Flood Monitoring and Warning System

by

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17363

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CERTIFICATION OF APPROVAL

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Approval by,

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UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

May 2015

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons

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(MUHAMMAD RAMIZU AB HALIM)

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ABSTRACT

Flood is one of the natural disasters that occurs every year in Malaysia and also worldwide. It destroys the infrastructure and causes fatalities. Flood monitoring system can monitor the flood level and warn people upon the danger of the flood. Existing flood monitoring techniques include multi-satellite analysis, image classifications and wireless sensor networks. Unlike the existing systems, this project intends to develop a more robust and durable system which can withstand the wet weather condition. It aims to monitor the water level and alert the authorities as well as notifying victims. In order to do this, the system needs to have the basic information such as water conditions, water level and precipitation level to detect the increase of water level during flood. Two major components consisting of the sensor network and the data transmission were designed in this project. A Global Systems for Mobile communication (GSM) was used as the means of transmitting the water level to the user and rescue team to alert the flood condition.

Table of Contents

List of Figures

List of Table

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Flood is one of the major disasters which effects many people in many countries around the world each year. It damages lives, natural source and environment as well as causing the loss of economic. Figure 1 shows the statistic of the disasters that occurred in Malaysia from 1980 to 2010 [1] including earthquakes, tsunamis, flood and epidemics. Among these disasters, flood records the highest occurrence. The impact of floods has been increased due to a number of factors such as rising sea levels and relentless rain.

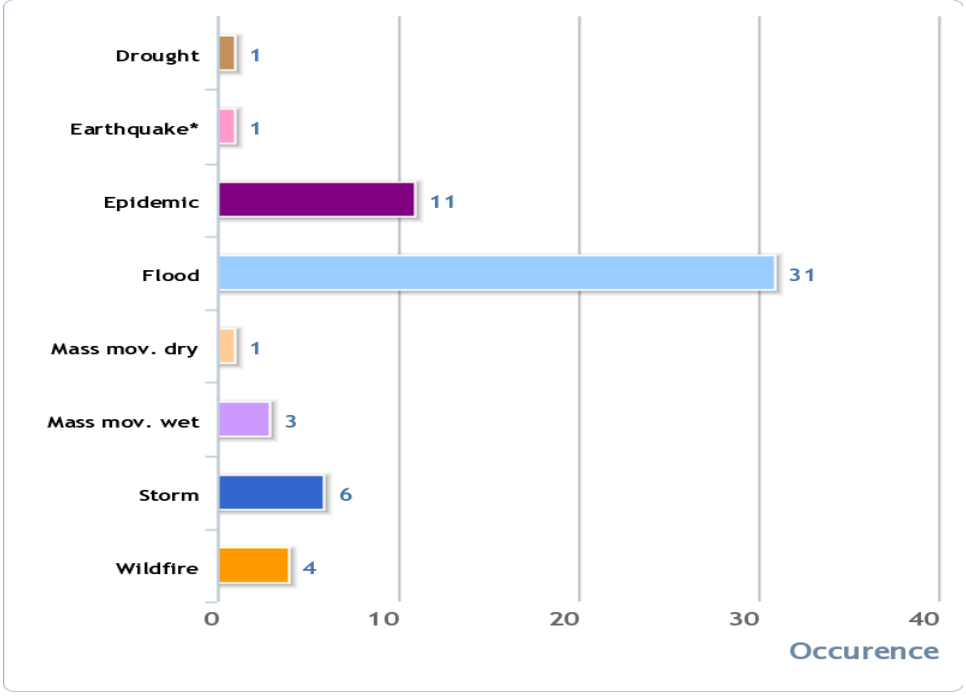

Figure 1: Disaster Statistic in Malaysia [1]

In Malaysia, river flood and flash flood are two common floods that usually occur every year. Flash flood occurs due to slow-moving thunderstorm that repeatedly moving over the same area or heavy rain from hurricane and tropical storms. It takes about several minutes to hours to develop. It can also occurs due to man-made dam

collapse as an example. Normally, flash flood occurs 6 to 7 hours after heavy rainfall, meanwhile river flood occurs longer and lasted a week or more. Flash flood is not seasonal but it can happen anytime and it has certain limitations compared to the river flooding. Normally floodwater moves with fast speed and flash flooding occurs when a barrier holding back water fails or when water falls too quickly on saturated soil or dry soil that has poor absorption ability. Flash floods often occur in a dry place and do not have a good drainage system.

However, river flood (monsoon flooding) happens during local tropical wet season generally around the month of October to March. Flooding occurs when heavy rain lasting for several days or when heavy rain in a short period causes a river or stream water levels submerge to land. Normally, this flood occurs at east coast countries such as Kelantan, Pahang and Terengganu. A river flood is common natural disaster. River flooding causes loss of human life and damages property. Every year, the amount of deaths from river flooding is more than any other natural disaster in Malaysia.

Flood Monitoring system is one of the technologies that can be used to prevent loss of life in floods mainly in the east coast states like Kelantan , Terengganu and Pahang. The alarm system can be integrated into the system to alert public and authorities on flood to avoid loss of life. Such system is called a flood monitoring system with GSM. The system requires the need of telecomunication services from companies like Maxis, Celcom and Telekom Malaysia. The function of this system is to measure the water level of river and when the water level is beyond the threshold level, it will send a notification to the user. This system is specially designed for rescue team such as PDRM, BOMBA and JPAM. With this system, the rescue team will get the water level information and alert the information to the public especially flood victims for evacuation purposes.

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1.2 Problem Statement

Most of the flood monitoring techniques are based on telemetry systems which require transmitters and repeaters to relay the information to a central terminal. This approach is expensive and is not reliable when there is malfunction of equipment in some section of the sensed area. Some other techniques are dependent on the communication infrastructure of some third-party providers making them unreliable. Therefore, there is a need to build a low cost and reliable system using a wireless sensor network.

1.3 Objectives

The objectives of the project are:

- To develop a sensor network device for sensing water level
- To develop processing and transmission units using GSM

1.4 Scope of Study

This project focuses on the nearby area that is affected by recent flood at Sungai Perak. The proposed system was installed and tested at Rumah Pam Sungai Perak with the permission and consultation from Department of Irrigation and Drainage (JPS) Perak Tengah. Water level data was collected and updated from time to time to monitor the changes in the water level. The project utilizes the mobile GSM network to trigger the flood incidents to the user.

CHAPTER 2

LITERATURE REVIEW

2.1 What is Flooding?

Flooding is a situation in which water from a river or from rain covers large areas of land. It is also defined as a temporary rise of the water level, as in a river or lake or along a seacoast, resulting in its spilling over and out of its natural or artificial confines onto land that is normally dry. Flooding in Malaysia is a normal phenomenon occuring every year. It usually occurs in low surface area and exposed to the river. It can occur at the city or metropolitan area like Kuala Lumpur, Johor Bharu and Pulau Pinang due to the limited drainage systems which fail to bear the excessive rain water.

According to [2], flooding commonly happens at the dry area, but suddenly gets submerged under water. Flooding can happen all of a sudden and retreated rapidly. It also takes a long time for the water to recede. Flood can also occur at irregular intervals and vary in size, duration and area affected. During flood, water flows from high area to low lying area. This means low-laying areas might be flooded quickly before it starts to get to higher ground. This can be illustrated by Figure 2.

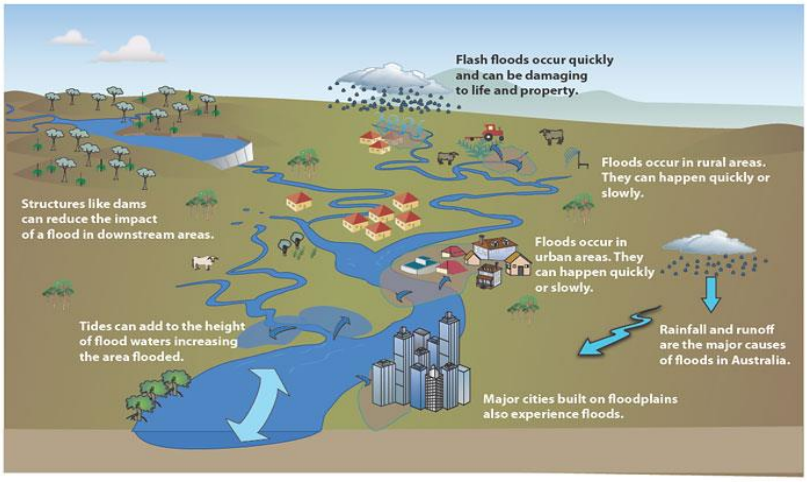


Figure 2: Flood Flow [2]

2.2 Types of flooding within Malaysia

2.2.1 Flash Flooding

Flash Flood is a short-term flood, normally occurs within 6-7 hours of the heavy rain and often within 2 hours of the start of high intensity rainfall. Figure 3 shows the flash floods. It can be described as a rapid river rise with depth of water that can reach beyond the river. It most likely to occur in areas adjacent to the river. Flash flood can also happen when there are thunderstorms that occur in the same areas. At the same time, when storms move faster, flash flooding is less likely to happen because the rain is moving into a wide area. It can also occur even if no rain has fallen like operations such as after levees or dams have failed, or after the release of a sudden the water by debris [3].

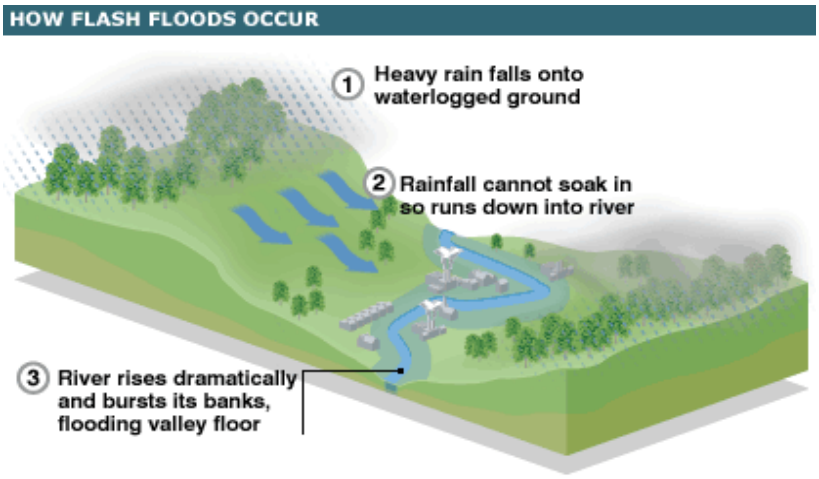


Figure 3: How Flash Flood Occur [3]

2.2.2 River Flooding

Floods are natural events every year. Usually, that occurs at east coast state such as Kelantan, Pahang and Terengganu. It depends to movement of the monsoon and occurs on October to March every year within Peninsular Malaysia. It can occur at Sabah and Sarawak state. River flood is almost similar to monsoon flooding because river flooding depend on the heavy rainfall. River floods happen when the river catchment that is the zone of area that supports water into the river and the streams contains excess water level, for example, through precipitation. The river can't adjust the precipitation during heavy rain and this additional water causes the water level in the river to increase and floods to happen. The river floods may take place at any areas along the river course.

River flooding can also occur when a river or stream to flood stage, and the water will rise and spill over the banks of the river. Number of river flooding from rainfall usually depends on an area, the amount of time required for the rain to gather, before saturation local land and the land around the river system. For example, a river or stream that is in the board, flat floodplain will often produce a continuous flood and flood waters in an area that does not subside for long periods. The most river flooding occurs at the low-lying place and adjacent to the river [5]. Figure 4 shows river flood occur. The impact of river flooding can be fatal if a flooding river overflowing quickly. It causes loss of life due to drowning, loss of property and causes disruption of living [4].

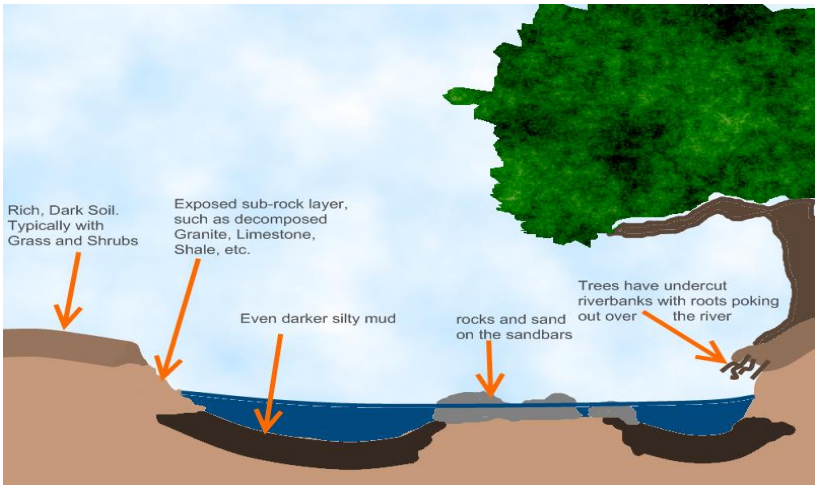


Figure 4: How River Flood Occur [5]

2.3 Floor Monitoring and Warning Technologies

There are two common flood systems implemented namely flood monitoring and warning system and flood monitoring alone. Section 2.3.1 will describe the flood monitoring and warning system while Section 2.3.2 will describe the flood monitoring system without the warning system. This project falls under the category described in Section 2.3.1 with different approach in alerting using the SMS system.

The following sections provide an overview of existing technologies used for flood monitoring and warning system and flood monitoring system.

2.3.1 Flood Monitoring and Warning System

Flood monitoring and warning system using real-time sensor is one of the flood controls measures. This system not only monitors the flood but also has some warning or alert mechanism to notify people. Losses due to flooding can be reduced by measures such as monitoring, forecasting, simulation and evaluation of water level [6]. According to [7-8], one of the measuring flood systems is using a wireless sensor and web – based decision support system in monitoring, controlling, relieving, and assessing natural disasters, particularly flood disaster. Implementation of the monitoring and flood warning system is not unimportant, if not it requires reliability coupled with the correct information. The sensor network is one of the sensor technologies used to detect the level of increase in the water level and air temperature. The sensor network in this case is a pressure sensor, temperature sensor and rain sensor. In the work [3], sensor nodes are placed on the tree by the river to measure the water level and air temperature in the river and the data is recorded every 5 minutes and transmitted to base station via GPRS systems.

One limited factor in the system is the factor of distance in which each sensor node has restricted distance and having the frequency which is fixed. In project [9], each sensor node used 144MHz as a frequency and in communication range is 25km. For example, field testing will has a lot of sensor nodes in order to communicate smoothly and less signal losses. Each sensor node needs to update the state of the river water to the base station. Figure 5 shows the architecture of the system in [9] and explains how the nodes communicate.

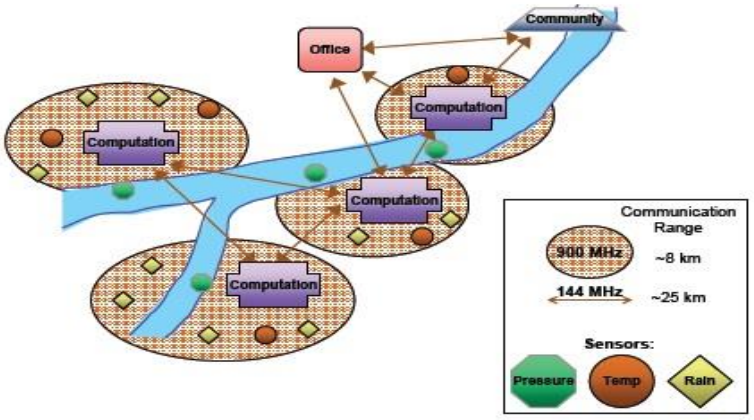


Figure 5: Sensor Network consisting of four node [9]

In the wireless sensor network there are many types of sensor used such as Honeywell pressure sensor, instrumentation amplifier and computation electronic. In project [10], three types of sensor nodes are used. The first sensor is a hydrological sensor, where this sensor serves to monitor the water level and water flow. The second sensor is a meteorological sensor nodes used to monitor light, temperature, humidity, barometric pressure, wind pressure and wind speed. The third sensor node [10] is landslide, used as a detection area exposed to the hazard.

2.3.2 Flood Monitoring System

Flood monitoring system is different from flood monitoring and warning system as it does not have an alerting mechanism. According to [15], almost flood monitoring system is associated with flood forecasting to make decisions about whether flood warning shall be issued to the public or whether previous warnings should be canceled or withdrawn. Figure 6 shows different conditions between normal and flood.

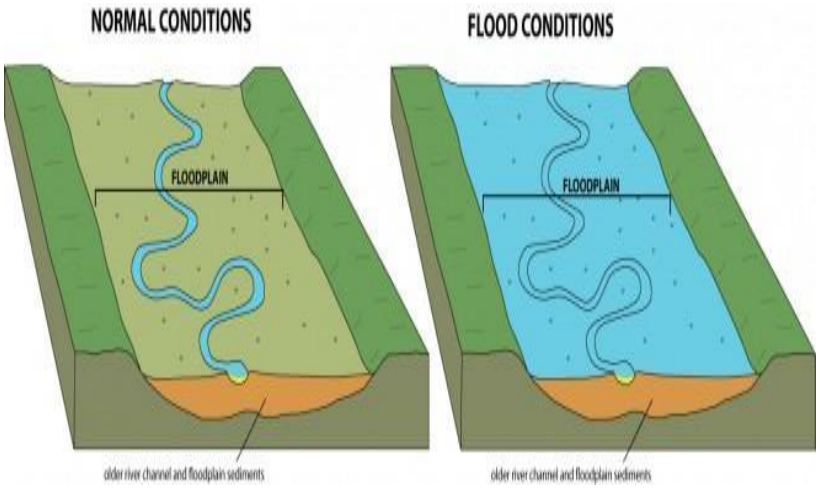


Figure 6: Normal Conditions and Flood Conditions [15]

Pakistan, Thailand, Hong Kong and many others have flood monitoring systems. In Malaysia, the government has set up a team or department to control and give warning to the state's major rivers which are prone to flooding. Authorities also play an important role to ensure that survivors of the flood affected population. Authorities also need to help the residents to evacuate. In the flood situation, many parties need help to alleviate the burden of population vulnerable to flooding. This system is designed to warn about the state of the adjacent river water.

2.4 Calculation System

This system uses an ultrasonic sensor to measure the distance of water level at the river. The microcontrollers do the processing using the measurement data from ultrasonic sensor. In this case, this system used the Arduino ATMega328 as a microcontroller. Ultrasonic (PING) has two transducers. Each transducer has a role. The transducer knows as emits a pulse of high frequency sound sounds waves and detect reflected sound waves that impact a surface such a water level.

Distance of ultrasonic can be determined with the measuring the time interval between sending the pulse and receiving the reflection or echo and convert the distance based on the speed of sound. This sensor can be used any application and to perform measurement between moving or static object [11]. The signal emitted by the ultrasonic transmitter frequency 40Hz and handled by transmitter circuit. The propagation range of transmitter 340 m/s with sound velocity. For receiver, the signal

will reflected by the ultrasonic receiver, then the receiver signal will be processed to calculate the distance. The distance is calculated by this formula ***S = 340t/2,*** where S is the distance between ultrasonic to the reflected field, and t is difference of timing between transmitter and receiver.

2.5 Jabatan Pengairan Dan Saliran Malaysia System

For Malaysia, Drainage and Irrigation Department is a department that was established to investigate the current state of the water level in the river [13]. Drainage and Irrigation Department (JPS) Malaysia uses several ways to measure the water in the river face, one way is a telemetry where the sensor will be placed under the pump house. The telemetry acts when the water looks up and exposed on the sensor and the sensor deliver the data to the host in the space provided. In that position also provides data water level through the website. The data will updated every 1 hour to the website application, this system shows in Malaysia only have one way to monitor and alert of the flood. In telemetry systems just only detect the water level. Figure 8 shows that the data contained in the water at the Perak State River and figure 7 shows the hydrograph for Sungai Perak at Parit in Perak Tengah.

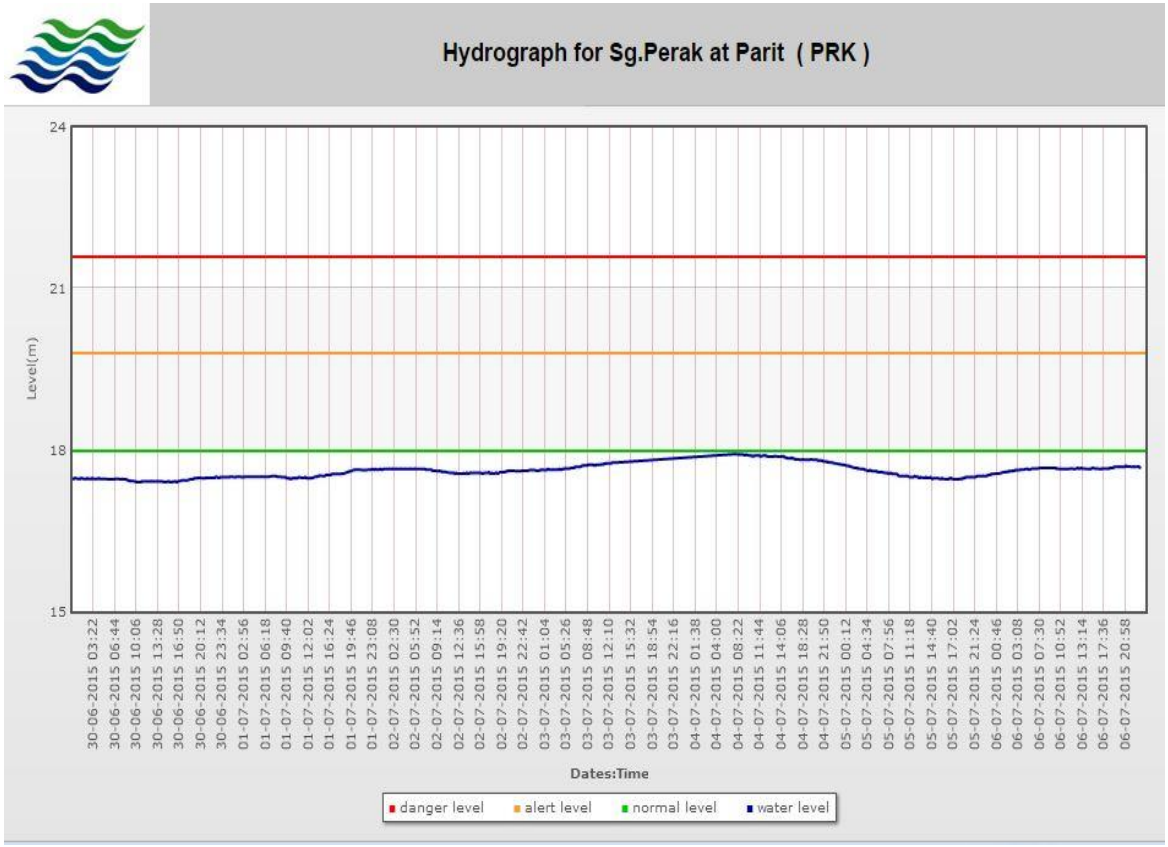


Figure 7: Graph of water level in Sg Perak, Parit

StationID (Photo)	Station Name (Cross-section)	District	River Basin (Trend)	Last Update Time	River Level (Graph)	Normal level	Alert Level	Warning Level	Danger Level
3907403	Pasang Api	Hilir Perak	Sg.Perak	06/07/2015 - 22:00	0.58	1.00	3.00	3.30	4.00
5108401	Sg.Ijok di Bekalan Ijok	Selama	Sg.Kerian	06/07/2015 - 23:00	33.24	29.00	35.00	35.15	35.50
5206432	Sg. Kerian di Selama	Selama	Sg.Kerian	06/07/2015 - 22:45	7.72	10.00	12.00	12.30	13.00
5005405	Samagagah	Kerian	Sg.Kerian	- 00:00	-99.99	0.00	0.00	0.00	0.00
4907422	B14BatuKurau	Larut Matang	Sg.Kurau	06/07/2015 - 23:00	20.77	23.50	24.00	24.70	25.40
5007421	Sg.Kurau di Pondok Tanjung	Selama	Sg.Kurau	06/07/2015 - 22:30	10.53	13.00	15.00	15.24	15.80
5006401	Kolam Air Bukit Merah	Kerian	Sg.Kurau	06/07/2015 - 23:00	8.25	8.68	9.00	9.04	9.14
5513401	Tasik Temengor di Banding	Hulu Perak	Sg.Perak	06/07/2015 - 23:00	243.87	240.00	247.00	247.69	248.38
4911445	Sg.Plus di Kg.Lintang	Kuala Kangsar	Sg.Perak	06/07/2015 - 23:00	52.54	52.00	54.00	54.24	54.80
4809443	Sg.Perak di Jam. Iskandar	Kuala Kangsar	Sg.Perak	06/07/2015 - 23:00	31.85	32.00	35.00	35.65	36.30
4409401	Sg.Perak di Parit	Perak Tengah	Sg.Perak	06/07/2015 - 23:00	17.68	18.00	19.80	20.70	21.60
4310401	Sg Kinta di TanjungTualang	Kinta	Sg.Perak	06/07/2015 - 23:00	10.71	10.00	13.00	13.75	14.50
4209493	Sg.Perak di Teluk Sena	Perak Tengah	Sg.Perak	06/07/2015 - 22:30	8.93	8.50	11.00	11.90	12.80
4109401	Sg.Perak di Kampong Gajah	Perak Tengah	Sg.Perak	06/07/2015 - 23:00	5.07	5.00	6.50	6.65	7.00
4611463	Sg.Kinta di Tanjung Rambutan	Kinta	Sg.Kinta/Sg.Perak	06/07/2015 - 23:00	64.29	65.00	66.50	67.15	67.80

Page 1 of 2 Next

Figure 8: Example of Water Level Data from Perak State

2.6 Flood Stage

In this flood there are several stages to be considered as a reference to the authority. The authorities must know about flood stage as easy to make estimates about the flood. According to [14], shows the types floodstage taken into account by all authorities to conduct flood control system. Floods have a five categories stage levels in Table 1:

Table 1: Stages Level of Flood in River

Stages	Description
Action Stage	• In the river normally at this level, water surface is a generally near or slightly above top of banks. In this level no man-made structures are flooded. Usually these water overflowing is limited to small area of parkland
Minor Flood Stage	• In the river, the minor flood can occur in this level, for this level the road may be covered with water. The lawns or field also can inundate with the water.
Moderate Flood Stage	• For the river, this stage can be begins at the road, the road are likely to be closed and area cut off. Normally this stage occur on monsoon flooding. This stage also mostly occur at East Coast State (Malaysia)
Major Flood Stage	• This stage is very important for this project because this stage have a disaster, threatening floods. Major flooding in several low-lying zones flooded really possible. May be the structures is totally immersed. Large-scale relocation may be necessary
Record Flood Stage	• At this stage, the river is at its highest it has been since records began for the area in which the flow gauge is located. This does not imply a major flood. Some areas may have never experienced a major flood, and with it the record level is in the medium category.

2.7 Features of Proposed

Table 2 shows the features of this project. This project is more user friendly and easy to use by everyone at the time of this cutting-edge technology. This project is the innovative or upgraded systems. This project is also in line with the modern technology.

Table 2: Features of proposed

Features	Description
• Water Level	• In this project, there are used ultrasonic to measure of water level this project is more robust and longer lasting than the system previously contained in section 2.3.1 and 2.3.2.
• Fast Notification	• With the Implementation of this project will be able to find out information or circumstances flood water level in the river with a faster and more efficient.
• Field Testing	• The project can be implemented in real environment. To make field testing, it will make a collaboration with the Department of Irrigation and Drainage

CHAPTER 3

METHODOLOGY

3.1 Project Methodology

This project uses GSM technology and ultrasonic sensor to detect the water level and sends data to a rescue team to serve as a warning. Rescue team can get data processing based on the results of point prediction model to trigger timely warnings (Short Message System) and give the information to the stakeholder that are exposed to floods. For the warning system using ultrasonic sensor to be used as a marker or detector water level in the river and this system will send SMS alert via GSM system. GSM also serves as a modem for transmission to the satellite so that the rescuer can know information about the water level in a river vulnerable to flooding.

In this project, will be used as an ultrasonic sensor network to detect the level of water in major rivers prone to flooding. Ultrasonic sensors will be placed in containers such as PVC pipe measuring 100mm circumference, ultrasonic be placed in PVC pipe. The length of the pipe shaft in 6 meters. Pipe will be placed on the surface of the normal condition of river water. Three different levels are marked on the PVC pipe to indicate the water level. At level 1 will be set as a normal situation, no level 2 will be set as cautious level and at the level of 3 would set a dangerous level. The measurement of this level shown at Table 3. Arduino is known as node 1 and the data will be sent to node 2, node 2 will transmit to the base station. At node 2, it serves as a GSM system where it is processed in the form of SMS and send it to the population or the authorities. Figure 9 shows how the concept of project works.

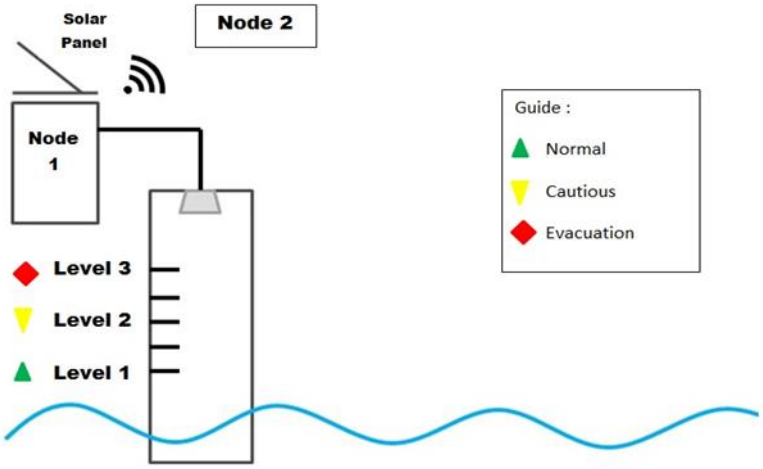


Figure 9: Sensor Network Works

Table 3 shows the ultrasonic measurement is divided to three levels, which is known as the normal level, middle level and danger level. Usually normal level is labeled as a safe level. While for the middle level, it indicates an impending flood or overflow of the river and the authorities or residents should be vigilant on possibility of flooding to occur. At the level of danger, residents should be prepared to move to higher ground or safe place as over the hill and schools. The authorities also should act more quickly to help or rescue flood victims.

Table 3: Label of Level

Level	Measurement Between Water Level to Ultrasonic Sensor
NORMAL	>> 4 Meter
CAUTIOUS	2 to 4 Meter
EVACUATION	2 Cm to 2 Meter

3.2 System Architecture

This project uses the solar system to turn on the system. The system uses GSM shield. Ultrasonic sensor will send a signal to GSM shield and GSM shield will process the data to send short message to the authorities or communities affected by floods. When Ultrasonic Sensor act as input. This system combines ultrasonic sensors and GSM shield in a microcontroller. Figure 10 shows system architecture.

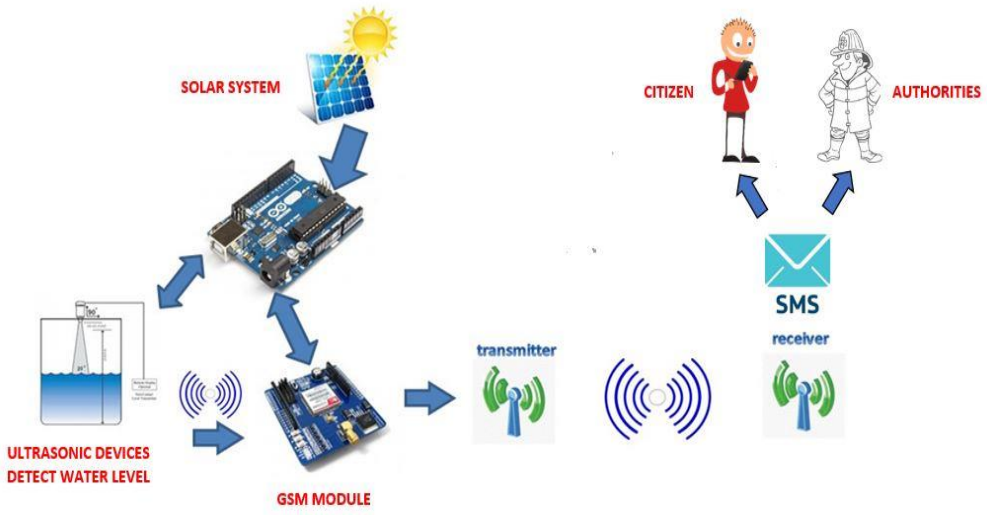


Figure 10: System Architecture

Solar panels act as electricity, it will generate 5.5v to turn on the wireless sensor network. At the time of day, solar panels to charge the battery also acts where it also serves as a battery switch on the wireless sensor network at night. This ultrasonic sensor and GSM Shield requires only a 5v 0.2A to be turned on.

3.3 Installation

For the installation process, the project is divided into two installation where an in-house testing and field testing. This project has been working with the JPS Perak to make installation on the river.

3.3.1 In-House Testing

For in-house testing process, was using some appropriate tools such as the water container, tape, PVC pipe, and water taps. The figures 11 below shows a set of prototype that has been installed.

Figure 11: In-house Testing Unit

3.3.2 Field Testing Rumah Pam, Parit

To prove this concept, the project has been installed at Sungai Perak at Rumah Pam,Parit. This installation is intended to prove that the system works and able to measure the increase in water level. Among the equipment used is PVC pipe, ultrasonic sensor and water float. Figure 12 shows installation in the field testing.

Figure 12: Field Testing at Rumah Pam, Parit

In this installation, the measurement of ultrasonic sensors is depending on the actual water level measurement at the pump house at Trenches. The measure is included in the next chapter.

3.4 Sensing Systems

For starters, the system uses ultrasonic sensors with a microcontroller board installed. The main task is the ultrasonic sensor to calculate the distance between the surfaces of the water and the ultrasonic sensor. For in house testing, the ultrasonic sensor is mounted on the container in Figure 31.

Figure 13: Ultrasonic installed on the container

Figure 14: Pump House at PerakTengah

Figure 15: Ultrasonic installed in field testing

For field testing, this system will be designed and installed in the PVC pipe to be placed in the pump house. PVC pipe is installed according to the applicable place in the pump house such as in Figure 13. The maximum distance it can measure is 400cm. This system will be set according to how much the water level in the pump house. Normally, the normal water level in the pump house is less than 400cm, it means this system can be applied. Figure 15 shows a pump house located in the area Perak Tengah be used for testing field.

The flow chart below shows how ultrasonic sensor operates and give the signal to GSM shield Ultrasonic sensors will be tested and installed. When the water level rises in the set, it will give a signal to be sent to the GSM shield and when the water is at normal levels, it will not give any action.

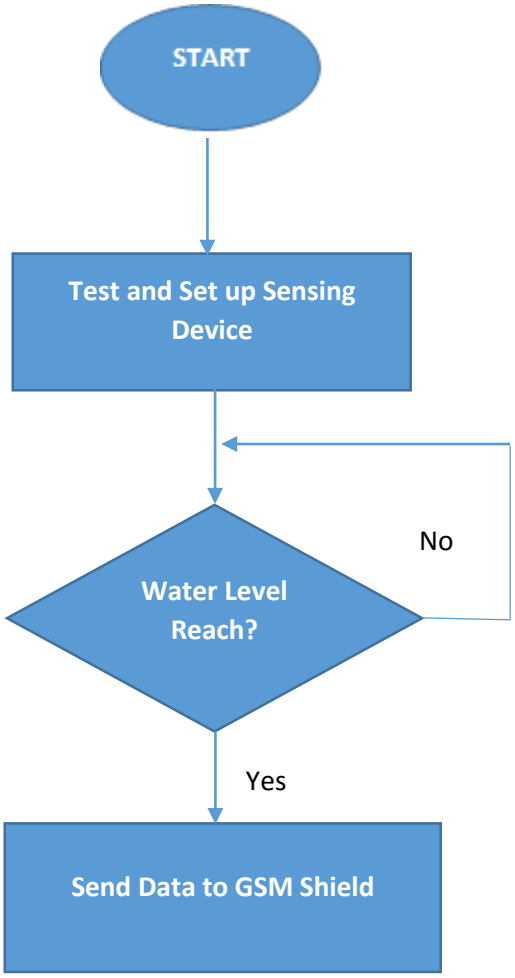


Figure 16: Flow Chart Sensing Device

This data will be sent to the GSM shield system make the send SMS process. This configuration can communicate with each other. For example, after the GSM shield it will send SMS alert to receive new signals from sensing systems. While sensing system can communicate with GSM configuration if got ultrasonic sensor data on the state of water in the river.

3.5 GSM Configuration

In the GSM configuration, the GSM Shield is installed inside the microcontroller along with the ultrasonic sensor. GSM Shield is the main function of processing data in the form of SMS and send SMS to the people who are exposed to flooding or the authorities. To send an SMS, this system requires programming to operate.

In GSM shield have an antenna and the network SIM card slot. This project uses a CELCOM network for sending SMS. When turn on GSM, the antenna will find the network to send SMS. Figure 17 shows the GSM installed with Arduino microcontroller.

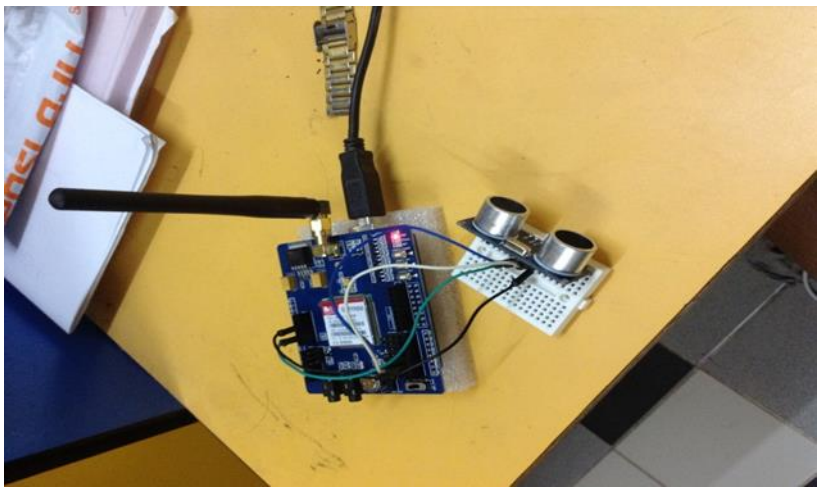


Figure 17: GSM Shield installed with Microcontroller

GSM Shield will process to send SMS alerts to the base station before sending to the authorities of the population. If got data from sensing systems, it will communicate with the base station for SMS system. It will be explained according to the flow chart 2 IN figure 18.

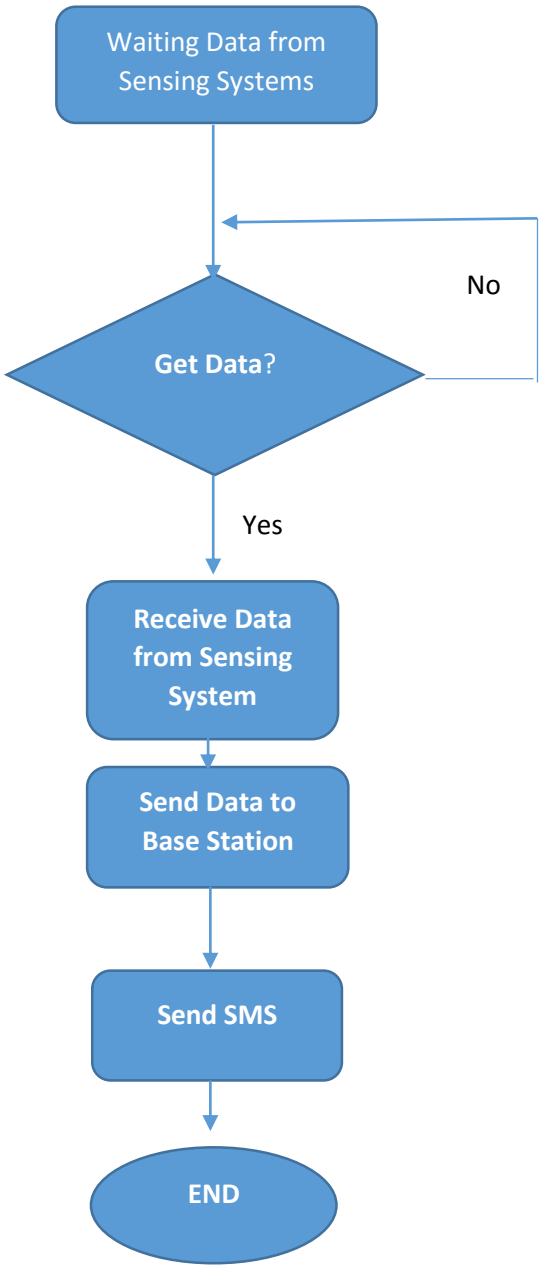
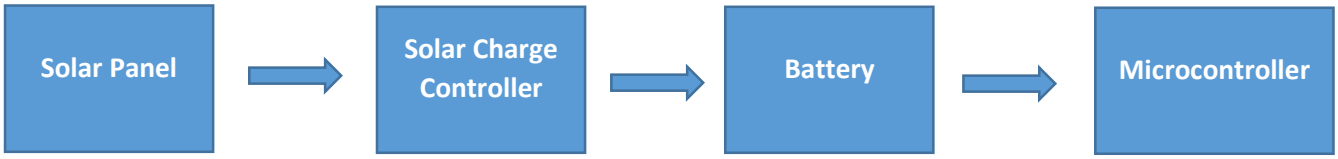


Figure 18: Flow Chart of GSM Shield

This flowchart represents the whole process flow for this project covering FYP 1 and FYP 2 phases. At the end of the project, a written report will be submitted to the academic board consisting of detailed information. This flowchart represents the whole process flow for this project covering FYP 1 and FYP 2 phases. At the end of the project, a written report will be submitted to the academic board consisting of detailed information and analysis of the project on and analysis of the project.

3.6 Solar System

To turn on these projects requires Solar as a power source. In the solar system, there are a few equipment such as solar controller and lead acid battery. This project uses a voltage 5v and current 500mA.



3.6.1 Solar Panel

The solar panel is a tool that has environmentally friendly. Solar panel function is to generate voltage and current to the battery and load. In this project using solar panel 6V 3A. The output of solar will be sent to a battery to charge the battery. Solar input is from the sun. The solar normally work in the afternoon. The figure 19 below shows the solar panels used for this project.

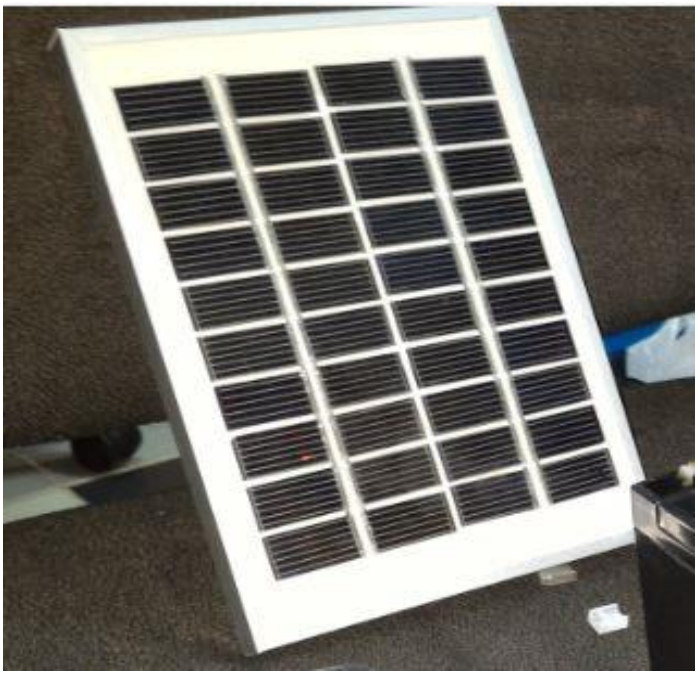


Figure 19: Solar Panel 6V 3A

3.6.2 Solar Charge Controller

Solar charge controller is a device that controls the overload current and voltage. Current and voltage overload occurs when the solar panel is not functioning properly. Solar charge controller has one input and two outputs, where the input from solar and the output from the battery and the load. The figure 20 below shows the solar charge controller used for this project.

Figure 20: Solar Charge Controller

3.6.3 Lead Acid Battery

Lead Acid Battery is a battery that can be used in this project because it has a rechargeable and durable. Lead Acid Battery 6v 12Ah used there, it is connected to the solar charge controller to turn on the load. The figure 21 below shows the solar charge controller used for this project.

Figure 21: Solar Charge Controller

3.7 Engineering Tools and Software Tools

Major of Engineering Tools:

Table 4: Major of Engineering Tools

Engineering Tools	Specification
• Arduino (ATMega328)	• Input: 5~12 Volt (50mA) • Temp Range: -40˚C to 80˚C • Max I/O Pins: 26
• Ultra Sonic Sensor	• Input: 3.3~5 volt • Distance: 2cm-400cm
• GSM Shield	• Input Power: 5volt • Output: SMS texts

To run this project should have an engineering and software tools. To produce quality work should choose engineering tools correctly. Every engineering tool has its own function.

For this project, it must choose the correct specification to avoid any errors. Table 6 shows the major of engineering tools and Table 5 shows an electricity of sensor network tools

Power Electricity for Sensor Network:

Table 5: Power for Tools

Engineering Tools	Specification
• Solar Panel	• O/P: 6V • Power: 3W • Current: 300mA
• Battery Lead Acid 6V 12Ah	• Capacity: 12Ah

Software tools to be more focused on simulation, report writing and research. These projects have three types of software as shown in Table 6.

Table 5: Software Tools

Software Tools	Function
• Arduino	• Microcontroller board programmer
• Word	• Writing a Report
• Power Point	• Proposal Defense / Final Viva

3.8 Key Milestones

FYP 1 Key Milestones

Progress of the project is observed according to the key milestones as stated in Final Year Project 1 (FYP 1) timeline in Figure 22. This milestone shows what the planning for this semester. Referring to the timeline, there are several milestones which the author needs to comply, in order compensate with the academic standard required and procedure.

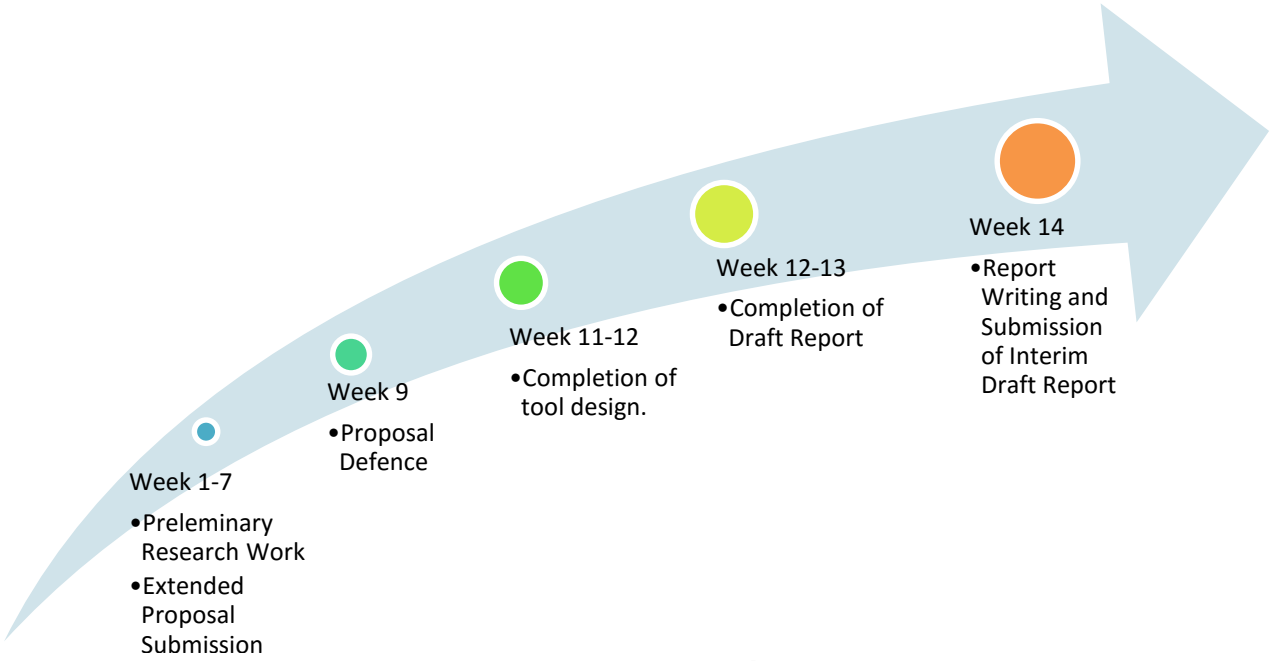


Figure 22: FYP 1 Timeline

FYP 2 Key Milestones

In Final Year Project 2, this milestone shows the planning and progress for this semester. Referring to the timeline, there are several milestones which the author needs to comply, in order compensate with the academic standard required and procedure

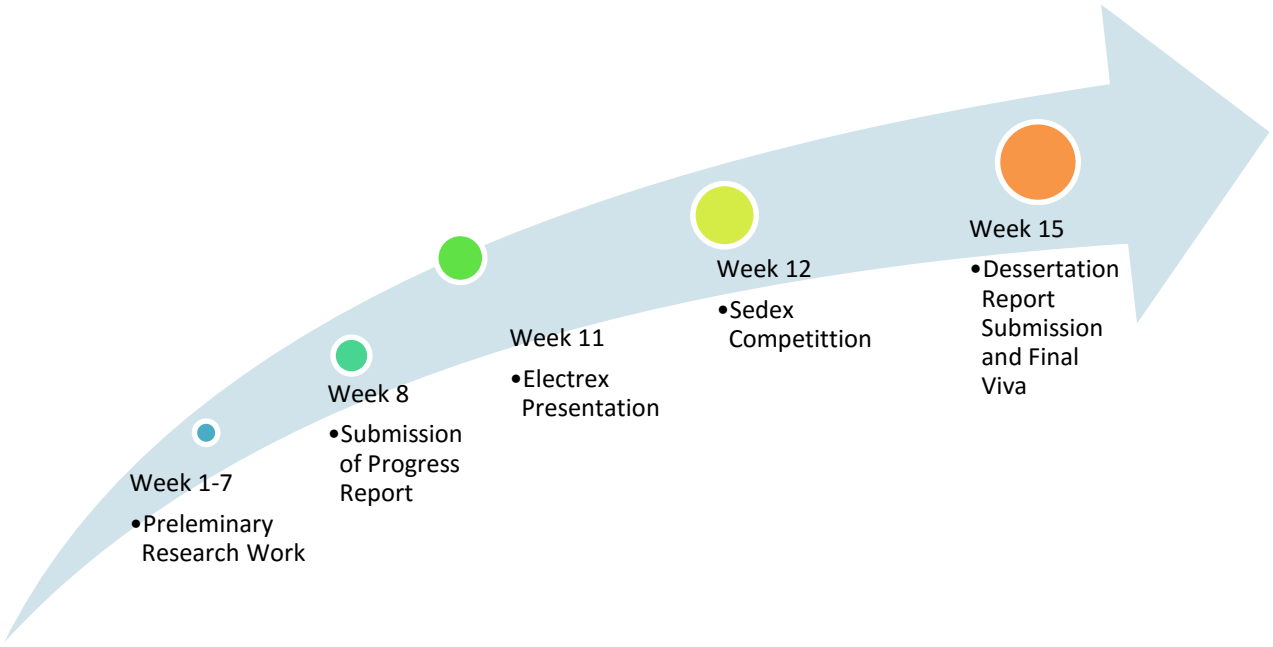


Figure 23: FYP 2 Timeline

3.9 Gant Chart

Table 7 and 8 is the Gantt chart for FYP I and FYP II

Final Year Project I Gantt Chart

Table 6: Gantt Chart FYP 1

No	Activity / Time	Semester Week													
		2015													
		Jan		Feb				March				April			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Project Title Research														
2	Research and prepare extended proposal														
3	**Submission of Extended Proposal**														
4	Algorithm design and preparation of proposal defence														
5	**Proposal defence presentation to supervisor and external examiner**														
6	Development of algorithm														
7	Demonstrate algorithm and prepare interim report														
8	**Submission of Draft Interim Report**														
9	**Finalization and submission of Interim Report**														

Final Year Project II Gantt Chart

Table 7: Gantt Chart FYP 2

No	Activity / Time	Semester Week													
		2015													
		May				Jun				July				August	
		-	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Debugging of algorithm															
2	Development life cycle, Implementation, and testing															
3	**Submission of progress report**															
4	Deployment and finalization of system															
5	**Pre-Sedex presentation**															
6	**Submission of draft final report**															
7	**Submission of Dissertation (soft bound)**															
8	**Submission of Technical Paper**															
9	**Viva**															
10	**Submission of Project Dissertation (Hard Bound)**															

CHAPTER 4

RESULT AND DISCUSSION

This chapter discusses the result and discussion. This system can be divided 3 categories, the sensing test, GSM modem test and solar system test within the microcontroller. This system consists of the software and hardware test and designed.

4.1 In-House Testing Result

To make a measurement of the water level, ultrasonic can detect rise of the water at the river. When the water level increase the ultrasound will give an alarm to give a signal. Usually, the ultrasonic can make a measurement, the range of measurement 10cm to 400cm for the water. In this project, ultrasonic will connect to the Arduino to control the water level in the river. But for now, this project just made some measurement between 5cm to 30cm because for this project need provide the prototype. This project has made some algorithm to make the ultrasonic works. The table 8 shows below, measurement of ultrasonic sensor from water to ultrasonic sensor

Table 8: Measurement of Ultrasonic

LEVEL	DISTANCE	NOTICE	ACTION
SAFE	=>20 cm	-	No Need for Relocation
LEVEL 1	19cm>15cm	WARNING-level 1-!	No Need for Relocation
LEVEL 2	14cm>10cm	WARNING-level 2-!	No Need for Relocation
LEVEL 3	9cm>0cm	WARNING-level 3-!	Relocation

4.2 Field Testing Result

For field testing results, the movement of water doesn't change significantly due to a major flood occurred on the custom during the monsoons. Field testing takes only 10 days. Result in figure 10 shows changes water level at Sg Perak, Parit.

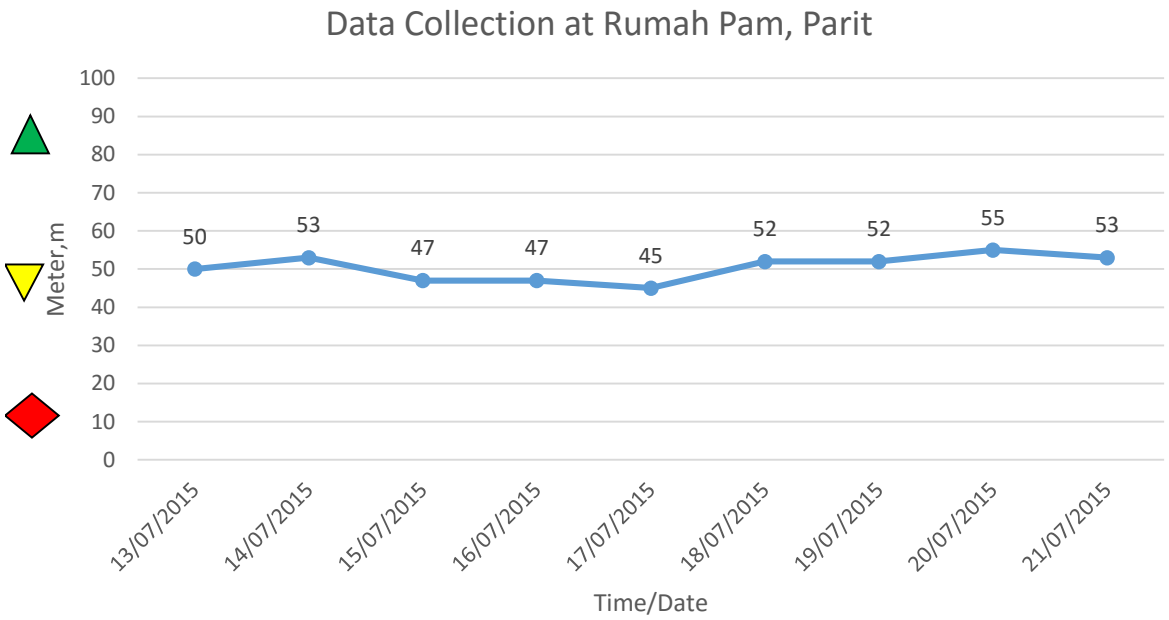


Table 10: Range of Ultrasonic sensor in field testing at Rumah Pam, Parit

Condition	Range (m)	Level	Status
▲	81 - 100	Level 1	Safe
▼	41 – 80	Level 2	Caution
◆	0 - 40	Level 3	Relocate

4.3 Sensing Results

Ultrasonic Sensor is the most important tool for this project. It is known as a sensor network. The tools used for detecting water levels rose in some degree. Ultrasonic used for this project is the HC-SR04. This model has had to detect object distance. The maximum distance to detect the object is 4 meters. While the minimum distance is 2 cm. It also has a 5v to power

on. Ultrasonic sensor has four pins, each pin has its own function. 4 pins are Vcc, Trigger, Echo and GND.

This ultrasonic have a 4 pins. The first pin from right is a Vcc, it acts as a power on the ultrasonic sensor. Normally, this ultrasonic connected to the Arduino. Vcc got the power turn on from Arduino. Vcc need 5v to turn on this ultrasonic. However, the next pin is a trigger pin, it will be used to send the signal. The next pin is an echo pin, it works as to listen for returning the signal. For the GND pin, only for the Grounded. All pins should be connected to the Arduino.

From this circuit, the author will get some data. For this experiment, the author uses only short distances because of not having enough time to do field testing in appropriate places. Figure 24 shows the step ultrasonic sensor after got the data.

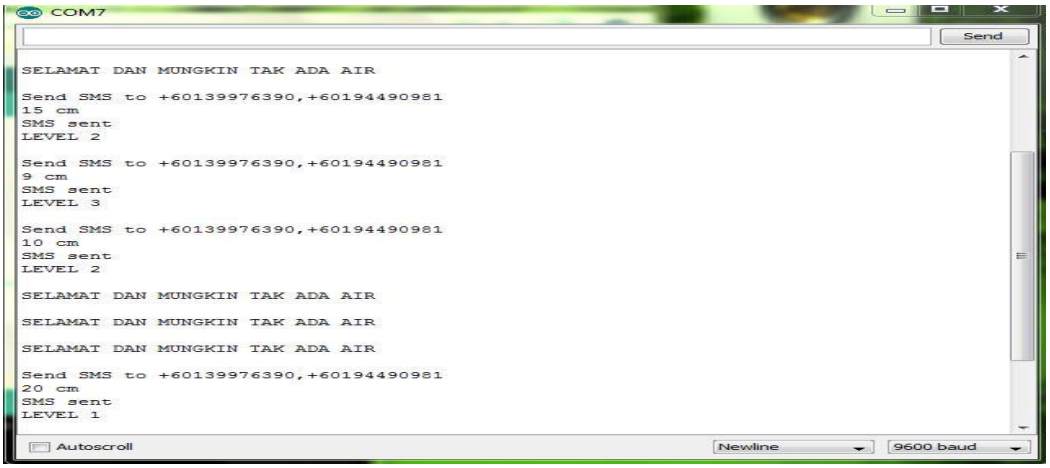


Figure 24: Result from prototype

4.4 GSM Modem Test

For SMS system, the author used a GSM modem as a medium between nodes to base station. In this project using GSM modem IComsat Sim900 GSM/GPRS module. For this tool usually uses as to send SMS to mobile. In this SMS system will implement to the citizen or authorities to make a preparation for evacuation in place.

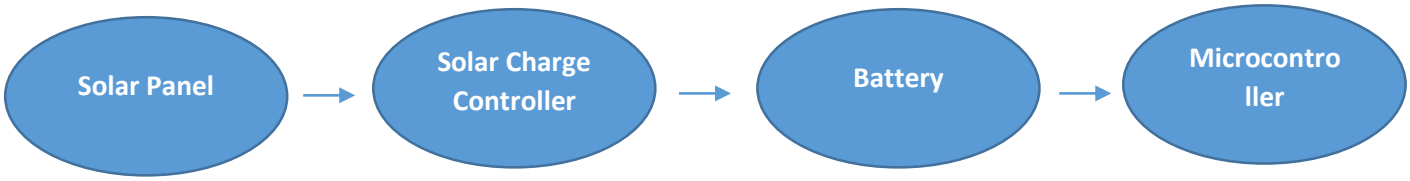
Apart from sending SMS, it can also receive SMS from mobile. It also can make incoming calls as a voice call. By using this tool, it can also be connected to the internet via GPRS system. This shows the GSM system can use many functions. But in this project is focused only on the SMS system. The author has made the SMS system by entering a text message, the process is using the Arduino software. The author will try to combine GSM with Ultrasonic sensor in the coding. Figure 25 shows GSM modem work with sent SMS. In this tool have some command will be consider which AT Command. AT Command used in this system as a modem. AT Command have special coding to send the SMS to mobile phone.

Figure 25: SMS system from GSM Modem

4.5 Solar System

Solar is a component that acts as a power source. Microcontroller need 5v 500mA for operation. In the solar system, there are several other components like battery and solar charge controller. Each component has its own function. For example, solar charge controller can control excessive overload voltage and current. While the battery is used to stabilize and

energize microcontroller. Microcontroller act as load in this solar system. This block diagram shows the connections between the components that should be included in this solar system.



Voltage is applied to solar6V, 3AA. This is consistent with the power on the microcontroller. Solar battery charging will act to give voltage and current to the microcontroller from the battery. This system requires a 5v to turn on the microcontroller. 5v is taken from lead acid batteries. The capacity of the battery is a 12Ah. This means current form will be deducted to the microcontroller. Microcontroller need only 500mA to turn it on. If calculated, lead acid batteries can be used for 24 hours to turn the microcontroller. Figure 26 shows the overview of the solar system solar system

Figure 26: Overview of Solar System

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This work proposed the development of the technology for disaster control in Malaysia mainly for flooding disaster to minimize the loss of property and life. This project can help authorities to control the flood situation throughout Malaysia through the use of robust sensor network system compared to the existing systems. The prototype of the proposed design was successfully built and tested in-house and in the field of Sungai Perak. It was able to record the water level and transmit the data to the base station using the GSM technology.

5.2 Recommendation

For future recommendation, in addition to the use of SMS system, a web application can be implemented and the number of sensor nodes can be used to develop a more complete system. Various sensors should also be implemented to have more flood measurement parameters.

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APPENDICES

Arduino Coding:

```
#include <SoftwareSerial.h>
SoftwareSerial SIM900(4, 5);
#include <GSM_Shield.h>
# define LED 13
# define trigPin 7
# define echoPin 6

//*************************************************************************
**********
char number[]="+60139976390";  //Destination number
char text1[]="FIRST WARNING-level 1-!!!!!!!!";  //SMS to send
char text2[]="SECOND WARNING-level 2-!!!!!!!!";  //SMS to send
char text3[]="LAST WARNING-level 3-!!!!!!!!";  //SMS to send

//*************************************************************************
**********

GSM gsm;
int error;
int sensor1 = 0;
int sensor2 = 0;
int sensor3 = 0;
int state_new = 0;
```

```
int state_old = 0;
long duration, distance;

void setup()
{
  pinMode (LED, OUTPUT);

  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);

  Serial.begin(9600);
  Serial.println("system startup");
  Serial.println("waiting");


  SIM900.begin(19200);
  SIM900power();
  delay(20000);  // give time to log on to network.
}
void SIM900power()
// software equivalent of pressing the GSM shield "power" button
{
  digitalWrite(9, HIGH);
  delay(1000);
  digitalWrite(9, LOW);
  delay(5000);
}
```

```
void sendSMS()
{
  SIM900.print("AT+CMGF=1\r");                    // AT command to send SMS message
  delay(100);
}

void loop()
{
 Serial.println("\nready to sent sms");


 goto update_sensor;



status_update:
if (state_new - state_old == 0)// no update in sensor status
{
   goto update_sensor;
}
else if (state_new - state_old < 0 || state_new - state_old > 0) // changes in status
{
   goto texting;
}
status_update1:
if (state_new - state_old == 0)// no update in sensor status
```

```
{
  goto update_sensor;
}
else if (state_new - state_old < 0 || state_new - state_old > 0) // changes in status
{
  goto texting2;
}
status_update2:
if (state_new - state_old == 0)// no update in sensor status
{
  goto update_sensor;
}
else if (state_new - state_old < 0 || state_new - state_old > 0) // changes in status
{
  goto texting3;
}




update_sensor:
 {
  digitalWrite(LED, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(10);              // wait for a second
  digitalWrite(LED, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
}
```

```
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration/2) / 29.1;
  delay (4000);

if (distance >=0 && distance <= 12){
sensor1 = LOW;
sensor2 = HIGH;
sensor3 = HIGH;
}
else if (distance >=13 && distance <= 18){
sensor1 = LOW;
sensor2 = LOW;
sensor3 = HIGH;
}
else if (distance >=21 && distance <=24){
sensor1 = LOW;
sensor2 = LOW;
sensor3 = LOW;
}

else if (distance >25){
sensor1 = HIGH;
```

```
sensor2 = HIGH;
sensor3 = HIGH;
Serial.println("SELAMAT DAN MUNGKIN TAK ADA AIR");
delay (3000);
}

if (sensor1 == LOW)
  {
    if (sensor2 == LOW)
    {
      if (sensor3 == LOW)
      {
       text3;
       state_new = 3;
       goto status_update2;
      }
      text2;
      state_new = 2;
      goto status_update1;
    }
   text1;
    state_new = 1;
    goto status_update;
  }
else
   {
   state_new = 0;
```

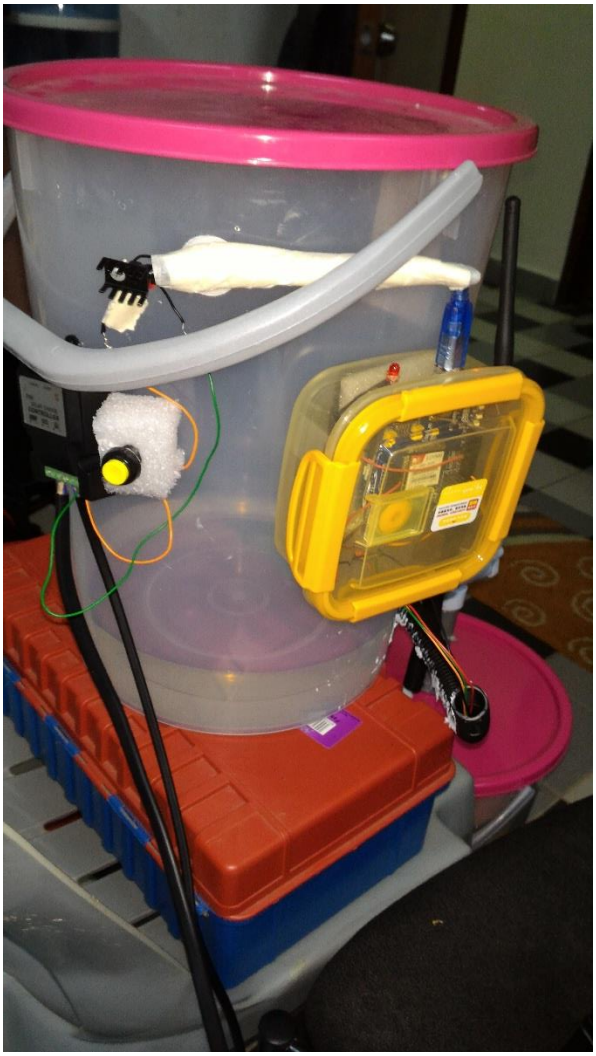
```
    }
goto update_sensor;


texting:
        digitalWrite(LED, HIGH);
        delay(3000);
        digitalWrite(LED, LOW);
        SIM900.println("AT + CMGS = \"+60139976390\"");        // recipient's
mobile number, in international format
        delay(100);
        SIM900.print(distance);
        SIM900.println(" cm");
        SIM900.println("WARNING-level 3-!!!!!!!!\n RELOCATION");        //
message to send
        delay(100);
        SIM900.println((char)26);                    // End AT command with a ^Z,
ASCII code 26
        delay(100);
        SIM900power();



        Serial.print("\nSend SMS to ");
        Serial.println(number);
        error=gsm.SendSMS(number,text1);
        Serial.print(distance);
        Serial.println(" cm");
        Serial.println("SMS sent");
        Serial.println("LEVEL 3");
```

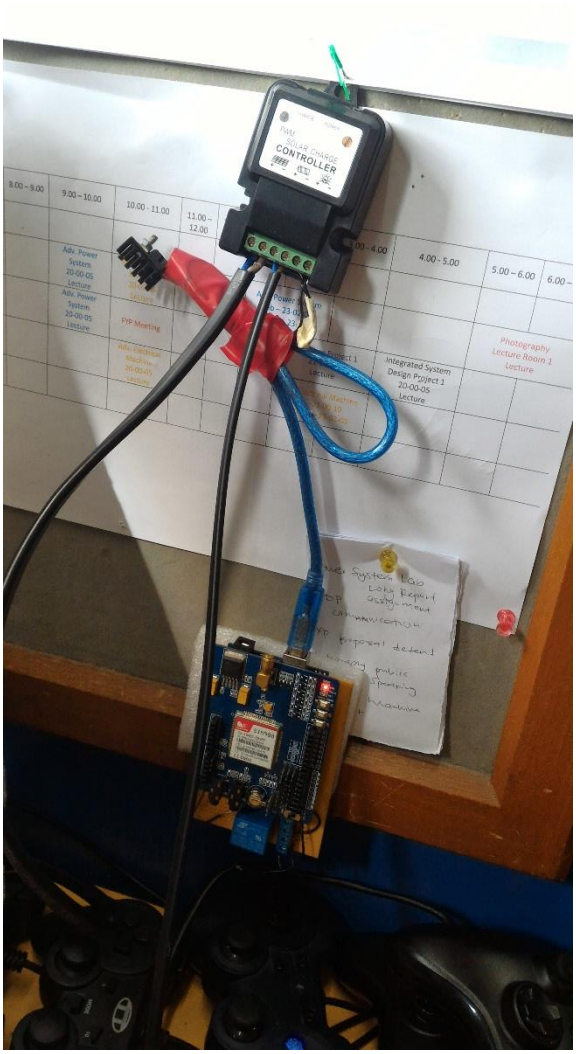
```
        state_old = state_new;
        goto update_sensor;


texting2:
        digitalWrite(LED, HIGH);
        delay(3000);
        digitalWrite(LED, LOW);
        SIM900.println("AT + CMGS = \"+60139976390\"");       // recipient's
mobile number, in international format
        delay(100);
        SIM900.print(distance);
        SIM900.println(" cm");
        SIM900.println("WARNING-level 2-!!!!!!!!\n CAUTIOUS");       //
message to send
        delay(100);
        SIM900.println((char)26);                    // End AT command with a ^Z,
ASCII code 26
        delay(100);
        SIM900power();



        Serial.print("\nSend SMS to ");
        Serial.println(number);
        error=gsm.SendSMS(number,text2);
        Serial.print(distance);
        Serial.println(" cm");
        Serial.println("SMS sent");
        Serial.println("LEVEL 2");
```

```
        state_old = state_new;
        goto update_sensor;


texting3:
        digitalWrite(LED, HIGH);
        delay(3000);
        digitalWrite(LED, LOW);
        SIM900.println("AT + CMGS = \"+60139976390\"");       // recipient's
mobile number, in international format
        delay(100);
        SIM900.print(distance);
        SIM900.println(" cm");
        SIM900.println("WARNING-level 1-!!!!!!!!\n NORMAL");       //
message to send
        delay(100);
        SIM900.println((char)26);                    // End AT command with a ^Z,
ASCII code 26
        delay(100);
        SIM900power();



        Serial.print("\nSend SMS to ");
        Serial.println(number);
        error=gsm.SendSMS(number,text3);
        Serial.print(distance);
        Serial.println(" cm");
        Serial.println("SMS sent ");
        Serial.println("LEVEL 1");
```

```
        state_old = state_new;
        goto update_sensor;

}
```

Picture:



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SG. PERAK @ KG. TENGAH
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JPS PERAK TENGAH
05 - 3712141
PENGURUSAN SUMBER AIR DAN HIDROLOGI
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05 - 5225409