AMERICAN INTERNATIONAL UNIVERSITY BANGLADESH

Faculty of Engineering

Project Report Cover Sheet

PROJECT TITLE: Heart Rate Monitoring system based on IoT, Arduino Uno and ESP8266 sensor.

Submitted to:

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1 Introduction

- ## Abstract

In the field of bio-signal monitoring, the demand for integrating sensing and telemetry devices has increased significantly. The available technology has allowed the doctors to monitor the patient in real time from anywhere over the internet. This have helped both doctors as well as patients and brought a revolution in patient health monitoring system. In this project, an Arduino Uno, IoT, and ESP8266 sensor based Heartbeat Monitoring system has been designed. It allows us to monitor the heartbeat of a person over the internet. Heart-rate is a very vital health parameter because it has use in determining the health of the cardiovascular system of the patient. The designed IoT system is integrated with the heartbeat monitoring and automatically updates the heartbeat of the patient over the internet.
KEYWORDS: IoT, Bio-Medical Signal, Health Monitoring & Care System

- ## State of the Art

As Internet is the new frontier in the technology sector. This project has tried to use the power of the internet to make this project as state of the art as possible by using an WIFI module. Previously so many work have been done on this topic by using various modules.
Various sensor has been used like analog sensor, fingertip sensor etc. Now a day's new sensor is using to make it more accurate and perfect. Pulse sensor is using. WI-FI modules and IOT is used to make it more perfect and increase the communication skill.

- ## Motivation

In several nations, cardiovascular disease is one of the major causes of death, accounting for more than 15 million deaths worldwide. Additionally, cardiovascular disease disables many million men. The delay between the first symptom of any heart disease and the call for medical assistance varies widely between different patients and can have fatal consequences. One critical inference drawn from epidemiological data is that resource deployment for early detection and treatment of heart disease has a higher potential to reduce cardiac-associated fatality than improved care after hospitalization. Therefore, new approaches are needed to shorten time. Since the system is constantly tracking the patient heartbeat, thus patient's condition can be easily tracked and can be sent all information to the doctors and relatives concerned.

- ## Organization of the Chapters

Chapter One: Provides an overview of this project as a whole containing a background about the project, scope of the project, keywords, motivation and finally chapter organization.
Chapter Two: contains literature review
Chapter Three: specify the Methodology and Modeling used, system operations, implementation techniques and a description on the components used.
Chapter Four: present the results obtained from the system simulation and implementation
Chapter Five: Conversation about Impact of project in society and environment.

Chapter Six: Includes a discussion of the project and why some of the things wasn't properly implemented, what was done about it.
Chapter Seven: Includes a final conclusion of the project and possible future work and enhancements on the project performance

2.Literature Review

Table 1. Comparison of diverse existing Heart Rate Monitoring system

Sr.No.	Title of Papers	Year	Sensors and Technology Used
1	IoT based Heart Attack Detection, Heart Rate and Temperature Monitor[1]	2017	Pulse sensor, ESP8266 Wi-Fi module, LM35 temperature sensor, Arduino Uno
2	Heartbeat Sensing and Heart Attack Detection using Internet of Things[2]	2017	Pulse sensor, Wi-Fi module, Arduino Uno
3	IoT Based Heart Attack Detection and Alert System[3]	2017	Analog sensor, wireless module, ECG leads, AVR microcontroller
4	IoT on Heart attack detection and heart rate monitoring[4]	2016	MI Band 2, android phone, Big Data Analytics
5	Heart attack detection using Android Phone[5]	2016	ECG monitor, Android phone
6	Heart rate monitoring and Heart attack detection using wearable Device[6]	2016	Smart band, Android phone
7	Heart rate monitoring system using fingertip through Arduino and processing software [7]	2016	Fingertip sensor, Arduino Uno, Nodemcu, Android Phone
8	Heart attack detection and Medical attention	2014	Kinect, Xbox one

	using Motion Sensing Device-Kinect[8]		
9	Heart attack detection using Smart Phone[9]	2013	Smart Phone

3.Methodology and Modeling

These days a number of people are losing their life due to heart attack. Heart attack can occur when the flow of blood to heart is blocked. Owing to late diagnosis of heart attack we are inadequate to save the lives of many humans. In this project, we suggest a system that will detect heart attack by monitoring the heart rate based on IoT (Internet of Things) Arduino Uno and ESP8266 sensor. Thing-Speak is a great IoT platform to display our sensor data over the internet at any time and from any place. The reason of being superior to other IoT platform is that, Thing-speak shows real-time data without lagging. In this project, we are going to make a Heart Rate Monitoring System using Arduino, Pulse sensor and ESP8266 Wi-Fi module. Pulse sensor will detect the heart rate, and Arduino will send it to Thing-speak using the ESP8266 Wi-Fi module. For a healthy adult, ordinary heartrate is 60 to 100 bpm (beats per minute). Athlete's heart beat generally range from 40 to 60 bpm depending upon their fitness. If a person's heart rate is constantly over 100 beats per minute, then the person is said to be having higher heart rate which is also notorious as tachyarrhythmia. It can diminution the efficiency of heart by letdown the amount of blood pumped through the body can result in chest pain and lightheadedness. With the advancement in technology it is easy to monitor the patient's heart rate even at home. IoT is dexterity of network mechanism to intellect and gather information from world ubiquitously us then share the information athwart internet anywhere it can be managed for some tenacity.

- Working Principle of the PROPOSED Project

The proposed system has eminence of detecting heart attack with help of observing heart rate based on internet of thing. Our method uses a pulse sensor, Arduino board and a Wi-Fi module. After setting up the system First we need to attach the Pulse Sensor to any organ of body where it can detect the pulse easily like finger. Then the Pulse Sensor will measure the change in volume of blood, which occurs when every time heart pumps blood in the body. This change in volume of blood causes a change in the light intensity through that organ. The Arduino will then convert this change into the heart beat per minute (BPM).

The ESP8266 will then communicate with the Arduino and will send the data to Thing-Speak. The ESP8266 will connect the network of your router that you will provide in the code and will send the data of the sensor online. This data on the Thing-Speak will be shown in a Graph form showing the past readings too and can be accessed from anywhere over internet.

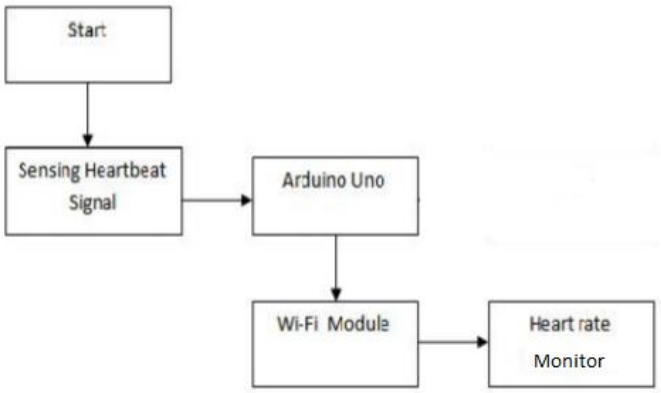

Figure.1: System Architecture

- Description of the Important Component

A. The Arduino Uno

Arduino Uno, it is a microcontroller board. It is based on ATmega328. Moreover, there are 14 digital input and output pins of which six can be usage as PWM outputs. RX and TX pins are utilizing for communication between Arduino board, computer or additional devices for serial communication. It has operating voltage of 5V. The ATmega 328 has 32KB of flash memory for storing code. The ICSP (in-circuit serial programming) header will permit us to use an outside programmer to upload software to our microcontroller unit [9].

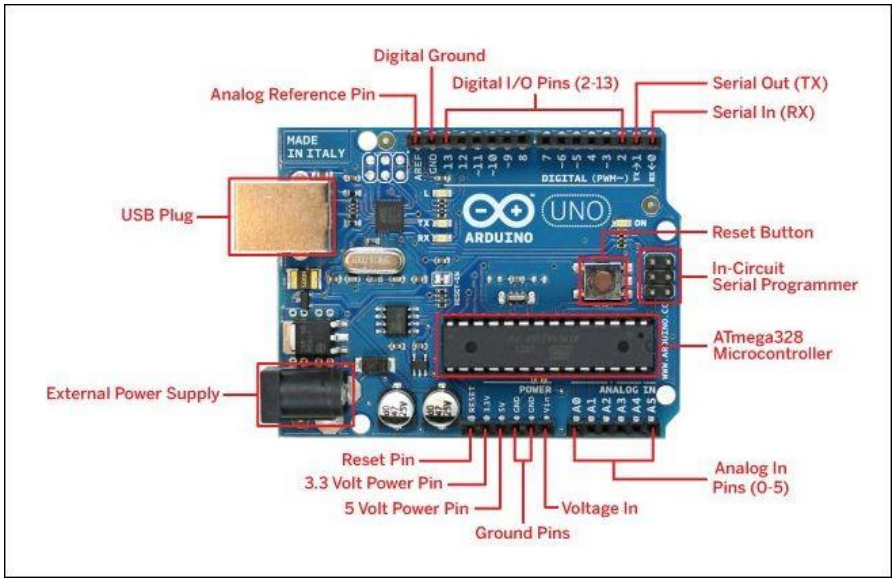

Figure.2: Arduino Uno board

B. Pulse Sensor

For Arduino, the pulse sensor is plug and play heart rate sensor. It can be utilized by any persons who want to simply include live heart rate information into their developments. The sensor displays the movement of blood through the finger and is intended to give numerical output of heart beat once a finger is positioned on it [1].

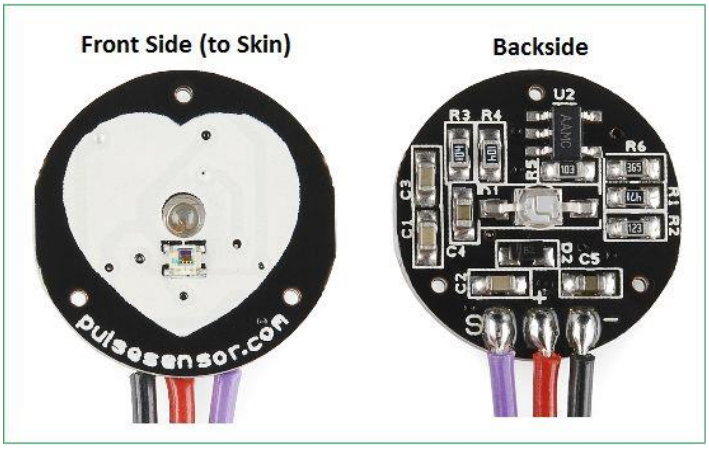

Figure.3: Pulse Sensor with Arduino

C. ESP 8266

The Node Microcontroller Unit (NodeMCU) is open source software and hardware enlargement background that is constructed everywhere a very inexpensive system on a chip named the ESP8266. In our System we have used NodeMCU to receive data from Arduino and send that data over internet [5].

Figure.4: ESP 8266

- Program Flowchart

The following is a flowchart of the tool design procedure.

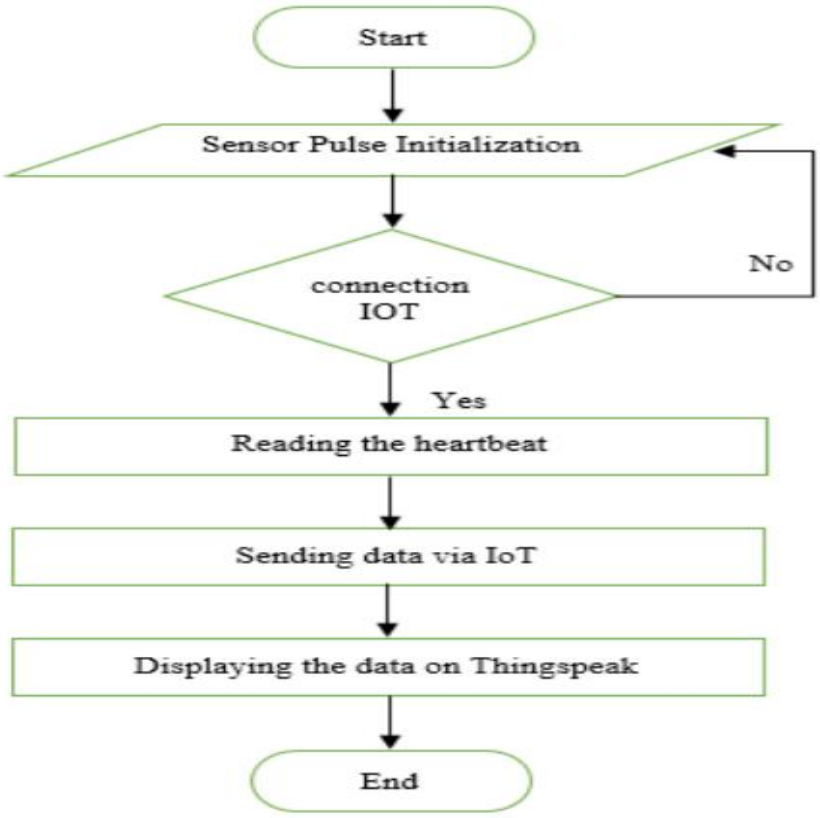

Figure.5: Program Flowchart

From Figure above it can be seen that when the system starts and then the program input is carried out, the Pulse sensor will send data, if not, then the program input is repeated. If yes, then it is processed using IoT (Internet of Things). The data released is processed or sent to the Thing-speak Application as output on this tool, complete.

- Implementation

First the Pulse Sensor is attached to any organ of body where it can detect the pulse easily like finger. Then the used Sensor measures the change in volume of blood, which occurs when every time blood in the body is pumped by heart. The light intensity through the organ of body changes corresponding to the change in volume of blood in that organ. The software then converts this change into beats per minute (BPM). The LED which is connected at pin 13 also blinks per the heartbeat. 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 A0 of Arduino.

The ESP8266, which is shown in Figure communicates with Arduino and sends the data to thing-speak. This data on the Thing-Speak is displayed in a graph form showing the past readings too and can be accessed from anywhere over internet. The LCD connected also show the BPM.

ESP8266 requires 3.3V and if the Arduino Uno board provides it with 5V then it will not function properly and it might get damaged. Connect the CH_PD and the Vcc to the 3.3V pin of Arduino. The RX pin of ESP8266 requires only 3.3V and it does not respond to the Arduino when it is connected directly to the Arduino. So, a voltage divider for it is made which converts the 5V into 3.3V. This can be done by connecting three resistors arranged in series. Connect the TX pin of the ESP8266 to the pin 9 of the Arduino and the RX pin of the ESP8266 to the pin 10 of Arduino through the resistors.

- Circuit Diagram

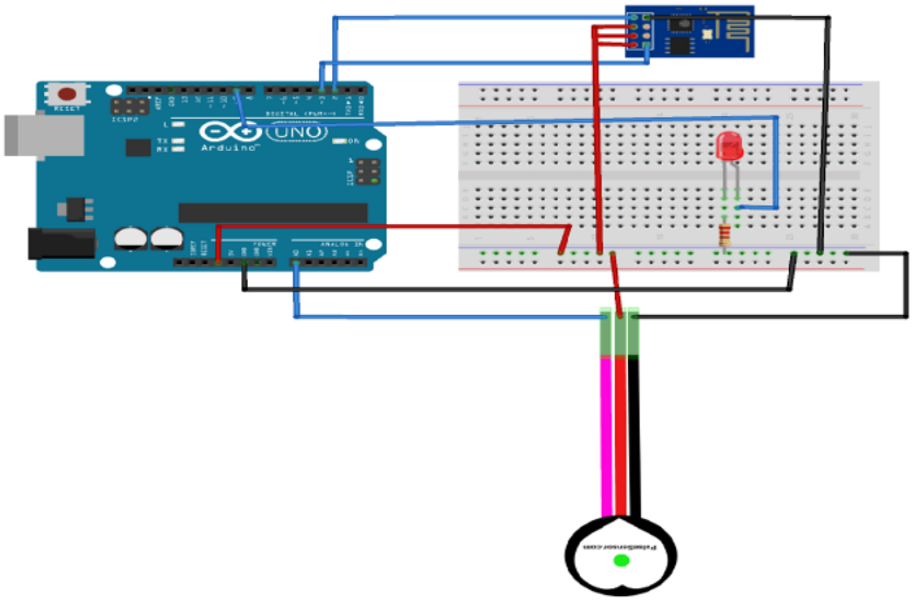

Figure.6: Circuit Diagram

Connections are given in the below table:

S.NO.	Pin Name	Arduino Pin
1	ESP8266 VCC	3.3V
2	ESP8266 RST	3.3V
3	ESP8266 CH-PD	3.3V
4	ESP8266 RX	TX
5	ESP8266 TX	RX
6	ESP8266 GND	GND
7	Pulse Sensor VCC	3.3V
8	Pulser Sensor Signal	A0
9	Pulse Sensor GND	GND
10	Led +ve Pin	9
11	Led -ve Pin	GND

- Code Work

```
#include <LiquidCrystal.h>
```

```
#include <TimerOne.h>
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);

int HBSensor = 4;
int HBCount = 0;
int HBCheck = 0;
int TimeinSec = 0;
int HBperMin = 0;
int HBStart = 2;
int HBStartCheck = 0;

void setup() {
  // put your setup code here, to run once:
  lcd.begin(20, 4);
  pinMode(HBSensor, INPUT);
  pinMode(HBStart, INPUT_PULLUP);
  Timer1.initialize(800000);
  Timer1.attachInterrupt( timerIsr );
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Current HB  : ");
  lcd.setCursor(0,1);
  lcd.print("Time in Sec : ");
  lcd.setCursor(0,2);
  lcd.print("HB per Min  : 0.0");
}

void loop() {
  if(digitalRead(HBStart)  ==  LOW){lcd.setCursor(0,3);lcd.print("HB  Counting
..");HBStartCheck = 1;}
  if(HBStartCheck == 1)
  {
     if((digitalRead(HBSensor) == HIGH) && (HBCheck == 0))
     {
       HBCount = HBCount + 1;
```

```
      HBCheck = 1;
      lcd.setCursor(14,0);
      lcd.print(HBCount);
      lcd.print(" ");
    }
    if((digitalRead(HBSensor) == LOW) && (HBCheck == 1))
    {
      HBCheck = 0;
    }
    if(TimeinSec == 10)
    {
       HBperMin = HBCount * 6;
       HBStartCheck = 0;
       lcd.setCursor(14,2);
       lcd.print(HBperMin);
       lcd.print(" ");
       lcd.setCursor(0,3);
       lcd.print("Press Button again.");
       HBCount = 0;
       TimeinSec = 0;
    }
  }
}

void timerIsr()
{
  if(HBStartCheck == 1)
  {
    TimeinSec = TimeinSec + 1;
    lcd.setCursor(14,1);
    lcd.print(TimeinSec);
    lcd.print(" ");
  }
}
```

The Arduino Code is used for

• To setup the Wi-Fi name, WI FI password and IP address of the WI FI modules ESP 8266 and the API key of Thing-Speak.

• To read the sensor and to convert the output of the sensor into BPM.

• To set up the baud rate per the ESP8266.

• To transmit data at the IP address and to manage the fields we have set up for heartbeat.

• To connect the ESP8266 Wi-Fi Module with the Wi FI and then to use it to send the data to the Thing-Speak.

Some of the Key Capabilities of Thing

• Easily configure a device to send data to Thing-Speak.

• Visualization of sensor data in real-time.

• Aggregate data on-demand from third party sources

• Run your IoT analytics as per the schedules.

• Develop and use IoT systems without setting up servers or developing any web software.

- Test Setup

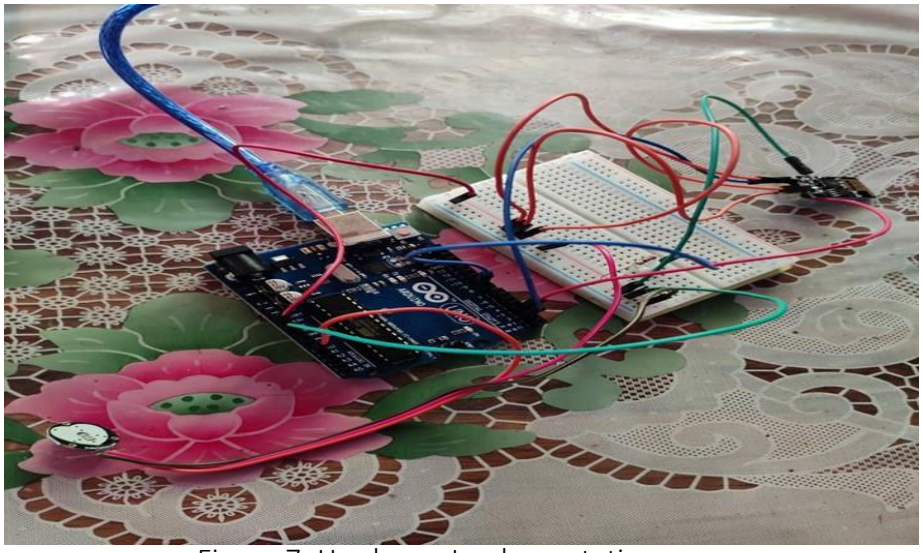

Figure.7: Hardware Implementation

- Cost Analysis

Components Required	Cost
Pulse sensor	200tk
ESP8266 Wi-Fi module	400tk
Arduino Uno	500tk
Bread Board	60tk
220-ohm resistors	5tk
LED	5tk
Connecting wires	30tk

Total cost is 1200tk. That is cost effective. If we compare with other monitoring system, those are most cost required and also time consuming. If we thing to visit a doctor to checkup it takes more time and cost but this monitoring system can easily have made and use.

4.Simulation and Results

Simulation

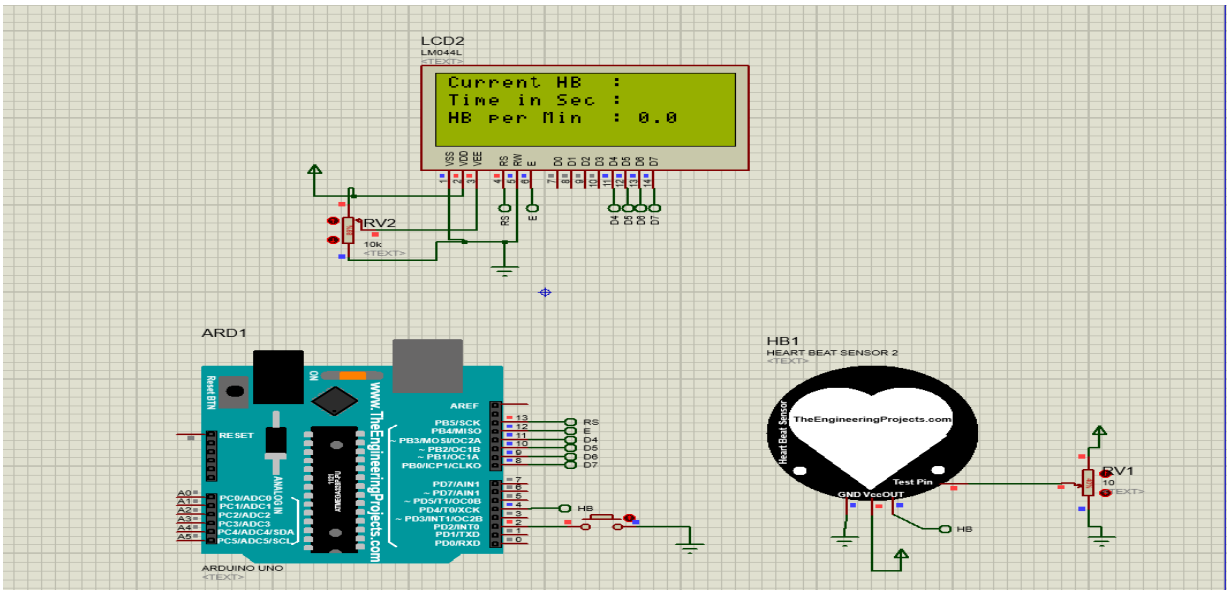

Figure.8: Simulation Started

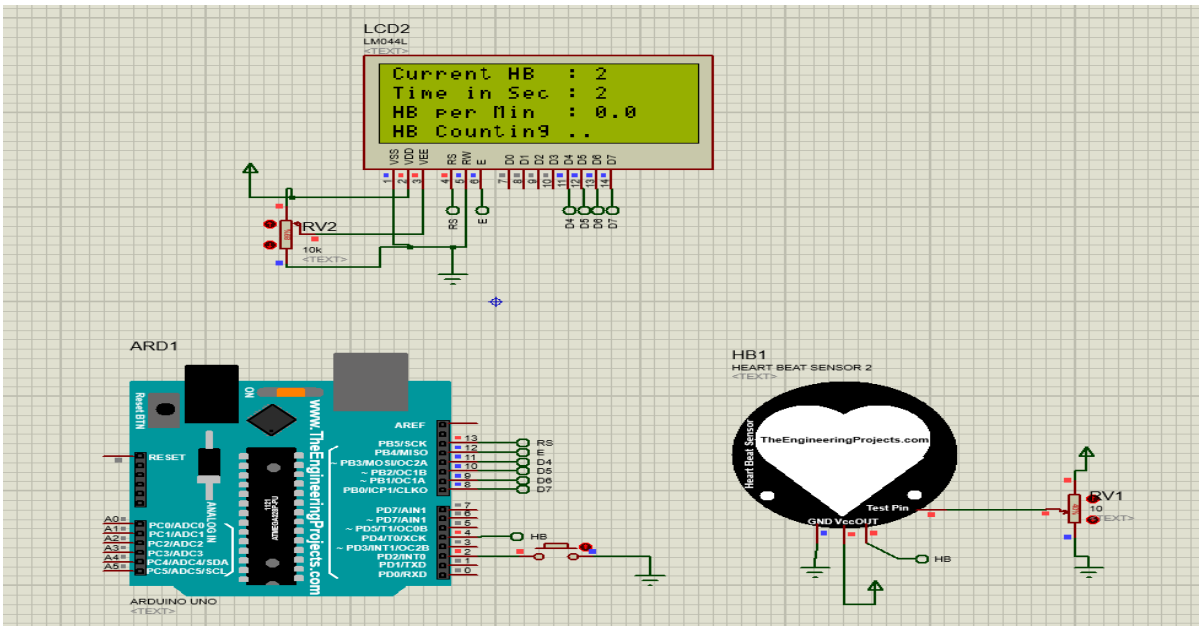

Figure.9: Button clicked & Heart Beat counting

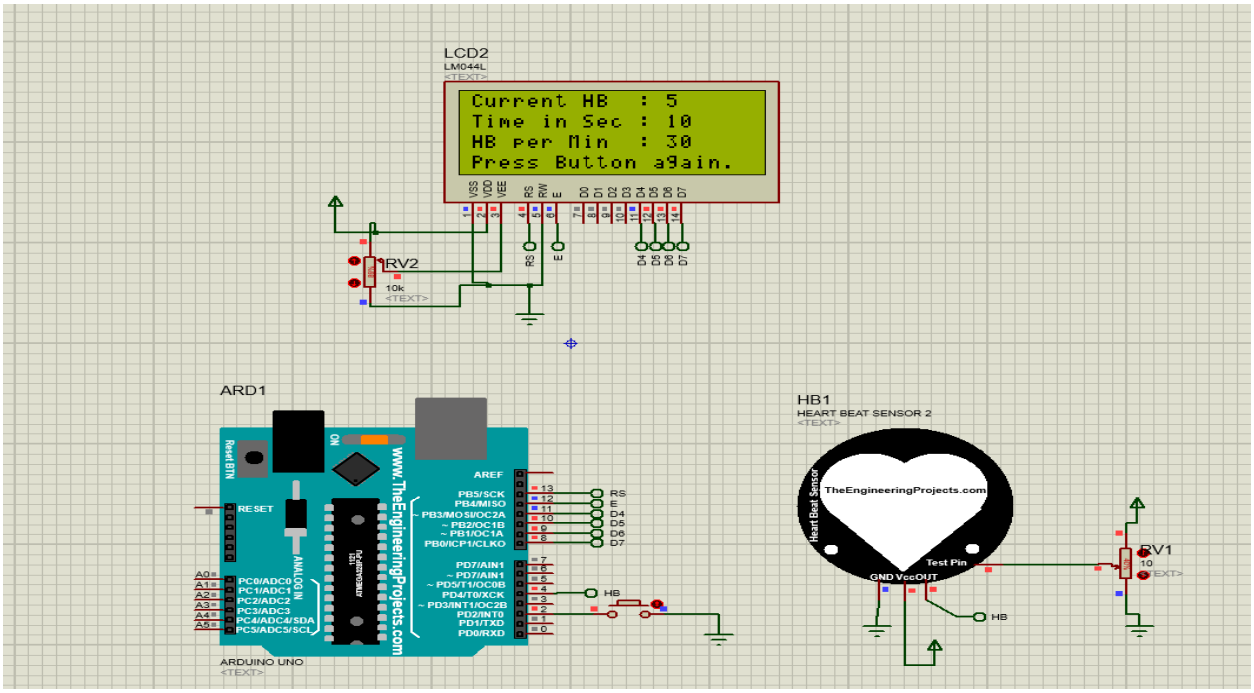

Figure.10: Device Counted Heart Beat for one minute and stopped

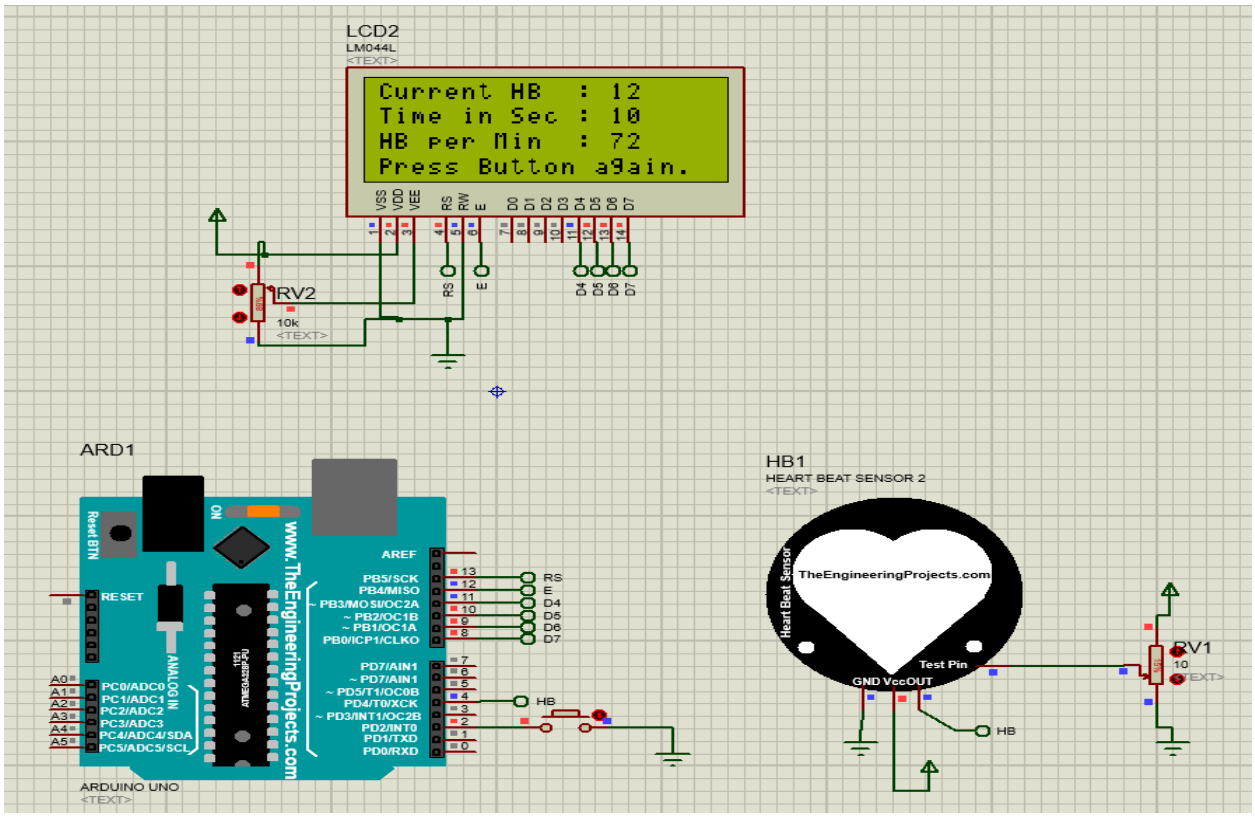

Figure.11: Device Counted HB per minute has increased (since resistor value is small)

Experimental Result

After clicking HB button, it will start counting the Heart Beat as well as will count the Time in seconds.

Here as we can see in the figure.10 After ten seconds it will multiply the current Heart Beat (in the figure it is 5) with six and will give the Heart Beat Per Minute.

The value of Heart Beat can be changed from the variable resistor connected with Heart Beat Sensor.

Also, we can see in figure.10, when the resistor value is large 40% of 10ohm, Heart Beat per min is a smaller value, 30 HB per Min.

But, at figure.11, when the resistor value is large 10% of 10ohm, Heart Beat per min is a large value 72 HB per Min.

5.Impact of project in society and environment

The heart is one of the most important organs in the human body. It acts as a pump for circulating oxygen and blood throughout the body, thus keeping the functionality of the body intact. Heart rate monitoring is a vital aspect of maintaining heart health. People from different age groups have different ranges for maximum and minimum values of heart rate, the monitoring system must be compatible enough to tackle this scenario.

Stethoscope is a device used to measure heart rate. This tool is simple and easy to carry but has a weakness that must be checked repeatedly and requires concentration to calculate the heart rate. In addition, the device is only owned by paramedics and when someone wants to check the heartbeat, it must be done by doctors and health workers.

Visiting the hospital is cost effective so this project will reduce the cost. Patient can see their heart rate by their own at any time. The result is more accurate. Collecting data is more easy. Tracking is easy so it can hold the data. It also saves time and life.

It will help to further expand the potential of telemedicine. So, caring for patients remotely when the provider and patient are not physically present with each other will be much easier. So, in remote areas where there are no doctors or hospital is present, this device will help people to examine their heart condition and doctors from another part of the world can help them.

6.DISCUSSION

As it is clearly visible that, the project and the simulation have different type of implementation of the project. It is needed to be explained properly to why it is the case. We were trying to implement the project where a Wi-Fi module sends the data on the internet to be displayed. But, due to the pandemic that is going on in the world, all the group member is separated from each other. The group member who had the hardware's does not have a personal computer, so though we have the hardware it is still near impossible to implement it. In the proteus simulation we have not found a WIFI-module device that can be modified to send data over internet. That is why, we have made the simulation with an LCD display. The simulation is operating perfectly as we have expected. Ultimately, what is been said here is that due to some problem that raised because of this pandemic, our group had to set some cutbacks to finish the project.

7.CONCLUSIONS

The heartbeat taken is displayed on LCD monitor and displayed over internet at Thing Speak. Output over the internet can be viewed by searching the particular channel at the public channel section of the Thing-Speak website by searching for tags such as Heartbeat monitor, Internet of things or Photo-plethysmography over the thing-speak. The LED also blinks as per the corresponding heartbeat. The WI-FI module in this device can be automatically connected to only that Wi-Fi network, whose Wi-Fi network name password is known and present in the program embedded in the Arduino Uno. Although WI-FI network can be changed if required, by changing the name as well as password of the WI-FI network in the main program and embedding it again into the Arduino Uno board. Otherwise, the program can also be developed in such a way that the WI-FI network can be chosen from the available Wi-Fi networks in that area by making minute changes in the program and adding a monitor with the system. The device can be further improved by interfacing various other biomedical sensors with Arduino. The data obtained can be sent via Think-speak to any personal cloud storage or the cloud storage of a hospital for easy access by the doctors.

References

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