



## **UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

### **PSM TITLE (Development of cost effective human powered generator and fitness health analyzer by using LabVIEW)**

This report submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the degree of Bachelor of Engineering Technology (Bachelor's Degree in Electronics Engineering Technology (Industrial Electronics) with Honours)

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## DECLARATION

I hereby, declared this report entitled “Development of cost effective human powered generator and fitness health analyzer by using LabVIEW” is the results of my own research except as cited in references.

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Date : 10 DECEMBER 2017

## **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's Degree in Electronics Engineering Technology (Industrial Electronics) with Honours**. The member of the supervisory is as follow:

.....  
(IR MOHAMMAD 'AIFI BIN KASNO)

## ABSTRAK

Laporan ini akan membentangkan pembangunan penjana tenaga dan penganalisis kesihatan dengan menggunakan LabVIEW. Kini, masalah kesihatan semakin meningkat hari demi hari kerana gaya hidup yang tidak sihat, terutama masalah jantung. Penyakit jantung telah menjadi pembunuh utama di kalangan rakyat Malaysia. Oleh itu, masyarakat perlu sentiasa mengawasi kadar denyutan mereka dan mengambil langkah berjaga-jaga sebelum sesuatu yang buruk berlaku. Dalam projek ini, sensor denyut telah digunakan untuk mengesan nadi pengguna dan memaparkan kadar jantungnya. Isyarat sensor nadi akan disalurkan ke program LabVIEW melalui Arduino UNO sebagai DAQ. Satu Graphical User Interface (GUI) telah dibina di LabVIEW untuk memaparkan kadar denyutan pengguna dan memberi amaran jika pengguna tersebut melebihi kadar jantung maksimumnya. Di samping itu, untuk mengelakkan masalah kesihatan ini, masyarakat perlu mengekalkan gaya hidup yang sihat. Oleh itu, dalam projek ini, ia menggalakkan orang untuk berbasikal dan pada masa yang sama menjana kuasa untuk menyelamatkan bumi. Sistem penjana kuasa manusia bergantung kepada kuasa pedal pengguna dan kuasa yang dihasilkan akan mengecas bateri untuk kegunaan selanjutnya. Pengguna perlu mengayuh basikal dan menyebabkan penjana motor dynamo berputar dan menghasilkan kuasa untuk mengecas bateri.

## **ABSTRACT**

This report will present the development of cost effective human powered generator and fitness health analyzer by using LabVIEW. Nowadays, the number of health problems is increasing day by day because of the fast growing unhealthy lifestyle, especially the heart problem. The heart disease has become the top killer among the Malaysians. Therefore, it is necessary for the people to regularly monitor their heart rate and taking early precaution before anything bad happen. In this project, a pulse sensor is utilized to detect the pulse of the user and display his/her heart rate. The pulse sensor signal is transfer to the LabVIEW program through the Arduino UNO as the DAQ. A Graphical User Interface (GUI) was developed at the LabVIEW to display user heart rate and give out warning if he/she has exceeded the maximum heart rate. In addition, in order to prevent these health problems, people should maintain a healthy lifestyle. Therefore, in this project, it encourages the people to cycling and at the same time generate power in order to save the earth. The human powered generator system depends on the pedal power of the user and the power produced will charge into a battery for further use. The user will have to pedal the bicycle and cause the dynamo motor generator to rotate and produce power to charge into the battery.

## **DEDICATION**

This thesis is dedicated to:

My beloved parent,

Tan Kheng Lee and Teng Cheng Sim

My supervisors,

IR Mohammad 'Afif bin Kasno and A.Shamsul Rahimi bin A.Subki

And all of my friend.

Thank you for their encouragement and unconditionally support.

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## LIST OF ABBREVIATION, SYMBOL AND NOMENCLATURE

BPM	-	beats per minute
ECG	-	electrocardiogram
PPG	-	photoplethysmogram
HRM	-	heart rate monitor
HR	-	heart rate
IR	-	infrared radiation
LED	-	light emitting diode
IC	-	integrated circuit
Op-amp	-	operational amplifier
LCD	-	liquid crystal display
ADC	-	analogue to digital converter
GUI	-	graphical user interface
PC	-	personal computer
B.C	-	before Christ
A.D	-	anno Domini
AC/DC	-	alternating current and direct current
BMI	-	Body Mass Index
PWM	-	pulse width modulation
USB	-	universal serial bus
DAQ	-	data acquisition
Rx	-	receiver
Tx	-	transmitter
Hz	-	hertz
V	-	volt
RPM	-	revolution per minute

# CHAPTER 1

## INTRODUCTION

This chapter will introduce the background of this project, which about the fitness analyzer and human powered system. Besides that, the problem statement and the objectives of this project also will mentioned. Next, there is also the scope of study related to the project.

### 1.1 Background

The number of health problems is increasing day by day because of the fast growing unhealthy lifestyle, especially the heart problem. For example, the common heart disease such as coronary artery disease (narrowing of the arteries), heart attack, abnormal heart rhythms, or arrhythmias, heart failure, and so on. Nowadays, the heart disease still the top killer among the Malaysians. For example, the findings stated that heart disease has caused the death of the population, which age between 15 to 64, at 13.8 percent in 2014 [1]. Therefore, it is necessary to monitor the heart rate of one on a regular basis.

Heart rate is the number of heartbeats per unit of time, typically expressed as beats per minute (bpm). The heart rate can vary for everybody as the body's need to absorb oxygen and excrete carbon dioxide changes during rest or exercise. Therefore, heart rate measurement could show the condition of the heart. Heart rate is varying according to subject's age, person physical and activity condition. For a healthy adult his/her heart rate at rest should be around 72 bpm. While for an athlete, his/her normally has lower heart rates compare to less active people do. For the baby, they usually have a higher heart rate, which around 120 bpm, on the other hand, children or



kids will have a heart rate at around 90 bpm. Bradycardia was the abnormal heart rate, which it is lower heart rate than the normal rate, whereas tachycardia are referring higher heart rate, which is higher than the normal.

Heart rate can be measured at any spot on the body at which an artery is close to the surface and a pulse can be felt. The most common places to measure heart rate using the palpation method is at the wrist (radial artery) and the neck (carotid artery). By placing the fingers either at the neck or at the wrist, then count the number of pulses within a 1-minute period. The subject may just measure the beats per minute rate by counting for 10 seconds and multiplying it by 6, or count for 15 seconds and then multiply by 4, or even count for 30 seconds and double the result. However, this method usually has high potential of error. Therefore, a heart rate monitor or ECG or PPG is needed to help get an accurate heart rate measurement. A standard Electrocardiogram (ECG) machine normally found in big hospitals or clinic. The machine is very expensive and requires a specialist or skill to operate the machine. Thus, by the development of a cost effective fitness analyzer using an infrared pulse sensor to detect heart rate will benefit the users to monitor their heart rate easily at home or at any place.

Therefore, in order to overcome this problem, people should maintain a healthy lifestyle. One of the methods to maintain a healthy body and life is exercise. In this project, cycling is recommended which is one of the best exercises and it can help the environment at the same time, which is human powered generation. As of today, fuel is by far the most used energy products in the world's energy supply, with coal at the second place. However, as we all know, these are not renewable energy. If there are still cannot find an alternative energy, one day, our earth will face the consequence, as there is no energy to be used. Furthermore, the usage of oil and coal as energy resources had caused the pollution to the environment such as produce a lot of carbon dioxide to the atmosphere causing greenhouse effect. In the process of searching of the alternative energy, human power would be one of the options. By using human powered generation, it would produce a power source that is not directly derived from the natural. For example, a human powered generator can operate even if there is no sun for solar generation, no wind for wind generation, and no water for hydro generation. Pedal power is one of the human power, the power created from the pedal

is ideal for remote zones, hilly areas, strategic location, and islands and so forth, where electricity is inadequate if not nil. It is vital to visualize better approaches to convey energy to the people as population keeps on increasing and power shortages continue to occur.

Lastly, the human powered system, pedal power can which use as a power generator also can use as a cycle exerciser. It serves a dual purpose of power generation and helping the person to maintain physical fitness through exercise.

## **1.2 Problem statement**

From our footsteps to our mouse clicking, humans are constantly expending energy, and we are not fully using this energy as we are tapping into these movements to help power the world around us. Fossil fuel, including coal, oil and natural gas, are currently the world's primary energy source. As we all know, these are not renewable energy and these resources might reach the day where it all finished. Therefore, it is important for us to search for a new alternative resource.

Nowadays, the heart problem among the Malaysians are getting more and more serious. It has become one of the top killer disease to the people [1]. People should be more concern about their health by keeping on monitoring their health and exercising.

However, the heart rate monitor usually located in the hospital and the clinic. People have to go there and pay a lot of money in order to receive the treatment or analysis. Moreover, the heart rate monitoring machine is difficult to handle and require a specialist to operate.

### 1.3 Objective

The main objectives of this project are:

- i. To study the heart rate monitoring system and a human powered system.
- ii. To develop the system which generates power from the human energy and the fitness test system by using LabVIEW.
- iii. To analyses the health status of the user and provide day-to-day fitness monitoring.

### 1.4 Scope of study

The system made will allow the subject to exercise while monitor its heart rate and generate power at the same time. This project can divided into two sections, which are the fitness analyzer part and the human powered part.

a) Fitness analyzer

To design a system that will give a result of the heartbeat detection. The sensor is able to detect an input signal for heartbeats, then transfer it into the Arduino UNO, and then interface with the software LabVIEW.

b) Human powered system

To generate the pedal power with the bicycle generator. When the subject cycling on the bicycle, it will rotate the motor generator and the power produced will charge into the battery.

## 1.5 Thesis outline

For this project, there are five chapters in the report.

- i. Chapter 1: Introduction  
This chapter introduces the overview and the background of this project. It discusses about the problem statement and the objectives of the project. In addition, it consists of the scope of work of this project.
- ii. Chapter 2: Literature review  
This chapter discusses about the study and research, which related to the project. It involved the related research, article, report, journal, even books and literature review to use as reference to support and improve the project.
- iii. Chapter 3: Methodology  
This chapter discusses about the hardware selection and how will it applied in the project. It also focuses on the design of the circuit and the coding for simulation of the project.
- iv. Chapter 4: Result and discussion  
This chapter shows the result and outcome of the project. The result and the outcome were analyzed and discussed in this chapter.
- v. Chapter 5: Conclusion and recommendation  
This chapter states the conclusion of this project. Besides, it discusses about the recommendation or improvement that can apply to this project, in order to make the project better and more advance in the future.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter summarizes several works related to the development of a fitness analyzer and a human powered system. It will cover the background and the definition of the fitness analyzer and human powered system. Besides, it will introduce the usability of hardware and software that will going to be applied to this project and the reason of selecting these particular components or parts. Furthermore, this chapter will also discuss about the past-related research of the project and the existing technology for the fitness analyzer and human powered system.

#### **2.1 Introduction**

From this chapter, the research on the theory and analysis that related to the project have been studied and compared. In this project, generally, it can divide into 2 sections, which are the fitness analyzer part and the human powered part. In the fitness analyzer part, the project is focused on determining the heart rate of the user while in the human powered part, the pedal power system will be utilized.

#### **2.2 Definition of fitness**

Fitness is much more than essentially practicing consistently. Keeping up a decent level of physical fitness is something that we ought to all try to do. However, what does fitness actually mean?

Physical fitness defines as the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and respond to emergencies [2]. Based on this definition, fitness involves every physical activity from as easy as getting out of bed to being able to run long distances or lift heavy weights. Into physical fitness, there are 5 main components of physical fitness: Cardiorespiratory fitness, Muscular endurance, Muscular strength, Body composition, and Flexibility.

In this project, it will consider the cardiorespiratory fitness only. Cardiorespiratory fitness or cardiorespiratory endurance, typically measured by how long or fast a person can perform an activity and how will it affects the measurements such as heart rate and oxygen consumption. It indicates how well our body can supply fuel during physical activity via the body's circulatory and respiratory systems [3].

Exercising will strengthen the heart muscle so that it is able to pump more blood per pulse. In addition, additional small arteries are growing within muscle tissue with the goal that blood can be delivered to working muscles more effectively when needed. Lastly, cardiorespiratory fitness had found to help avert the danger of coronary illness, lung cancer, diabetes and stroke and so on.

## **2.3 Heart Rate Monitoring**

### **2.3.1 History about Heart Rate Monitoring**

Nowadays, one of the trending public concerns is human health. No matter how wealthy one is, or how powerful one are, everything will become meaningless if one gets sick or dead. For that reason, people willing to spend a lot of money to maintain a healthy life. Unfortunately, people always find that it is too late to receive serious medical care when things are non-invertible. If early actions can take in time then many patients could cure and tragedy can be prevented.

Over the last 20 years, heart rate monitors (HRMs) have become a widely used training aid for a variety of sports and exercising. The development of new HRMs has also evolved rapidly during the last two decades.

For several centuries, HR monitoring consisted of placing an ear on the patients' chest, in order to listen for the heartbeat. Until around 200 years ago, the first stethoscope using a long, rolled paper tube to funnel the sound was invented by Rene Laennec, which made it possible to listen more precisely to the heartbeat [5]. A typical stethoscope model nowadays has a flat, round chest piece covered by a thin, tightly stretched skin of plastic called a diaphragm. The diaphragm vibrates when sound occurs. These high-frequency sounds will travel up the hollow plastic tubing into hollow metal earpieces and to the user's ears. However, it was still unable to create an actual picture of the heartbeat, or to monitor the heart rate of the people during exercise.

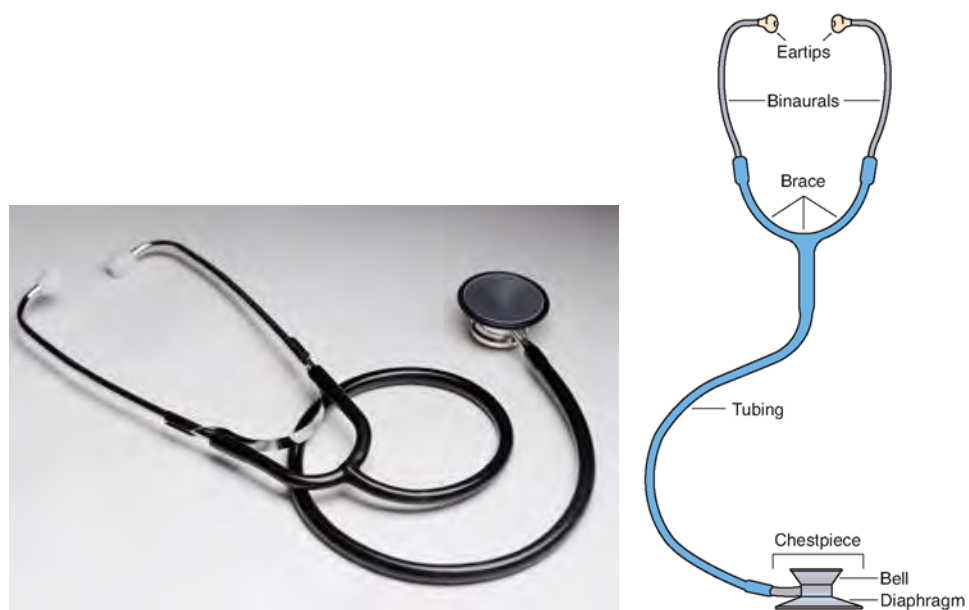


Figure 2.3.1: Stethoscope

At the start of the 20<sup>th</sup> century, HRM achieves a new era where a Dutch physiologist, Willem Einthoven who developed the first electrocardiograph (ECG). An electrocardiogram (ECG) is a graphical trace of the voltage produced by the heart. These electrodes detect the tiny electrical changes in the

skin that arise from the heart muscle's electro physiologic pattern of depolarizing and repolarizing during each heartbeat. The ECG is divided into 3 sections, a P wave, a QRS wave and a T wave, which represent depolarization of the atrium, depolarization of the ventricles and repolarization of the ventricles respectively. By referring to the ECG, it can be used to calculate the rate and rhythm of heartbeats, , the presence of any damage to the heart's muscle cells or conduction system, the size and position of the heart chambers, the effects of cardiac drugs, and so on [7].



Figure 2.3.2: Example of electrocardiogram (ECG)

Soon after the invention of the ECG, the Holter-monitor was developed. The Holter Monitor is a portable device for continuously monitoring heart activity of a patient for an extended period of time, typically 24 hours. The monitor records electrical signals from the heart that sent via a series of electrodes attached to the chest. The data are then analyzed for different sorts of heartbeats and rhythms. However, the large sized control box, which up to 85 pounds is not practical, plus the wires necessary to record the changes in the electric field created by the heart. These factors make the Holter-monitor unsuitable for recording the HR during exercise in all conditions. However, with the development of transistors, radio electrocardiography was made out of date and it became possible for all of the components to be set in a solitary unit sufficiently little in a coat pocket or satchel.