INVESTIGATION OF THE PERFORMANCE OF RASPBERRY PI TO DIGITIZE ANALOG SIGNAL WITH RESPECT TO 8-BIT AND 12 BIT VERTICAL RESOLUTIONS

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I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

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DEDICATION

To my beloved parents, brothers and sister, thank you for your endless love and support, without them, I would be aimless.

To my lecturers and friends, guidance and knowledge we shared and discuss together till a sleepless night.

Thank You

ABSTRACT

Lightning has been a mysterious natural phenomenon since ancient time. Although the phenomenon of lightning has been revealed as the transmission of electrical discharges, there are still many unknown areas inside the occasion of lightning itself. Thus, the studies or researches about lightning are still a hot topic and being carried out until nowadays. A lot of equipment involved during these researches but they are very expensive, turn out to be costly budget to the whole research or studies. For example, Piscoscope is a PC software develop by Pico Technology Inc. with a lot of functionalities such as oscilloscope and digitizer. However, the market pricing for a standard PicoScope package is more than RM 8,000 depending on the models and specifications. A master kit of PicoScope can reach more than RM 10,000 per unit. Therefore, this project is carried out to make a low-cost digitizer by implementing a module (BitScope) onto Raspberry Pi board. Why is this digitizer so important? As we know, the signals from this real world, including lightning signals are in the analog form which cannot be understand by electronics components which communicate in digital form. Therefore, implementing the Raspberry Pi board as the ADC is the great use and help in converting the real-world signals and further processing to extract vital information from the lightning signals.

ABSTRAK

Kilat telah menjadi fenomena semulajadi yang misteri sejak zaman purba. Walaupun fenomena kilat telah diturunkan sebagai penyaluran pelepasan elektrik, masih terdapat banyak yang tidak diketahui tentang kejadian kilat itu sendiri. Oleh itu, kajian dan penyelidikan mengenai kilat masih menjadi topik hangat sehingga kini. Banyak peralatan yang digunakan dalam penyelidikan ini tetapi ia sangat mahal, menjadi ia mahal untuk keseluruhan penyelidikan atau kajian. Contohnya Piscoscope adalah perisian PC yang dibangunkan oleh Pico Technology Inc. dengan pelbagai fungsi seperti osiloskop dan pendigit. Walau bagaimanapun, harga pasaran untuk pakej PicoScope adalah lebih daripada RM 8,000 tergantung pada jenis model dan spesifikasi. Kit utama PicoScope boleh mencecah lebih RM 10,000 seunit. Oleh kerana itu, projek ini bertujuan untuk membuat pendigit kos rendah dengan melaksanakan suatu modul (BitScope) ke papan Raspberry Pi. Mengapa pendigit ini begitu penting? Seperti yang kita tahu, isyarat dari dunia nyata ini, termasuk isyarat kilat adalah dalam bentuk analog yang tidak dapat difahami oleh komponen elektronik yang berkomunikasi dalam bentuk digital. Oleh itu, melaksanakan papan Raspberry Pi sebagai ADC adalah penggunaan yang hebat dan membantu dalam menukar isyarat

dunia sebenar dan pemprosesan selanjutnya untuk mengeluarkan maklumat penting dari isyarat kilat.

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LIST OF SYMBOLS AND ABBREVIATIONS

For examples:

-CG	:	Negative cloud-to-ground flash
+CG	:	Positive cloud-to-ground flash
+NBE	:	Positive Narrow-bipolar Event
-NBE	:	Negative Narrow-bipolar Event
E-Field	:	Electric Field
B-Field	:	Magnetic Field
I/O	:	Input/output
GPU	:	Graphic Processing Unit
CPU	:	Central Processing Unit
RAM	:	Random Access Memory
GPIO	:	General-purpose input/output
SD	:	Secure Digital
ARM	:	Advanced RISC Machines
USB	:	Universal Serial Bus
STB	:	set-top box
QPS	:	Queries-per-second

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CHAPTER 1

INTRODUCTION

1.1 Background

Lightning flash is one of the world fascinating wonders. Despite of preserved records of the naked eyes observations of lightning flashes in ancient scriptures, until now we don't understand the fundamental mechanism of lightning flashes.

Electrical discharges in air (dielectric breakdown) which emit electromagnetic (EM) fields across very wide spectra from a few Hertz up to visible wavelength is defined as a lightning flash. Latest disclosure reveals that lightning flash emit X-rays and Gamma-rays and dependable to create positrons also known as anti-matter particle.

Generally, there are 3 types of lightning flashes based on movement and direction of electrical charges namely positive cloud-to-ground flash (+CG), negative cloud-to-ground (-CG) and Cloud Flash (CF). For Cloud Flash, it can further be divided into two subtypes which are narrow bipolar event (NBE) flash and intra-cloud (IC) flash.

An oscilloscope is a laboratory instrument that has been used to capture and collect the waveforms of lightning that has been sensed by the antenna where is the antenna is directly or through filter circuits connected to the oscilloscope. This device draws a graph of the instantaneous signal voltage as a function of time. Usually oscilloscope displays alternating current (AC) or direct current (DC) waveforms. It has frequency as low as 1 HZ or as high as several Megahertz (MHz) and the display is divided into horizontal and vertical divisions.

1.2 Problem Statement

Recently, a group of lightning researcher's studies about the relationship between the signal of the lightning and the electromagnetic fields received from the buffer circuit. The researchers want to analyze the smooth digital data from the cloud to make a further study about the characteristics of the signal of lightning and electromagnetic fields but found some difficulties such as:

1) The oscilloscope in laboratory is heavy, it is difficult for the researcher to bring the oscilloscope for outdoor research.

2) This item also is not portable, they need ac supply to power up the oscilloscope. Without the ac supply oscilloscope cannot functioning.

3) The third problem is, oscilloscope is very expensive such as Yokogawa, Tektronik, and Keysight. They will become more expensive when the resolution is higher.

Therefore, a significant question should be asked, can we design low-cost oscilloscope that portable, adjustable and stand-alone but producing same quality with the current oscilloscope?

In this project, we propose an alternative to the current oscilloscope which is low-cost, portable, adjustable, and stand-alone. The quality performance of the proposed oscilloscope will be evaluated.