City, University of London

Department of Electrical and Electronic Engineering

LAB - MANUAL

EE3600 / EE3700 Design - III

Arduino Based Heartbeat Monitor

T1 LAB - 7

Version: 2020/2021

1.0 Introduction

Heart rate, body temperature and blood pressure monitoring are very important parameters of human body. Doctors use various kind of medical apparatus like thermometer for checking fever or body temperature, BP monitor for blood pressure measurement and heart rate monitor for heart rate measurement. In this project, we have built an Arduino based heartbeat monitor which counts the number of heartbeats in a minute. Here we have used a heartbeat sensor module which senses the heartbeat upon putting a finger on the sensor.

2.0 Required Components

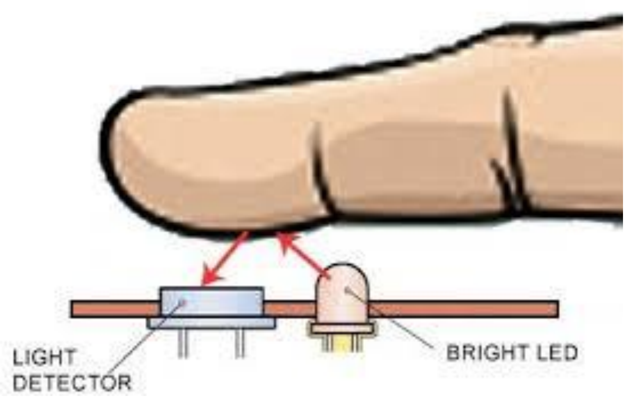
- 1 x Arduino UNO
- 1 × Breadboard
- 1 × LCD 2004A display
- 1 × Pulse sensor module
- 2 x Push buttons
- Connecting wires

3.0 Component Description

3.1 Pulse Sensor

The working of the **Pulse/Heartbeat sensor** is quite simple. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body. This can either be your Fingertip or you ear tips, but it should be placed directly on top of a vein.

Now the LED emits light which will fall on the vein directly. The veins will have blood flow inside them only when the heart is pumping, so if we monitor the flow of blood, we can monitor the heart beats as well. If the flow of blood is detected, then the ambient light sensor will pick up lighter since they will be reflected by the blood, this minor change in received light is analysed over time to determine our heart beats.



Using the pulse sensor is straight forward but positioning it in the right way matters. Since all the electronics on the sensor are directly exposed it is also recommended to cover the sensor with hot glue, vinyl tape or other nonconductive materials. Also, it is not recommended to handle these sensors with wet hands. The flat side of the sensor should be placed on top of the vein and a slight presser should be applied on top of it, normally clips or Velcro tapes are used to attain this pressure.

To use the sensor simply power it using the V_{CC} and ground pins, the sensor can operate both at +5V or 3.3V system. Once powered connect the Signal pin to the ADC pin of the microcontroller to monitor the change in output voltage. If you are using a development board like Arduino, then you can use the readily available code which will make things a lot easier.

Warning: This sensor is not medical, or FDA approved. It is purely intended for hobby projects/demos and should not be used for health critical applications.

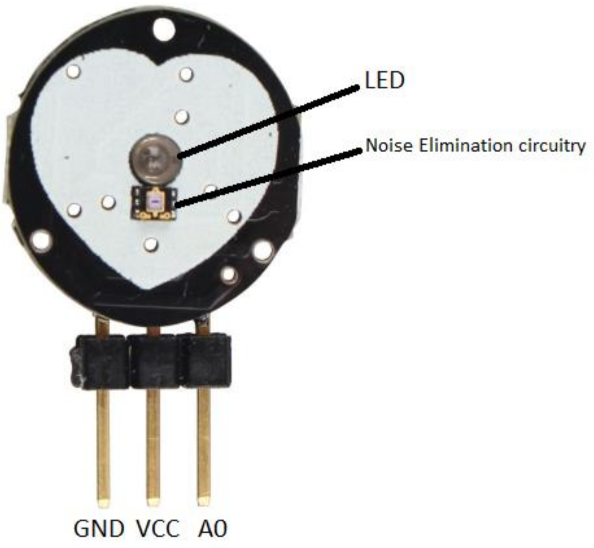
3.1.1 Pulse Sensor Specifications

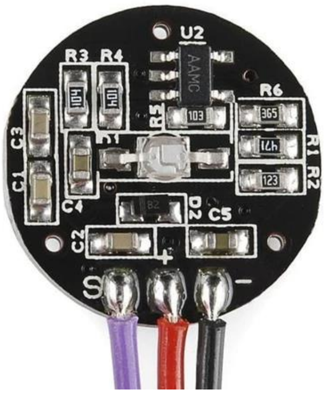
The main specifications of this sensor include the following.

- Biometric Pulse Rate or Heart Rate detecting sensor
- Plug and Play type sensor
- Operating Voltage: +5V to +3.3V
- Current Consumption: 4mA
- Inbuilt Amplification and Noise cancellation circuit.
- Diameter: 0.625”
- Thickness: 0.125” Thick

3.1.2 Pin Configuration

The heartbeat sensor includes three pins which discussed below.





Pin Number	Pin Name	Wire Colour	Description
1	Ground	Black /Green	Connected to the ground of the system
2	V_{cc}	Red /Brown	Connect to +5V or +3.3V supply voltage
3	Signal	Purple / Blue	Pulsating output signal.

3.1.2 Applications

- Sleep Tracking
- Anxiety monitoring
- Remote patient monitoring/alarm system
- Health bands
- Advanced gaming consoles

3.2 Heartbeat Calculation

There are many methods for calculating the heartbeat but here we will take forty-five pulses and will calculate the total heart rate in minute by using this formula.

Five pulse time = time2 – time1

Single pulse time = Five pulse time /45

Rate = 60000 / Single pulse time

Where,

time1- First pulse counter value

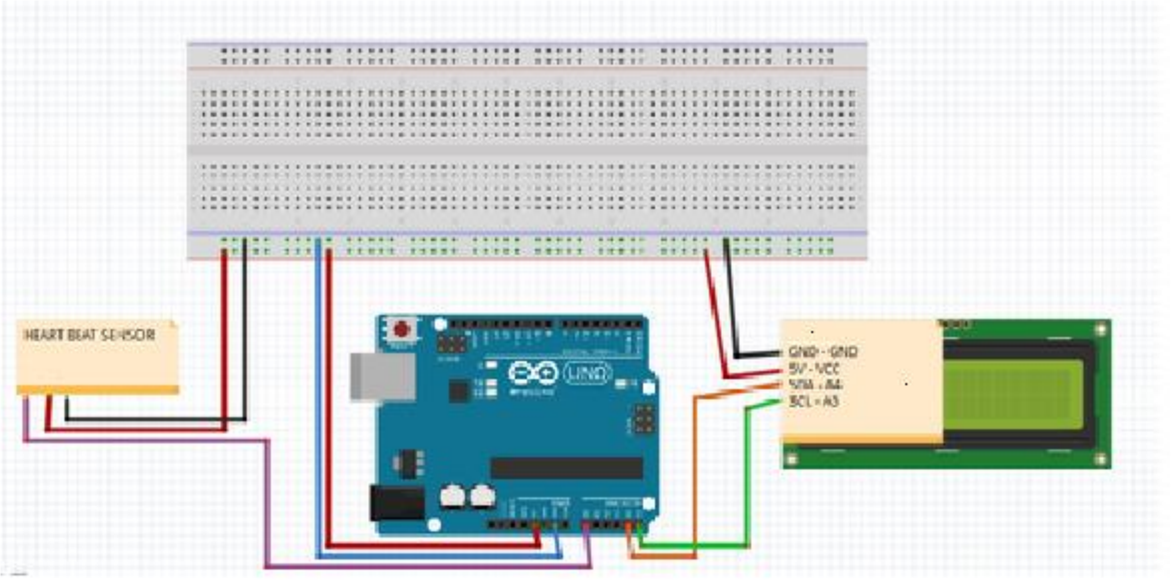
time2 - Last pulse counter value

Rate - Final heart rate

4.0 Working of the Project

Working of this project is straight forward but a little calculation for calculating heart rate is required. In this project we will be using Heartbeat sensor module to detect Heartbeat.

Connect the Pulse Sensor with the Arduino. The Pulse sensor has three pins. Connect 5V and the ground pin of the pulse sensor to the 5V and the ground of the Arduino and the signal pin to the 8 of Arduino.



Connect the LCD’s GND to GND pin of the Arduino, VCC to 5V the SDA to analog pin A4 the SCL to A5 of the Arduino board. We are done building the circuit so lets start to set up and make a code for this.

5.0 Code

After the hardware setup, we need to write a program that will take care of everything.

The program will make the Arduino to automatically read the data from the sensor and display the heartbeat on the screen.

6.0 Tasks

1. Understand the overall concept of this design,
2. Familiarise with the hardware setup,
3. Modify the given circuit to introduce two push buttons for start and reset to count the pulse,
4. You must use the given partial coding to develop a workable program for this design. Also, you must include the push buttons options in your coding.
5. Suggestions for future improvements.

7.0 Sample MCQs for Quiz

7.1) What will happen if in a C program you assign a value to an array element whose subscript exceeds the size of array

1) The element will be set to 0
2) The complier will report an error
3) The array size would appropriately grow
4) The program may crash if some important data gets overwritten

7.2) In Arduino the function **'pinMode()'** cannot be used to configure the Atmega pins as

1) Both A & B
2) OUTPUT_PULLDOWN
3) INPUT_PULLUP
4) None of the above

7.3) Which of these is an output device?

1) Pulse sensor
2) Servo motor
3) Potentiometer
4) Push Button

7.4) Which of the following is not a valid data type in Arduino?

1) Short
2) String
3) Void
4) Word

End of Lab - 7