MOUSE PULSE DETECTOR CIRCUIT

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This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronics Engineering (Computer Engineering) With Honours

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BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : MOUSE PULSE DETECTOR CIRCUIT

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Special dedication to my beloved father and mother, my siblings and my kind hearted supervisor Mr.Farid Arafat bin Azidin, and my dearest friends.

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ABSTRACT

The project aim was to develop a pulse detector circuit which detects a pulse signal from a mouse. Using an Infrared Sensor HSDL 5400 as a sensing device, the detector circuit is developed based on amplifier concept which is a principle of differential amplifier. This sensor will be attached to a mouse tail and the wavelength of the infrared light intensity will transmitted through the tissue and received by a photodiode. The captured pulse signal is senses and amplified from a mouse and transmits the signal to be displayed on oscilloscope. The important things need to be considered in designing the detector circuit are, the performance of the detector circuit in produces the expected waveform of the pulse signal and noise that will occur. Since the differential amplifier is limited in its performance, a simple transimpedance circuit is used in designing the detector circuit to overcome this problem. The Sallen-Key active filter will be designed and added into detector circuit to filter out noise frequency. This detector circuit was not only detecting the mouse signal but also can detect human signal as well.

ABSTRAK

Tujuan utama projek ini dijalankan adalah untuk membina sebuah alat pengesan yang akan mengesan denyutan nadi tikus. Dengan menggunakan sensor inframerah HSDL 5400, alat pengesan ini dibina berdasarkan Konsep Penguat Amplifier, iaitu prinsip *differential amplifier* . Sensor akan dilekatkan pada ekor tikus dan keamatan gelombang cahaya inframerah akan dihantar melalui lapisan tisu kulit dan akan diterima oleh *photodiode*. Sensor akan mengesan, menguat isyarat denyutan nadi tikus yang telah ditangkap dan menghantar isyarat tersebut untuk dipaparkan pada osiloskop. Perkara penting yang perlu dititikberatkan dalam pembinaan alat pengesan ini ialah prestasi alat tersebut dalam mengeluarkan isyarat gelombang sebenar bagi denyutan nadi dan gangguan isyarat yang akan berlaku. Memandangkan prestasi yang dihasilkan oleh *differential amplifier* adalah sangat terhad, litar *transimpedance* akan digunakan dalam pembina alat pengesan tersebut bagi mengatasi masalah tersebut. Penuras aktif *Sallen-key filter* (*active filter*) dihasilkan dan ditambah pada litar alat pengesan untuk membuang ganguan dalam isyarat frekuensi. Alat pengesan ini bukan sahaja boleh digunakan untuk mengesan denyutan nadi tikus tetapi juga boleh digunakan untuk mengesan denyutan nadi manusia.

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CHAPTER I

INTRODUCTION

1.1 Project Introduction

Before this, the ECG, EEG and EMG – signal were introduced in bioelectrical signal which to detect the signal from human body like the brain, muscles and hearth. This bioelectric signal is measured from the surface of the skin that is mostly in range of 0-2000μV. In this project, a detector circuit will be constructed to detect a pulse signal from an animal which is a mouse. The same concept used in detecting human signal will be used in this project. The concept that will be used in designing this detector circuit is an amplifier concept.

The ultimate goal of this project is to ensure the detector circuit capable to amplify and filters the captured signal and transmits the signal to be displayed in oscilloscope. This circuit is developing with principal of differential amplifier. Since, the differential amplifier is limited in its performance, a simple instrumentation amplifier and the combination of Sallen-Key filter will be added into this detector circuit to overcome this problem.

1.2 Project Background

The basic concept of this detector circuit is the infrared light (875nm) are being transmitted through the skin and absorbed at the level of the wavelength by the electrical activities and blood contraction of the blood inside the body. This electrical activities and blood contraction allows more infrared light to pass through it. Thus, after the wavelength of light have been transmitted through tissue and received by a photodiode, the infrared light intensity is computed. The mouse pulse detector circuits design with a transimpedance circuit, which is the receiving circuits that convert the infrared light currents into voltages which can then be observed using an oscilloscope. The process can be illustrated by as a general schematic as in Figure 1.1 below:

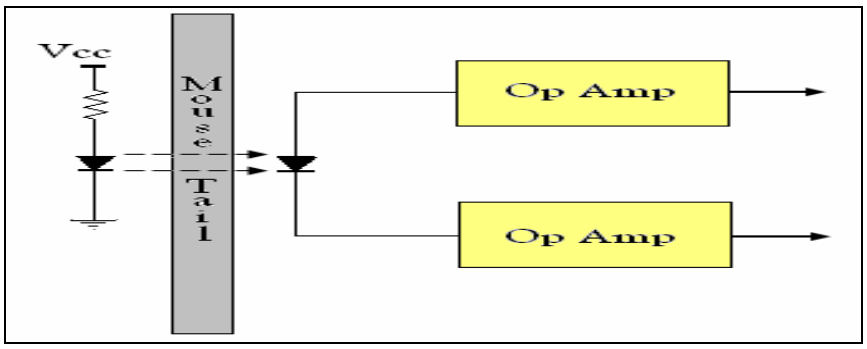

Figure 1.1 Process of the detector circuit

1.3 Problem Statement

Nowadays, electronic engineering can be developed to other various fields including in medical field. For this study, a Mouse Pulse Detector Circuit is developed. Pulse Detector also known as Pulse Analyzer is a method used to measure a pulse rate. This measurement is not only used to human but is also great value to animals undergoing with similar procedures. This detector circuit is designed to detect a pulse signal effectively in mouse. This detector will amplified the captured signal from a mouse and transmit it to the oscilloscope. This device is designed to assist in the medical field (biological) which can help biologist to get pulse reading with quick and easier.

1.4 Objective

Due to the problem statement stated above, the aim of this project is to build a pulse detector circuit using an infrared photodiode sensor, which will be connected to an amplification circuit and then fed to an oscilloscope for observation. This pulse detector circuit will detects a mouse pulse using a principle of differential amplifier. This detector circuit used to detect an actual waveform of a mouse pulse signal. This pulse will be displayed on oscilloscope in range around 1.5s – 2.0s.

1.5 Project Scope

A mouse pulse detector circuit project function based on several scope of work which are:-

i. Design circuit and run simulation in Multism.
ii. The amplifier concept (the principle of differential amplifier) is used in designing the detector circuit.
iii. An infrared (IR) sensor, IR detector HSDL 5400 and IR emitter HSDL 4400 is used to detect and receive the signal from mouse and transmit the signal to be displayed on oscilloscope.
iv. An active filter: High pass and Low pass filter will be added into this detector circuit to discard unwanted signal (noise).
v. A special cage is designed so that the measuring process will not disturbing the mouse.

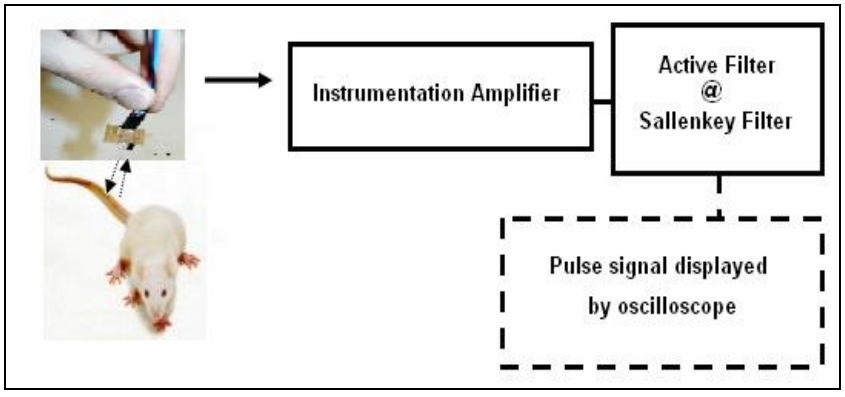

Figure 1.2 Block diagram on how the detector circuit works

1.6 Design Criteria

This project used a sensor that will successfully measure the blood hemoglobin of a mouse. The device will attached to a mouse tail and will be capable of doing the following:

- Measure a mouse hemoglobin level of 65 – 95%.
- Work in a range of average mouse hearth rates of approximately 400-600 beats per minutes.
- Fit comfortably on a mouse tail of approximately 3-5 mm diameter.

1.7 Project Methodology

Phase 1: Understand the project

Study about the amplifier concept, differential amplifier and instrumentation amplifier. Understand the concept and function of filter and sensor in this circuit. Get the datasheet for of component involved. (Sensor HSDL 4400 and HSDL 5400). Understand the circuit operation.

Phase 2: **Literature Review**

Research and find more information about the detector circuit from supervisor, internet, books, journal, and thesis and so on. Try to understand the concept and desired result for this detector circuit.

Phase 3: Design and simulate circuit

Find and determine the primary component involved in the detector circuit. Design and simulate a circuit using Multism. Design and simulate circuit in Proteus and transfer the circuit to PCB board.

Phase 4: Design model of detector circuit

Design, test and troubleshoot the circuit on breadboard and PCB. If the circuit can run successfully, start with designing the detector circuit model with a cage.

Phase 5: Writing Report and Thesis

Start with a report and thesis.

1.8 Report Outlines

This report consists of five chapters. The following chapters are the outline of the implementation of the project, a mouse pulse detector circuit.

Chapter I

Discuss briefly about overview of the project. This chapter contains with introduction, problem statement, objectives, project scope and methodology.

Chapter II

Covers the literature review. Contains the research and information about the project on several important concepts of designing the detector circuit.

Chapter III

Covers in design methodology. Including details about design and modeling of the detector circuit. Discuss briefly about all component involve in designing detector circuit.

Chapter IV

Including the simulation results, analysis and observation of the detector circuit.

Chapter V

Contains of simple conclusion about the project progress for PSM1.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Literature Review is important in each project as a base for gathering information necessary to complete the project. All information is gathered from various sources such as:-

- Journal
- Books
- Conference Transcript
- Thesis
- Patent
- Website

After searching through all this various material, all information will be filtered to be related to pulse detector circuit. All this information will be compiled to be included in the report.

2.2 Introduction to Detector

Detector can be defines as any device that receives a signal or stimulus (as heat or pressure or light or motion etc.) and responds to it. A detector is implemented as a sensitive element or a primary energy transducer is the main unit of electric systems for measuring nonelectric parameters. Detector for measuring the pulse wave should have a high intrinsic frequency, low frequency and temperature errors within the range from 0 to 40^0C. They should be compatible with devices for measuring both AC and DC components of signal.

Detector are synonym to sensor which defines as a device that measures or detects a real-world condition, such as motion, heat or light and converts the condition into an analog or digital representation. Because sensors are a type of transducer, they change one form of energy into another. For this reason, sensors can be classified according to the type of energy transfer that they detect.

2.3 Sensor as Detector Elements

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. There are many sensing method that is widely used in order to detect an object or obstacle. However, its application will decide whether the sensor is suitable to use or not. However, not all of it will be suitable to apply on pulse detector circuit. There are some specific definitions pertaining to sensor performance that must be clarified. A good sensor should acts as the following rules:

i. The sensor should be sensitive to the measured property
ii. The sensor should be insensitive to any other property
iii. The sensor should not influence the measured property