetooth, GSM, or Wi-Fi. Each method has their own advantages and disadvantages.