SMS BASED EARLY FLOOD WARNING SYSTEM USING RASPBERRY PI

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

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DECLARATION

I hereby declare that this project report entitled

SMS BASED EARLY FLOOD WARNING SYSTEM USING RASPBERRRY PI

Is written by me and is my own effort and that no part has plagiarized without citations.

STUDENT : _____ Date: _____

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(DR FAHMI ARIF)

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ABSTRACT

Floods are the most damaging natural disaster in this world. When it happened, it can destroy the community and killed many lives. The government would end up spending billions of dollars to recover the affected area. It is crucial to develop a flood control system as a mechanism to reduce the flood risk. Getting a quick feedback regarding the rise of the water level would help the surrounding area to take early pre-caution such as move away quickly to a safer and higher place. Thus, this project is about designing a system that can measure the speed of the rise of the water level at the potential flooded area. Waterfall model is used as the methodology in this project. The water sensor, Raspberry Pi and GSM module are the hardware used in the system. Raspberry Pi is used to collect the data from the water sensor and transmit the data to GSM Module to send the alert by using an SMS via a mobile phone. The analysis will be done to show how the Raspberry Pi will be integrated with the smartphone to give an alert. The system will be tested in order to ensure that all specifications needed have been met. A performance test will also be ran in order to see the efficiency of the system.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

According to Eleuterio (2012), floods are the most damaging natural hazard in this world. Better understanding about the flood hazard phenomenon and its potential consequences in our society is crucial for the development of flood risk reduction projects, control policies and other types of flood management strategies. According to Tomaszkiewicz (2013), since the Flood Control Act of 1927, interest in flood control has been a surge in South Louisiana. Several experts have studied over the years on ways to improve flood control, thereby reducing risk.

Nowadays, the climate is changing drastically. Natural disasters like typhoon, earthquake, flood and others are expected to occur unconsciously. Since Malaysia is located near the equator, the most severe climatic related natural disasters are monsoonal flooded. It is considered as a norm in Malaysia. It happens almost every year and causes a lot of damages, property loss, and not to mention the lives taken during the disaster. For example, in December 2006 and January 2007 where a massive flood had killed 18 people and more than 110,000 people were relocated. Furthermore, the total loss of this flood was estimated around RM1.5 billion and was considered as one of the most costly flooding ever happen in Malaysia. The worst flood in Malaysia in more than a decade had also killed 10 people and nearly 160,000 people were relocated from their homes.

The major disasters happened in the several states on the east coast side of peninsular Malaysia. The estimated cost of damages was about RM1 billion as stated in the Reuters and BBC News on December 2014.

The goal of this project is to give the society an earlier feedback to move before the water rises and also to reduce the risk of flooding via mobile phone which is sent through *Short Message Service* (SMS). This project is based on the *Raspberry Pi* where it will collect the data from the water sensor and transmit the data to GSM Module to send the alert. Based on the evaluation on April 2014 by Azilawati in the Communications and Multimedia Pocket Book of Statistic, about 30,379,000 units of mobile phones were used in Malaysia, and Malaysia was ranked in 40th place in the world as most mobile phone users with the population of 28,250,000 people. Therefore, the majority of people in Malaysia uses mobile phones and it is a good strategy to give an early warning to the society using an SMS via mobile phone because it is the most effective way to this point of view.

1.2 Problem Statements (PS)

Based on the introduction above, the problem statements found in this project are stated in Table 1.1 as shown below.

Table 1.1: Problem Statements

PS	Problem Statement
PS1	The society does not aware of the rise of the water level in the nearest river.
PS2	The society was not well informed when the water level reaches its dangerous level

1.3 Project Questions (PQ)

Project questions, PQ1 and PQ2, are found based on the problem statements, PS1 and PS2, as stated above. One project question, PQ3, is also constructed to identify PS2. The summary of the project questions is described in Table 1.2.

Table 1.2: Summary of the Project Questions

PS	PQ	Project Question
PS1	PQ1	How to measure the rate of increasing of the water level?
PS2	PQ2	Can the society get the information by utilizing the existing tools?
	PQ3	How is the performance of the early warning system?

1.4 Project Objective (PO)

There are three objectives identified for this project. They are:

PO 1: To design the system that can measure the speed of water level rise

The main objective is to design a system that can measure the speed of the rise of the water level. With this, we can know how fast is the water rising and thus, the information regarding this can be sent quickly to the nearest authorized station which is responsible to alert and inform the surrounding people.

PO 2: To develop the system that can alert or send information regarding the water level hazard to society

This is also important where the society can also receive the first hand information on the current situation of the water level in their area. By using an SMS based early warning system, it will spread the information regarding the water level hazard to society effectively through a mobile phone.

PO 3: To evaluate the performance of the proposed system.

After designing the system, it must be tested in order to ensure that all specifications needed have been met. Performance test must also be ran in order to see the efficiency of the system. Table 1.3 summarizes the objective that can be achieved at the end of this project.

Table 1.3: Summary of the Project Objectives

PS	PQ	PO	Project Objective
PS1	PQ1	PO1	To design the system that can measure the speed of the rise of the water level
PS2	PQ2	PO2	To develop the system that can spread the information efficiently regarding the water level hazard to society
	PQ3	PO3	To evaluate the performance of the proposed system

1.5 Project Scope

1.5.1 Components used

Figure 1.1: Water Sensor Model SEN113104

- The input data for the system are collected from this water sensor by triggering the water rise. The system needs at least two sensors to collect the data where each of them will be placed at a certain height to calculate the time of the water rise from the first to the second water sensor. With this, the user can know the

time of water rise and prepare for the worst case which is the flood and also this can also help to reduce the flood risk where people can move before the flood getting worst. Figure 1.1 shows the water sensor that will be used to develop the system.

Figure 1.2: Raspberry Pi Model B+

- Raspberry Pi (Figure 1.2) will be used to do a calculation process of prediction time taken by the water to reach the next level of the water sensor and also the speed of the water rise. A report will be generated at the end of the process and will be sent as an alert via SMS to users to tell them about the current situation.

Figure 1.3: Huawei mobile broadband E173

- Once the report has been generated, it will be delivered via SMS to the end user over the GSM network. The SIM card used will be justified and thus, will alert the authorized people and society regarding the water rising. It can also post a status on the Facebook page or tweet on the Twitter to inform other people about the current situation happened in that area. Figure 1.3 is one of the examples of the mobile broadband used in the system. There are others of the Huawei modem that can support with Raspberry Pi but not all of it can integrate with it.

1.5.2 Testing Environment

This project will test the rises of the water where the water sensor will be placed in a box or basin and placed on the river. The top of the box or basin is covered so that the water sensor will not be triggered by the rain water. When the water rises and reaches to the first sensor, automatically, the sensor will send an alert message to the authorized user or the head of the society to inform about the water level of the nearby area. Later, when the water reaches to the second sensor which is placed at a much higher level than the first sensor, another alert message will be sent to inform that the water is now reaching to a dangerous level. This project does not test in a real environment, instead, it will just be tested in a controlled environment.

1.6 Project Contribution (PC)

This project will benefit the society who lives in a flooded-risk area. It will increase the awareness of those people of what is expected to happen during a heavy rain so that some precaution measures can be taken. It can also give an early warning about the flood so that the people can quickly move to a safer place within the time frame and thus, will reduce the loss of life and belongings. Table 1.4 summarizes the project contributions.

Table 1.4: Summary of Project Contributions

PS	PQ	PO	PC	Project Contribution
PS1	PQ1	PO1	PC1	Increase awareness to the society which live in the flooded-risk area
PS2	PQ2 PQ3	PO2	PC2	Give an early message regarding the flood so that they can quickly move to a safer place

1.7 Thesis Organization

Chapter 1: Introduction

This chapter discusses about the introduction of the project and the project background. It outlines the problem statements, project questions, project objectives, project scopes, project contributions and the thesis organization of this project.

Chapter 2: Literature Review

This chapter discusses about the literature review of the project. It describes the related work or previous work, critical review of the current problems and justifications, and also the proposed solution or further project of this project.

Chapter 3: Project Methodology

This chapter discusses the project methodology and how it would be carried out. It describes each stage of the selected methodology and explains the action plan for the end of the project in Project Milestones.

Chapter 4: Analysis and Design

This chapter discusses the Problem Analysis, Requirement Analysis, Requirement analysis (Data Requirement, Functional Requirement, Non Functional Requirement and Others Requirement), High- Level Design (System Architecture, User Interface Design and Database design) and the Detailed Design (Software and Physical Database Design).

Chapter 5: Implementation

This chapter discusses the activity involved in the implementation phase. It deliberates the Software Development Environment setup, Software Configuration Management (Configuration Environment Setup and Version Control Procedure) and the Implementation Status.

Chapter 6: Testing

This chapter discusses about the testing phase and what is the testing strategy to be adopted in this project. There are also Test Plan (Test Organization, Test Environment and Test Schedule), Test Strategy (Classes of tests) and Test Design (Test Description, Test Data and Test Results and Analysis).

Chapter 7: Project Conclusion

This chapter concludes the project summarization, project contributions, project limitation and the future works of this project.

1.8 Conclusion

Finally, it is hoped that a clear understanding is gotten about what the project is going to happen. The analysis will show how the Raspberry Pi will be integrated with the mobile phone to give an alert. In the next chapter, the literature review will be discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, we will discuss about the literature review related to this project. We will look at some studies that have been made in the previous or related work, its methodology, and the critical review of current problems as well as the proposed solution for further studies of this project.

2.2 Flood

A flood is a land which is usually dry being submerged by an outpouring of water. An overflow of water from water bodies is what occurs in flooding, such as it may happen due to a collection of rainwater on saturated soil in an area flood or a lake or river, resulting in some of that water overflowing its usual limits. Alongside with the size of other body of water or a lake will differ with every seasonal change in rainfall and snow melt, these alterations in size are impossible to be considered significant unless they drown livestock or flood property.

With the meanders or bends in the waterway, floods can also occur in rivers when the flow rate is more than the volume of the river channel. The natural flood plains of rivers are the basis of flood which often damage to businesses and home if they are in it. People have traditionally worked and lived by the rivers because rivers provide easy travel and access to industry and commerce and also the land there is usually abundant and flat.

There are floods that develop gradually, while there are others, such as flash floods that can develop without visible marks of rain in just a few minutes. Moreover, floods can be confined, effecting a community, society or neighborhood, or the entire river basins.

This is why the flood detection system is vital and needed to reduce the risk related to the floods. The system is supposed to detect the overflow of the water and at once, give an early caution to the community, society or neighborhood about the floods. With that, people can be well prepared and move away faster to a safer or higher place.

2.3 Raspberry Pi

The Raspberry Pi is a series of credit card-sized single-board computers developed in the UK by the Raspberry Pi Foundation with the purpose of supporting the learning and teaching of the basic computer science in schools.

The Raspberry Pi was originated based on the Broadcom BCM2835 system on a chip (SoC), which include a VideoCore IV GPU, ARM1176JZF-S 700 MHz processor, and was initially shipped with 256 megabytes of RAM, later upgraded (models B and B+) to 512 MB. The system has a Secure Digital (SD) (models A and B) or MicroSD (models A+ and B+) sockets for persistent storage and boot media.

In 2014, the Raspberry Pi Foundation presented the Compute Module, which packages an eMMC flash chip and a BCM2835 with 512 MB RAM into a module to use as a part of embedded systems.

The Foundation provides Debian and Arch Linux ARM distributions for downloading. Tools are available for Python as the main programming language, with support for BBC BASIC (via the Brandy Basic clone for Linux or the RISC OS image), Java, C++, Perl, C and Ruby. Specifications of Raspberry Pi Model B+ were shown in Table 2.1 below.

Table 2.1: Specifications of Raspberry Pi Model B+

Raspberry Pi	Model B+
Target Price	US$25 (RM90)
System On a Chip	Broadcom BCM2835 (CPU, GPU, DSP, SDRAM, one USB port)
CPU	700 MHz single-core ARM1176JZF-S
GPU	Broadcom VideoCore IV@250 MHz OpenGL ES 2.0 (24 GFLOPS) MPEG-2 and VC-1 (with license), 1080p30 H.264/MPEG-4 AVC high-profile decoder and encoder
Memory	512 MB (shared with GPU)
USB 2.0 ports	4 (via the on-board 5-port USB hub)
Video input	15-pin MIPI camera interface (CSI) connector, used with the Raspberry Pi camera or Raspberry Pi NoIR camera
Power Source	5 V via Micro USB or GPIO header
Size	85.60 mm x 56.5 mm (3.370 in x 2.224 in) – not including protruding connectors
Weight	45 g (1.6 oz)

The water sensor that is being used to sense the water level is water sensor Model SEN113104. The water sensor module is part of the Grove system. It indicates

whether the sensor is dry, damp or completely immersed in water by measuring conductivity. The sensor traces have a weak pull-up resistor of 1 MΩ. The resistor will pull the sensor trace value, high until a drop of water shorts the sensor traces to the grounded trace. Believe it or not, this circuit will work with the digital I/O pins of the Arduino or it can be used with the analog pins to detect the amount of water induced contact between the ground and the sensor traces. Some of the features of it are grove compatible interface, low power consumption, 2.0cm x 2.0cm Grove module and high sensitivity. The application ideas of this sensor are rainfall detecting, liquid leakage and tank overflow detector. Table 2.2 shows the specifications of this water sensor:

Table 2.2: Specifications of Water Sensor

Item	Min	Typical	Max	Unit
Working Voltage	4.75	5.0	5.25	V
Current		<20		mA
Working Temperature	10	-	30	℃
Working Humidity (without condensation)	10	-	90	%

The GSM Module used is Huawei mobile broadband E173. This USB modem is by far compatible and better to use for this project. Also, in terms of the costs, it is much cheaper than using other types of GSM Module for Raspberry Pi. It is a compact, plug & play devices with MicroSD slot and SIM card. The specifications of the Huewei mobile Broadband were shown in Table 2.3 below.

Table 2.3: Specifications of Huawei mobile broadband E173

Specification	
Model	E173
Color	White, Black
Form	USB Stick
Communication System	UMTS/HSUPAGSM/GPRS/EDGE