

“I admit that I’ve read this thesis, and in my opinion, this thesis is fulfilled its requirements like scope and quality for the award of the Bachelor of Electronic Engineering (Industrial Electronic)”.

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PULSE DETECTOR THROUGH DIFFERENCE AMPLIFIER


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“Hereby the author declares that all the material presented in this thesis to be the effort of the author himself. Any kind of materials that is not the effort of the author has been stated clearly in the references”.

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Dedicated to:

Mom and Dad, Sisters and Beloved Friends

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Assalamualaikum w.b.t. Alhamdulillah, finally I've completed my final year project thesis successfully. It is not easy to fulfill this thesis requirements on just by myself. People around me also contribute their very own best to make sure my thesis is complete in a proper way.

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ABSTRACT

This project is about to develop a circuit which can detect the human pulse with the principal of correlation analysis or known as lock-in analysis. Human pulse signal which around 0.5 to 1 second with $20 \mu V$ that can be detected through the photodiode. This detector can detect human pulse through difference amplifier. The blood pressure varying with the heartbeat changes the amount of blood in the peripheral blood vessel. This lead to an optically measurable alteration of skin reflectance and transmittance. An infrared LED is used to transmit and receive the signal from the pulse from a finger. Back scattered light is detected by a photodiode. Then, the high frequency noise from the measured signal is removed by a low-pass filter which build up with operational amplifiers. The principal of correlation analysis or known as 'Lock-in' analysis, is being used to extract signal buried in a noise.

ABSTRAK

Projek tahun akhir ini adalah untuk membangunkan satu alatan elektronik yang dapat mengesan nadi manusia dengan menggunakan analisis pertalian atau *correlation analysis*. Isyarat nadi manusi yang dapat dikesan melalui diod cahaya atau fotodiod adalah dalam lingkungan 0.5 hingga 1 saat dengan voltan sebanyak $20 \mu V$. Pengesan ini dapat mengesan nadi manusia melalui tekanan darah bersama degupan jantung yang sentiasa mengubah jumlah darah dalam sempadan saluran. Ini menyebabkan perubahan gerakan nadi yang dapat dikesan melalui pengesan ini. LED inframerah digunakan untuk memancarkan dan menerima isyarat dari denyutan nadi yang berpunca dari jari yang didekatkan dengan LED itu. Ia juga merupakan aplikasi dari diod cahaya atau fotodiod. Dalam projek ini juga, frekuensi yang tinggi akan menghasilkan hingar. Hingar ini akan dikurangkan menggunakan prinsip penapis lulus rendah. Prinsip analisis pertalian atau *correlation analysis* digunakan untuk megeluarkan dan mengurangkan hingar pada isyarat.

CONTENTS

CHAPTER	TITLE	PAGE
	AUTHENTICATION	
	PROJECT TITLE	i
	ADMISSION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	CONTENTS	vii
	TABLELIST	x
	FIGURE LIST	xi
	ABBREVIATION	xiii
	ENCLOSURES LIST	xiv
I	INTRODUCTION	
	1.1 Overview	1
	1.2 Title and Objectives	2
	1.3 Scopes of Work	3
	1.4 Methodology	3
	1.5 Expected Result	4
	1.6 Thesis Outline	5

II LITERATURE REVIEW AND CONCEPT

2.1	Introduction	7
2.2	Correlation Analysis	7
2.2.1	Lock-In Amplifier	8
2.2.2	Block diagram and equation	9
2.3	Difference amplifier	12
2.3.1	Double-ended (differential) output	12

III PROJECT METHODOLOGY

3.1	Introduction	14
3.2	Equipments	16
3.2.1	Power Supply	16
3.2.2	Oscillator	17
3.2.2.1	The 555 IC Timer	18
3.2.2.2	Pinouts and internal circuits of the 555 IC timer	19
3.2.2.3	Astable operation of the 555 IC timer	22
3.2.3	Variable Resistor	24
3.2.4	Transistor	24
3.2.5	Op-amp	25
3.2.6	Active Filters	27
3.2.6.1	Low-pass filter	27
3.2.6.2	Component Selection	29
3.2.7	Analogue Switches	30
3.2.7.1	Operation with supply voltages other than $\pm 15V$	31
3.2.7.2	Overvoltage Protection	31
3.2.8	IR detector / emitter	33
3.2.8.1	Infrared emitter	34

3.2.8.2	Infrared detector	37
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IV PROJECT RESULT AND ANALYSIS

4.1	Introduction	39
4.2	The oscillator	40
4.3	Other output signals	42

V CONCLUSION AND SUGGESTION

5.1	Conclusion	45
5.2	CIRCUMSTANCES THAT FACED	46
5.3	SUGGESTIONS	47

REFERENCES	48
-------------------	-----------

ENCLOSURES	49
-------------------	-----------

TABLE LIST

NO	TITLE	PAGE
3.1	The DG419 truth table	31
3.2	The DG419 pin description	32
3.3	The product specification of SEP8705	35

FIGURE LIST

NO	TITLE	PAGE
2.1	The pulse detected from a finger	9
2.2	Block diagram of correlation analysis	10
2.3	Correlation analysis concept	11
2.4	One of symmetrical difference amplifier in the circuit	13
3.1	Flow chart of the methodology	15
3.2	Block diagram showing parts of a power supply	17
3.3	555 timer as oscillator circuit.	18
3.4	Internal circuit of 555 timer	19
3.5	555 timer in miniDIP package	20
3.6	Astable 555 internal circuit	23
3.7	Pulse relationship	24
3.8	Basic op-amp	26
3.9	Ideal filter response for low-pass filter	27
3.10	The second order low-pass filter	28
3.11	The pin configuration of DG419 switches	30
3.12	The DG419 Circuit	32
3.13	The transition time	33
3.14	The infrared detector / emitter	33
3.15	SEP Series AlGaAs Infrared Emitting Diode (SEP8705-003)	34
3.16	The schematic of SEP8705	36
3.17	The form of SEP8705	36
3.18	The SDP8405 IR detector	37

3.19	The schematic of an IR detector	37
3.20	The form of SDP8405	38
4.1	The project circuit	40
4.2	The output signal of the 555 timer oscillator	41
4.3	The output signal of 555 timer in Excel	42
4.4	The transistor (emitter) output signal in digital oscilloscope	42
4.5	The analog switch (S1) output signal in digital oscilloscope	43
4.6	The analog switch (S2) output signal in digital oscilloscope	43
4.7	The output signal	44

ABBREVIATIONS

LED	-	Light Emitter Diode
T _{on}	-	Operation Time
T _{off}	-	Non-operation Time
T	-	Period
LP	-	Low-Pass Filter
Op-Amp	-	Operational Amplifier
PCB	-	Printed Circuit Board
V _{dc}	-	Direct Current Voltage
AC	-	Alternating Current

ENCLOSURES LIST

NO	TITLE	PAGE
1	Data Sheet SDP8405	49
2	Data Sheet SEP8705	53
3	Active Low-Pass Filter	57
4	Pulse Wave Velocity	58
5	555 Timer	62

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter would tell about the overall of the project which is pulse detector through difference amplifier. It will include the project synopsis, scopes of work, and project objectives, problem statements, project methodology, expected result, the circuit simulation and background study.

It also will tell about the flow of the project and ways to make this pulse detector through difference amplifier project success. At the beginning, it shows us what exactly the project is about.

This project is about the devices that can detect the human pulse through difference amplifier as the receiver. This project is to develop the circuit by using the correlation analysis as one of the ways to complete the human pulse detector. It can detect human pulse around 0.5s to 1s and $20\mu\text{V}$ which can be detected by photodiode.

1.2 Title and Objectives

The title of this project is “Pulse Detector Through Difference Amplifier”. The main aim of this project is to develop a hardware that can detect human pulse by using the differential amplifier in to build the circuit.

Therefore, this project objective can be defined as below:

- To build the perfect pulse detector through difference amplifier by manually and basically.
- To get the most accurate value of voltage produced which is $20\mu\text{V}$ which can detect human pulse around 0.5s to 1s.
- To study more besides enhance more knowledge about basic electronic circuit.
- To study the devices and circuits that combine to build the pulse detector through difference amplifier. Thus, I know and understand more the usage for every devices and circuits.
- To know and learn something new by doing this project.

1.3 Scopes of Work

As what we already know, this project is about to develop human pulse through difference amplifier. The usage of difference amplifier is as a receiver device to produce the pulse signal.

But before that, this project have to develop a low noise pulse detector through correlation analysis or 'lock-in analysis'. This is to extract the signal buried in a noise. When reference signal combine with measured signal, the signal amplitude will be multiplied. This signal is actually produce a noise which can affect the result if we not extract it. Thus, the low pass filter as the way to extract the noise produced.

These all processes happen in receiver circuit, as it produce signal from the sender which uses the timer 555.

1.4 Methodology

- The information collected :

At the beginning, the information about this project should be collected. The source to find these information are from related books, websites and from the supervisor's itself. The information that have be collected are about :

- ✓ Pulse detector information :

Knowing and learning about the pulse detector which already exist in market and how it works.

- ✓ How to build the circuit :
Learn and create the circuit one by one. For a full circuit, there are divided in many small circuits which have their own duty. The usage have to be learned For example the lock-in analysis, the 555 timer circuit, the low pass filter circuit, modulator, demodulator, photodiode, differential amplifier circuit and so on.
- ✓ The human pulse :
Have to learn the basically of human pulse, where can be detected, the time rate of human pulse and so on.
- The circuit design :
After complete all the theory and calculation required, then I have to start making or designing the circuit through paper and simulation. The circuit is simulated by using a software like PSpice/Multisim of Protel/Eagle. A help from supervisor is very important in order to make sure the circuit complete in a direct way.
- When the circuit designed works, transfer and build it through the PCB.
- Then the testing will be made to prove that the system works.

1.5 Expected Result

When a finger stated nearer the photodiode, the circuit starts working. Then the result that expected would be the pulse signal displayed itself in a form of waveform. The waveform should be displayed on the oscilloscope. The waveform will show us that the photodiode is sensitive to the finger which can detect the pulse through it.

1.6 Thesis Outline

This thesis is divided into 5 chapters, including:

Chapter 1 is all about the introduction. This will include the title, objectives, roughly methodology and expected result. In this chapter, I will give the introduction view on what the project that I've done.

Second chapter will tell about the literature review and the concept of this pulse detector using differential amplifier project. In this chapter, I will explain what the literature review involve that would be my source of doing this project and the concept of my project.

Chapter 3 will explain about the methodology of doing this project. This will include the flow of process when completing this project besides what are the components and equipments that used in the realization of this project.

The 4th chapter of this thesis will show u about the project result. This chapter will discuss about the result that found, problems encountered and analysis of the result.

Chapter 5 will show the conclusion of this project and any recommendation to enrich the project and knowledge.

- Chapter 1** Overview of the project.
- Chapter 2** Literature review and concept.
- Chapter 3** Project methodology.
- Chapter 4** Project result and analysis.
- Chapter 5** Conclusions and suggestion.

CHAPTER 2

LITERATURE REVIEW AND CONCEPT

2.1 Introduction

This chapter would discuss about the theory and overall concept of this project. The purpose of this discussion is to explain about the perspective and method which used in doing the project besides to observe how far this project could be related with the experimental and available theory. Besides that, this chapter also would show the theory and concept which used to solve the problem by doing this project. Theoretical understanding is important as the guideline before making any project experimental. The result of any experiment can't be evaluated if we not compare it with the theories.

2.2 Correlation Analysis

Correlation analysis or called as lock-in analysis is used in order to build this project. The purpose of using this procedure is an attempt to make sure that the output signal has low noise.

The reference signal which comes from an oscillator (timer 555) which also as a transmitter besides act as modulator and the measured signal which comes from the signal that had been produced from a pulse that detected (which also as a receiver), combined together by the switch that also act as a demodulator.

The reference signal which the frequency is 1kHz has low noise rather than the measured signal. This is because the measured signal is a combination of reference signal and pulse signal that would cause the disturbance in a way to the switching.

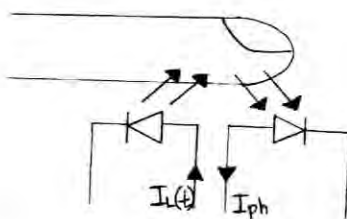
In the receiver circuit before the switching, there have a differential amplifier to produce to inverting signal that will go through the switch. Then this two inverting signal are connected to the analog switch which have two switches (S1 and S2) that are normally closed switch and normally open switch.

This signal produced plus the signal from the transmitter will produce the higher peak signal but still got noise. The low-pass filter then do its job which is to remove the noise besides to produce the output signal.

2.2.1 Lock-In Amplifier

In its most basic form a lock-in amplifier is an instrument with dual capability. It can recover signals in the presence of an overwhelming noise background or, alternatively, it can provide high resolution measurements of relatively clean signals over several orders of magnitude and frequency. However, modern instruments offer far more than these two basic functions and this increased capability has led to their acceptance, in many scientific disciplines, as units which can provide the optimum solution to a large range of measurement problems.

2.2.2 Block diagram and equation



The pulse detected from a finger

(2.1)