Faculty of Electrical and Electronic Engineering Technology

GSM-BASED LIGHTNING MONITORING AND ALERT SYSTEM

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Bachelor of Electrical Engineering Technology with Honours

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A project report submitted
in partial fulfillment of the requirements for the degree of
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DECLARATION

I declare that this project report entitled "GSM-BASED LIGHTNING MONITORING AND ALERT SYSTEM" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date : 11 / 01 / 2021

APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology with Honours.

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Date : 11 / 01 / 2021

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Co-Supervisor :

Name (if any)

Date :

DEDICATION

To my beloved mother and other family member whose does always gives me support and motivation throughout my whole life and journey in studying at UTeM. Also thank you for all the motivation that helps online learning in this pandemic which is quite hard due to different surrounding, especially settling my assignment. Special thank you to my siblings who always help me in advising, giving idea and solving problems. Besides, giving inspiration by showing their hardworking in pursues studying and end up with a good career.

ABSTRACT

Malaysia is the third country in the world with the most frequent lightning strikes, after Rwanda and Congo, with an average of 190 days of occurrence in a year. In April 2006, Petronas which is a well-known Malaysian oil and gas company lost about RM100 million when two oil tanks and a natural gas tank of its own exploded and caught fire due to lightning strikes at an oil depot in the Pasir Gudang industrial area, Johor. The consequences of lightning on oil depot have repercussions a few tanks also can be life threatening for the worker that happen to be nearby. Oil and gas industries face the risk of fire and explosion due to ignition of flammable vapours or gases. In this project, a system that can give the early warning of lightning phenomena is developed and implemented to reduce the damage due to lightning specially to ensure the safety of the worker. The lightning is detected, and the signal is sent by the Arduino based controller to alert the worker via alert message through smartphone and monitor the occurrence of lightning disturbance with distance estimation. As the result, the worker can take early counter measure by avoid being near to the lightning occurrence area.

ABSTRAK

Malaysia adalah negara ketiga di dunia dengan serangan kilat yang kerap, setelah Rwanda dan Kongo, dengan purata 190 hari kejadian dalam setahun. Pada bulan April 2006, Petronas yang merupakan syarikat minyak dan gas terkenal Malaysia kehilangan sekitar RM100 juta apabila dua tangki minyak dan tangki gas asli sendiri meletup dan terbakar akibat serangan kilat di sebuah depot minyak di kawasan perindustrian Pasir Gudang, Johor. Akibat berlaku kilat di depot minyak, ia memberi kesan kepada beberapa tangki dan juga boleh mengancam nyawa pekerja yang kebetulan berada berdekatan dengan tangki tersebut. Industri minyak dan gas menghadapi risiko kebakaran dan letupan kerana pencucuhan wap atau gas yang mudah terbakar. Dalam projek ini, sistem yang dapat memberi amaran awal mengenai fenomena kilat dikembangkan dan dilaksanakan untuk mengurangkan kerosakan akibat kilat khususnya dalam menjamin keselamatan pekerja. Kilat dikesan, dan isyarat dihantar kepada pekerja berasaskan Arduino untuk memberi amaran kepada pekerja melalui pesanan amaran melalui telefon pintar dan memantau kejadian gangguan kilat dengan menganggar jarak. Akhinya, pekerja dapat mengambil langkah awal dengan mengelakkan diri dari berada di kawasan berlakunya kilat.

ACKNOWLEDGEMENTS

Firstly, I thank Allah (SWT) for his blessing because I finally complete my PSM successfully. With this, I would like to express my heartfelt gratitude to all people who helped me in making my Bachelor project successful. I would like to express my gratitude to my supervisor, PM Mohd Ariff Bin Mat Hanafiah for the guidance and suggestions, words of wisdom and patient throughout out this project and for giving me moral support throughout the journey. My highest appreciation goes to my parents and family. An honourable mention also goes to my siblings and to my colleague, thanks for all the hardship, cooperation, and memories during our journey in UTeM.

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V	-	Voltage
km	-	kilometer

LIST OF ABBREVIATIONS

f	-	frequency
LC	-	Liquid Crystal
Q	-	Q factor
Bw	-	Bandwith

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CHAPTER 1

INTRODUCTION

Background

Development in technology become more advance as people strive to create more and more technology with their creative innovation to reduce workload in daily life. Besides technology, people also create advance system such as create drainage system that prevent flooding of low-lying areas, there by avoid causing property damage and health risks. There are many systems have been develope. One of the system is warning system against natural phenomenon which is ligtning. Lightning is an electrical discharge caused by imbalances between storm clouds and the ground, or within the clouds themselves. Most lightning occurs within the clouds. Even it occur as natural phenomenon lightning is very dangerous. Lightning strikes on people, though comparatively rare, can cause conditions ranging from amnesia to cardiac arrest or known as the abrupt loss of heart function. Lightning can also cause the surrounding air to heat up to 27,700 degrees Celsius (almost 50,000 degrees Fahrenheit), often setting nearby objects on fire. This natural phenomenon cannot be stop but people can take safety precaution of it.

This project will discuss about how to monitor the lightning and send alert notifications to user using GSM. Furthermore, the encouragement to develop this project is stated in the problem statement given of this chapter. Hence, the main objective in developing and scope are both mention in this chapter.

Problem Statement

Lightning strikes are wildly erratic and unpredictable natural phenomenon, and their immediate and erratic effects can be disastrous to structures. Because of the low possibility of a hit, building owners and managers sometimes fail to ensure that their structures are adequately protected from direct lightning strikes. As a result, the structure is exposed to the risk of being struck by lightning with no protection. Different structures are located in areas

where lightning strikes as frequently as possible, making a direct impact on the structure essentially unavoidable and maybe rehashed a few times each year.

Figure 1 shows Lightning occurs near construction buildings.

The advancement of technology has made it possible to use security situations for private, commercial, and mechanical structures, such as leading lightning releases from the point of impact via the protection system and securely into the ground. The system's ability to function safely is contingent on the environment in which it is maintained. Even in a facility with a defensive mechanism, measurements show that a quick lightning strike might produce a fire or, more commonly, can obliterate electrical apparatuses and other gear. As a result of the problem caused by lightning, a system that forecasts its appearance and alerts authorities to take preventative steps is needed.

Project Objective

For this project the aim is to propose a systematic and effective method for monitoring and warning system. Specifically, the objectives are as follows:

- To design the GSM-based lightning monitoring and alert system.
- To predict lightning using sensor to detect lightning and make estimation distance from where the lightning occur.
- To send the alert message to user with the help of GSM.

Scope of Project

This project scope is focus on two main components which is monitor the lightning that occur and send a warning message via wireless network. The system uses Arduino interfaced with sensors, LCD and GSM module for real time monitoring of data. Data from sensors is sent to Arduino and displaying on LCD. The results of the analysis in the form of lightning warnings will be provided to the user with the help of GSM. Hence lightning detection system alert where the disturbance of lightning by using sensor values. Specifically, Arduino UNO is used which will processes the input from the sensors and monitor data. It also displays output on LCD and sends the message to smartphone via GSM Module.

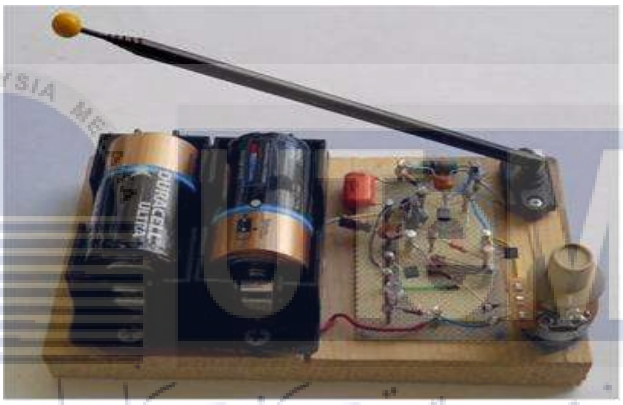


Figure 1.1 An example circuit of lightning detector circuit.

Figure 1.1 shows a simple sample of a diagram just to illustrates the scope of this project or study with simple connection of components while this project will be more advance which involve GSM. Thus, send alertg message to smartphone.

1.5 Thesis Organization

The report explained all the process of making GSM-based lightning monitoring and alert system. It has an overall of five chapters which is an introduction of project, literature review, methodology of the project, final outcomes of the project and final summary about this project.

In chapter one, an introduction of this project is explained which contains the background of the project, the problem statement, the objective that need to be achieved, and the scope of this project.

While for chapter two, it will be focused on about the journal that show some research that has been done on theory and literature review that related to this project.

Chapter three will be the methodology of this project operation. The method and component were chosen based on some references and studies. Therefore, the components and system that will be use on this project is decided. Flowchart, coding and works flow also explained in this chapter.

Next chapter is chapter four. For this chapter, it will focus on the result of the project. Still, the theoretical finding and some analysis of this project also will be discussed in this chapter.

Lastly, chapter five will show the conclusion of this project and upcoming recommendation to improve this project with grasp based on the research that have been conducted.

CHAPTER 2

LITERATURE REVIEW

Introduction

This subtopic will go through some of the previous work that has been done on the obvious verification of lightning, lightning concept utilisation, and other helpful knowledge that will be needed to complete this project.

2.2 Lightning Detection System

Lightning is a natural phenomenon that causes people great concern. In addition, industry is evaluating the negative impact on human prosperity, risk, and hardware disappointment caused by AC rule control driving electrical transient. As a result, the Lightning Detection System was developed to determine the current state of lightning in a specific location. The Lightning Detection System is used to identify and break down continuous lightning data, including lightning strokes, lightning area, and peak current.

The Lightning Detection System can reliably confirm the presence of lightning at a certain location and time. Lightning imagery corresponds to that of the environment satellite and environment radars in a similar way. Aside from that, the lightning data is extremely useful and can be utilized repeatedly in current environmental tossing and climatological analysis. In addition, the Lightning Detection System is employed to plan for the flight plan's use. The precision of a Lightning Detection System is determined by several factors, including the types and number of sensors available, sensor space, design, and condition. Lightning detection equipment primarily detects cloud-to-ground lightning. It's difficult to distinguish between cloud-to-cloud and intra-cloud lightning streaks. The size and type of lightning streaks varies (trade positive or 6 negative charges to the ground). The proportion of current fluctuates in a similar way, affecting the waveform's character.

Furthermore, in the evolution of lightning strikes, previous lightning detection systems were unable to predict the event of a lightning strike. The three main types of lightning can be distinguished by where they strike: within a single storm cloud, between

two mists, or between a cloud and the ground. Numerous other observable variations are seen, including "hot lightning," which can be seen but not heard over a long distance, dry lightning, which can trigger woodlands fires, and ball lightning, which is logically overlooked.

2.3 Lightning Monitoring System

There are two classes of lightning checking, to be specific earth and space-based system. In this framework, just the previous is thought of. For the most part, lightning checking, and identification systems have a similar unbiased, that is, to anticipate the area and power of lightning events. The principal segments are the sensors. In a commonplace framework, the sensor arrangement differs. It might comprise of Atmosphere Electric Field (AEF) sensors along with lightning sensors or lightning sensors alone. The advantage of the previous design is that it can follow storm cloud improvement cycles and developments.

Hence, it gives a freedom to foresee the rainstorm's area before it shows up. Utilizing the last mentioned, such forecasts cannot be accomplished. Different segments of a detecting framework incorporate a sign conditioning unit to deal with the yield signal from the sensor. For the most part, it comprises of a sign enhancer and channel segments. It might likewise include a microcontroller to deal with the information and yield signals from the sign molding unit. At that point, the condition sign will be sent as a simple or advanced sign, contingent upon the information transmission convention embraced. At last, the information is gathered and put away in a PC system. They will be breaking down utilizing certain numerical prediction apparatuses, and the outcomes will be utilized for additional activities.

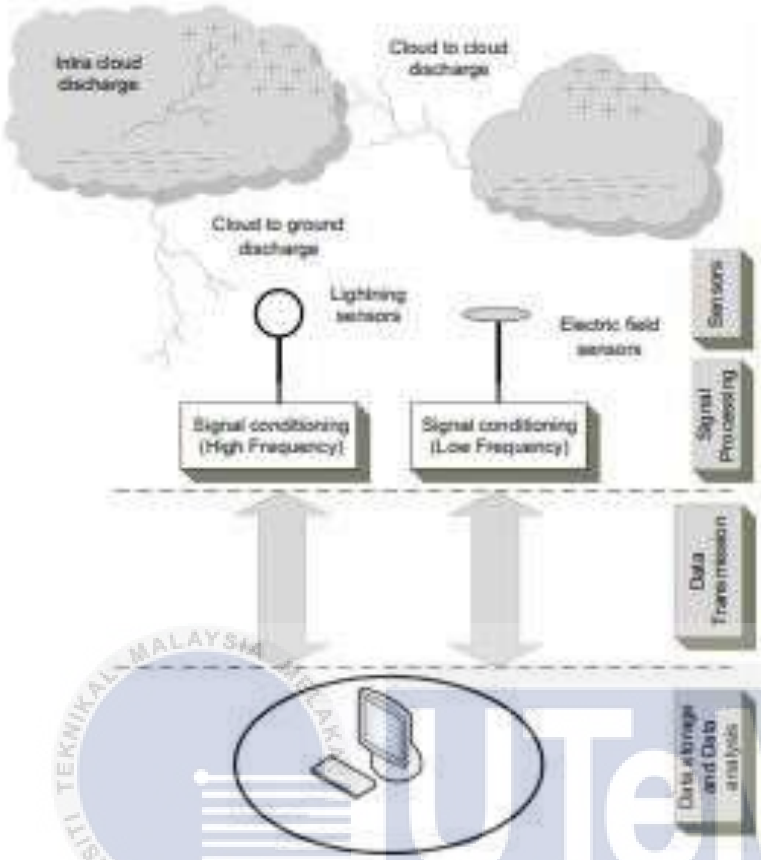


Figure 2 shows the overall square chart of an average lightning monitoring system.

2.4 Lightning Warning System

A lightning warning system is a gadget which cautions of lightning strike hazard in territories that should be ensured against the impact of climatic electrical releases.

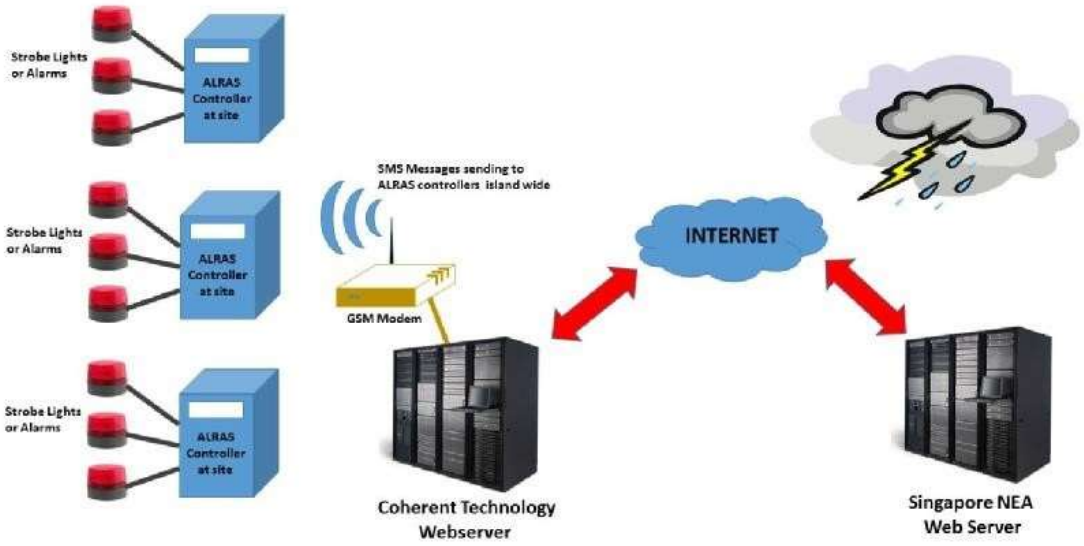


Figure 2.1 shows the lightning warning system in Singapore.

Figure 2.1 shows how Singapore lightning warning system works. Singapore is an island country which is prone to lightning strikes all year round. With the location laying near the Equator, the weather here is hot and humid create a condition that are favorable for lightning and thunderstorm clouds.

With an average of 168 thunderstorm days per year this make Singapore one of the highest lightnings occurrence in the world. So, they have developed Lightning Alert or Warning System or ALRAS to detect lightning activity in Singapore and alert the public to take necessary precautions.

2.5 Previous related work

Previous related research focuses on the researcher who has completed a project in a similar manner. A few scholars throughout the world are almost finished with the comparative study, but the equipment and system they have created for the project are inadequate. The most relevant articles had to be chosen and summarized to fulfil this section.

All the articles that were chosen and summarized are included as references.

2.5.1 Lightning monitoring system for sustainable energy supply: A review by Muhammad Abu Bakar Sidik[1].

This paper is by Muhammad Abu Bakar Sidik. This paper proposed using a passive optical lightning sensor to detect lightning's electromagnetic pulses. Next is the lightning location technique that can be divided into two categories which are single-station and multi-station lightning location techniques. The single-station lightning location technique requires a single observation station to locate lightning. Furthermore, there are lightning signal sensing, lightning data acquisition and lightning data display modules. They also used the LDD module which is a software pack installed on a PC. The LDD module provides realtime lightning monitoring and off-line data playback functions, as well as the visualization, statistical analysis and permanent storage of lightning events. The lightning strike locations were estimated by calculating the ratio of EMF to EF. The Pekan Lightning Detection System system analyses the raw lightning data and transforms it into real-time lightning data.Analysis using the fuzzy logic method created a graph of lightning level and also a graph of the number of lightning incidences corresponding to the type of lightning.

2.5.2 Prototyping a RF signal-based lightning warning device using with Internet of Things (IOT) integration by Hwang, Y. J. Wooi[2].

Lightning had caused in any event 25, 000 passings worldwide every year. The examination expects to research the actuated voltage produced by lightning strikes utilizing a lightning indicator. Proteus programming was utilized to recreate the principle leading body of the lightning indicator before manufacture. The lightning identifier was planned as a radio frequencies beneficiary and it was tuned to the level (300 kHz to 500 kHz) which empowered it to get signals from lightning strikes. A lightning test system was planned utilizing different obstruction (100 Ω to 200 Ω) to test the usefulness of a lightning identifier to approve the precision of the proposed model. This lightning identifier could be actuated at whatever point a little initiated voltage (0.2 V or more) were created by lightning occasions happened inside 10 km from the indicator. This locator catches both the instigated voltage and the time distinction distinguished lightning release and its sound for additional investigation. An opportunity to roar strategy was utilized to discover the

assessed lightning releases distances in corresponding to this framework to approve the current lightning finder.

The exactness of the lightning locator was discovered to be 88.03%.The dissected information were conveyed to the client's cell phone utilizing cloud framework.

2.5.3 GSM based alert and warning system for LANDSLIDING and THUNDER activity by V.Supekar[3].

The event of avalanche and tempest is hurtful for human existence and property. The normal causes can't be halted, yet the framework can caution before they happen. So for alarming individuals from avalanche and tempest this method is helpful. The information is gathered from the info sensors, then, at that point and given to regulator for transmission and an alarm message is sent with the assistance of GSM Module. The sensors yield is being shown on the LCD as rate. The SMS framework will alarm individuals and save life and furthermore the property. The planet Earth has many effect occasions, for certain events causing both as far as human loss just as financial misfortunes. There are various kinds of sensors to gauge the social parts of earth. The sensors incorporated with WSN, give an exact and coterminous information for examination and understanding. This paper momentarily addresses earth perception and spaces of basic significance to individuals and society. The framework screens the changing geotechnical condition utilizing different geo-specialized sensors like soil dampness sensors, downpour sensor, strain guage. This paper additionally addresses the parts of information transmission over Global System for Mobile Communication (GSM) to a distant server farm.

2.5.4 Measurement of Lightning-Induced Overvoltage in Power Distribution Lines Using Ceramic-Capacitor Insulator by Q. Yang[4].

The estimation of overvoltage in a force dissemination network is the reason for distinguishing lightning-initiated overvoltage. This paper proposes a lightning-incited overvoltage observing gadget utilizing an artistic capacitor protector that is controlled by the line and utilizes remote transmission. The detecting rule of the observing gadget, the force supply rule of artistic capacitor voltage division, and force electronic exchanging

gadget, just as the rule of sign procurement and remote transmission are elucidated. The force selfprocurement module can take out 2 W of force from a solitary line to meet the prerequisites of the checking gadget. The observing framework was tried with a 10 kV test stage. The transient reaction attributes, the force self-securing capacity, and the linearity of the sensor were acquired. The general presentation of the observing gadget was likewise tried. The activity status of the observing gadget on the conveyance line and the checked overvoltage signal showed that the gadget can catch lightning-actuated overvoltage flags and be utilized in a circulation network framework.

2.5.5 Design and Development of IoT-Cloud-based Lightning/Storm Detection System with an SMS Alert on Android Mobile by R. Kanchi[5].

Climate observing by and large and lightning discovery specifically is of foremost significance since it is hazardous to people and creatures, risky to electronic contraptions. It is essential to screen the lightning recognition continuously to keep away from the passings brought about by lightning. In this paper we present the plan and advancement of an IoT based Storm (Lightning) identification framework with an arrangement to show message on an Android versatile utilizing Cloud figuring innovation. The whole framework is worked around Franklin lightning identifier chip AS3935 on a thunder click board with an on-board incorporated loop radio wire MA5532. This board is connectedto the Texas Instruents' CC3200 LaunchPad and SIM900A GSM module to finish the plan. The correspondence interface set up among sensor and ThingSpeak cloud through CC3200 will help online information checking anyplace in the globe. Arrangement is made to store the historical backdrop of lightning on a SIM card for additional examination like assessment of precipitation. The investigation is performed at Sri Krishnadevaraya University,
Anantapuramu. The distinguished area and the lightning esteems are shown on Cloud (IoTCloud). The product is created utilizing Energia IDE.

2.6 Other Reference of Journal and Article.

TABLE 2.6 JOURNAL AND ARTICLE (REFERENCES).

NO.	TITLE	AUTHOR	PURPOSE
1	Lightning monitoring system for sustainable energy supply[1]	Muhammad Abu Bakar Sidik a,c,n , Hamizah Binti Shahroom a	To predict the location and intensity of lightning occurrences. The main components are the sensors. In a typical system, the sensor configuration varies. It may consist of (1) several atmospheric electric field (AEF) sensors along with lightning sensors or (2) lightning sensors alone
2	Prototyping a RF signal-based lightning warning device using with Internet of Things (IOT) integration[2]	: Y J Hwang et al 2020 J. Phys.: Conf	To investigate the induced voltage generated by lightning strikes with proteus software was employed to simulate the main board of the lightning detector before fabrication
3	GSM based alert and warning system for LANDSLIDING and THUNDER activity[3]	Vaishnavi Supekar1, Pragati Mote1	To alert and warning of landsliding and thunder activity based on GSM
4	A LIGHTNING CONDUCTOR MONITORING SYSTEM BASED ON A WIRELESS SENSOR NETWORK[6]	Jan Mikeša,, Ondrej Kreibichb , Jan Neužilb	To propose system for monitoring the passage of a lightning current through a collection conductor
5	Development of a Low-Cost IoT System for Lightning Strike Detection and Location[7]	Ismael Mialdea-Flor 1, Jaume Segura-Garcia 2	To detect lightning location networks of sensors, detect electromagnetic pulses emitted by lightnings and use power and distance data to locate them
6	The quality monitoring of outdoor lightning using IoT technologies[8]	A A Bachurin et al 2019 J. Phys.: Conf	This work aims to develop a prototype of an automated system for controlling the quality of outdoor lighting and assessing the possibility of replacing manual

			measurements with automated ones.
7	GSM Based Multipurpose Alert System[9]	Romit S Beed, Nandini Barman,	To implements a control system that allows the user to
		Spandan Ray Chaudhuri*	effectively monitor a building from a remote location.
8	Measurement of Lightning-Induced Overvoltage in Power Distribution Lines Using Ceramic-Capacitor Insulator[4]	Qing Yang, Member, IEEE, Lu Yin, Hongwen Liu, Ke Wang, and Jisheng Huang	To proposes a lightninginduced overvoltage monitoring device using a ceramic capacitor insulator that is powered by the line and employs wireless transmission
9	Design and Development of IoT-Cloud-based Lightning/Storm Detection System with an SMS Alert on Android Mobile[5]	Raghavendra Rao Kanchi* and Divyavani Palle	To design and development of an IoT based Storm (Lightning) detection system with a provision to display message on an Android mobile using Cloud computing technology.
10	Real-Time Wildfire Monitoring and Alert System Using GSM Technology[10]	Aniedu A. N1, Chukwuneke C.I2, Asogwa D. C3, Nwokoye C. S.4	To make a system that is capable of providing real time remote wildfire monitoring and SMS alert

2.7 Summary

Because of lightning is a natural phenomenon that cannot be controlled, using GSM as medium to send warning message and lightning sensor detect where the lightning occur can give an impact to apply in this project. Furthermore, majority of people now days have smartphone which can ease the application using GSM. Next, lightning can cause severe damage to its surroundings. Thus, lightning warning system is very helpful so that early countermeasure can be taken by user.

CHAPTER 3

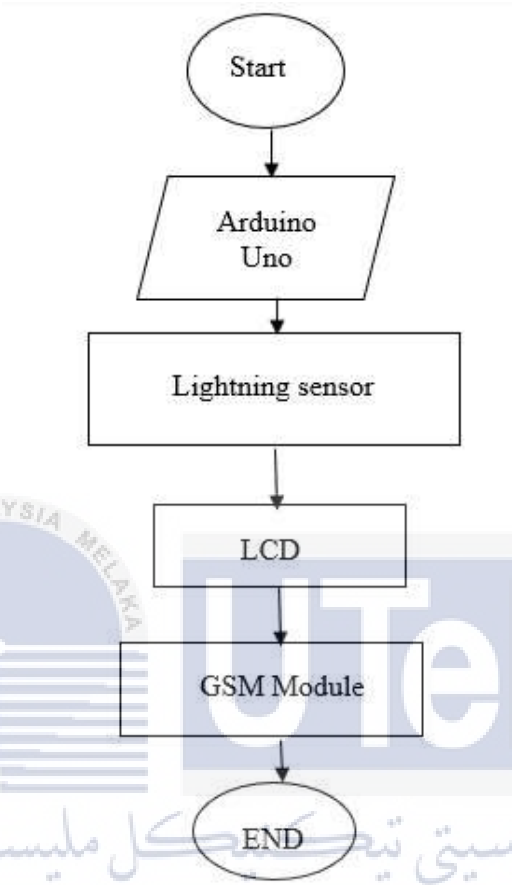
METHODOLOGY

Introduction

In general, accuracy and effectiveness are considered the two conflicting requirements of any TL evaluation model for the power utility. Here, accuracy refers to how close the estimation result is to the "real" TL values. Typically, the more accurate the model, the higher resources it requires (i.e. computation effort and time, amount of data and cost). Meanwhile, effectiveness refers to the ability of the model to estimate TL with the least resources but, with reasonable loss of accuracy.

3.2 Methodology

3.2.1 Flowchart



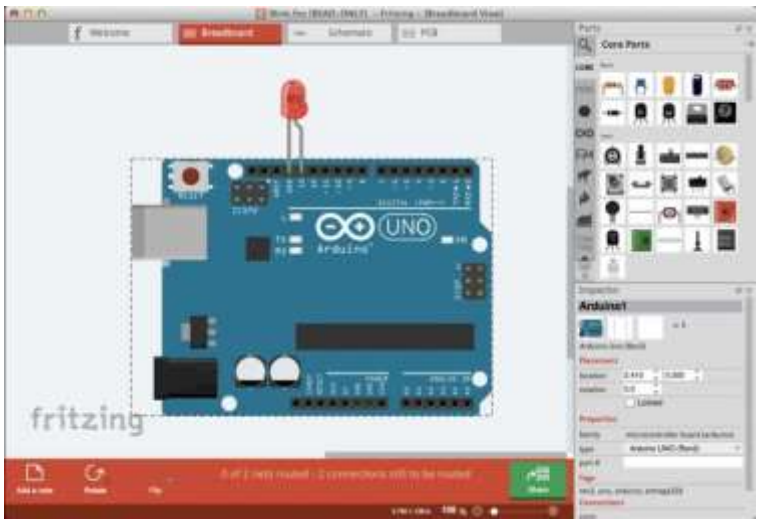
• Figure 3 System Flowchart

3.3 Software and components

3.3.1 Fritzing software

Fritzing is an open-source initiative to foster novice or diversion CAD programming for the plan of gadgets equipment, to help creators and specialists prepared to move from exploring different avenues regarding a model to building a more lasting circuit

The product is made in the soul of the Processing programming language and the Arduino microcontroller and permits an originator, craftsman, specialist, or specialist to record their Arduino-based model and make a PCB design for assembling.



• Figure 3.1 The interface of fritzing software

3.3.2 GSM module

GSM module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network. From the view of the mobile phone network, they are essentially identical to an ordinary mobile phone, including the need for a SIM to identify themselves to the network.

GSM module typically provide TTL-level serial interfaces to their host. They are usually used as part of an embedded system.

• Figure 3.2 GSM module SIM800L

3.3.3 Microcontroller

Microcontroller is considered as the backbone of Embedded Systems. A Microcontroller looks like a simple electronics chip, but it contains memory, input/output, and processor and programmable.

Features	Raspberry Pi 2 Model B	Arduino Uno
Built-in Wi-fi	No	No
Ethernet Port	Yes	Yes
Power used	1.9 W	0.29 W
Speed	900 MHz	16 MHz
Price	RM 173	RM 92

• Table 3.3.3 The differences between two microcontrollers

• Figure 3.3 Raspberry Pi 2

• Figure 3.4 Arduino Uno

3.3.4 Lightning sensor

The lightning sensor AS3935 is a programmable fully integrated Lightning Sensor IC that detects the presence and approach of potentially hazardous lightning activity in the vicinity and provides an estimation on the distance to the head of the storm.

Features	AS3935
Distance Range	1km to 40km
SPI Interface	Yes
Operating voltage	2.4 V to 5.5 V
Price	RM 170

• Table 3.3.4 The features of sensor

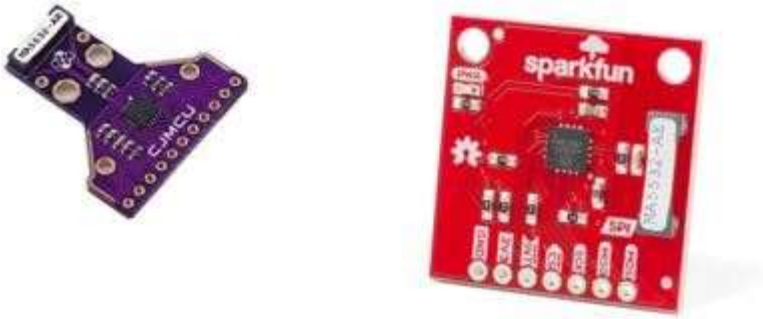


Figure 3.5 Lightning Sensor AS3935

3.3.5 Liquid Crystal Display (LCD)

The LCD will display the estimation distance from the lightning.

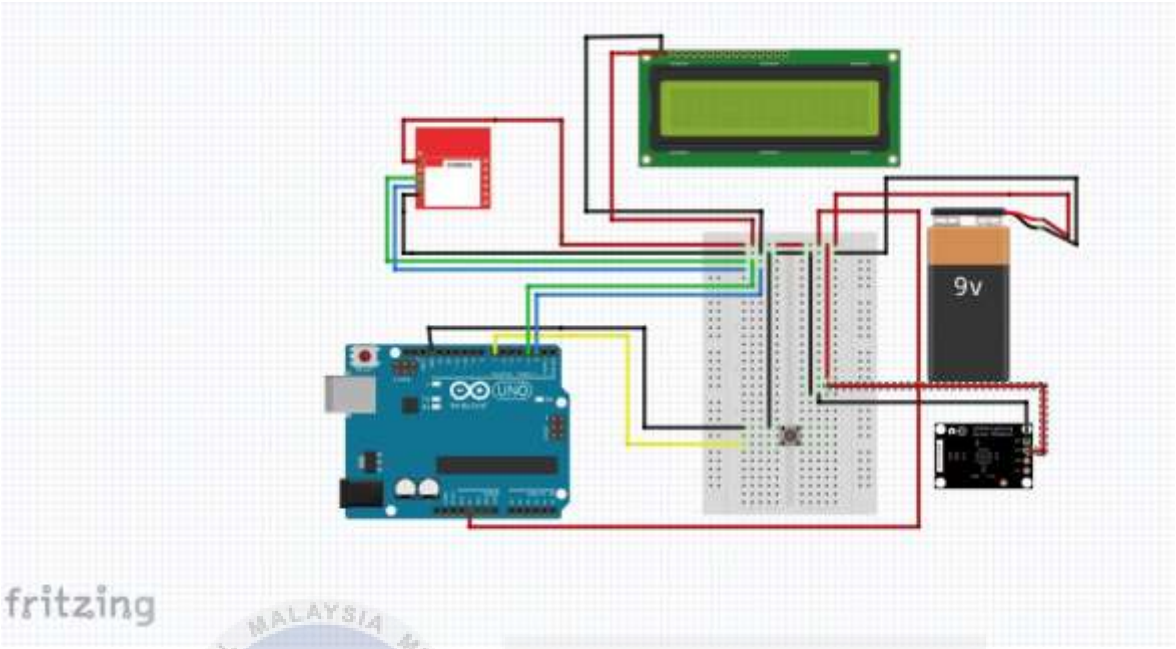
Figure 3.6 Serial Enable 16x2 LCD.

3.3.6 Sample formula

$$f = 1/6{,}28 \times LC$$

$$Q = f/Bw$$

3.4 Circuit Design



• Figure 3.7 Project circuit design

3.5 Coding

```
#include <avr/wdt.h>
#include <SPI.h>
#include <Wire.h>
#include "SparkFun_AS3935.h"
#include <SoftwareSerial.h>


SoftwareSerial mySerial(9, 10);


#define AS3935_ADDR 0x01
#define INDOOR 0x12
#define OUTDOOR 0xE
#define LIGHTNING_INT 0x08
#define DISTURBER_INT 0x04
#define NOISE_INT 0x01

SparkFun_AS3935 lightning(AS3935_ADDR);
// SparkFun_AS3935 lightning;
```

```
const int STRIKEINT = 2;

int tries = 0;

long lastRestart, lastTest;

boolean failed = false;

byte noiseFloor = 2;
byte watchDogVal = 2;
byte spike = 2;
byte lightningThresh = 1;
byte intVal = 0;
byte distance;


void setup()
{

  wdt_enable(WDTO_2S);
  Wire.begin();
  pinMode(STRIKEINT, INPUT);
  Serial.begin(19200);
  Serial.println("BOOTING...");
  setupSensor();
}

void loop()
{
  wdt_reset();

  if (millis() - lastRestart > 300000)   // REFRESH SENSOR EVERY 5 MINUTES
  {
    setupSensor();
    lastRestart = millis();
    //    testI2C();
  }


  /*  if (millis() - lastTest > 20000)   // TEST
     {
       lastTest = millis();
       testI2C();
     }  */
```

```
if (digitalRead(STRIKEINT) == HIGH)
{
 intVal = lightning.readInterruptReg();

 if (intVal == NOISE_INT)
  Serial.println("Noise.");

 else if (intVal == DISTURBER_INT)
  Serial.println("Disturber.");

 else if (intVal == LIGHTNING_INT)
 {
  Serial.println("Lightning Strike Detected!");
  distance = lightning.distanceToStorm();
  Serial.print("Approximately: ");
  Serial.print(distance);
  Serial.println("11 km away!");
  long lightEnergy = lightning.lightningEnergy();
  Serial.print("Lightning Energy: ");
  Serial.println(lightEnergy);
  SendMessage();

 }

 /*   if (intVal == NOISE_INT)
    {
     Wire.beginTransmission(2);
     Wire.write("///");
     Wire.write("NSE*");
     Wire.write("!");
     Wire.endTransmission();
    }

    if (intVal == DISTURBER_INT)
    {
     Wire.beginTransmission(2);
     Wire.write("///");
     Wire.write("DIS*");
     Wire.write("!");
     Wire.endTransmission();
    }  */

 if (intVal == LIGHTNING_INT)
 {
  Wire.beginTransmission(2);
  Wire.write("///");
```

```
    Wire.write("STR*");
    Wire.write(distance);
    Wire.write("!");
    Wire.endTransmission();
   }
  }

   void loop();
   {
    if (Serial.available()>0)
     switch (Serial.read())
     {
      case 's':
       SendMessage();
       break;
      case 'r':
       RecieveMessage();
       break;
     }

    if (mySerial.available()>0)
     Serial.write(mySerial.read());
   }
}


 void setupSensor()
 {
  // SPI.begin();
  // while (!lightning.beginSPI(CS, 2000000) && tries < 10)


  if (!lightning.begin())
  {
   tries++;
   failed = true;
   Serial.println (">>> Lightning Detector did not start up!");
   while (1);
  }

  if (!failed)
   Serial.println(">>> Lightning Detector Ready");

  lightning.maskDisturber(false);
```

```
int maskVal = lightning.readMaskDisturber();
Serial.print("Are disturbers being masked: ");
if (maskVal == 1)
  Serial.println("YES");
else if (maskVal == 0)
  Serial.println("YES");


lightning.setIndoorOutdoor(OUTDOOR);

int enviVal = lightning.readIndoorOutdoor();
Serial.print("Are we set for indoor or outdoor: ");
if ( enviVal == INDOOR )
  Serial.println("Indoor.");
else if ( enviVal == OUTDOOR )
  Serial.println("Outdoor.");
else
{
  Serial.println(enviVal, BIN);
  Serial.println(F(">>> BAD RESPONSE, REBOOTING"));
  while (1);
}

lightning.setNoiseLevel(noiseFloor);

int noiseVal = lightning.readNoiseLevel();
Serial.print("Noise Level is set at: ");
Serial.println(noiseVal);
```



```
lightning.watchdogThreshold(watchDogVal);

int watchVal = lightning.readWatchdogThreshold();
Serial.print("Watchdog Threshold is set to: ");
Serial.println(watchVal);


lightning.spikeRejection(spike);

int spikeVal = lightning.readSpikeRejection();
Serial.print("Spike Rejection is set to: ");
Serial.println(spikeVal);


lightning.lightningThreshold(lightningThresh);
```

```
  uint8_t lightVal = lightning.readLightningThreshold();
  Serial.print("The number of strikes before interrupt is triggerd: ");
  ;

}
// When the distance to the storm is estimated, it takes into account other
// lightning that was sensed in the past 15 minutes. If you want to reset
// time, then you can call this function.

//   lightning.clearStatistics();
//  lightning.resetSettings();
void SendMessage()
{
  mySerial.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
  delay(1000);  // Delay of 1000 milli seconds or 1 second
  mySerial.println("AT+CMGS=\"+60135297265\"\r"); // Replace x with mobile number
  delay(1000);
  mySerial.println("Lightning near by");// The SMS text you want to send
  delay(100);
  mySerial.println((char)26);// ASCII code of CTRL+Z
  delay(1000);
}


void RecieveMessage()
{
  mySerial.println("AT+CNMI=2,2,0,0,0"); // AT Command to receive a live SMS
  delay(1000);
}
```

3.6 Parameters

The parameter used in this project is the estimation of the distance between the lightning took place and from the user place that measure in kilometer (km).

3.7 Equipment

This project use Arduino Uno as the main controller of the system. The coding is made so that when the circuit is running, the lightning sensor which AS3935 will detect the electrical emission that occur. Then, the coding will run and display the output which is the value of distance between lightning occur and the user. Lastly, the warning notification will send to user through GSM module.

3.8 Limitation of proposed methodology

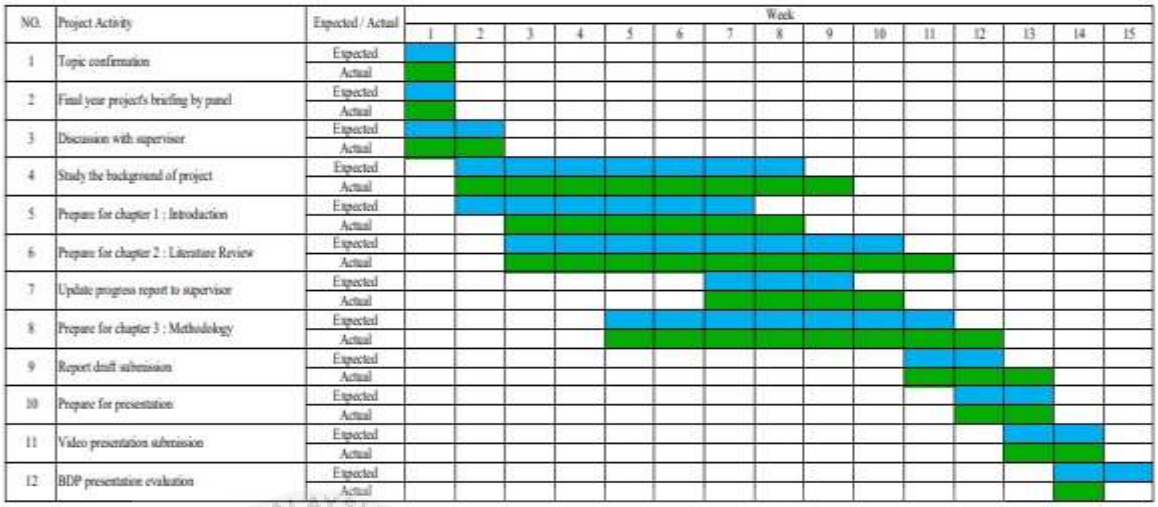
The limitation of this project is that it focused on single user to get the warning message from GSM module. This project is developed for application of system in monitoring and warning system of lightning.

3.9 Summary

This chapter presents the proposed methodology to develop a new, effective, and integrated approach in GSM based lightning monitoring and warning system. The primary focus of the proposed methodology is in accomplishing a simple, less rigorous, and effective estimation of distance in kilometer between user and where the lightning occurs in such a way that it would not cause harm to user with the help of lightning sensor. The methods also intended to use the generally available and easy to use component which is Arduino Uno in this project. The ultimate intend of the method is to warn user with alert message about the lightning by using GSM system that can send message through smartphone.

3.10 Gantt Chart

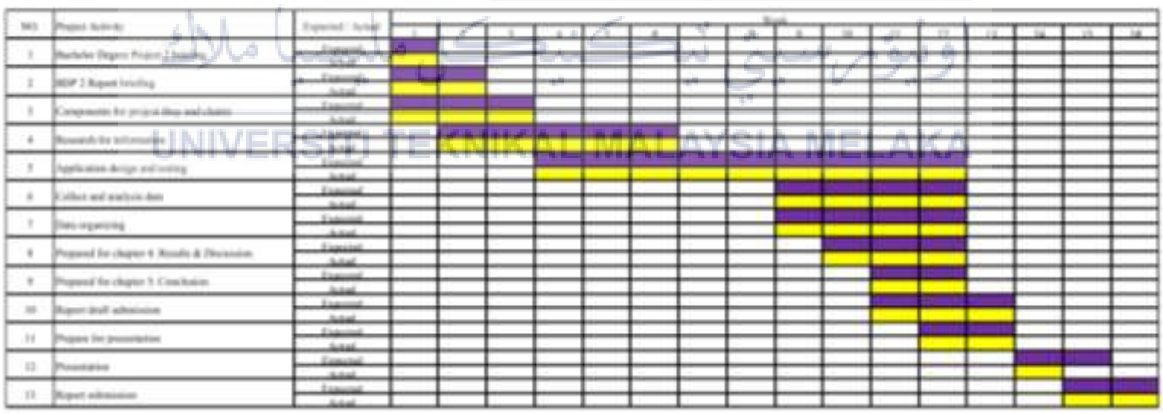
PSM 1



NO.	Project Activity	Expected / Actual	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Topic confirmation	Expected															
		Actual															
2	Final year project's briefing by panel	Expected															
		Actual															
3	Discussion with supervisor	Expected															
		Actual															
4	Study the background of project	Expected															
		Actual															
5	Prepare for chapter 1 : Introduction	Expected															
		Actual															
6	Prepare for chapter 2 : Literature Review	Expected															
		Actual															
7	Update progress report to supervisor	Expected															
		Actual															
8	Prepare for chapter 3 : Methodology	Expected															
		Actual															
9	Report draft submission	Expected															
		Actual															
10	Prepare for presentation	Expected															
		Actual															
11	Video presentation submission	Expected															
		Actual															
12	BDP presentation evaluation	Expected															
		Actual															

Figure 3.8 Gantt Chart

PSM 2



CHAPTER 4

RESULTS AND DISCUSSIONS

Introduction

This chapter presents the results and analysis on the development of GSM-Based Lightning Monitoring And Alert Sytem. This project use Lightning sensor which AS3935 that work by detect radio frequency emissions that generate by lightning activity. Also the sensor is made to distinguish the emissions from man-made disturbers with the help of algorithms and calculate the energy from lightning strikes. This chapter will discuss more about the development phase of project until the result.

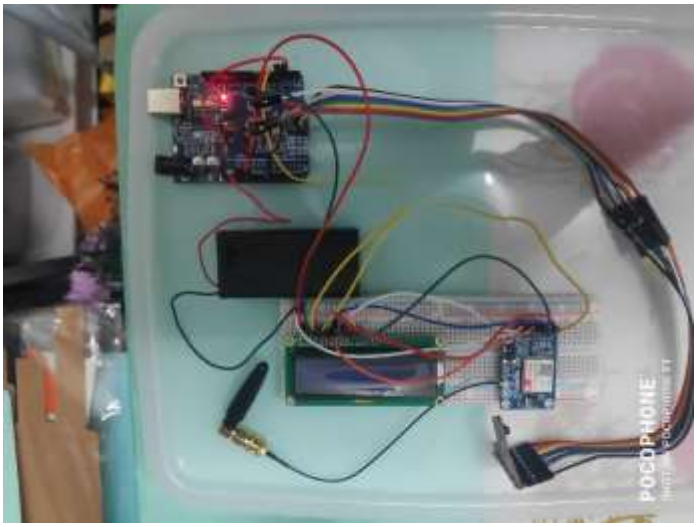
Results and Analysis

Before the project can be develop and run successfully, there are steps need to go through which are testing the components, troubleshoot the project, get the result, and finally make some data collection. By following the right steps, the project can be run, and the error can be minimized.

Testing the equipment

Arduino UNO

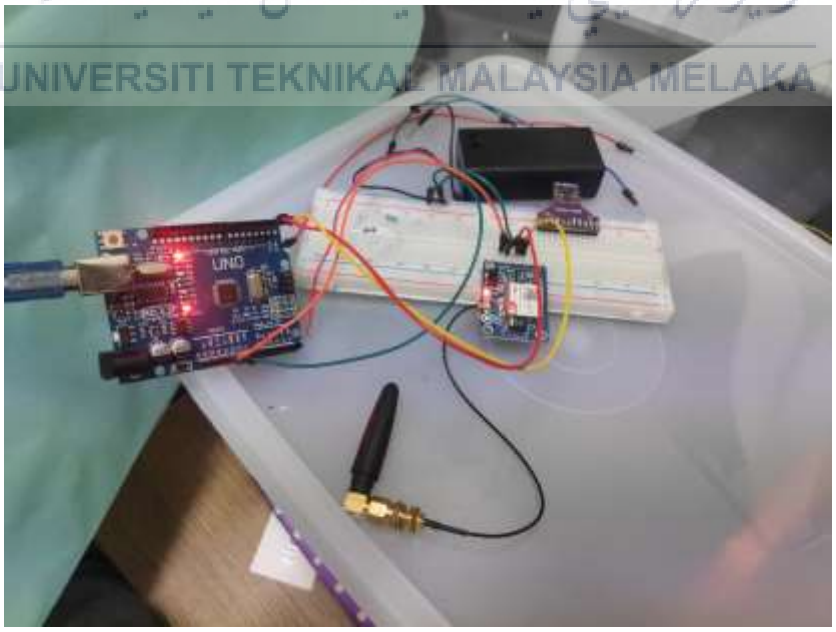
Arduino UNO is a microcontroller board which based on the electronic component which ATmega328P. It has 14 pin of digital input/output pins. It also has a USB connection, power jack, ICSP header and a reset button. This component can be test by simply connect the USB cable from laptop to Arduino UNO. After the connection, there will be a LED light which use as indicator of the Arduino is on and running.



This picture shows red light indicate the Arduino UNO is running

GSM SIM800L

GSM module is a hardware electronic component that use GSM mobile telephone technology that provide data link to a remote network. This component can be view essentially identical to normal mobile phone because it needs a SIM to be identify on network. This GSM module need SIM card and simple codes to test it.

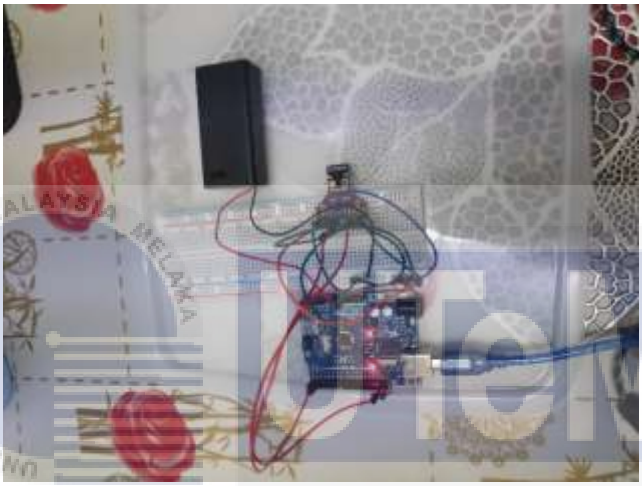


There is also red light that indicate the GSM is running. Besides the red light there is second red light to show the connection between phones. If the light blinks every 1 second, it shows

there is no connection happen yet between phone and GSM. If it blinks every 2 seconds, it shows the GSM is link with the mobile phone. Finally, if the red light blinks every 3 seconds, it shows the connection have been establish and can transfer data.

Lightning Sensor AS3935

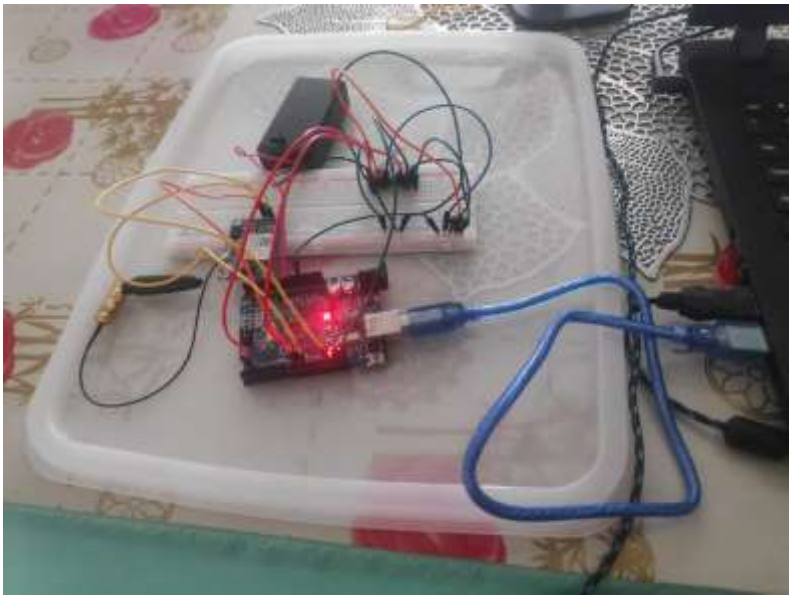
The sensor detects radio wave to tell the input and need a display medium to show the results. By connect the circuit with the sensor, measure the voltage drop or current using multimeter.



The diagram shows the connection have been made and simple code is running through Arduino. The result can be seen on serial monitor od Arduino UNO coding software on laptop.

Troubleshoots

For this project, the troubleshoot starts after connection of complete circuit have been made. The diagram below shows the complete connection of project circuit hardware.

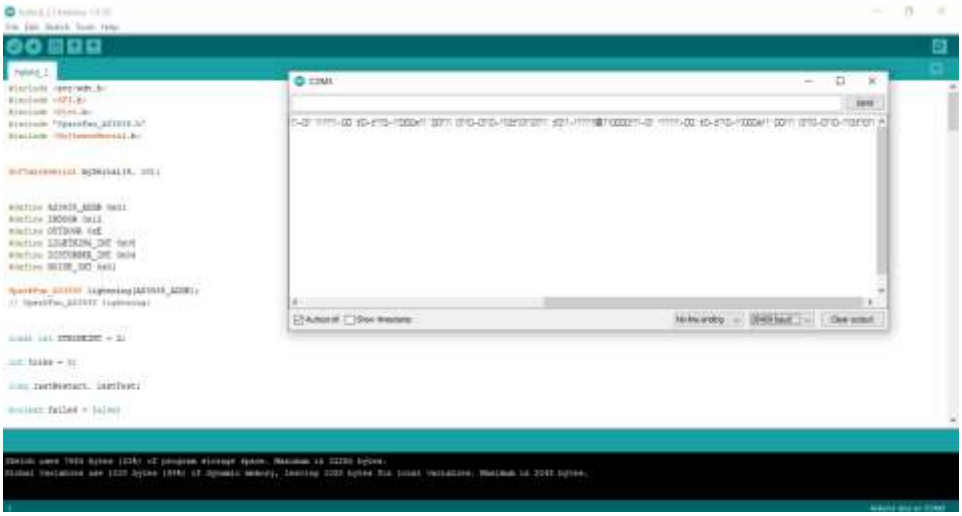


After making troubleshoot of project, the are several problems occurs. The problems consist of two part which software and hardware.

Software

Software use for this project is Arduino UNO. The codes are construct for this project which been made between Arduino UNO, AS3935 lightning sensor, GSM SIM800L, and LCD display. Unfortunately, it takes a lot of time to try and error but finally is decided to use serial monitor of UNO software on laptop to be the monitoring system. The codes having with certain errors which: -

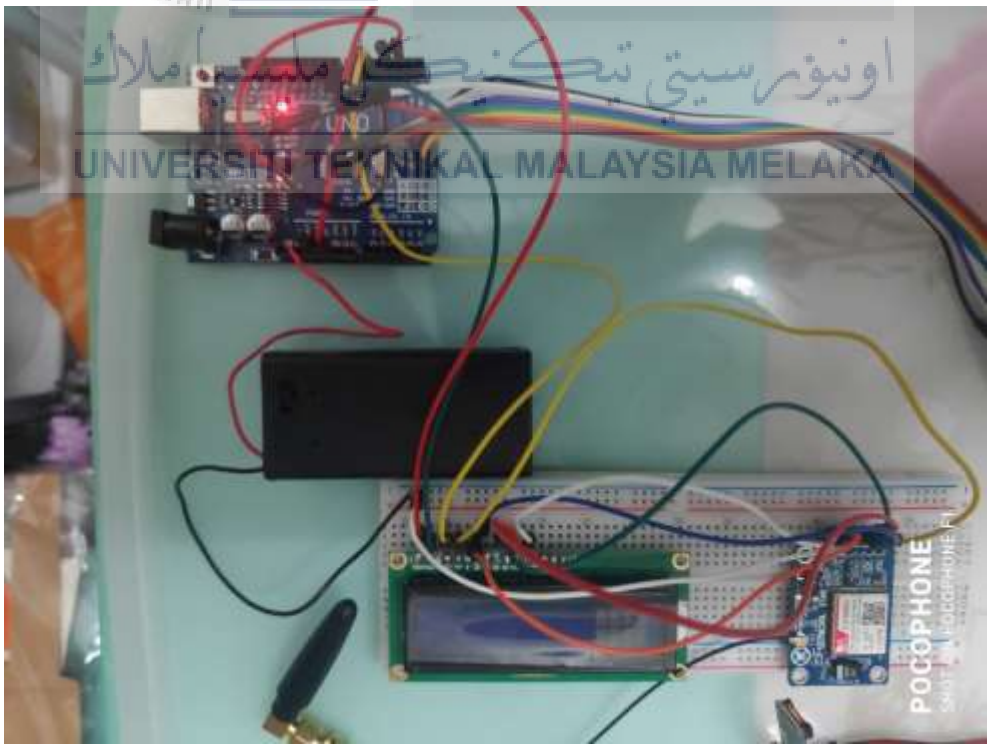
- String
- No detect function
- Not declare the function.
- Problem looping



The serial monitors of UNO software show garbage character after run the system because of errors that occur.

Hardware

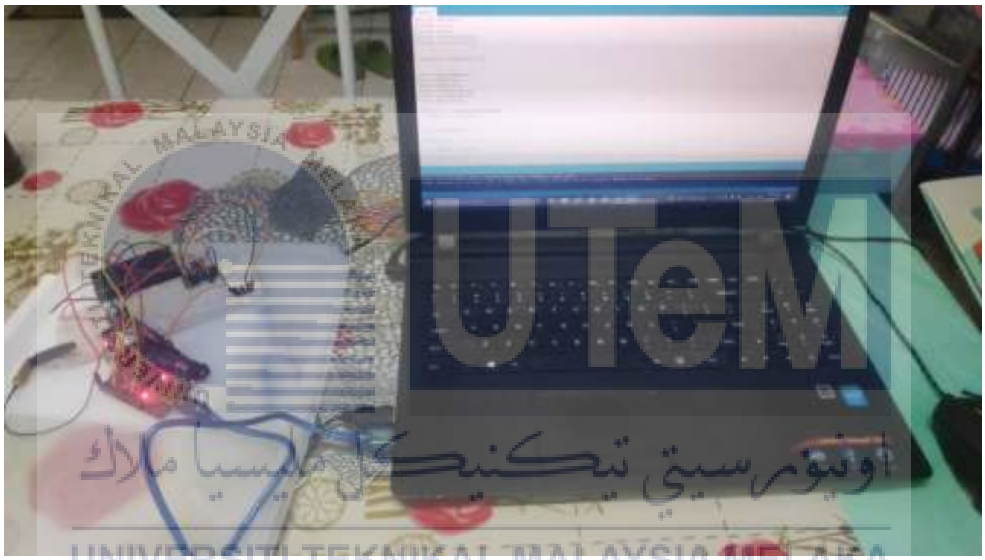
For the hardware, the error cause by wrong connection and grounding is not done. The diagram below shows the project circuits when connect to LCD display.



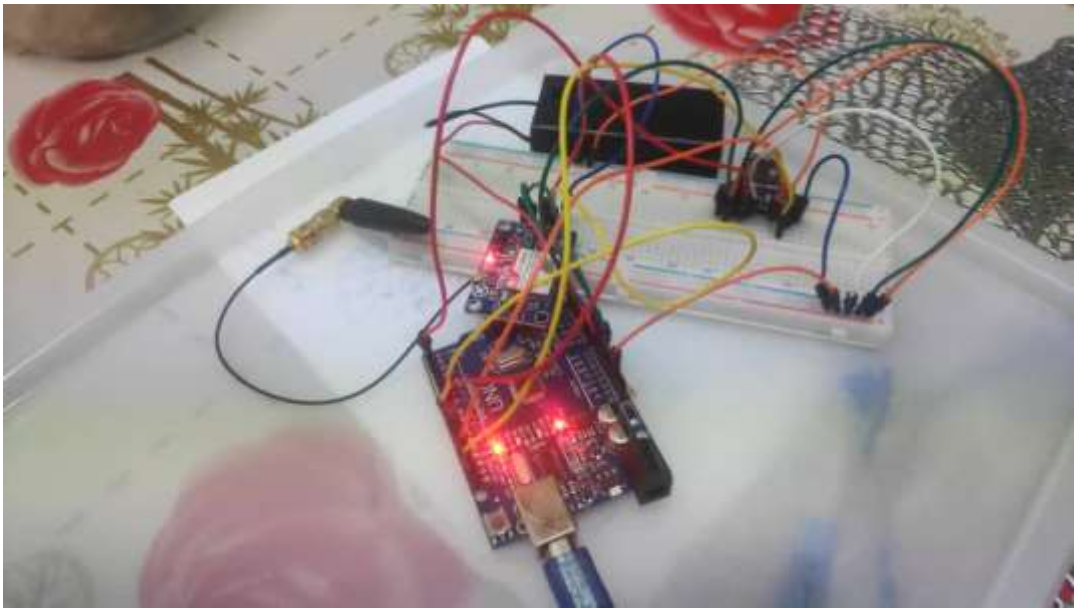
The LCD shows the bad coding that constructed and wrong connection of supply, ground, input, and output pin. Finally decide to use serial monitor on UNO software for monitoring the output of project.

Results

The connection is made with connect laptop through USB to Arduino UNO. Then connect Arduino to lightning sensor AS3935 as input, connect 9V battery as external supply to the circuit and finally the GSM module SIM800L as the output to send alert system to phone with SMS.



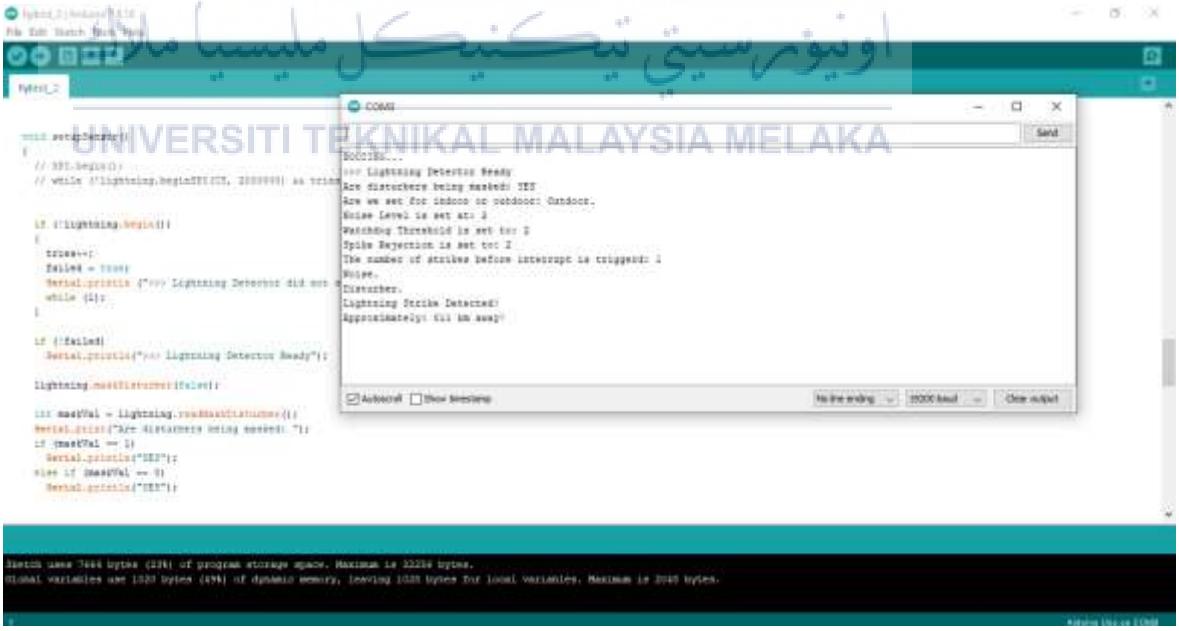
This picture shows the full connection of circuit project.



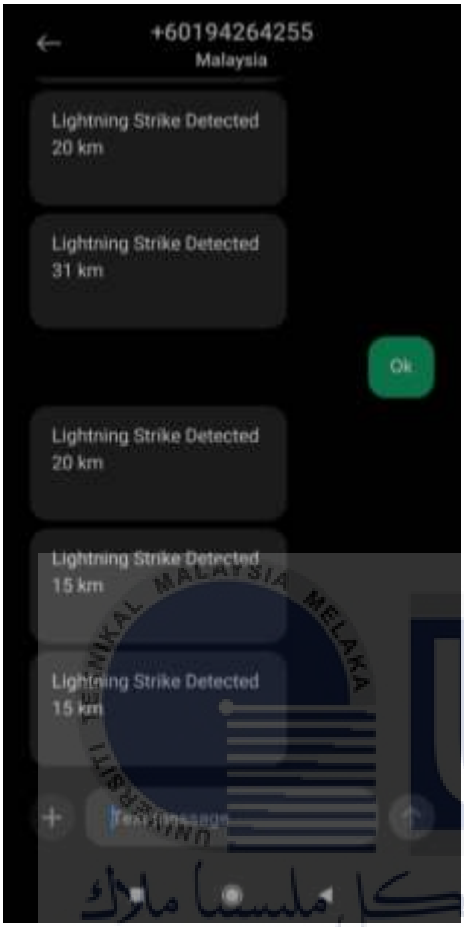
This the clear picture of circuit connection of GSM-Based Lightning Monitoring and Alert System.

After the circuit is connected and running this is the result of project.

1. Output of project which monitoring system of project.

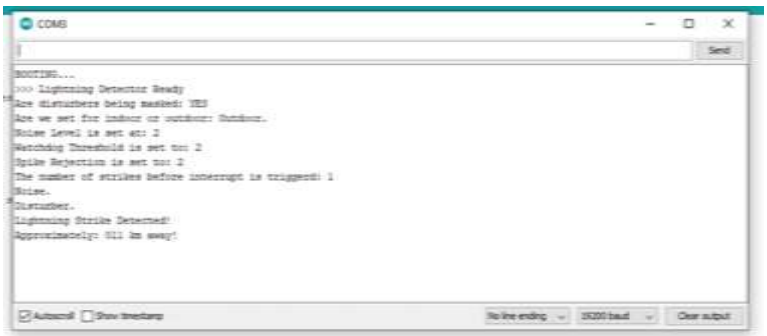


2. Output of project alert system.



Output Data Monitoring System through serial monitor Arduino UNO

Lightning occurs



No lightning

Summary

This chapter how to develope GSM-Based Lightning Moniotring and Alert System. To be able running this project, testing components need to be done. Other than that, after make full connection troubleshoot need to be done especially for software because without good coding and the right one hardware cannot be done. Finally, after the project run successfully, the output need to be recorded.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

Conclusion

This report presented a GSM-based lightning monitoring and alert system. Lightning can give negative impact on building also to human being. Lightning conveys a gigantic electrical heartbeat over a small part of a millisecond. Electrical flow going through the body produces heat, which consumes and obliterates tissues. Consumes can influence skin and once in a while interior tissue. The short length of the openness every now and again restricts the harm to the external layer of skin. Also, lightning is significantly less prone to cause inner consumes than electrical wounds from produced power. Lightning can likewise harm the sensory system, including the cerebrum, causing seizures, loss of awareness, or different anomalies. This project can detect lightning through lightning sensor as3935. After detecting, it will display the lightning disturbance and the distance between on LCD display. Lastly, alert message about the lightning disturbance send to user via smartphone using GSM module. This system has been designed to produce higher flexibility, lower cost and ease of implementation. Finally, this project help increase awareness of people about how important safety step need to take in daily life.

Future Works

For future improvements, accuracy of the GSM-Based Lightning Monitoring and Alert System is the results could be enhanced as follows:

i) Fully focus and enhance self to learn how to make a great coding by knowing the function and what the errors if not constructed carefully.

ii) Rather than use serial monitor on Arduino for monitoring, is better to use LCD display for smooth project and can bring it anywhere.

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APPENDICES

Coding