



Faculty of Engineering

**SOLAR-POWERED FLOOD DETECTION SYSTEM USING
ARDUINO UNO**

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Bachelor of Engineering (Hons) in Electronics
(Telecommunication)

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Final Year Project Report

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**SOLAR-POWERED FLOOD DETECTION SYSTEM USING
ARDUINO UNO**

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This project is submitted in partial fulfillment
of the requirement for the degree of
Bachelor of Engineering with Honours in Electronics
(Telecommunication)

FACULTY OF ENGINEERING
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2016/2017

Dedicated to all my beloved family, supervisor and friends

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ABSTRACT

Floods always occur unexpectedly and unpredictable. As today's technologies is grow up, it helps everyday life of people becomes easier. This Flood Detector Warning System technology helps to monitor and give warning to people for facing the floods. By using one of the newest microcontroller technologies which is Arduino Uno R3, this system can be developed. Combining hardware and software, this system needed some programming part for interfacing. The water sensors are used to send the signal to microcontroller board for signal analysing into output. Applying the concept of wireless connection for communication, nRF24L01 + 2.4GHz wireless modem are used. Users can monitor flood far from the monitored area by displaying the output of water level on LCD (Liquid Crystal Display) and computer monitoring. This system is stable as it has a wireless transmitter and also can be connected by wire to the display. Building with presence of solar energy as backup power source, the energy for this system can be long lasting and more reliable compared to the conventional flood detection system. Other than that, this system is able to give warning to the user by producing alert system.

ABSTRAK

Banjir berlaku tanpa diduga dan tidak dapat diramal. Sejurus perkembangan teknologi pada masa kini, ia dapat membantu kehidupan seharian orang ramai menjadi lebih mudah. Teknologi Pengesanan Banjir Dengan Sistem Amaran ini dibina untuk membantu memantau dan memberi amaran kepada orang ramai untuk menghadapi banjir. Dengan menggunakan salah satu teknologi mikropengawal terbaru iaitu *Arduino Uno R3*, sistem ini boleh dibentuk. Dengan menggabungkan perkakasan dan perisian, sistem ini memerlukan pengaturcaraan untuk digabungkan. Pengesanan ketinggian paras air digunakan untuk menghantar isyarat kepada pengawal mikro untuk dianalisis sebagai data pengeluaran. Mengaplikasikan konsep sambungan tanpa wayar untuk komunikasi, *nRF24L01+ 2.4GHz* modem tanpa wayar digunakan. Pengguna boleh memantau banjir dari jarak yang jauh dengan kawasan yang dipantau dengan memaparkan data untuk paras air pada *LCD (Liquid Crystal Display)* dan pemantauan komputer. Sistem ini stabil kerana ia mempunyai pemancar tanpa wayar dan juga boleh disambungkan dengan wayar untuk paparan. Dibangunkan dengan kehadiran tenaga solar sebagai sumber kuasa sandaran, tenaga untuk sistem ini boleh menjadi tahan lama dan lebih dipercayai berbanding dengan sistem pengesanan banjir konvensional. Selain daripada itu, sistem ini dapat memberi amaran kepada pengguna dengan menghasilkan sistem amaran.

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LIST OF ABBREVIATIONS

Term	Meaning
GUI	Graphical User Interface
GSM	Global System for Mobile Communication
SMS	Short Message Service
IDE	Integrated Development Environment
LED	Light Emitting Diode
Tx	Transmit
Rx	Receive
LCD	Liquid Crystal Display
RF	Radio Frequency

CHAPTER 1

INTRODUCTION

1.1 Introduction

Flood is one of the most devastating natural disasters that are often experienced in Malaysia. Flood can be defined as the overflow of water from the water bodies such as river and lake that causes or threaten damage. According to one of the expert Abhas Jha [1], flood is the most common natural disasters and it increasingly Asian phenomenon. Based on his research show that seven of the most destructive floods of the past 30 years occurred in Asia and 90% of those killed and affected by floods lived in Asia [2].

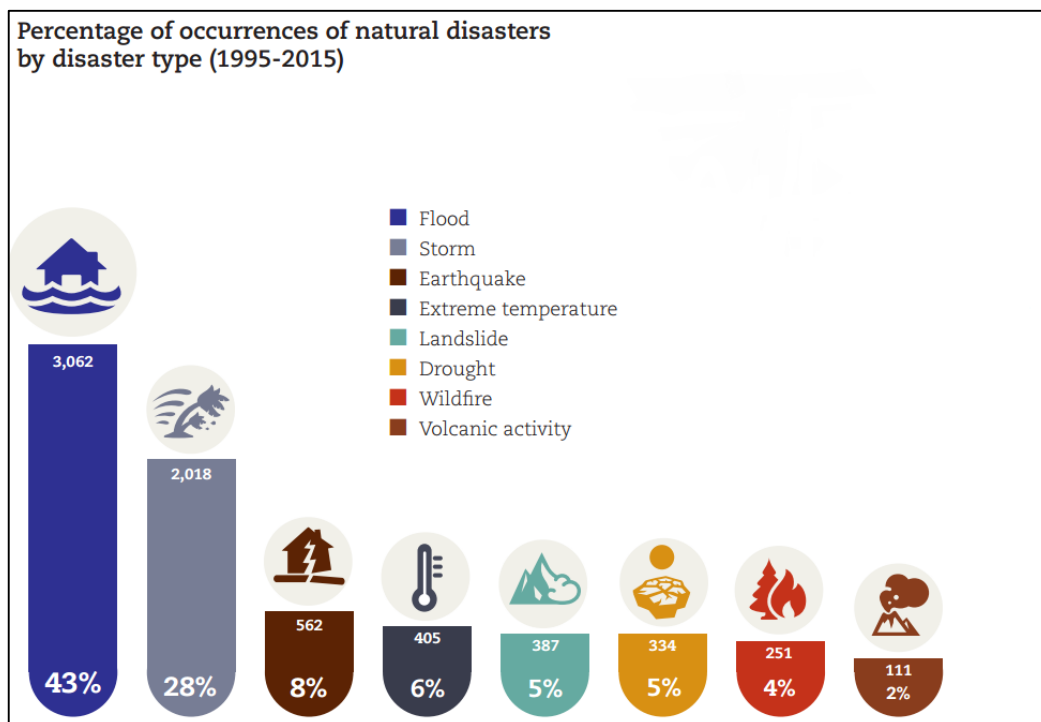


Figure 1.1: Percentage of Occurrences of Natural Disasters by Disaster Type (1995-2015) [18]

The graph shows in Figure 1.1 shows the percentage of the most natural disasters occurred in the world. This graph is in joint with the report from United Nations Office for Disasters Risk Reduction, the Centre for research on Epidemiology of Disasters that has been recorded 3062 natural disasters in between 1995 to 2015 [18]. The graph highlights the most frequently natural disaster occurred is flood. In this report also, the argument for the better flood detector is needed to reduce the risk of the disasters.

Since Malaysia is one of the Asia countries that located near the equator, Malaysia's climate is hot and humid throughout the year. Malaysia will undergo an extreme rainfall which the water level will lead to flood. Based on statistic by the National Disaster Management Agency Malaysia, starting from January 2011 to October 2016, the most disaster type occur in Malaysia is flood. These occur in all states around the country.

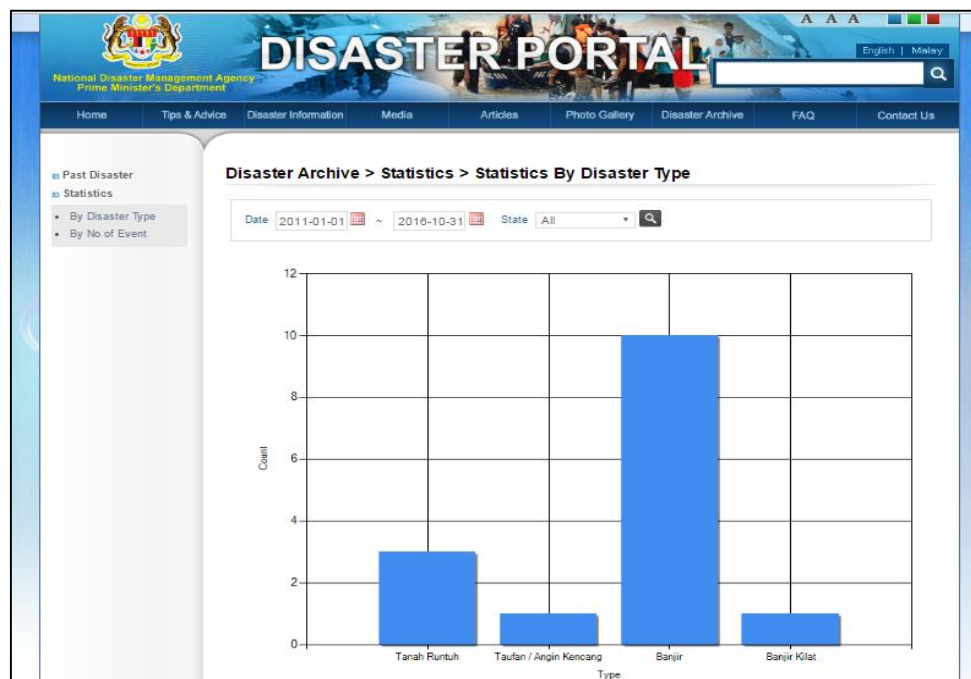


Figure 1.2: Static by Disaster Type in Malaysia [3]

Graph in Figure 1.2 shows the statistic of the disaster types in Malaysia. A warning and monitoring system are needed as early precautions so that the number of those killed affected by flood can be decreased. Besides, it also acts as innovation that helps to protect an area from the flood.

In this project, a flood detector with monitoring system is built. The flood detector system built to sense the water level at different type of level. This system will be located at a strategic place with a suitable unit like a pole. The system also built with monitoring system that tells us the water level at the area. This gives the early measurement of water to public without need to go to the near areas that have a high probability affected by flood. Besides monitoring and detector system, a warning system will be built together that able to inform citizens around the area.

1.2 Problem Statement

Flooding is one of the natural disasters which are happen unpredictable. Floods usually occur due to excess water that comes from the continuous heavy rainfall and other local factors. As we know, Malaysia is one of the countries located on the equator which related with the changes of climate every year. The changes of climate cause the extreme rainfall which may be followed by a series of natural disasters like flash flood. Floods have been commonly known to do with some significant damage such as destroy home and property, destruction of crops and loss of livestock. Animals and human need to wait for the rescue when get caught in the flowing water.

The existing detector only used to monitor the water level at some places. But, with this existence of flood detector and warning system, besides monitoring and getting the data, it will give early warning to people faster and they can get ready to save their belongings and family before the flood come more dangerous. Thus, it will help to reduce the risk of having the problems stated above.

1.3 Project Objectives

There are some objectives that have to be achieved in this project and the objectives will act as a guideline in order to finish this project successfully.

- i. To design a system which can reduce the impact and cost of the flood damage by providing warning, monitoring and detect of local flooding for people.
- ii. To build a prototype system of flood detector using hardware and software provided.
- iii. To understand the Arduino Uno applications and the basic concept of communication system.

1.4 Project Scope

The project will be followed several scopes to create the limitation and specification for this project. It is mainly to build a hardware and software for flood detector, monitor and warning system. Microcontroller based on Arduino Uno R3 will be used in this project. This flood detector will be working on wireless system by using radio frequency. The project will use two boards of Arduino which acts as transmitter and receiver. For transmitter, the water level sensor and flood detector circuit will be attached to the Arduino board. Meanwhile, for receiver, computer and LCD that will be installed will shows the output from the transmitter part. All hardware that used in this project will be programmed by using Arduino IDE software. Besides, the solar power system will be install in this project for the power source and backup energy.

1.5 Project Outlines

This thesis will consist of five chapters that include all the details about this project.

Chapter 1 will explain all about the factors and effects of flood occur in Malaysia, briefly introduction to flood detector system, problem statement for this project, the objectives and scope project.

Chapter 2 consists of the overview of the flood detector project. It included the design of the flood detector and how the system will be functions.

Chapter 3 will discuss on the methods used to design this flood detector system from the early stage. It also shows the design of the solar system as an alternative power source for this detector. Besides, it includes the way to troubleshoot the circuits and systems involved.

Chapter 4 will show the result from the project development. The output from the implementations of the Arduino Uno R3 based on the microcontroller ATmega328P will be explained and discussed. Besides, the problem faced during the period of project development also will be discussed with solutions.

Chapter 5 will give the conclusion and recommendations on the project and summarization of the whole project.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of Flood Detector System

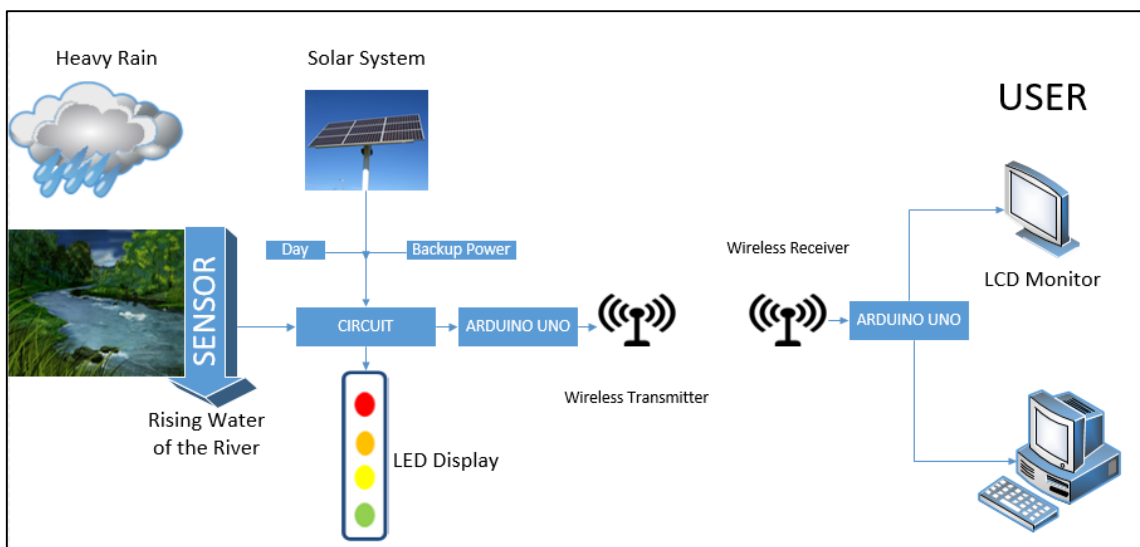


Figure 2.1: Overview of Flood Detector System using Arduino Uno

Figure 2.1 shows that how this system will work at some places like a river. This detector system will combine both hardware and software and every part of it has their own function. The water level of the river will be measured by the sensor places near to it. Arduino water level sensor will be used to measure different type of water level. The signal from the sensor will be sent to the Arduino Uno and four different colour type of LEDs will shows the measurement of water levels. The solar power system is provided as a backup power supply. This backup energy will be needed by the system so that it never running out of energy and working properly. By using two boards of Arduino, this system will work on wireless which required transmitter and receiver part. Besides displaying the water level on the LED's light, Arduino microcontroller also sent the signal through the computer and LCD.

Computer and LCD will show the output from the transmitter signals. These make the monitoring part became more easily and the process to display the water level needed some programming parts.

Other than that, a warning system also will be installed in this project. An alarm will be on when the water reaches the dangerous level. The warning gives the early information to people so that they can get ready early.

2.2 Water Level

Water level is depending on height that can be reached by the water in a reservoir or a water tank. It can be classified from low to high water level depending on the suitable range. It is important for knowing every level of water to prevent a safety problem that caused by the flooding event. The rising of water level increasing the chance of bad flooding event that can created huge problems. Developing a water level system that can monitor and give warning on every stage are important to allow early precautions taken and ensured the safety.

2.3 Hardware

In this project, the hardware is needed to ensure that the unit (prototype) is successfully built and working accurately.

2.3.1 Arduino Uno R3 Microcontroller ATmega328P

Arduino Uno is one of the microcontroller board technologies and an open source platform to create interactive computerized device. It builds with microcontroller that can interface to various types of circuits and expansion boards. This type of board was widely used by community as a brain of thousands of interesting projects. There are many other microcontroller platforms available for computing physical device [4]. Same with Arduino Uno, it most simple platform and it comes in complete package. Besides it ready to use, Arduino also flexible and inexpensive.

In this project, Arduino board based on ATmega 328P microcontroller is used. Building with 14 digital input/output pins (6 can be used as PWM outputs), 6 analog inputs and several power pins, it used to write and uploads computer code to the physical board.

The diagram in Figure 2.2 shows the Arduino Uno board based on the ATmega328p microcontroller. It contains everything needed to support the microcontroller; 16 MHz ceramic resonator, USB connection, power jack, an ICSP header and reset button. It simply connects to computer with a USB cable or powers it with an AC-to-DC adapter or battery to use it [5].

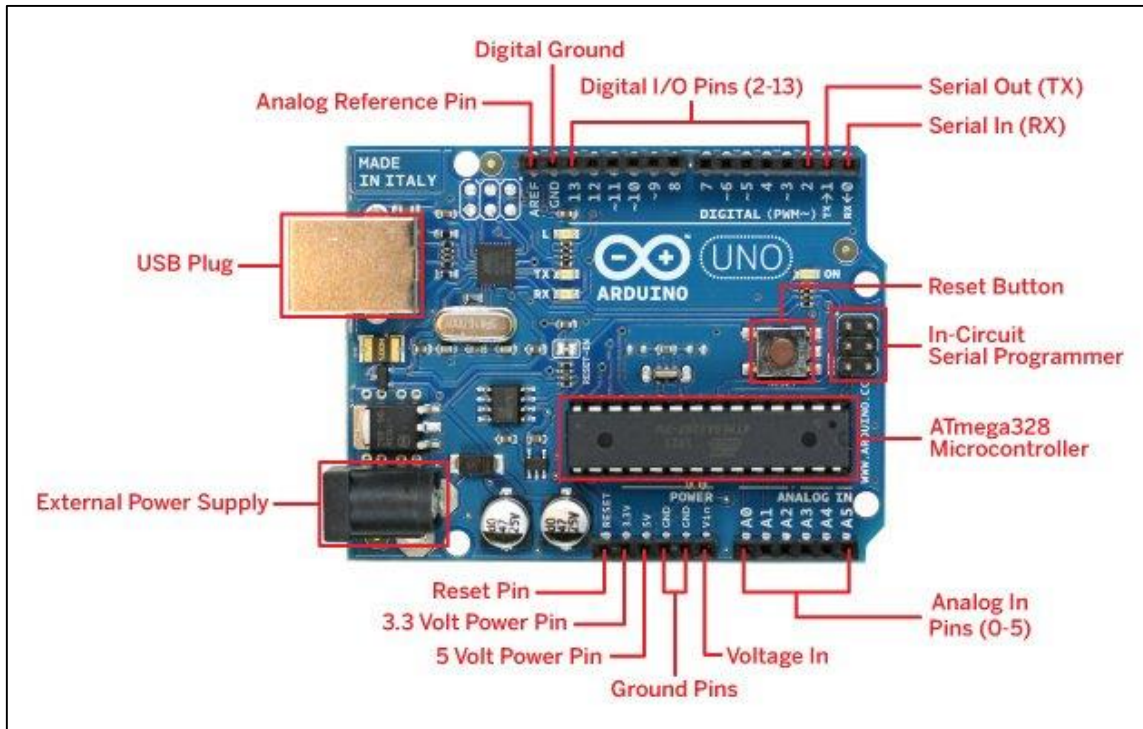


Figure 2.2: Arduino Uno R3 Board [5]

The pins out details for the microcontroller is shows in the diagram of Figure 2.3 which including chip pin numbers.