



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**IMPLEMENTATION OF DIGITAL FILTER FOR PRE  
PROCESSING OF LIGHTNING DETECTION AND MONITORING  
SYSTEM**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electrical Engineering Technology (Department of Electrical Engineering Technology) (BETI)

by

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## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

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## **APPROVAL**

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

.....

(Mr. Ahmad Idil bin Abdul Rahman)

## ABSTRACT

This project present a system used to identify the characteristics of the cloud and ground flash of the lightning strikes and also reduce noise from lightning measured data. The existing lightning measured data was analyzed in detail because some of the data have noise. A digital filter and the identification of lightning had been programmed by using the MATLAB software. The digital filter is used to minimize the noise from the lightning measured data. Based on the analyzed data, a few parameters had been determined. The result shows that the system can recognize the type of lightning strikes based on the parameter being measured. At last, some suggestions are given to improve the system for future research.

## ABSTRAK

Projek ini membentangkan satu sistem yang digunakan untuk mengenalpasti jenis-jenis kilat dan juga mengurangkan gangguan daripada data kilat yang diukur. Data kilat yang diukur yang sedia ada perlu dianalisis kerana sesetengah data kilat mengandungi gangguan. Justeru itu, satu penapis digital telah diprogramkan menggunakan MATLAB. Penapis digital digunakan untuk mengurangkan gangguan dalam data kilat yang diukur. Berdasarkan data yang telah dianalisis, beberapa parameter dikenalpasti. Keputusan menunjukkan sistem ini dapat mengenalpasti jenis-jenis kilat berdasarkan parameter-parameter yang diukur. Akhir sekali, beberapa cadangan untuk penambahbaikan bagi sistem ini telah dicadangkan.

## **DEDICATION**

To my beloved parents

Jamil bin Salleh

NorzitabintiOmmerBashier

Siblings

NurHafifahbinti Jamil

Muhammad Hafiz bin Jamil

NurQasidahbinti Jamil

Supervisor

Mr. Ahmad Idil bin Abdul Rahman

Co-Supervisor

Mr. Johar Akbar bin MohamatGani

Thank you very much for the support, love, encouragement, help and blessing.

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## LIST OF SYMBOLS AND ABBREVIATIONS

|     |   |                                  |
|-----|---|----------------------------------|
| CG  | - | Cloud Flash                      |
| LDS | - | Lightning Detection System       |
| TNB | - | Tenaga Nasional Berhad           |
| MMS | - | Malaysian Meteorological Service |
| GF  | - | Ground Flash                     |



# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

In this chapter, the project background, problem statement, scope and objective of this project will be explained.

### 1.1 Background

Lightning is an unpredicted electrostatic that release during an electrical storm between electrically charged zones either between the cloud and another cloud or between a cloud and the ground. Ibrahim, W.I., & Ghazali, M. R, (2016) stated that one of the natural phenomenon which is which is lightning is the boundless care to humankind and industry in light of the effect on human wellbeing, risk and failure of equipment because of AC primary power leading electrical transient. The charged areas in the environment briefly even out themselves through this release referred to a strike in the event that it hits an object on the ground, and a blaze in the event that it happens inside a cloud. Lightning causes light as plasma, and sound as thunder. Lightning might be seen and not heard when it happens at a separation excessively incredible for the sound, making it impossible to convey similar to the light from the strike or blaze. According to the U.S. National Weather Service, "Lightning is the first thunderstorm hazard to arrive and the last to leave".

By utilizing the characteristics of field information, it can separate data, for example, the time reliance of the voltage or current, which can be utilized for displaying and as a contribution for the calculation of lightning electromagnetic

fields. The two type of lighting Cloud to Ground lightning can happen with both positive and negative polarity. The polarity is that of the charge in the area that began the lightning leaders. A normal electrical discharge lightning conveys an electric current of 30,000 amperes (30 kA), and exchanges 15 coulombs of electric charge and 500 super joules of vitality. The higher electrical discharges can convey up to 120 kA and 350 coulombs.

Positive lightning starts from the decidedly charged top of the cloud (for the most part iron block cloud) instead of the lower rate of the tempest is the not a typical "negative" lightning. Leader shape in the iron of the cumulonimbus and may travel evenly for a few miles before veering towards the ground. A positive lightning bolt can strike anyplace inside a few miles of the iron block of the rainstorm, regularly in regions encountering clear or just somewhat shady skies; they are otherwise called "jolts from the blue" thus. Positive lightning commonly makes up under 5% of all lightning strikes.

In light of the substantially more prominent separation to ground, the decidedly charged area can grow impressively higher levels of charge and voltages than the negative charge areas in the lower some portion of the cloud. Positive lightning bolts are impressively hotter and longer than negative lightning. They can create six to ten times the measure of charge and voltage of a negative jolt and the release current may last ten times longer. An electrical discharge lightning may convey an electric current of 300 kA and the potential at the highest point of the cloud may surpass a billion volts around 10 times that of negative lightning. During a positive lightning strike, higher amounts of low recurrence (ELF) and low recurrence (VLF) radio waves are created.

Technopedia explained a digital filter contains an analog-to-digital converter (ADC) that consist of samples the signal coming in as input, a microprocessor and some other components for storing filter coefficients and data. The software that keeps running on the microprocessor executes a digital

filter by following up on a number from the ADC and performing mathematical operations. It can perform a few impacts, for example, intensification and deferral on the sample signal. The performance of a digital filter is also important. The understanding of the reactions is approaches in different mathematical. The filter is the simplest way to analyze the response when a simple input, for example an impulse. Therefore, complex inputs can also be analyzed.

## 1.2 Problem Statement

Downward negative lightning flashes represent around 90% from an examination led. Ordinarily, the tropical nation, for example, Malaysia was found to have just negative cloud-to-ground lightning flashes as announced by numerous agents. Malaysian Meteorological Service (MMS) has been dependable in gathering information on electrical storm occasion (counting lightning ground blaze and cloud release), day level for over 30 years. The lightning ground streak thickness  $N_g$  is characterized as the quantity of cloud-to-ground flashes in  $\text{km}^{-2} \text{ yr}^{-1}$ . This information is really a critical meteorological information that is utilized as a part of ascertaining the danger of lightning strikes to structures, aeronautical framework, flight exercises and any touchy gadgets. Moreover, Tenaga Nasional Berhad (TNB) likewise assume an imperative part to monitor this movement since 1995. It is trusted that the MMS and TNB utilized the outstanding kind of lightning estimation for Lightning Locating framework (LLS, for example, Magnetic Direction Finding (MDF), Time of Arrival (TOA) and interferometry. The course of action can be either individual or blend of assorted types.

The accessibility of lightning information is recorded by MMS and TNB. It has been guaranteed that the information gathered either by MMS or TNB exhibited site blunders in their mapping framework. They recommended that these mistakes may because of uncertain site blunders inborn in the current

Lightning Detection System (LDS). Besides that, from their casual similar review between their information and the information recorded by TNB, were observed to be not indistinguishable to each other. The electrical engineers and researchers study of the thorough subject about the lightning phenomena. They found that some of the data measured and analyzed is could not be identified due to noise problem. Based on the related study, the analysis about the preliminary signal and the return stroke of lightning found that there are some of the data could not be analyzed. The noise is influence the value of lightning that has been measured. Before this, the zero crossing method has been used to analyze the lightning data but it does not suitable for reduction noise process. Therefore, this research will build a system that can remove the noise that influences the data measure which is pre-processing system. The system of pre-processing will develop by using the engineering software that commonly used which is MATLAB software.

### **1.3 Objectives of this project are:**

- 1.1.1. To implement a pre-processing system for Lightning Detection System (LDS) by using digital filter to improve and enhance the lightning flash signals.
- 1.1.2. To obtain suitable parameter associated with first return stroke (RS) from the measurement of LDS.
- 1.1.3. To analyze and monitor remotely the identification of cloud and ground flashes for LDS.

### **1.4 Scope of Project**

The scope of this project is the type of lightning that often happen in Malaysia by using the data received from TNB or MMS should be identified and interpreted. In this project, graphs will be constructed by using MATLAB software based on the data reading of the lightning. After that, based on the graph analysis, there are a few parameters that will be measured to identify the types of lightning and a pre-processing operation will be carried out, thus will potentially eliminate the

noise that occurs on the signal to acquire a more accurate data. Moreover, the identification of lightning type can be monitor by using Arduino and Visual Basic GUI.

## **1.5 Report Outline**

There are three chapters in this project report. Chapter 1 is described about the introduction, objective and scope of this project. The next chapter which is Chapter 2 is about the literature review of this project. This chapter will review the related research and project that had been done by the other people. Chapter 3 is explaining about the methodology to complete this project. Followed by Chapter 4 is about the result from the analysis of the project and the discussion based on the result. Finally, the conclusion of the project is in Chapter 5.

## CHAPTER 2

### LITERATURE REVIEW

#### **2.0 Introduction**

This subtopic will review about a portion of the past work that has been produced which identified with the recognizable proof of lightning, lightning concept, specification, usage and other helpful data that will be identified with execute this project.

#### **2.1 Lightning Detection System(LDS)**

Lightning is a natural phenomenon that is a great concern to humankind and industry in light of the fact that the negative effect on human wellbeing, hazard and failure of equipment because of AC principle control leading electrical transient. Therefore, the Lightning Detection System (LDS) has developed to estimate the present of the lightning at a specific location. The LDS is use to detect and analyzed he real-time lightning data, lightning stroke, location of lightning and the peak current. The data outcome will show in textually and graphically. (Ibrahim W.W, Ghazali M.R,2016).

The LDS can affirm the present of lightning at a particular place and time with adequate exactness. Lightning symbolisms likewise matches intimately with that of the climate satellite and climate radars. Other than that, the lightning data absolutely helps and can be utilized dependably in climate now throwing and climatologically examines. Moreover, LDS is used to mapping for the usage of the flight schedule. The accuracy of a LDS relies on upon various components which is the sorts and number of sensors introduced, the area of the sensor, structures and condition. Lightning detection hardware distinguishes principally cloud-to-ground lightning movement. Cloud-to-cloud and intra-cloud lightning flashes are difficult to distinguished. Lightning flashes differ in size and sort (exchange positive or

negative charge to the ground). The measure of current likewise changes which influence the quality of the waveform produce. **Lightning Monitoring System**

Generally, lightning detection system and monitoring system have same function which is to predict the location and amount of the present of lightning strike. There is a sensor which is the important component for this system. In a typical system, the sensor configuration varies. The advantage of the former configuration is that it can track the development of the process and movement of the lightning strike. The previous lightning detection system is it cannot predict the occurrence of lightning strike (Salam.Z.e.t.all,2015). Figure 2.1 shows the general block diagram of a typical lightning monitoring system.

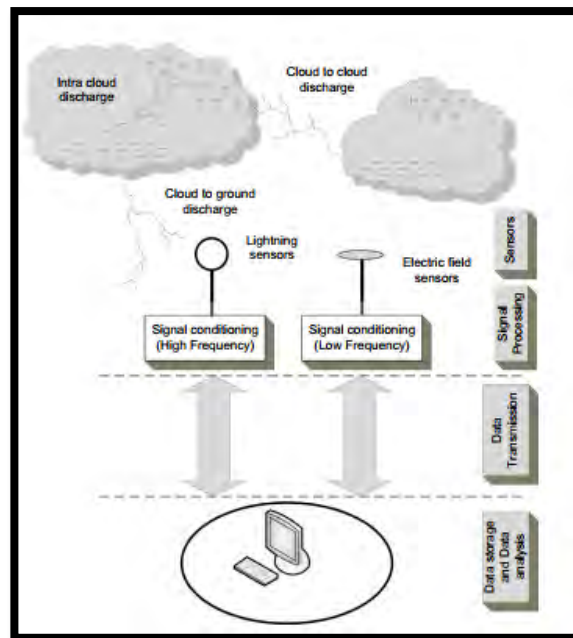


Figure 2.1: The general block diagram of lightning monitoring system

The existing of lightning monitoring system that manufactured by Steven Engineering is function to monitor the occurrence of lightning strike. Phoenix Contact LM-S Lightning Monitoring System stated that

the particular hazard of the lightning strikes is bares the structures such as offshore wind parks, radio masts, leisure facilities or high building. They also said that the lightning strike may cause the buildings and system damaged. Therefore, the employee needs to continuously monitor the system so, the damage can be detected too late. Since the detection of the lightning strike is too late can be detected, they design a system that can monitor the present of lightning. It can monitor and detect the present of lightning via network access. Te system may update the condition continuously which mean time by time if the lightning strike is available. The figure 2.2 is shows the Lightning Monitoring System that manufactured by the Steven Engineering.



Figure 2.2: The existing Lightning Monitoring System.

### 2.3 Cloud-to-Ground Lightning (Ground Flash)

There two type of lightning which is cloud-to-cloud lightning (Cloud Flash) and cloud-to-ground lightning (Ground Flash). Cloud-to-cloud lightning is happening in the sky while the stroke will happen at the sky. Cloud-to-ground lightning a channel of negative charge, called a stepped leader, will zigzag downward in roughly 50-yard segments in a forked pattern. The stepped leader is invisible to human eyes and it will shoot to the ground in less time. The stroke will look like blinking.