Dokuz Eylül University

Faculty of Engineering

Electrical and Electronics Engineering Department

2023-2024

EED 3009 (Engineering Design II)

Course Project

Heartbeat Monitor

Feasibility Report

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ABSTRACT

Technology provides convenience for people in many areas. Considering that one of the most important things for people is their health, it is inevitable that technology also makes things more convenient in this sector.

Heart rate monitors are one of many examples of this. Heart rate plays an important role in defining the health situation of the human body. With technology heartbeat, heart rate and the signal display of heart rate can be measured. From hospitals to wristbands that people use in daily life, it has a wide usage in modern life.

This is what we are going to develop in this project. Since we have a budget limit, it will not be a complicated one, but it will work effectively. We will use a fingertip sensor, and the project will measure each heartbeat and calculate the heart rate.

INTRODUCTION

Heartbeat and Heart Rate

Heartbeat is basically the regular movement or sound that the heart makes as it sends blood around the body. The human body controls the heartbeat according to the movement of the person or the situation of the person in it. Heart rate and heartbeat are different things. Heart rate is the number of times in each minute that the heart beats in between 60 and 100 times per minute for a healthy adult. This is also called BPM which means “beats per minute”.

Heart rate shows important things for the health of the person. If it is too slow or too fast, it means that there can be a problem. That is why measuring the heart rate is important. There are two ways to measure the heart rate. Manual way and by using a sensor.

The manual way can be measured from the pulses. Pulse is how can be felt the heart rate from the skin. It is the pressure in the arteries going up briefly as the heart pushes out more blood to keep circulation going. There are several places that are the arteries very close to skin and make it easier to feel pulses. These are neck (carotid artery), wrist (radial artery) and inside of the elbow (brachial artery).

Heartbeat sensor is based on the principle of photoplethysmography. It measures the change of volume of the blood that makes a change in the light intensity. The flow of blood volume is related with the rate of heart pulses. Since the light is absorbed by the blood, the signal pulses are equal to the heartbeat pulses.

Heartbeat Monitor

A heartbeat monitor is a complex device that measures heartbeats and allows the measurement obtained through the monitoring feature to be reported to the user or patient as 'heart rate.'

There are different types of heartbeat monitors for various use cases. In the healthcare field, devices used in hospitals are much more comprehensive, sensors provide more precise results and connections are made mostly with wires. These devices were only used in hospitals before technology had advanced to this extent and become integrated into our lives. With the advancing and widespread technology, these devices became so integrated into our lives, and now even personal smartwatches have heartbeat monitor function.

Unlike those used in hospitals, smartwatches do not use cables or large-scale circuit elements to measure heartbeats and relay this information to the user. These watches are not exclusively designed as heartbeat monitors, which is why their measurement results are generally less reliable compared to other dedicated medical devices. However, having a device that informs you about your heart health at any moment is a significant technological advancement, even if it may not be as accurate as hospital-grade equipment.

Being informed about our heart rate is important for our health, both for gaining insights into our well-being and for early diagnosis of potential illnesses. However, it is not possible to make a diagnosis based solely on a person's heart rate values, and relying entirely on these devices would be a mistake. Therefore, despite the precision with which these devices are designed to measure, it is always important to consult with a doctor and undergo a comprehensive health assessment.

There are two different methods for measuring heartbeats: the first one is electrocardiography (ECG, EKG), and the second one is photoplethysmography. Electrocardiography is carried out by detecting the electrical currents generated by our heart with each beat, whereas photoplethysmography measures the expansion of arteries when the heart pumps blood using infrared light and utilizes this information.

FEASIBILITY STUDY

To count and display the heartbeat rate, firstly we need a sensor circuit. As said in the introduction, there are several ways to measure heartbeat. In this project, we have decided to use the fingertip sensor. Fingertip sensors use PPG (Photoplethysmography), meaning that the sensor measures heartbeat by using light-based technology. Using IR LED (Infrared Light-emitting Diode) and phototransistors, the voltage is proportioned to the light absorbed through the skin, making the volume of the blood act as a variable resistor. This signal proportional to the heart rate is our input signal. To eliminate the noise, we will use a low-pass filter. At the output of the filter, we will have an analog signal which is proportional to heartbeat. To count the heartbeats, we need a counter circuit. To do that, we will use an ADC (Analog to Digital Converter) circuit. After attaining the digital signal, the counter circuit will count the heartbeat and heart rate will be displayed on the 7-segment display.

To make this project applicable we will use a timer circuit to count the time. To make the circuit more operable we will add a On/Off button that resets the timer and 7-segment display.

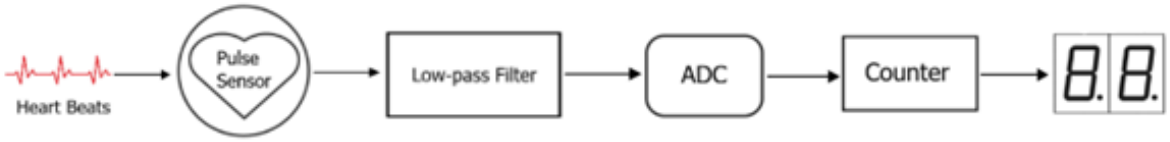

Figure 1: Box diagram of the circuit.

PROJECT TIMETABLE

WEEKLY PROJECT SCHEDULE			
Week	**Date**	**Topic**	**Requirement**
1	06.10.2023	Introduction – Project Discussion	
2	13.10.2023	Consultation	
3	10.10.2023	Consultation	
4	27.10.2023	Consultation	
5	03.11.2023	Feasibility Report	Report
6	10.11.2023	Consultation	
7	17.11.2023	Consultation	
8	24.11.2023	Consultation	
9	01.12.2023	Theorectical Design Report	Report
10	08.12.2023	Laboratory Work	
11	15.12.2023	Laboratory Work	
12	22.12.2023	Project Meeting	
13	29.12.2023	Laboratory Work	
14	05.01.2024	Project Presentation	Final Report

REFERENCE

https://www.elprocus.com/heartbeat-sensor-working-application/

https://my.clevelandclinic.org/health/diagnostics/17402-pulse--heart-rate

https://my.clevelandclinic.org/health/diagnostics/23429-heart-rate-monitor

https://en.wikipedia.org/wiki/Heart_rate_monitor

https://en.wikipedia.org/wiki/Photoplethysmogram