FLOOD DETECTION SYSTEM

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ABSTRACT

Floods will cause many problems and pressures on individuals or communities involved. Now the flood can happen anywhere. Not only in rural areas near the river, but it can also happen in the big cities there are many facilities and systematic management. Although there are methods to predict the weather, but it is not easy to determine whether flooding will occur or not. Therefore, early action should be established to obtain any information to reduce the risk of property damage and loss of life. Hence, a flood detector system has been developed to assist in providing early warning to consumers about the possibility of flooding. The system is designed for use by owners of residential houses, offices or factories. The system works on two occasions, the first warning will be sent to the homeowners through the short messaging system (SMS) when there is overflow from the drains in the home caused by rising water levels. The next function is these systems will cut off the flow of voltage to the Miniature Circuit Breaker (MCB), when the flood water level reached the height of light switches / fans or socket outlet. The aim is to avoid an electric shock to the people and prevent damage to the electrical equipments.

ABSTRAK

Bencana banjir akan menimbulkan pelbagai masalah serta tekanan kepada individu atau masyarakat yang terlibat. Kini banjir boleh terjadi dimana-mana sahaja. Tidak hanya di kawasan luar bandar yang berhampiran dengan sungai, tetapi ianya juga boleh berlaku di bandar-bandar besar yang terdapat pelbagai kemudahan dan pengurusan yang sistematik. Walaupun terdapat kaedah dalam meramal keadaan cuaca tetapi tidaklah mudah untuk menentukan samada banjir akan berlaku atau tidak. Oleh itu, tindakan awal perlu diwujudkan dalam mendapatkan sebarang maklumat bagi mengurangi risiko kerosakan harta benda dan kehilangan nyawa. Justeru itu sebuah sistem pengesan banjir telah dibina untuk membantu dalam memberi amaran awal kepada pengguna mengenai kemungkinan berlakunya banjir. Sistem ini direka untuk digunapakai oleh pemilik rumah-rumah kediaman, pejabat atau kilang. Sistem berfungsi pada dua keadaan, pertama amaran awal akan dihantar kepada pemilik rumah melalui sistem pesanan ringkas (SMS) apabila terdapat limpahan air dari parit ataupun longkang di kawasan rumah yang disebabkan oleh paras air yang meningkat. Fungsi yang seterusnya ialah, sistem ini akan memutuskan aliran voltan ke Miniture Circuit Breaker (MCB) apabila paras air banjir mencapai ketinggian suis lampu / kipas atau soket aliran keluar. Tujuannya ialah untuk mengelak berlakunya renjatan elektrik kepada manusia serta mengelak kerosakan yang teruk pada perkakasan elektrik.

TABLE OF CONTENTS

List of Table

List of Figures

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In Malaysia, the risk of human exposure to dangerous flash flooding, particularly in large urban areas with dense population distribution and the high rate of construction has increased significantly in recent years. This is evidenced by the incidents of serious flash flooding in major cities around the country like Kuala Lumpur, Georgetown, Ipoh, Kota Bharu and others.

Usually, the main reason that flash flooding is fast runoff due to changes in land use (from the surface of the forest to the surface concrete, cement and asphalt), river channels and drains are blocked, decreasing the ability of the river through the deposition of silt and rain convective storms, such as a heavy rain storm. Typically, flash floods occur rapidly (i.e. several minutes to half an hour after the rain event), but also ended quickly (i.e. term life is the half-hour today).

'Flood Hazard' is a phenomenon or event that gives rise to a threat or danger to humans. Flooding is a hazard when it comes to human society, particularly the floods that occurred intensely populated areas that are potentially result in loss of lives and destruction of property.

Flood danger could turn into bad that considered 'floods', when the impact caused massive destruction and / or significant loss of human life. In a flood, almost the entire human community is victimized. Support systems in these communities are also affected and the adjustment mechanism is also destroyed. Typically, the loss of life is high [6].

The question arises, especially from policy-makers and communities; what can be done to at least reduce the negative impact of floods? The answer to this question would be to implement effective and efficient flood-plain management in order to ensure sustainable development. A flood-plain management plan must be comprehensive and must provide an effective framework for the long-term planning in the compilation of development plan. So, the flood detected system is build to resolve the existing problems that occur from floods.

Flood detection system is the system is used to detect the rising water level in the resident area. When the water rises, circuit will send signal to the system. The system will inform the rising of water level to the users using short messaging service (SMS). The system also prevents short circuits which can cause fire or electric shock to the residents who were move concerned saving their property and important documents from damage due to flooding. The main purpose of flood detection system is to avert or minimize loss of life. We expanded this vision and defined the purpose of the flood detection system as a means of establishing public safety, to reduce damage to property and to relieve public anxiety.

For the research purpose, we just made a prototype that we did in basin by changing it as a resident area. After that we add a water to show the water rises till the level that will contribute a signal to the circuits. The prototype will show how the system works from begin to the end.

1.2 Problem Statement

Malaysia has a hot equatorial climate regime and humid throughout the year. The main feature of the climate is heavy annual rainfall of more than 1,500mm to 3,500mm. More importantly, the occurrence of periods of continuous heavy rains, usually for a few days with the intensity of the rain is heavy. For example, the total rainfall of 610mm in 24 hours is a convention.

In general, convective rain storms during the monsoon transition seasons in the months of April and October is coincident with the occurrence of flash floods. However, flash floods often occur on the east coast during the northeast monsoon. On the west coast of the peninsula, as well as flash flood occurred at the southwesterly monsoon northern states of Kedah and Perlis.

During the southwest monsoon season, south west wind that followed the incident 'a storm in line' (line squalls) known as 'Wind Sumatra' also brought heavy rainfall along the west coast of the peninsula, especially along the coast of Penang, Kedah, and Perlis. At that time, flash floods often occur [6].

In Malaysia, disaster situation is managed manually through a multi-organizational team according to the standard operation procedure for disaster management by the Prime Ministry Department. It has two departments: Department of Irrigation and Drainage (DID) and the District Office (DO). DID is responsible for monitoring water level and informing DO when the water level is dangerous and DO is responsible for setting up the emergency operation center (EOC) and informing the public. There is no automated communication between these two departments.

Pre flood monitoring is manually managed by DID and this might create a certain amount of risk. Furthermore, in current situation there is a delay in informing and notifying DO that water level is dangerous and possible flood because the current communication between DO and DID is done manually. Citizen will only be informed by DO about possible flooding and this will again add delays in getting ready for evacuation [10].

Flash floods have also become increasingly frequent in recent years and to increase the risk, and exposure to humans or human vulnerability to flooding. In Malaysia, the mortality caused by flash floods is not as big as experienced by Bangladesh; hundreds of thousands of lives are often sacrificed. However, damage to property, destruction of infrastructure, loss of business and loss of life is significant [6].

For examples, floods occurred in Taman Tun Dr Ismail Shah on 26 February 2006. Estimate number of house flooded is 1842 units. Average damage / house within 15,000. Total damage within RM 27 Million. Estimate no of car submerged is 2800 units. Average damage / car within RM 5000. Total damage within RM 14 Million [2].

Figure 1.0: Flood occurred at Taman Tun Dr. Ismail Shah Alam

1.3 Objective

1.3.1 To provide early warning to the occupants of the house through the buzzer and short messaging service (SMS)

1.3.2 To develop a system to detect the increase in water levels flood due to and cut off sources of electricity in the house.

1.4 Significance of Study

This research will reveal new solutions to control the flood emergency management. Flood detection system designed to provide early warning that the floods will come and save the lives of humans and animals by closing input supply at the miniature circuit breaker (MCB-inside distribution box).

1.5 Limitations of Study

This research will be made only to a single storey houses and the usage of electric current is very minimal. Water level sensor was placed in three stages. The first stage, 30mm of the lowest floor level, the second stage, and 250mm from the lowest floor level before the three-pin plug, and the third stage, 1450mm from the floor of the lowest level before switching the lights and fans.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Flood Detection System is a prototype model used to detect the rising water level. Many materials needed to be implemented in this prototype. Referring to the existing product that is almost similar to this prototype; we will use GSM modem, PIC16F876A, RS-232, RF module, Short Message Services (SMS), Miniature Circuit Breaker (MCB), Residual Current Device (RCD), or Residual Current Circuit Breaker (RCCB) and sensor to develop a Flood Detection System. It is very important to have references during the development of this prototype. This section will also discuss on several related papers to this study. Also focus on application.

2.2 Flood Barrier System

Self Closing Flood Barrier, a unique effective flood defence system to protect people and property from inland waterway floods caused by heavy rainfall, gales or rapid melting snow. Its automatic instant reaction to upcoming floods has proven to provide optimal protection against high water levels. This absolutely unique Flood Barrier System has been developed to provide optimal protection against extreme high water levels in rivers and other inland waterways.

The Self Closing Flood Barrier can be built in the top of a dike or quay to protect inhabited as well as industrial or other strategically areas. The Barrier systems have already been built and installed in The Netherlands, Belgium, Ireland, UK, Vietnam, and Australia and in the U.S.A. [11]

Figure 2.0: SCFB protects an underground parking place at Boulder, Co, USA.

Figure 2.1: The Commerce Bank PENSYLVENIA US is protected by the SCFB 1250

Technical description [11]

The standard Self Closing Flood Barrier (SCFB) consists of a prefab steel or concrete basin and a polyester floating wall. Its height depends on each typical site, where it needs to be deployed. Standard protection heights are 500 mms, 1,000 mms, 1,500 mms 2,000 mms and the new 2,500 mms above level, with alternative heights on request.

The steel elements are prefab fabricated and measure 1,000 – 6,000 mms. The elements are protected by a two-compound coating (Redox EP Ferroflake) and a Cathodic Protection (PC). The side plates are welded on the soul plate and find their balance and support from support plates at the outside. The width of the soul plate prevents the basin form floating up in subsoil water. The concrete basin is prefab made or can either be built on the job site in a mould.

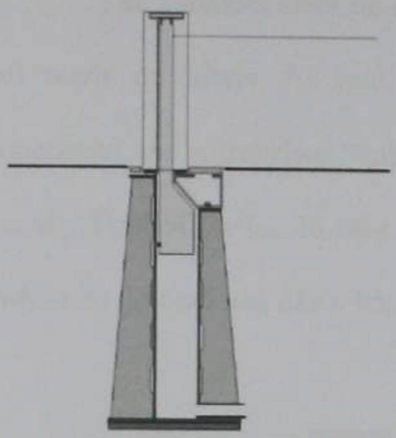


Figure 2.2: SCFB with a steel element

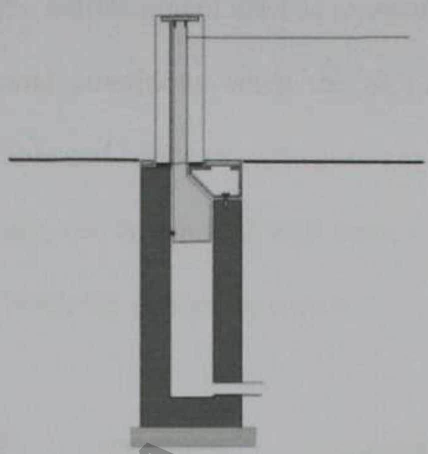


Figure 2.3: SCFB with a concrete element

The wall itself is prefab polyester made, with a thickness of 120 – 200 mms. It is laminated in a climate controlled hall with permanent humidity and temperature control to guarantee a consistent lamination process. In the order to minimize collision damage by flotsam, endangered areas in the floating wall are protected by Kevlar with impact strength. The wall is reinforced by laminated steel strips. The wall is filled up with a PUR-foam core in a very strong sandwich construction and hence does not absorb water, while retaining its floating power.

The walls are coupled in lengths of 990 mms by means of a rubber bib. So, the Barrier is constructed as a solid body. Two rubber elements at the wall side close off the chaser in that the system operates waterproof. The strength of the wall is calculated in terms of a minimum of 10 times the sideways water pressure. By coupling 2 side plates together, it is feasible to cover any angle and corner in this system.

The stainless steel lid closes off the entrenchment area to prevent any inflow of waste or debris. As said, under normal conditions when the SCFB is not in operation, the entrenched 'wall' is not visible and hence cannot cause any obstruction to any kind of traffic. In case of emergency, the entrenched wall comes up instantly while its lid operates like a breakwater to break the upcoming waves.

Figure 2.4: SCFB 1500 with steel basin

Figure 2.5: SCFB 1000 steel basin

Technical data with steel basin [11]

Table 2.0: Specification of steel basin

Type	SCFB 500	SCFB 1000	SCFB 1500	SCFB 2000
Protection height	500 mm	1000 mm	1500 mm	2000 mm
Depth in the ground	975 mm	1530 mm	2300 mm	2630 mm
Bottom width	600 mm	750 mm	1000 mm	1200 mm
Wall thickness	120 mm	120 mm	120 mm	180 mm
Lid with	200 mm	200 mm	200 mm	280 mm
Element length (st.)	1- 12mtr	1- 12 mtr	1- 10 mtr	1-10 mtr
Total length	unlimited	unlimited	unlimited	unlimited
Closing time	1 min.	1 – 2 min.	1 - 3 min.	1 – 4 min.

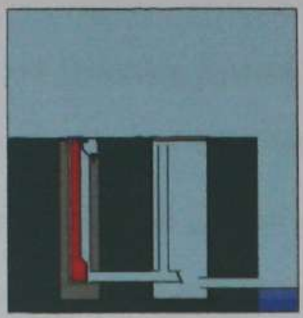
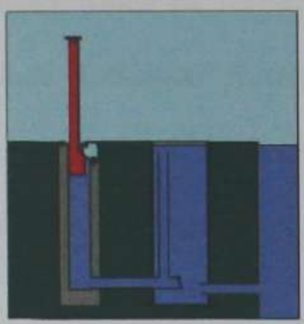
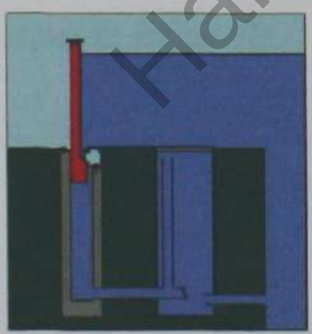
Technical data with concrete basin [11]

Table 2.1: Specification of concrete basin

Type	SCFB 500	SCFB 1000	SCFB 1500	SCFB 2000	SCFB 2500
Protection height	500 mm	1000 mm	1500 mm	2000 mm	2500 mm
Depth in the ground	1175 mm	1675 mm	2320 mm	3000 mm	3600 mm
Bottom width	620 mm	630 mm	720 mm	900 mm	1060 mm
Wall thickness	120 mm	120 mm	120 mm	180 mm	200 mm
Lid with	200 mm	200 mm	200 mm	280 mm	280 mm
Element length (st.)	2 mtr*	2 mtr *	2 mtr *	2 mtr *	2 mtr *
Total length	unlimited	unlimited	unlimited	unlimited	unlimited
Closing time	1 min.	1 – 2 min.	1 - 3 min.	1 – 4 min.	1-5 min

Each SCFB unit needs a Service Pit to control the water inlet and drain. There are two types of Pits, a standard Pit and one with a pump. Which one is needed depends on the situation where the SCFB will be installed when the surface water is not low enough a Service Pit with a pump is always required. The pumps switch on automatically once there is water in the system and prevent the system to come up if there is no need for it. Also in situations where water subsides slowly, the pump switch off once the flood is below flood level.

Working Principle [11]

SCFB	Operation
 Figure 2.6A	Once the SCFB has been installed, the floating entrenched wall consisting of polyester is practically invisible under normal water level conditions. On top, a stainless steel lid locks in the entrenchment space under same normal conditions.
 Figure 2.6B	Once the water rises to approximately 10 cm beneath the flood level, the basin of the Barrier fills up through a filling-pipe in a pit. The polyester wall rises and floats. As soon as the basin is totally filled, the closing surface will lock the Barrier waterproof.
 Figure 2.6C	Now the water can rise further without flooding the protected area. Once the water level subsides to a normal level, the basin is drained through a drain pipe with one way check valves or by means of a pump. Once the water has left the basin, the wall returns to its resting position within the basin. The lid on top of the wall then closes to prevent the inflow of waste or debris.

2.3 Westminster's unique Flood Detection System (WI Code: 10481)

Westminster's unique Flood Detection System range of leak sensors and control systems offer flexibility, reliability, value, and are easy to install and use. The Flood Detection System allows early action to be taken to prevent damage, reduce distributive and limit loss. Flood Detection Systems are installed in sensitive and critical areas to give an early warning of leakage from any source, e.g. pipes, tanks and air conditioning plants.

The systems works using lengths of water sensing detection cable or point sensors which are connected individually, or in groups, to multi-zone control panels (Flood Detection System) or to self-contained single control modules (Flood Detection Solo). Each sensor or group of sensors is allocated a separate zone with each zone having its own address.

Flood Detection zoned systems are flexible, accurate, easy to install, use and maintain and offer the best cost / benefit option for any application large or small, complex or simple. [7]

2.4 GEOREX Flood System

The geospatial data exchange (GEOREX) system for flood developed for Kelantan River basin comprised of five components, namely, C1 server, C2 server, C3 server, GEOREX Hydro, and GEOREX Flood Client. These components are schematically depicted in the Figure 2.7 have the following functions and features:

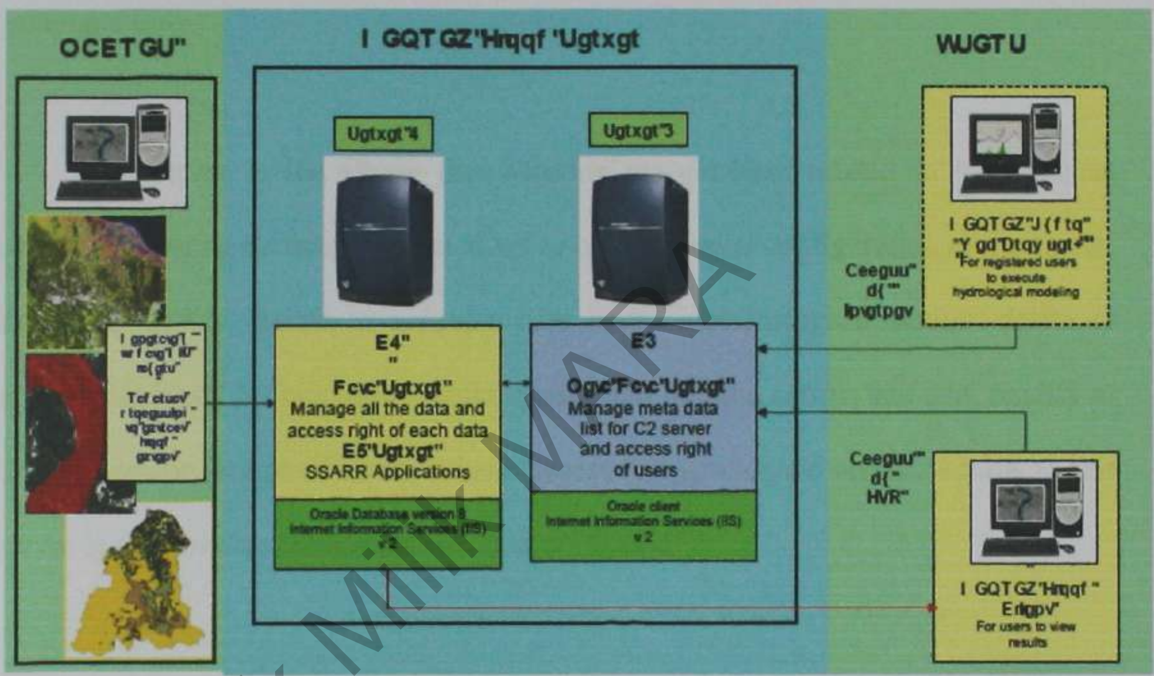


Figure 2.7: Schematic Diagram of GEOREX Flood System

C1 server is the main server that manages the meta data lists for C2 and C3 data servers and access rights of users of the system. Among its functions are to set or modify server configuration, allow viewing of data layers, historical data, location maps, make connection with one or many GEOREX data servers and to view users or group of users and their access rights to the data. Access to this server is restricted to administrative personnel only.

C2 server is a data server that manages all the data information and controls the access rights of each data. Among its functions are to set or modify server configuration, add, modify or delete names of owner, collections, themes, layers, data files, keyword, keyword categories, location maps and association of access rights to users; make connection to main server; and add, modify or delete users or groups of users to have access to data server. Access to this server is restricted to administrative personnel only.

C3 server is the server that controls the database related to hydrological modeling. Among its functions are to set or modify server configuration of the server, integrate, modify, delete or suppress new hydro meteorological station, delete or archive data used in forecasting, make connection to main server; and add, modify or delete users or groups of users to have access to hydrological server. Access to this server is restricted to administrative personnel only.

GEOREX Hydro is a module that allows users to retrieve hydrological data from C3 server, executes SSARR modeling and determines if forecast water level is at "alert", "warning' or "danger" level. It also allows users to search information stored related to a telemetry station based on user-specified date and time, input new water level or rainfall data and input forecast water level or rainfall data. Access to this module is through the Internet protocol and restricted to DID personnel authorized to carry out SSARR modeling.

GEOREX Flood Client is a module that allows end users to view or extract information from C2 and C3 servers to assist in the decision making process during flood operations. It also allows users to execute functions such as selecting location maps or hydro meteorological stations, searching for information based on date or water level and viewing of metadata such as river, road and evacuation centre's, results of water level forecast and statistical analysis. This module can be accessed by anyone with authorized access to view the information. [8]

2.5 GSM Modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main different between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves [3].

Typically, and external GSM modem is connected to a computer through a serial cable. In order to operate, a GSM modem requires a SIM card from a wireless carrier like a GSM mobile phone. A GSM modem supports a common and extended set of standard AT commands. With the extended commands, the GSM modem can be used as:

- ✓ Reading, writing, and deleting SMS messages.
- ✓ Sending SMS messages.
- ✓ Monitoring the signal strength.
- ✓ Monitoring the charging status and charge level of the battery.
- ✓ Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low, which is only about six to ten SMS messages per minute. The GSM net used by cell phones provides a low cost, long range, wireless communication channel for application that need connectivity rather than high data rates. Machinery such as industrial refrigerators and freezers, HVAC, vending machines, vehicle services and others could benefit from being connected to GSM system [3].

Figure 2.8: GSM Modem

AT commands are the instruction used to control a modem. AT is the abbreviation of attention. Every command line starts with “AT” or “at”. That’s why modem commands are called AT commands. Besides the common AT command set, GSM modems and mobile phones support an AT command set that is specific to the GSM technology, which includes SMS related commands like AT+CMGS(send SMS message), AT+CMSS (Send SMS message from storage), AT+CMGL (List SMS messages) and AT+CMGR (Read SMS messages). The first thing that is usually done is to test the communication between the PC and GSM modem to confirm that everything is working properly so far. Simply enter "AT" in the terminal program to perform the test. When the GSM modem receives "AT", the final result code "OK" will send back to indicate that the command was received successfully [14].

The following table lists the AT commands that are related to the writing and sending of SMS messages:

Table 1.2: AT Command

Command	Description
AT	Check if serial interface and GSM modem is working.
ATE0	Turn echo off, less traffic on serial line
AT+CNMI	Display of new incoming SMS.
AT+CPMS	Selection of SMS memory.
AT+CMGF	SMS string format, how they are compressed.
AT+CMGR	Read new message from a given memory location.
AT+CMGS	Send message to a given recipient.
AT+CMGD	Delete message

2.6 PIC 16F876A microcontroller

PIC16F876A-I/P microcontroller is used to control the whole system. It is designed using flash technology. So the PIC can read/write program for more than 100,000 times. The PIC 16F876A has 8 K words or program memory. Since each word in the midrange family is 14 bits long the program memory can also be expressed as 14 Kbytes. The unit has 368 bytes of data ram and 256 bytes of EEPROM. It has 8 channels of A/D with 10 bit resolution. The unit has two, eight bit Timer / Counters and a single 16 bit Timer/Counter. In addition to this it has several different types of serial communication functions such as SPI, I2C, and normal pc type serial communications functions [3].

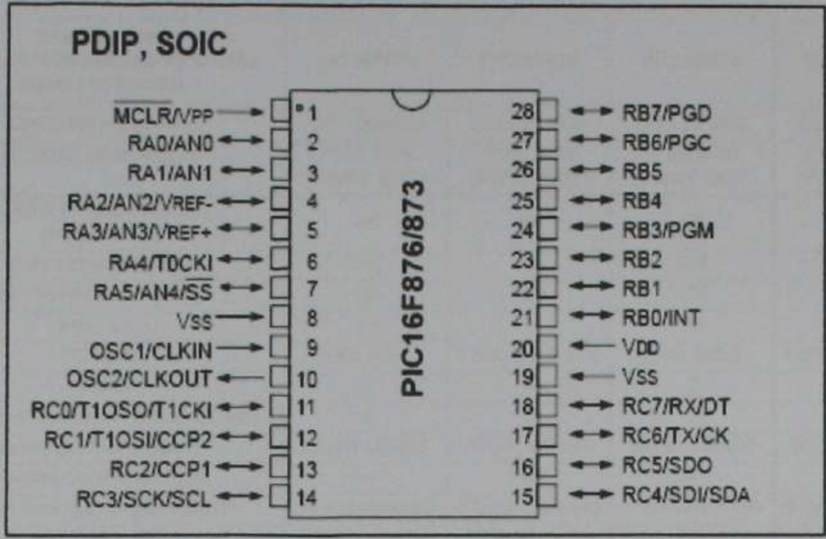


Figure 2.9: PIC Pin Out

OSC1 and OSC2 pins are connected to 20MHz crystal to execute every single program line in the system. 20MHz crystal is used because this is the maximum frequency that the PIC can support. If over frequency the PIC will burn. Else if crystal speed less than 20MHz then PIC response speed will slower. The MCLR pin of the PIC is pull up to 5V through a 10KR resistor.

The PIC can operate using 4.5V to 6.0V DC voltage. In the project is operating at 5.0V (by using 7805). The digital output of the PIC is 5V (for signal 1) and 0V (for signal 0) these signals will be directly connected to actuators for control purpose. When the PIC pin is set as digital input; it will detect input voltage 5V as signal 1 and 0V as signal 0. Any voltage less than 0V or more than 5V will damage PIC.

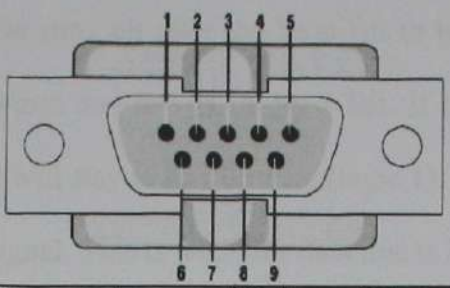
Table 2.3: PIC Manual Reference

Key Features PICmicro™ Mid-Range Reference Manual (DS33023)	PIC16F873	PIC16F874	PIC16F876	PIC16F877
Operating Frequency	DC - 20 MHz	DC - 20 MHz	DC - 20 MHz	DC - 20 MHz
RESETS (and Delays)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)
FLASH Program Memory (14-bit words)	4K	4K	8K	8K
Data Memory (bytes)	192	192	368	368
EEPROM Data Memory	128	128	256	256
Interrupts	13	14	13	14
I/O Ports	Ports A,B,C	Ports A,B,C,D,E	Ports A,B,C	Ports A,B,C,D,E
Timers	3	3	3	3
Capture/Compare/PWM Modules	2	2	2	2
Serial Communications	MSSP, USART	MSSP, USART	MSSP, USART	MSSP, USART
Parallel Communications	—	PSP	—	PSP
10-bit Analog-to-Digital Module	5 input channels	8 input channels	5 input channels	8 input channels
Instruction Set	35 instructions	35 instructions	35 instructions	35 instructions

2.7 RS-232

RS232 is an asynchronous communication protocol that lets you transmit and receive data between DTE (Data terminal Equipment) and DCE (Data Circuit Terminating Equipment) such as modem. It is the EIA/TIA (Electronic Industries Alliance/ Telecommunications Industry Association) that defines physical and electrical characteristics of the RS-232 interface [9].

RS-232 is active low voltage driven interface and operates at between -12V and +12V for which signal is LOW or 0 when voltage is higher than +3 Volt and signal is HIGH or 1 when voltage is lower than -3 Volt. For any voltage falling between +3 Volt and -3 Volts are considered 'dead area' or indeterminate value. TIA defines the power level for short circuit protection to be 100mA, however most RS-232 drivers will provide lower short circuit protection.



Pin	Signal	Pin	Signal
1	Data Carrier Detect	6	Data Set Ready
2	Received Data	7	Request to Send
3	Transmitted Data	8	Clear to Send
4	Data Terminal Ready	9	Ring Indicator
5	Signal Ground		

Figure 2.10: Interfacing Devices to RS-232 Ports

2.7.1 RS-232 Waveforms

RS-232 communication is asynchronous, means a clock signal is not sent with the data. Each word is synchronized using its start bit, and an internal clock on each side, keeps tabs on the timing.

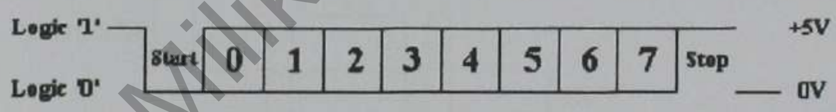


Figure 2.11: TTL/CMOS Serial Logic Waveform

The diagram above shows the expected waveform from the UART when using the common 8N1 format. 8N1 signifies 8 Data bits, No Parity and 1 Stop Bit. The RS-232 line, when idle is in the Mark State (Logic 1). A transmission starts with a start bit which is (Logic 0). Then each bit is sent down the line, one at a time. The LSB (Least Significant Bit) is sent first. A Stop Bit (Logic 1) is then appended to the signal to make up the transmission.

The diagram shows the next bit after the Stop Bit to be Logic 0. This must mean another word is following, and this is its Start Bit. If there is no more data coming then they receive line will stay in its idle state (logic 1). We have encountered something called a "Break" Signal. This is when the data line is held in a Logic 0 state for a time long enough to send an entire word. Therefore, if you don't put the line back into an idle state, then the receiving end will interpret this as a break signal.

The data sent using this method, is said to be framed. That is the data is framed between a Start and Stop Bit. Should the Stop Bit be received as Logic 0, then a framing error will occur. This is common, when both sides are communicating at different speeds.

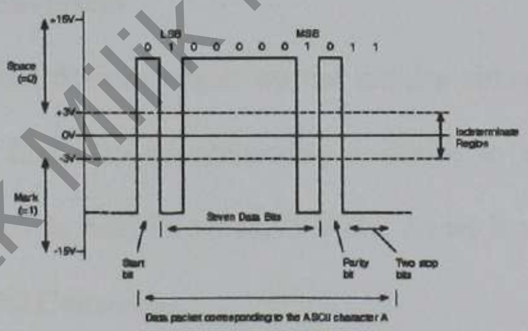


Figure 2.12: Data transmission waveform

The above diagram is only relevant for the signal immediately at the UART. RS-232 logic levels uses +3 to +25 volts to signify a "Space" (Logic 0) and -3 to -25 volts for a "Mark" (logic 1). Any voltage in between these regions (i.e. between +3 and -3 Volts) is undefined. Therefore this signal is put through a "RS-232 Level

Converter". This is the signal present on the RS-232 Port of your computer, shown below.

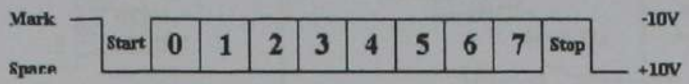


Figure 2.13: RS-232 Logic Waveform

The above waveform applies to the Transmit and Receive lines on the RS-232 port. These lines carry serial data, hence the name Serial Port. There are other lines on the RS-232 port which, in essence are Parallel lines. These lines (RTS, CTS, DCD, DSR, DTR, RTS and RI) are also at RS-232 Logic Levels [9].

2.7.2 RS-232 Level Converters

Almost all digital devices which we use require either TTL or CMOS logic levels. Therefore the first step to connecting a device to the RS-232 port is to transform the RS-232 levels back into 0 and 5 Volts. As we have already covered, this is done by RS-232 Level Converters.

Two common RS-232 Level Converters are the 1488 RS-232 Driver and the 1489 RS-232 Receiver. Each package contains 4 inverters of the one type, either Drivers or Receivers. The driver requires two supply rails, +7.5 to +15v and -7.5 to -15v.

Figure 2.14: Pin outs for the MAX-232, RS-232 Driver/Receiver

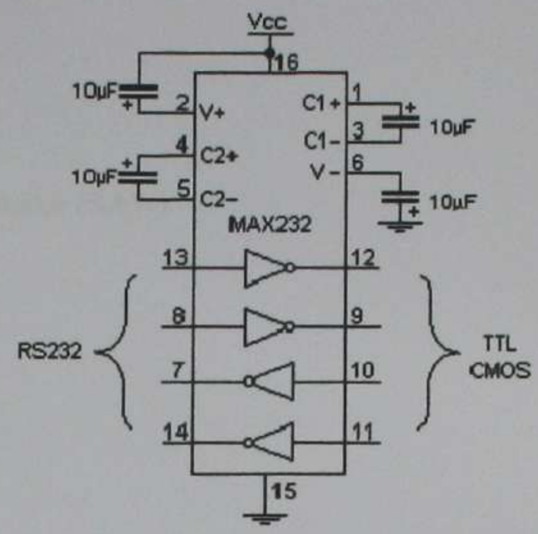


Figure 2.15: Typical MAX-232 Circuit.

Another device is the MAX-232. It includes a Charge Pump, which generates +10V and -10V from a single 5v supply. This I.C. also includes two receivers and two transmitters in the same package [3].

2.8 RF Module

These RF modules are adopting RF integrated circuit with super-heterodyne working mode and SAW resonance. Its features are stability and strong ability of anti-jamming. It is widely used at some spot of industrial control that has high requirement [13].

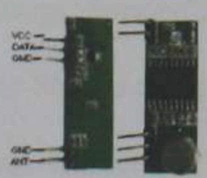


Figure 2.16: RF Receiver Module

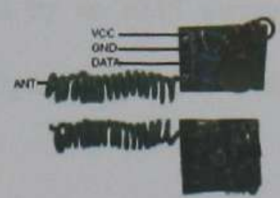


Figure 2.17: RF Transmitter Module

Technical specifications of the RF module:

- Control range: 20-50 meters
- Communication: Serial 8-bit data
- Resonance mode: sound wave resonance (SAW)
- Modulation mode: AM/OOK/ASK
- Working frequency: 315MHz
- Transmitting velocity: <9600bps
- Antenna length: 24cm

2.9 Short Message Services (SMS)

Short Message Service (SMS) is a technology that enables the sending and receiving messages between mobile phone. SMS first appeared in Europe in 1992 and was included in the GSM (Global System for Mobile Communication) standards right at the beginning. Now, the SMS was ported to wireless technologies [12].

SMS as used on modern hand phone was originally defined as part of the GSM series of standards in 1985 as a means of sending messages up to 160 characters (including spaces), to and from GSM mobile hand phone. The idea of adding text messaging to the services of mobile users was latent in many communities of mobile communication services at the beginning of the 1980s. As suggested by the name "Short Message Service", the data that can be held by an SMS message is very limited. One SMS message can contain at most 140 bytes (1120 bits) of data, so one SMS message can contain up to:

- ✓ 160 characters if 7-bit character encoding is used. (7-bit character encoding is suitable for encoding Latin characters like English alphabets.)
- ✓ 70 characters if 16-bit Unicode UCS2 character encoding is used. (SMS text messages containing non-Latin characters like Chinese characters should use 16-bit character encoding.)

There is more benefit of SMS services such as:

- ✓ SMS message can be sent and read at any time
- ✓ SMS message can be sent to an offline mobile phone
- ✓ SMS messages are less disturbing.
- ✓ SMS message are supported by 100% GSM mobile phone and they can be exchange between different wireless carriers.
- ✓ SMS message are capable of carrying binary data besides text

SMS messages are carried on either Stand-alone Dedicated Control (SDCCH) or Slow Associated Control (SACCH) depending on the use of the traffic channel. When the Traffic Channel (TCH) is not allocated, i.e., no voice call or data transfer in progress, the short message is carried on the SDCCH. The SDCCH occupy 32 slots in the 51 TDMA frame control multiframe in eight groups of 4 slots each, each group serving a different user. The total data that can be carried on these four slots is 456 bits (4x114) [11]. But for a signaling channel, 184 bits of data is encoded into 456 bits. So, the 4 SDCCH slots carry 184 bit of actual data. An SMS message of size c characters and time needed to send an SMS message contains is:

$$[(c \times 7) / 184] \times 235.5 \text{ ms}$$

Table 2.4: Logical Channel of GSM Protocol Layer 1

Channel type	Net data throughput (in kbit/s)	Block length (in bit)	Block distance (in ms)
TCH (full-rate speech)	13.0	182 + 78	20
TCH (half-rate speech)	5.6	95 + 17	20
TCH (data, 14.4 kbit/s)	14.5	290	20
TCH (data, 9.6 kbit/s)	12.0	60	5
TCH (data, 4.8 kbit/s)	6.0	60	10
TCH (data, ≤ 2.4 kbit/s)	3.6	72	10
FACCH full rate	9.2	184	20
FACCH half rate	4.6	184	40
SDCCH	598/765	184	3060/13
SACCH (with TCH)	115/300	168 + 16	480
SACCH (with SDCCH)	299/765	168 + 16	6120/13
BCCH	598/765	184	3060/13
AGCH	n × 598/765	184	3060/13
NCH	m × 598/765	184	3060/13
PCH	p × 598/765	184	3060/13
RACH	r × 27/765	8	3060/13
CBCH	598/765	184	3060/13

2.10 Miniature Circuit Breaker (MCB)

A miniature circuit breaker is automatically operated electrical switch designed to protect electrical circuits from damage caused by overload or short circuit. Basic function is to detect a fault condition and disturb the continuity, stop the flow of electricity. 20A MCB is used for three pin plug socket 13A.While 6A MCB is used to switch lights and fans [1].

The main purpose of switching off the voltage supply at MCB when flooding occurs is to prevent short circuits due to water in a conductor. This is one way to save the lives of animals and human life from electrical shock when it is busy to save property from destruction caused by floods.

2.11 Residual Current Device (RCD), Or Residual Current Circuit Breaker (RCCB)

A residual current device (RCD), or residual current circuit breaker (RCCB), is an electrical wiring device that disconnects a circuit whenever it detects that the flow of current is not balanced between the phase ("hot") conductor and the neutral conductor.

Such an imbalance is sometimes caused by current leakage through the body of a person who is grounded and accidentally touching the energized part of the circuit. A shock, possibly lethal, is likely to result from these conditions; RCCBs are designed to disconnect quickly enough to greatly reduce the harm caused by such shocks.

RCCBs operate by measuring the current balance between two conductors using a differential current transformer, and opening the device's contacts if there is a balance fault. 30mA RCCB used for three pin plug socket. While 100mA RCCB used to switch lights and fans [1].

2.12 Sensor

2.12.1 Mini Float Level Switch

Figure 2.18: Mini Float Level Switch

Float switches consist of a float, magnet, and reed switch and body / stem with mounting threads. When the probe is dry, the float rests on the bottom of the stem such that the magnet does not influence the reed switch. As the probe becomes immersed in liquid, the float becomes buoyant and the magnet elevates causing the reed switch to change state [5].

When the magnetic field of permanent magnet inside the float is moved into to the proximity of the reed switch inside the stationary stem, the reed switch "snaps" the contact together and closes the electrical circuit. When the magnetic field is moved away from the reed switch, the reed switch does not touch. The circuit is open.

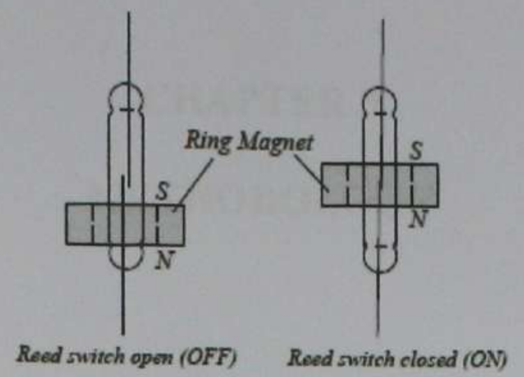


Figure 2.19: illustrates the method of perpendicular

2.12.2 Electroplating

Electroplating (often just called "plating") is the deposition of a metal coating onto an object by putting a negative charge on it and putting it into a solution which contains a metal salt. The metal salt contains positively charged metal ions which are attracted to the negatively charged object and are "reduced" to metallic form upon it [4].

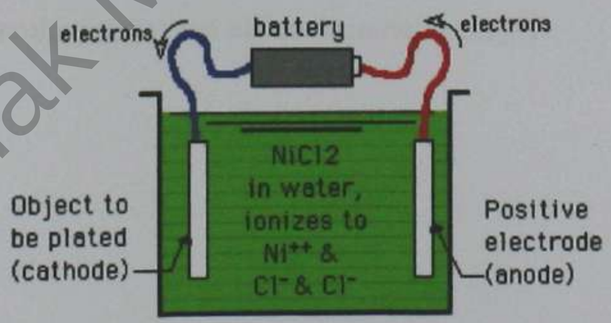


Figure 2.20: illustrates the method of electroplating

CHAPTER 3

METHODOLOGY

3.1 Introduction

Flood detection system design is divided into two parts: the first stage and second stage. The first stage is designed to give early warning that the flood came. In this section consists of software and hardware.

Software design is divided into three sections, namely the sending, receiving and sending a short message to the persistent phone number using GSM modem. While the hardware design is divided into two; transmit and receive circuits.

The second and third level is design to cut off power supply into the MCB. Electronic circuits used to cut off the electricity supply.

3.2 Design First Stage

3.2.1 Hardware Design

The hardware circuit in this research is designed using the Protel 99 SE software. The schematic designed is converted to the PCB layout before being printed and transferred to the PCB board.

3.2.1.1 Design Transmitter Circuits

The main components in this circuit are the PIC16F876A, RF Transmitter, buzzer and mini float level switch.

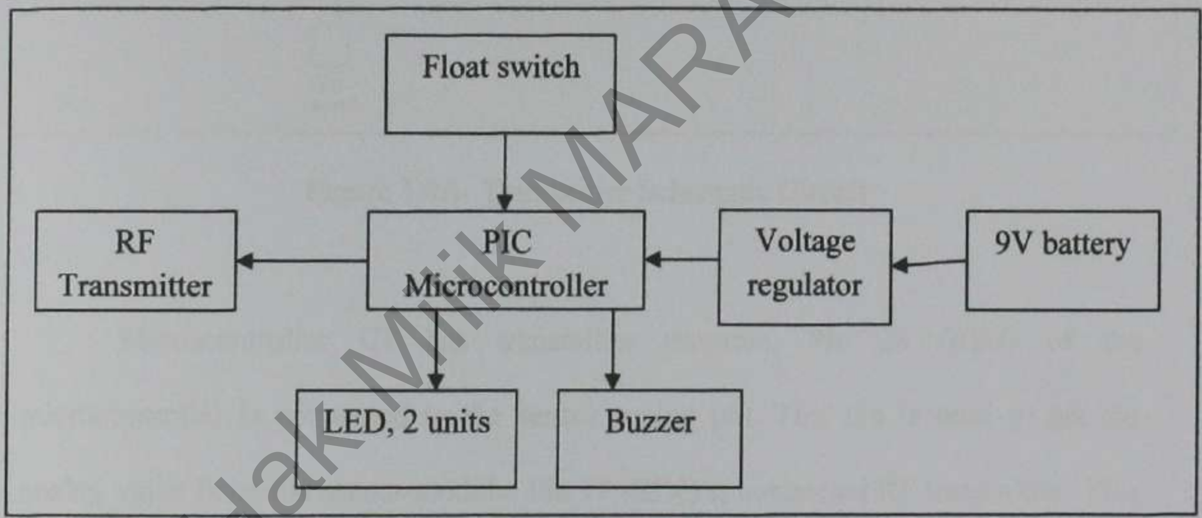


Figure 3.0: Transmitter Block Diagram

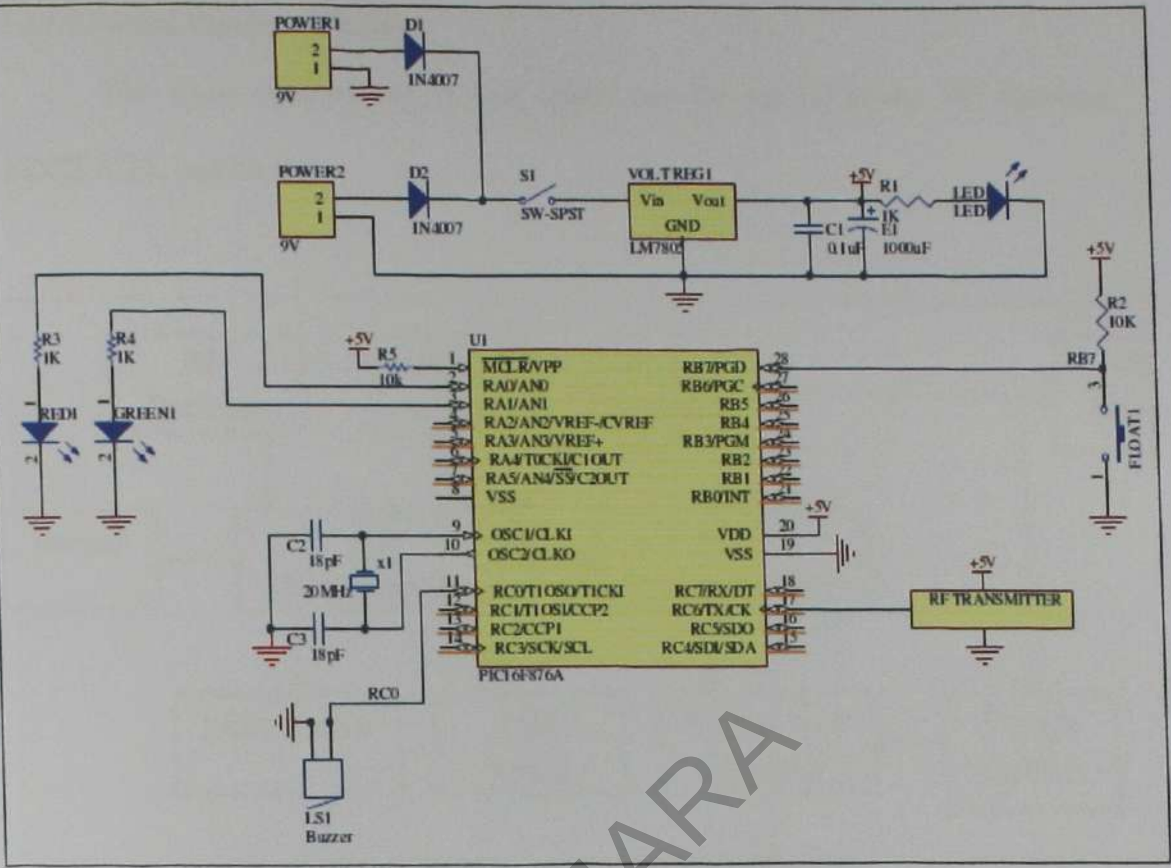


Figure 3.0A: Transmitter Schematic Circuit

Microcontroller U1 has transmitter program. Pin 28 (RB7) of the microcontroller is connected to the sensor analog pin. This pin is used to get the analog value from the sensor module. Pin 17 (RC6) is connected RF transmitter. This pin is used to send the signal if the sensor detect the flood. Pin 11 (RC0) is connected buzzer. The buzzer will on when the flood occur. Pin 2 (RA0) and pin 3 (RA1) is connected red and green LED respectively. Green LED will ON when no flood but red LED will ON when flood occur.

3.2.1.2 Design Receiver Circuits

The main components in this circuit are the PIC16F876A, RF Receiver, MX232CPE and buzzer.

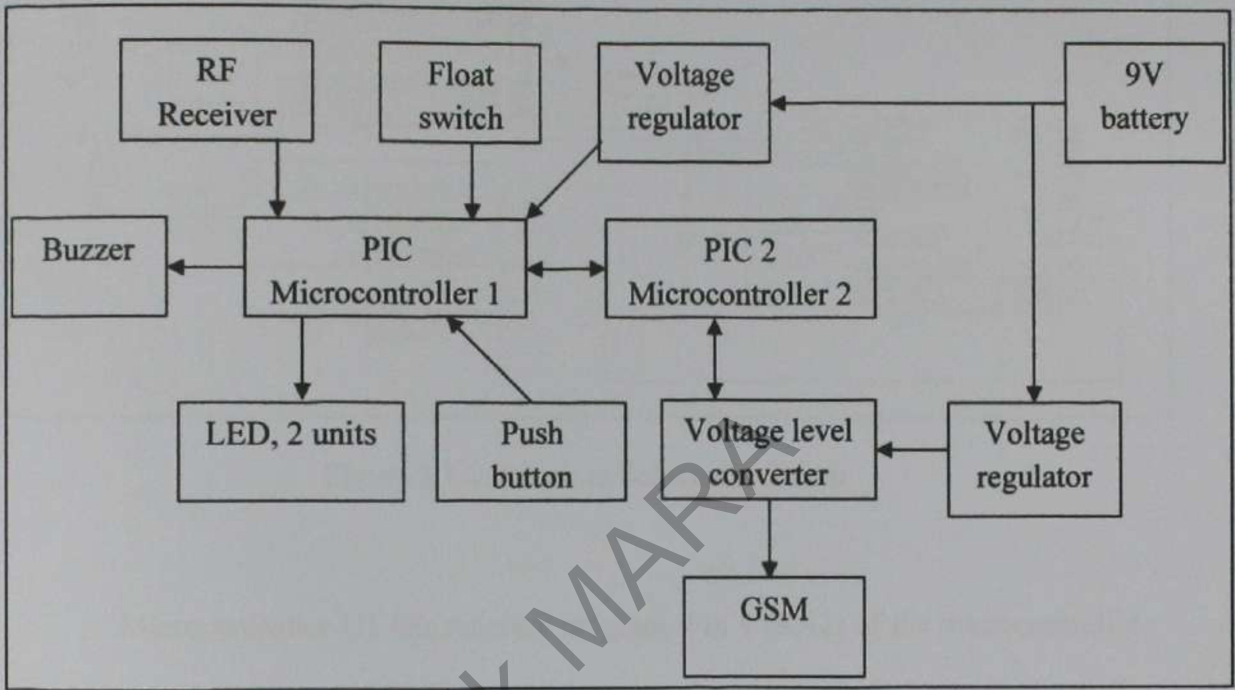


Figure 3.1: Receiver Block Diagram

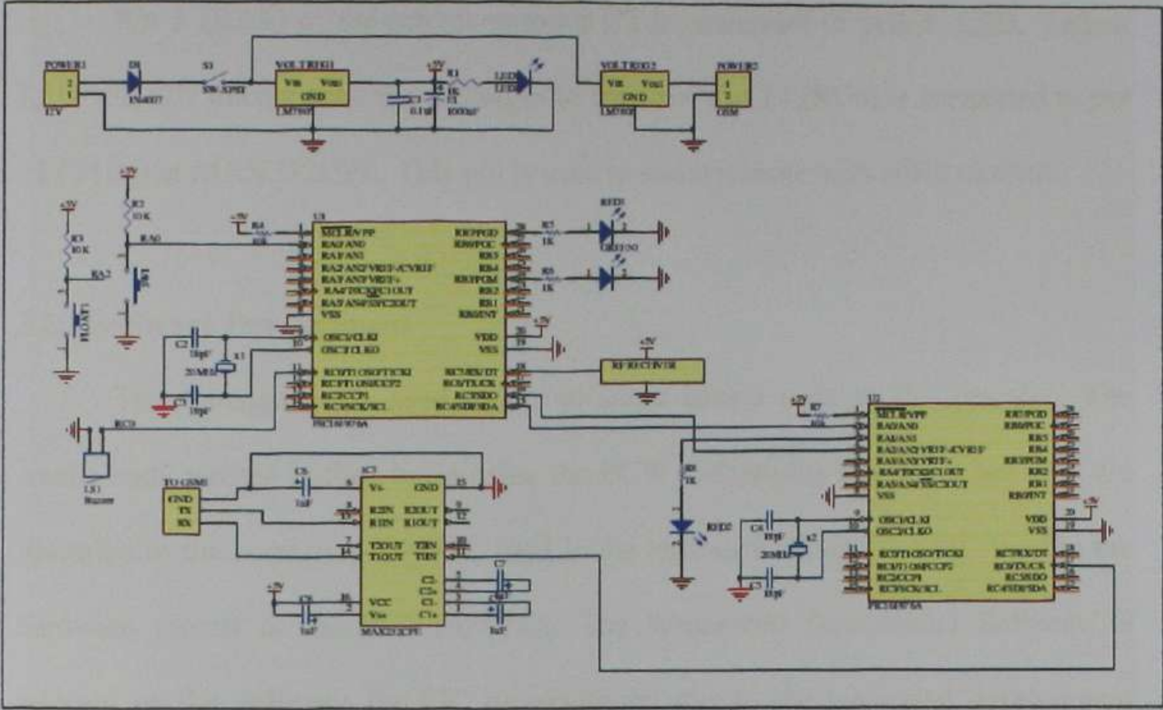


Figure 3.1A: Receiver Schematic Circuit

Microcontroller U1 has receiver program. Pin 4 (RA2) of the microcontroller U1 is connected to the sensor analog pin. This pin is used to get the analog value from the sensor module (If do not want to use the transmitter as an input circuit). Pin 18 (RC7) is connected RF receiver. This pin is used to receive the signal transmitter circuit board. Pin 11 (RC0) is connected buzzer. The buzzer will on when the flood occur. Pin 24 (RB3) and pin 28 (RB7) is connected green and red LED respectively. Green LED will ON when no flood but, red LED will ON when flood. Pin 15 (RC4) and pin 16 (RC5) is connected to pin 2 (RA0) and pin 4 (RA2) at microcontroller U2 respectively. Microcontroller U2 has GSM program. This pin is used to notify the GSM program that floods occur, so that the programs will send a short message to the user.

Pin 3 (RA1) of the microcontroller U2 is connected to yellow LED. Yellow LED will ON during send the messages to the user. Pin 17 (RC6) is connected to pin 11 (T1IN) at MAX232CPE. This pin is used to communicate with GSM modem.

3.2.2 Software Development

The C-language is used as the program source code in this research. The source code written is then build using the PCW C-Compiler before its hex files are uploaded to the corresponding PIC used in the hardware circuit. The PIC used in the hardware circuit is the PIC 16F873A. The Winpic800 Downloader Software is selected as the software for PIC programming due to the integrated development environment the software provides and the ability of the software to compile the assembly language into machine code as well as the built-in simulator and debugger features available in the software.

3.2.2.1 Flowchart of Transmitter Program

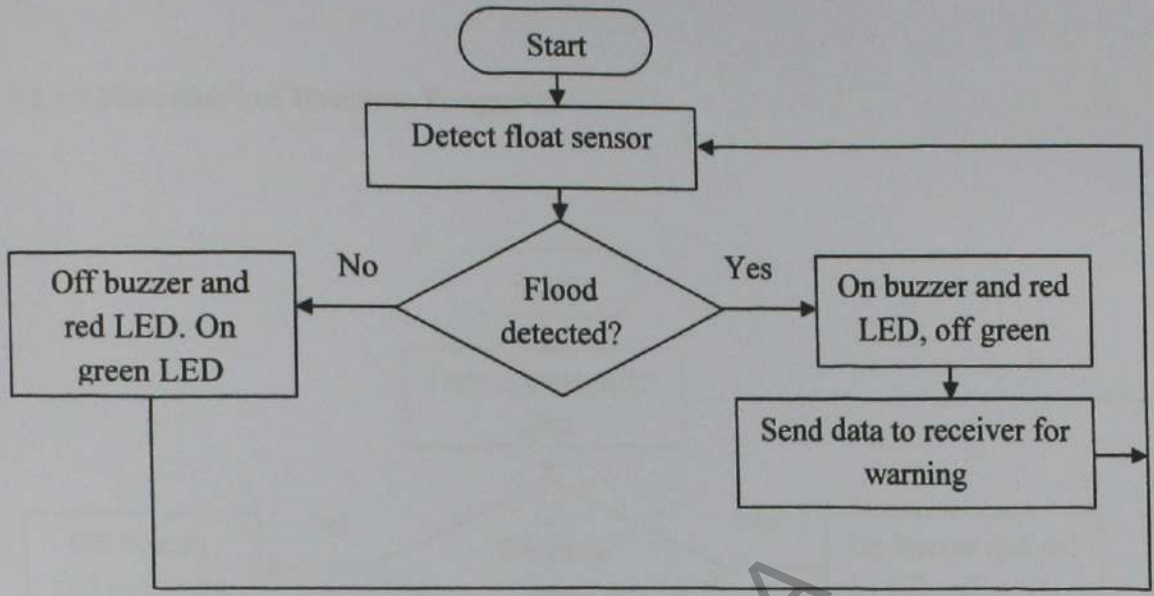


Figure 3.2: Flowchart of Transmitter Program

3.2.2.1a Transmitter Program Source Code

```
do
{
if(input(pin_b7)==0) //if no flood
{
txdata='A';
output_low(pin_c0);  //off buzzer
output_low(pin_a0);  //off red led
output_high(pin_a1); //on green led
}
```

Figure 3.2A: Partial of Transmitter Program (the full source code at appendix 1)

When the circuit is switched on, no water is detected; the green LED lights and signals are sent to the receiver that the system has been activated.

When the sensor is exposed to water, the buzzer and the red LED will ON also signals are sent to the receiver that the flood occurred.

3.2.2.2 Flowchart of Receiver Program

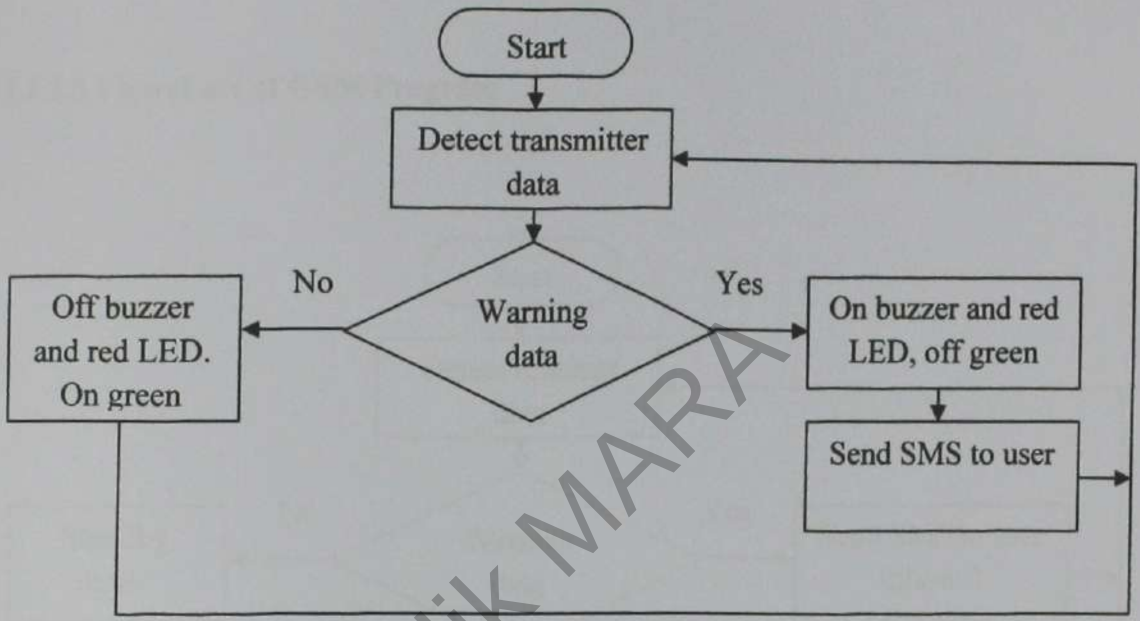


Figure 3.3: Flowchart of Receiver Program

3.2.2.2a Receiver Program Source Code

```
do
  {
  if(rx_detect==1)  //if any data received
  {  rx_detect=0;
```

Figure 3.3A: Partial of Receiver Program (the full source code at appendix 2)

When the received signal from the transmitter circuit, no water is detected, the green LED will ON and the short messaging system (SMS) sent to the user that the system has been activated. When the sensor is exposed to water, the buzzer and the red LED will ON also the short messaging system (SMS) will be sent to the user that the flood occurred.

3.2.2.3 Flowchart of GSM Program

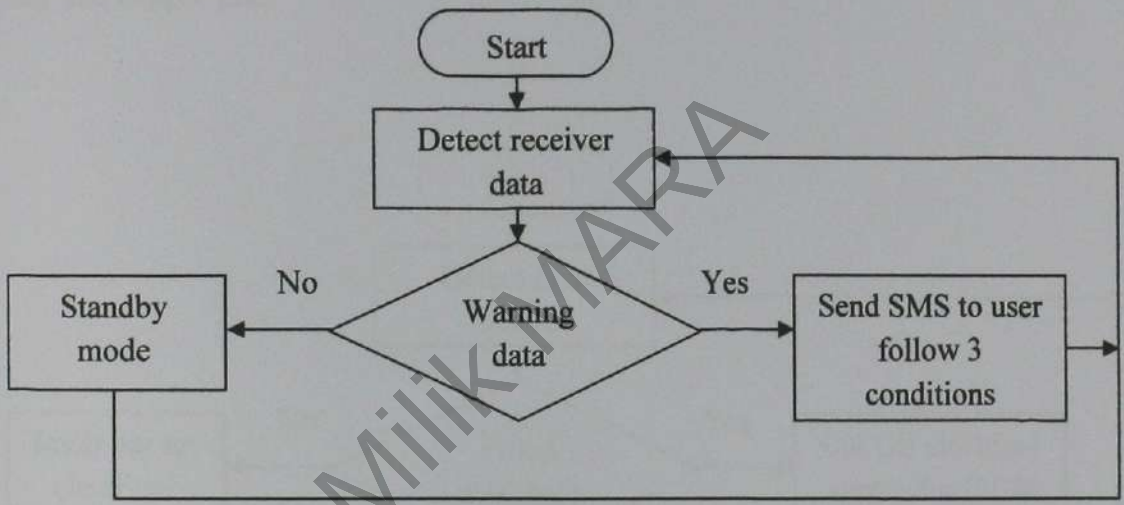


Figure 3.4: Flowchart of GSM Program

3.2.2.3a GSM Program Source Code

```
delay_ms(500);
printf("Flood Alarm Started...");
putc(0x1A);
delay_ms(2000);
```

Figure 3.4A: Partial of GSM Program (the full source code at appendix 3)

When the received signal from the receiver, GSM program will send a signal to the user by using the short messaging service (SMS) in the three situations, it is:

1. the system is activated
2. Flooding occurs
3. Safe from flooding

3.3 Design Second and Third Stages

The main components in this circuit are the IC CD4011, transistor BC457, relay and copper plat.

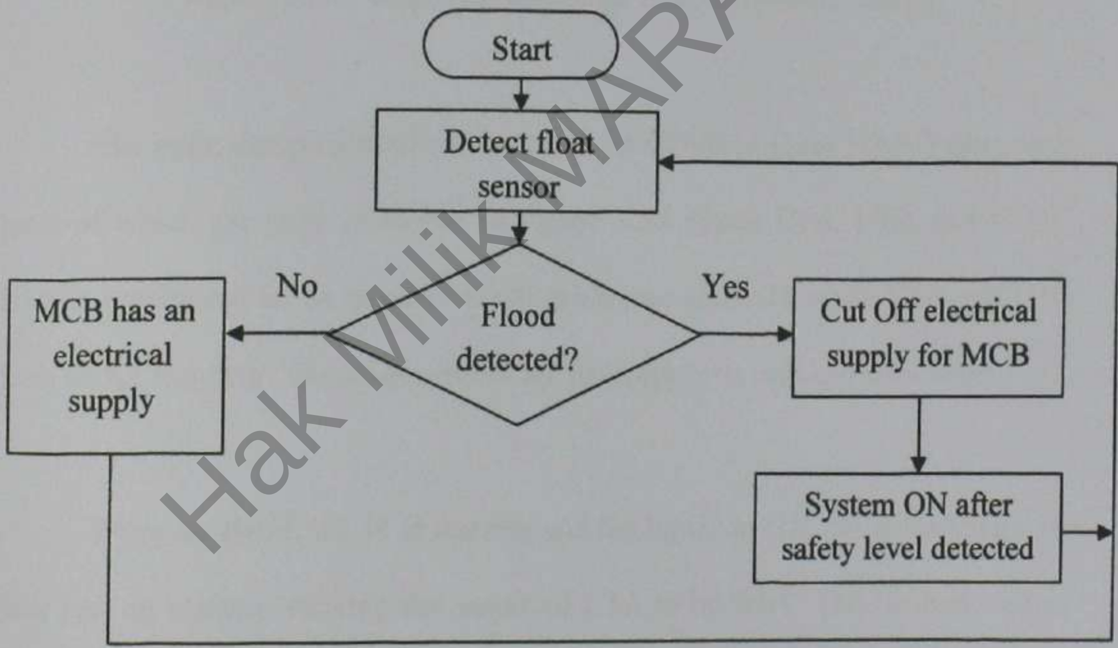


Figure 3.5: Flowchart of Second Stage and Third Stage

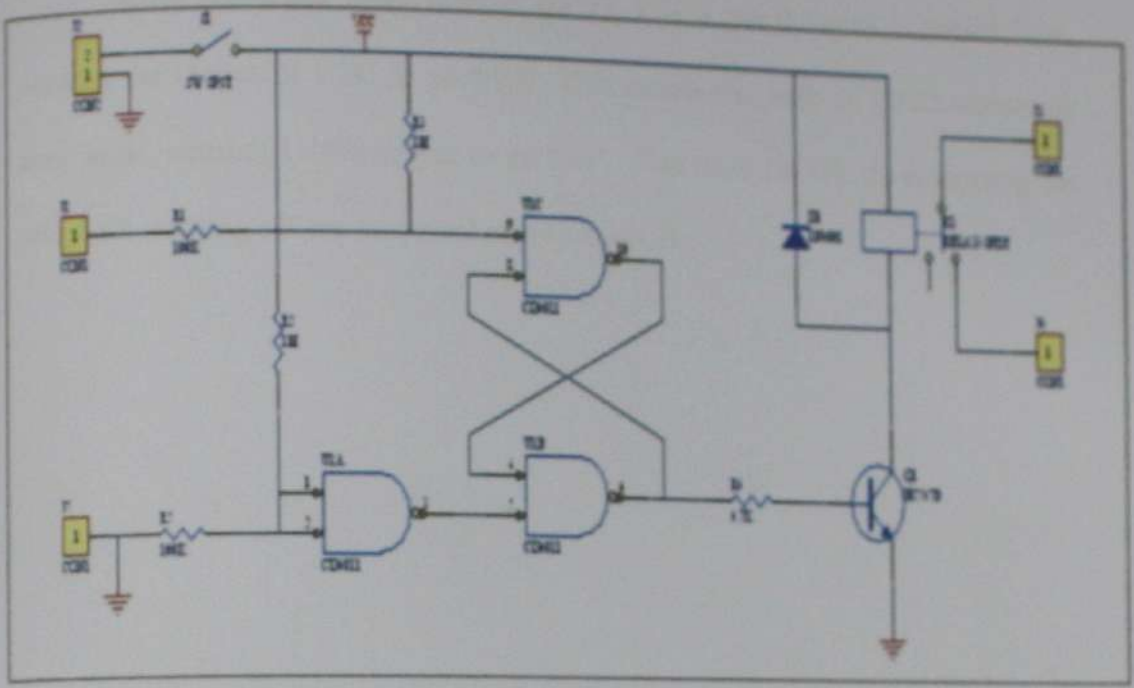


Figure 3.5A: Stage two and Stage three Schematic Circuit

The main component of the circuit is the CD-4011 Quad NAND gate, three gates of which are used as shown in Figure 3.5A (gates U1A, U1B, and U1C). U1A is configured as an inverter (both inputs are shorted), while U1B and U1C form an RS flip-flop. The level sensors are just copper or stainless steel wires.

When no flood, the J1 is floating and the inputs to U1C are pulled 'high' by their pull-up resistor, causing the output of U1A to be 'low'. This, in turn, causes the output of U1B to be high, turning on Q1 which energizes the relay that power up the input electrical supply for MCB. At this point, both of U1C's inputs are high, so its output is low.

When the water level reaches the J1, U1C's pin 9 inputs is pulled 'low', causing the output of U1C to go 'high'. This means that both of U1B's inputs are now 'high', causing U1B's output to go 'low'. This turns off Q1, de-energizing the relay and shutting off the electrical supply at MCB.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Result

Figure 4.0: Flood Detection System

Figure 4.0 shows the Flood Detection System consists of distribution fuse box, GSM modem, transmitter box, electronics box, and receiver box respectively. Transmitter and receiver boxes are used for the first stage system; while the electronics box is used for the second and third stages system. Aquarium was used to indicate rising water levels. Mini float switch is used as a sensor for the first stage; while the copper plate is used as a sensor for the second and third stages.

Figure 4.1: Flood Detection System Activated

Figure 4.1 shows when the system is activated; a short message (SMS) sent to the user that started the flood alarm system.

Figure 4.2: Flood Detection System in First Stage Condition

Figure 4.2 shows when the water reaches 30mm from the lowest region; the transmitter will send a signal to the receiver. Buzzer sounds and after 1ms, users will receive a short message (SMS) stating the flood is detected.

Figure 1.3: Flood Detection System in Second Stage Condition

Figure 4.3 shows when the water reaches 250mm from the lowest region; the flow of voltage for three-pin plug in MCB supply disconnected.

Figure 4.4: Flood Detection System in Third Stage Condition

Figure 4.4 shows when the water reaches 1450mm from the lowest region; the flow of voltage to the lights and fans in the MCB disconnected and at the same time the emergency light will turn on.

Buzzer sounds and flow of the supply voltage is interrupted as long as the water level outside the safe area. Once in the secure; buzzer will turn off automatically and the voltage flow back to the original state. After 12ms, users will receive a short message (SMS) stating the flood level of safety.

4.2 Discussion

4.2.1 Analysis of Overall System

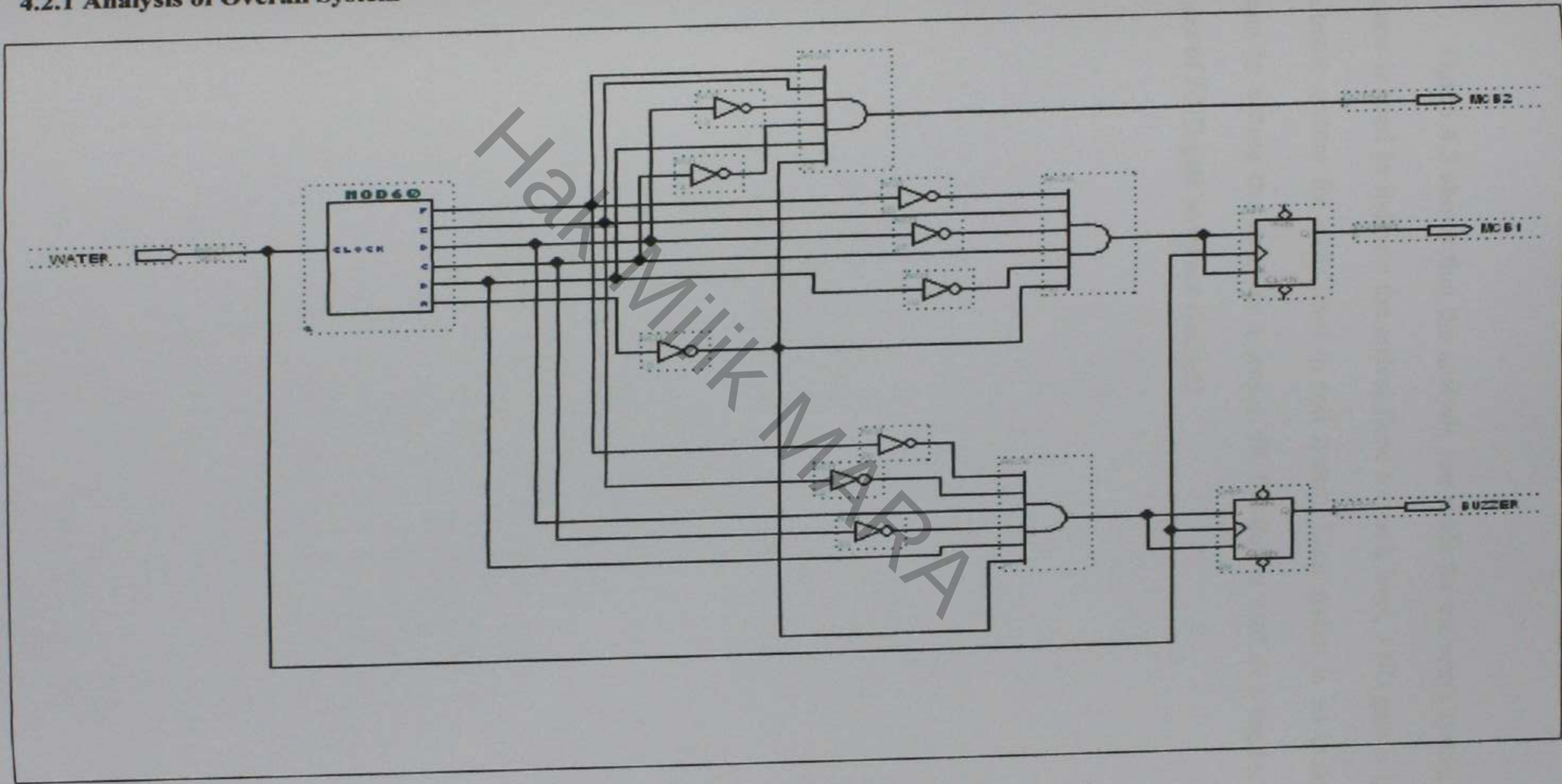


Figure 4.5: Analysis Overall system by using ALTERA software

Figure 4.5 shows that the analysis was made for the entire system. MOD60 Counter is used to indicate the arrival flood for each level. AND gate is used as an electronic system for each level in real system. Each system is set to activate the output by setting the entry as a sensor. JK flip-flop is used as a toggle, to set the output of AND gate so as not changed.

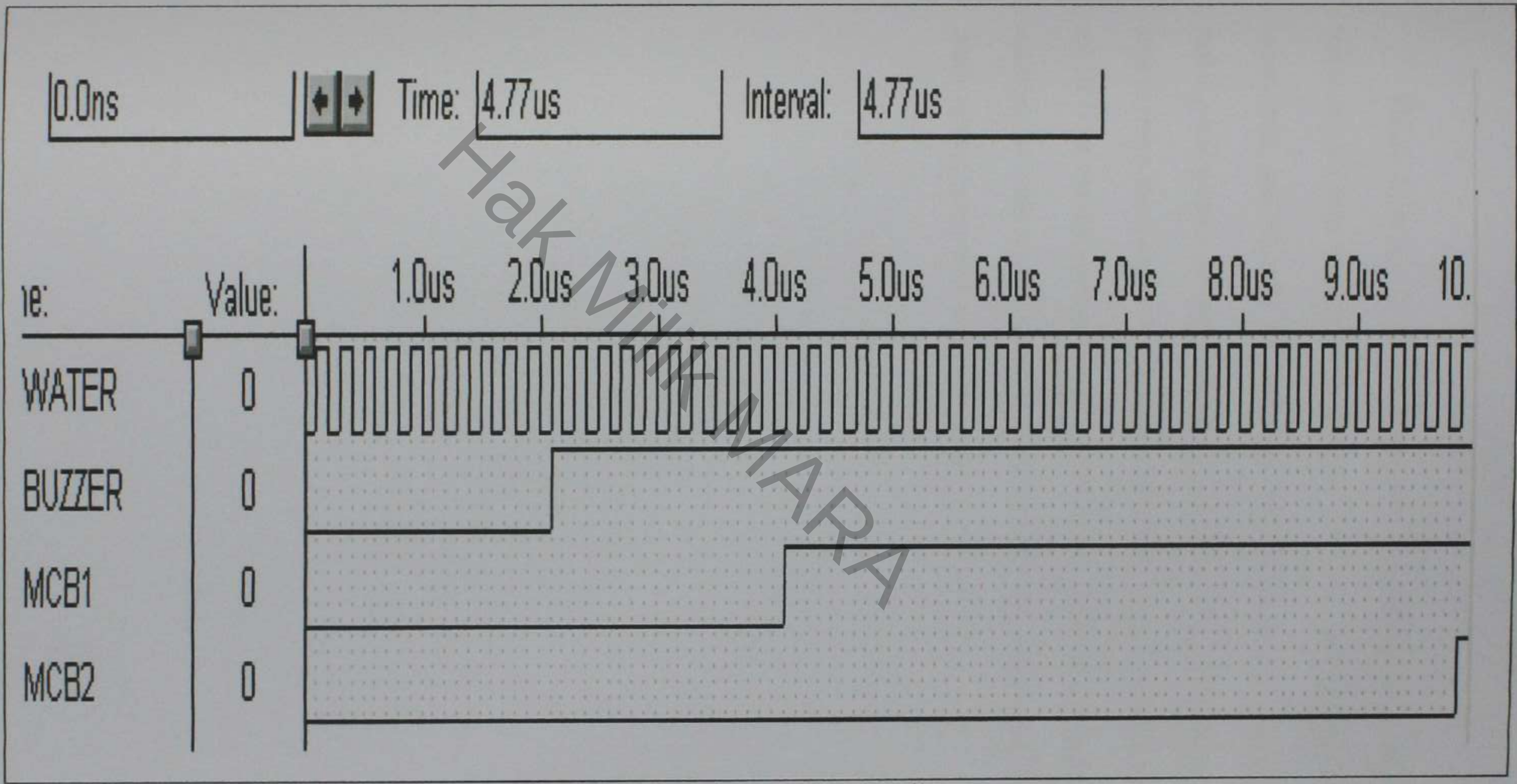


Figure 4.5A: Analysis output for overall systems

Figure 4.5A shows the resulting output of the circuit in the figure 4.5. The time is sets for each stage in this experiment is 10μs for the first stage, 20μs for the second stage, and 50μs for the third stage. This time is described as a sensor that is used in a real system. From this output waveform, it can be stated that no time delay occur between the sensor was exposed to water with a buzzer, the MCB for the lights, and MCB for the three pin plug socket as an outputs. It does also can be noted that the sensitivity of each sensor are same for each level. The output waveform will not change as long as the system is reset again.

4.2.2 Analysis of First stage System

The first stage; the analysis made in the time taken for the transmission of short messaging system (SMS) to the users. Users receive a short message in three different conditions.

When the system is activated, the user will receive a short message that the system has started. When the flood occurs, users will receive a short message that the flooding is detected. Finally, users receive a short message that the flooding level is safety condition. How the short message transmission time is calculated as follows:

a. The first short message has 19 characters. Each character used 7-bit data to transmit. So,

$$[(19 \times 7)/ 184] \times 235.5 \text{ ms} = 170.2255 \text{ ms}$$

b. The first short message has 18 characters. Each character used 7-bit data to transmit. So,

$$[(18 \times 7)/ 184] \times 235.5 \text{ ms} = 161.2663 \text{ ms}$$

c. The first short message has 22 characters. Each character used 7-bit data to transmit. So,

$$[(22 \times 7)/ 184] \times 235.5 \text{ ms} = 197.1033 \text{ ms}$$

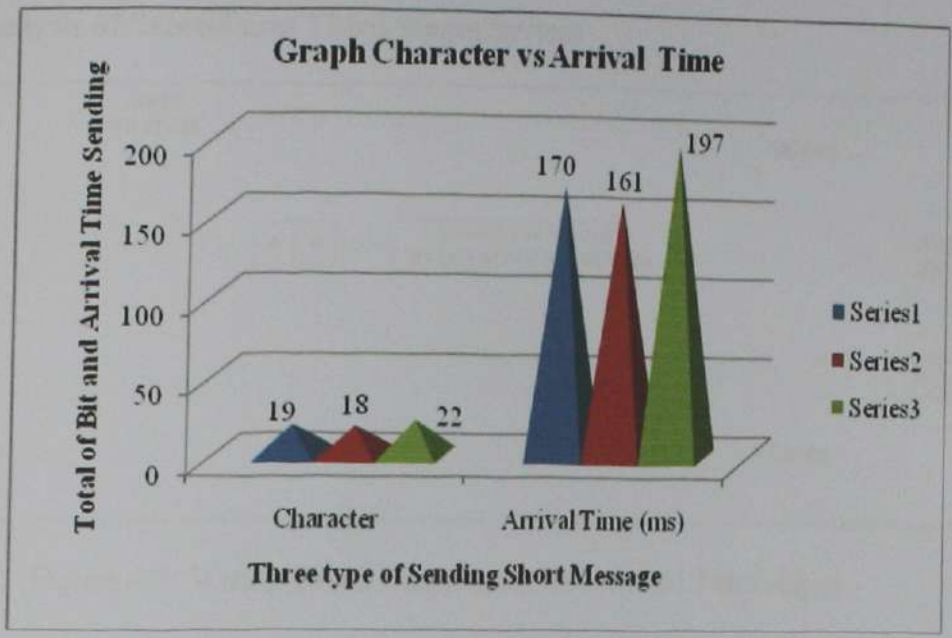


Figure 4.6: Graph Output of Quantity Character vs. Arrival Times

Result of the calculations is displayed in graph form as in the figure 4.6. From the graph can be stated that the arrival time depends on the quantity used character. Many character are used, so a lot of time to be taken.

4.2.3 Analysis of Second and Third Stages System

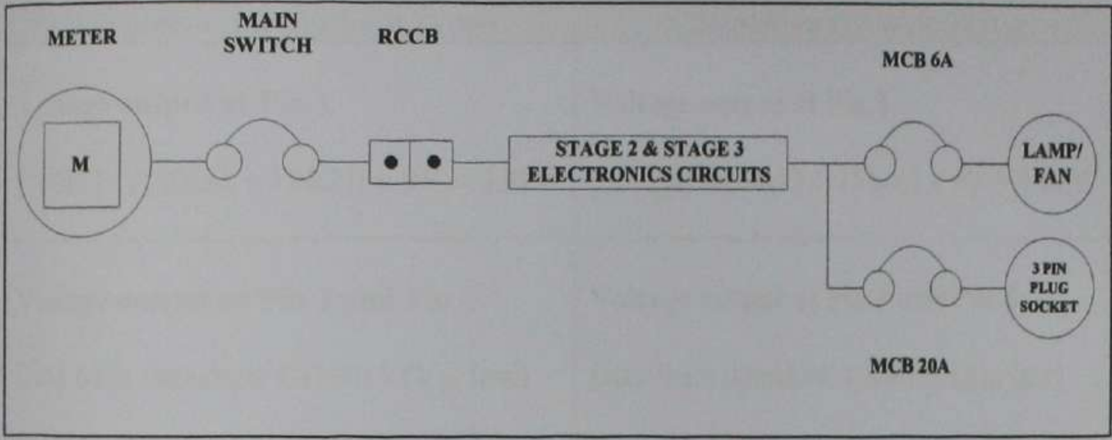


Figure 4.7: Wiring Block Diagram for Second and Third stages

Figure 4.7 shows how the circuit for the second and third stages is connected to the wiring system in the house. ENERGY COMMISSION stating that the installation of MCB to three pin plug socket is 20A and the MCB for the lights is switch 6A. Home wiring system that is supposed to use two RCCB; 0.03A for the three pin plug socket and light switches to 0.1A. But this does not happen because in order to save installation costs [15].

In the event short circuit, the MCB will trip. Meanwhile the leakage current to earth, RCCB will trip. If this happens it will damage the electrical equipment at home. Flood Detection System function as a current break into the MCB when flood occurs. This system is like closing the main switch in the substation by TNB [1].

For the second and third stages, the analysis made in two situations: without water and with water. Each state is divided into three section; theoretical, simulation and practical

Table 4.0: Result Calculation for theoretical

Calculation for Without Water	Calculation for With Water
Voltage output at Pin 1 [100kΩ / (100kΩ + 1MΩ)] x 9V = 0.82V	**Voltage output at Pin 1** [100kΩ / (100kΩ + 1MΩ)] x 9V = 0.82V
Voltage output at Pin 3 and Pin 5 Data from datasheet CD4011 (V_{IN} low) V_{CC} V_{OUT} 5V 4.5V 9V [9V / 5V] x 4.5V = 8.1V	**Voltage output at Pin 3 and Pin 5** Data from datasheet CD4011 (V_{IN} low) V_{CC} V_{OUT} 5V 4.5V 9V [9V / 5V] x 4.5V = 8.1V
Voltage output at Pin 4 and Pin 8 Data from datasheet CD4011 (V_{IN} low) V_{CC} V_{OUT} 5V 4.5V 8.1V [8.1V / 5V] x 4.5V = 7.29V	**Voltage output at Pin 4 and Pin 8** Data from datasheet CD4011 (V_{IN} high) V_{CC} V_{OUT} 5V -0.52V 7.29V [7.29V / 5V] x (-0.52)V = -0.76V
Voltage output at Pin 6 and Pin 10 Data from datasheet CD4011 (V_{IN} high) V_{CC} V_{OUT} 5V -0.52V 7.29V [7.29V / 5V] x (-0.52)V = -0.76V	**Voltage output at Pin 6 and Pin 10** Data from datasheet CD4011 (V_{IN} low) V_{CC} V_{OUT} 5V 4.5V 8.1V [8.1V / 5V] x 4.5V = 7.29V
Voltage output at resistor 4.7kΩ, V_{BE} and V_{CE} Data from datasheet BC457 $V_{BE} = 0.7V$ $V_{4.7k\Omega} = V_{PIN\ 4} - V_{BE}$ $V_{CE} = 0.6V$ $= 7.29V - 0.7V$ $= 6.59V$	**Voltage output at resistor 4.7kΩ, V_{BE} and V_{CE}** Data from datasheet BC457 $V_{BE} = 0.7V$ $V_{4.7k\Omega} = V_{PIN\ 4} - V_{BE}$ $V_{CE} = V_{CC} - V_{BE}$ $= -0.76V - 0.7V$ $= 9V - 0.7V$ $= -1.46V$ $= 8.3V$

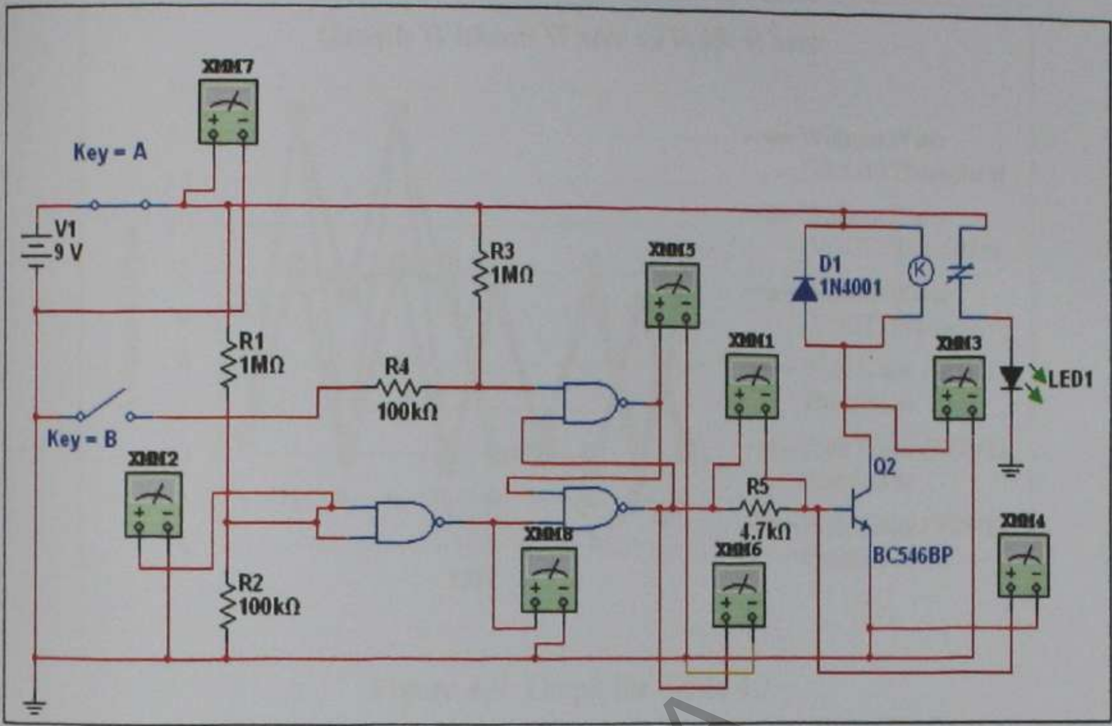


Figure 4.8: Simulation Testing using NI MULTISM

Table 4.1: Result Voltage Output from three analyses

Pin	Without Water (V_{OUT})			With Water (V_{OUT})		
	Theoretical	Simulation	Practical	Theoretical	Simulation	Practical
1	0.82	0.75	0.73	0.82	0.75	0.75
3	8.1	14.98	8.08	8.1	14.996	8.47
4	7.29	7.01	7.78	-0.76	0	0
5	8.1	14.98	8.08	8.1	14.996	8.47
6	-0.76	0	0	7.29	7.01	8.55
8	7.29	7.01	7.67	-0.76	0	0
9	0	0	0	0.82	0.75	0.73
10	-0.76	0	0	7.29	7.01	8.55
4.7kΩ	6.59	6.26	6.76	-1.46	0	0
V_{CE}	0.6	0.0238	0.0967	8.3	6	8.62

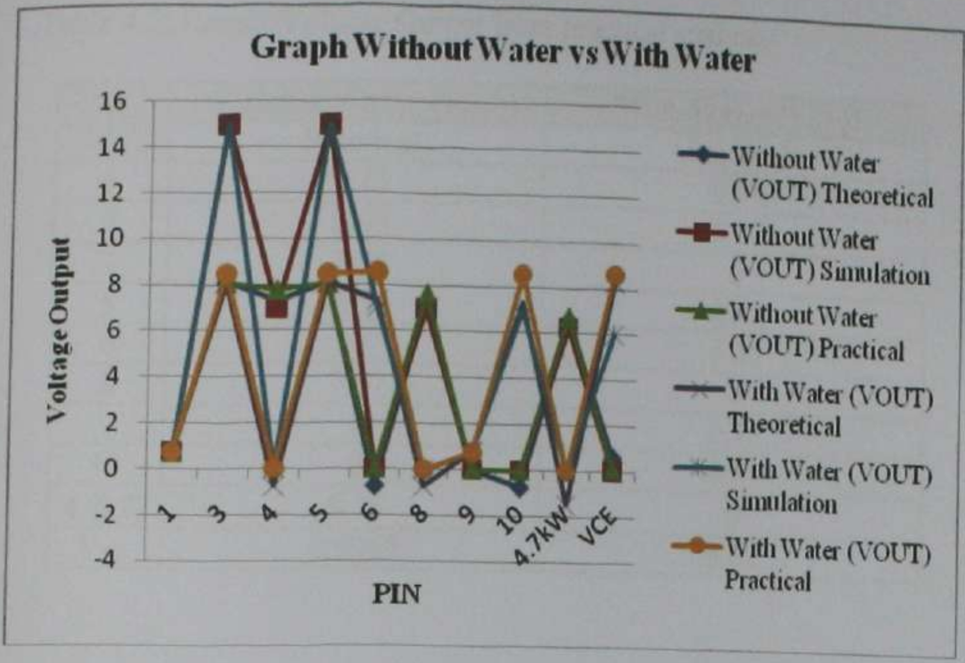


Figure 4.9: Graph for Table 4.1

In table 4.1, the overall result from three analyses is made in two situations. The theoretical results; the data use in calculation taken from datasheet CD4011 and BC457. CD4011 ICs are used, because the voltage on the network is 9V.

The simulation result; MULTISM software used and the output voltage readings taken from the multi-meter. Resistance of multi-meter set by the user. On practical results; the reading taken from a digital multi-meter and the resistance set by the factory.

The simulation result is different between theoretical and practical result; this is because the specification of building materials in the MULTISM software is not the same as that used in the theoretical and practical. The use of a multi-meter is also different between simulations and practical in term of resistance.

Table 4.2: Result Voltage Output from practical analysis

PIN	Without Water (V_{OUT})	With Water (V_{OUT})
	Practical	Practical
1	0.73	0.75
3	8.08	8.47
4	7.78	0
5	8.08	8.47
6	0	8.55
8	7.67	0
9	0	0.73
10	0	8.55
4.7kΩ	6.76	0
V_{CE}	0.0967	8.62

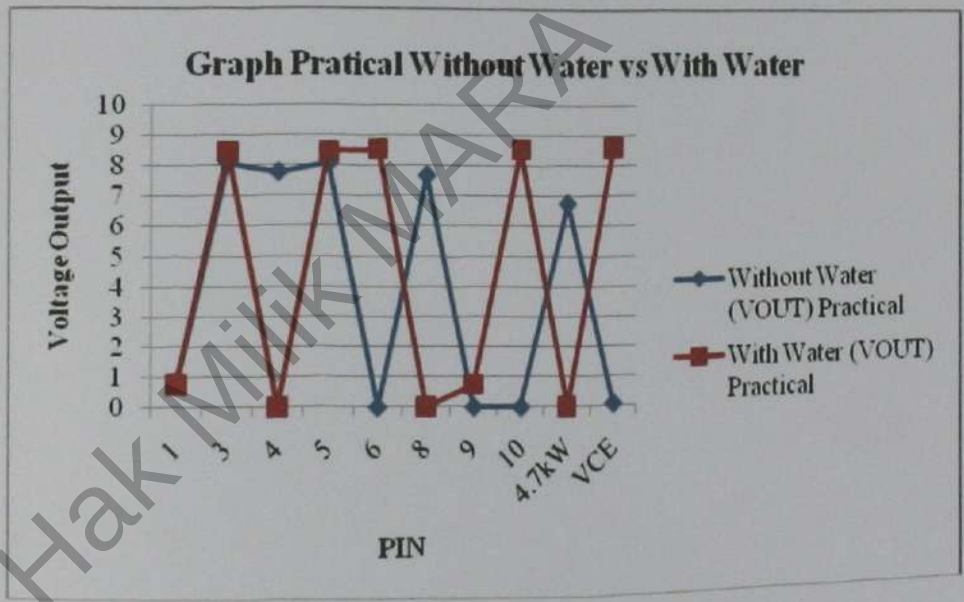


Figure 4.10: Graph for Table 4.2

From table 4.2; when flooding occurs, the output pin 4 goes low. This causes the voltage on the transistor cut off and at the same time the supply voltage for the MCB is also disconnected.

The Microcontroller successfully continuously sent the SMS. The use of SMS however, shows some delay at certain busy hour time, due to the unavailability and traffic busy of GSM network. This is avoidable since nothing is perfect in this world.

From the results it can be concluded, that by using the minimum input voltage of the circuit can disconnect the incoming voltage at the MCB. The resulting circuit is functioning according to the desired objectives.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

As a conclusion, the overall objective of this thesis is fully accomplished. The first objective of this thesis is to provide early warning to the occupants of the house through the buzzer and short messaging service (SMS). This objective is achieved by the prototype developed which indicates three short messaging service (SMS) send in three conditions; during the system activate, the flood occur, and safety level. At the same time buzzer also on. This is proven by the ability of the source code programmed to execute the overall system successfully and the functionality of the prototype hardware. Programs uploaded to the PIC controls the mini water level switch successfully as set data according to what is being programmed. The prototype hardware and software interface are also proven to be integrated successfully based on the ability of the microcontroller to communicate and controls the overall system operation.

The second objective of this thesis where one has to develop a system to detect the increase in water levels flood due to and cut off sources of electricity in the house are also successfully achieved. This objective is achieved by the prototype developed which indicates the second and third stages of water level. When the water raises the copper sensor at the second stage; the voltage flow into Miniature Circuit Breaker

(MCB) for three-pin plug socket is cut off. While, when the water raises the copper sensor at the third stage; the voltage flow into Miniature Circuit Breaker (MCB) for lights and fans is cut off. This is proven by the ability of the electronic circuit to execute the overall system successfully and the functionality of the prototype hardware.

5.2 Recommendations

Malaysia has a hot equatorial climate regime and humid throughout the year. Continuous rainfall caused flooding will occur; whereas when the summer drought and a continuing cause of fire was accepted.

By using this system, it is possible to handle problems that occur by placing a temperature sensor on the roof of the house and reading the temperature sensor will be used as information for the next system. This system can also handle cases of theft by adding motion sensor in the proper places.

As a conclusion, this system can be applied to a variety of application. A smart house can be built if the correct method of use in its place.

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APPENDIX 1

Transmitter Source Code

```
void main()
{
  int count, txdata;
  //set i/o for each pin
  set_tris_a(0b00000000);
  set_tris_b(0b10000000);
  set_tris_c(0b10000000);
  do
  {
    if(input(pin_b7)==0) //if no flood
    {
      txdata='A';
      output_low(pin_c0);  //off buzzer
      output_low(pin_a0);  //off red led
      output_high(pin_a1); //on green led
    }
    else  //if got flood
    {
      txdata='B';
      output_high(pin_c0); //on buzzer
      output_high(pin_a0); //on red led
      output_low(pin_a1);  //off green led
    }

    for(count=0;count<10;count++)
    {
      putc('(');
      putc(txdata);
      putc(')');
      delay_ms(10);
    }
    delay_ms(250);
  }while(1);
}
```

APPENDIX 2

Receiver Source Code

```
void main()
{
 set_tris_a(0b00000001);
 set_tris_b(0b00000000);
 set_tris_c(0b10000000);
 enable_interrupts(int_rda);
 enable_interrupts(GLOBAL);
 setup_port_a(NO_ANALOGS);
 output_low(pin_c4); //stop send sms1
 output_low(pin_c5); //stop send sms2
 output_low(pin_b7); //off red led
 output_high(pin_b3); //on green led
 output_low(pin_c0); //off buzzer
 do
 {
  if(rx_detect==1)  //if any data received
  {
   rx_detect=0;
   if(receive=='B')  //if flood case detected
   {
    alarm_en=1;
    on_timer=0;
   }
   if(receive=='A')  //if no flood case detected
   {
    buz_sta=1;
   }
  }
  if(input(pin_a0)==0 && btsta==1) //if push button pressed
  {
   btsta=0;
   if(buz_sta==0)
   {
    buz_sta=1;
   }
   else
   {
    buz_sta=0;
   }
  }
  else if(input(pin_a0)==1)  //if push button not pressed
  {
   btsta=1;
```

```
}

if(alarm_en==1 && on_timer<80)   //if triggered case
{
  output_high(pin_b7); //on red led
  output_low(pin_b3); //off green led

  on_timer=on_timer+1;
  if(buz_sta==1)
  {
    if(on_sta==1)  //on output
    {
      output_high(pin_c0); //on buzzer
      on_sta=0;
    }
    else
    {
      output_low(pin_c0); //off buzzer
      on_sta=1;
    }
  }
  else
  {
    output_low(pin_c0); //off buzzer
  }

  if(send_flood==1)
  {
    output_high(pin_c4); //enable send sms1
    delay_ms(300);
    output_low(pin_c4);  //stop send sms1
    send_flood=0;
  }
}
else if(alarm_en==1 && on_timer>=80)   //if not trigger case
{
  output_low(pin_b7); //off red led
  output_high(pin_b3); //on green led
  output_low(pin_c0); //off buzzer
  alarm_en=0;
  if(send_flood==0)
  {
    output_high(pin_c5); //enable send sms2
    delay_ms(300);
    output_low(pin_c5);  //stop send sms2
    send_flood=1;
  }
```

APPENDIX 3

GSM Source Code

```
void main()
{
 //set i/o pin for pic
 set_tris_a(0b11111101);
 set_tris_b(0b00000000);
 set_tris_c(0b10000000);
 setup_port_a(no_analogs);
 output_high(pin_a1);
 delay_ms(20000);
 //initialize gsm module
 printf("AT+CMGF=1\r");
 delay_ms(1000);
 printf("AT+CMGD=1\r");
 delay_ms(1000);
 printf("AT+CMGF=1\r");
 delay_ms(1000);
 printf("AT+CMGD=1\r");
 delay_ms(1000);
 //send sms out
 printf("AT+CMGS=");
 putc(0x22);
 printf("+60132190794");
```

```
putc(0x22);
putc(0x0D);
delay_ms(500);
printf("Flood Alarm Started...");
putc(0x1A);
delay_ms(2000);
printf("AT+CMGD=1\r");
delay_ms(1000);
//send sms out
printf("AT+CMGS=");
putc(0x22);
printf("+60133972610");
putc(0x22);
putc(0x0D);
delay_ms(500);
printf("Flood Alarm Started...");
putc(0x1A);
delay_ms(2000);
printf("AT+CMGD=1\r");
delay_ms(1000);
output_low(pin_a1);
do
{
 if(input(pin_a0)==1)
```

```
{
 output_high(pin_a1); //on led
 //send sms out
 printf("AT+CMGS=");
 putc(0x22);
 printf("+60132190794");
 putc(0x22);
 putc(0x0D);
 delay_ms(500);
 printf("Flooding Detected!");
 putc(0x1A);
 delay_ms(2000);
 printf("AT+CMGD=1\r");
 delay_ms(1000);
 //send sms out
 printf("AT+CMGS=");
 putc(0x22);
 printf("+60133972610");
 putc(0x22);
 putc(0x0D);
 delay_ms(500);
 printf("Flooding Detected!");
 putc(0x1A);
 delay_ms(2000);
```

```
printf("AT+CMGD=1\r");
delay_ms(1000);
output_low(pin_a1);  //off led
}
if(input(pin_a2)==1)
{
output_high(pin_a1); //on led
//send sms out
printf("AT+CMGS=");
putc(0x22);
printf("+60132190794");
putc(0x22);
putc(0x0D);
delay_ms(500);
printf("Flooding Level Safety!");
putc(0x1A);
delay_ms(2000);
printf("AT+CMGD=1\r");
delay_ms(1000);
//send sms out
printf("AT+CMGS=");
putc(0x22);
printf("+60133972610");
putc(0x22);
```

```
            putc(0x0D);
            delay_ms(500);
            printf("Flooding Level Safety!");
            putc(0x1A);
            delay_ms(2000);
            printf("AT+CMGD=1\r");
            delay_ms(1000);
            output_low(pin_a1);  //off led
        }
    }while(1);
}
```