CSE2006

Microprocessor and Interfacing

Final Project Report

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Submitted by:
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Project Title:

Collecting patient's physiological data and managing it over cloud and web interface

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

ABSTRACT

The idea behind the project is the limited health facilities for a large population of the developing and poor countries. Poor health conditions of the citizens are actually creating a huge burden on the economy and the efficiency of the country. By recording various physiological data like Temperature and heart beats per min of the patients will help doctors to treat them well and it can also help governments to take better decision in the field of health care for their citizens, this need motivated me and my team to create something innovative that can automate the process of examination for the treatment of patients. The purpose of this model is to design a device that can help hospitals and doctors to deal with a large number of patients in short period of time by automate the examination procedure. It can also provide the web and app interfaces to doctors and patients so that the physiological data can be accessed by cloud at any time for evaluation.

With the help of the device that is placed on the arm rest of the chair that placed near the doctor help to reduce the time of examination by as doctor will not be required to physically examine their physiological data of the patients for treatment. This is the thought that the device is designed in such a way that it can be used by the smallest hospitals, clinics or dispensaries of the remote village of the country so most of the people can make use of it. To make it possible the cost factor and reliability is the biggest issue and can be reviewed again and again.

The product being proposed is an extension and combination of a lot of existing products in the market. There are other healthcare products like patient health monitoring system which offer features like real time monitoring of patients health from remote locations. We are proposing a secure healthcare device that has a great importance in developing countries. Our product does not just make the patient’s life easier but also makes the doctors life easier. It has a hardware device to sense the physiological data, Cloud platform to handle the data and interfaces to access the data.

INTRODUCTION

With the changing life style and the pollution the diseases are very common today. The time is not same as earlier where most of the peoples either not get ill or get the treatment at the re home with some of the basic changes in their food habits. As the population grows and the environment get changes the disease causing pathogens also changed and the medicines get evolved with the evolution in pathogens. In today world there are so many diseases exists and they has to be cured in the supervision of doctors only.

There are several diseases that came into existence due to the changing lifestyle like Blood pressure, Cholesterol and Diabetes. The technology makes the life more comfortable for us and snatch every type of physical work from the daily life of humans that changed the physiology of human body to some extinct and has given rise to various life style related diseases.

Except these some of the reasons there are some others like pollution and adulteration make the things worst by causing some of the deadliest diseases like Cancer. In today world even healthy persons are always has fears to be ill due to any of the reason.

Due to the Increase in the number of the diseases and the frequency of their cause the burden on the health care system and industry is much high. Now, Most of the poor and the developing countries are facing a huge shortage of the doctors and other supporting para medical staff to treat their huge population. India is the send most populous country after China on earth. It accounts for the 17.5% of the world population and it can surpass china at any time. In India the shortage of Doctors created a havoc several times in history and many people lost their lives due to this reason. Due to the shortage of the health care education and infrastructures there is no proper way seen in near future to provide the effective solution by the traditional practices.

Here, Technology can be helpful as it can provide the real time, most effective solution for the patient care at a competitive cost. In the past years several systems has been created by the various life science and biomedical industry to support healthcare by making the critical procedures more safe and precise. But nobody looks at the most common but big issues in treatment like making the examination faster for treatment, providing prescription quickly or work in telemedicine field so that patients don’t need to visit to the hospitals for the common diseases like common cold.

In this project we are going to work on one of the most common problems in most of the government and private hospitals of the country that is the examination and management of the physiological data of the patients that visiting hospitals every days. If hundred patients are visiting to the their check-up then doctor has to spend at least 1 minute to check heartbeats Pulse and temperature of each and every patient and these 100 minutes are creating a lot more pressure on the doctor, isn’t it better if this data can be made available to the doctor even before the patient came to sit next to him by using some of the basic sensors and a small microprocessor. The devise will be simple, affordable and easy to uses and can remove the stethoscope, thermometer and the annoying procedure of basic examination by just putting finger on a sensor. There is a better management of data with the help of cloud and hospitals get benefited from this in many ways.

PROBLEM DEFINITION

Now-a-days the patient doctor ratio in the developing countries like India is very high. There is only one doctor for 1000 patient according to WHO in India, so it is quite important to create or implement some technical solution to make the treatment faster. This can be partially achieved by creating the faster solutions for examination part of treatment. So, we are trying to make device that automate the process of initial examination of patients. And help us to manage the generated data in the best way possible.

LITERATURE SURVEY

1. IoT Based Health Monitoring System using Raspberry Pi and Arduino

In this paper author use various health care sensors like heart beat monitor, weight monitoring, position, Temperature and EEG sensor and process the data with the help of Arduino and then send this data to the Raspberry pi with the help of USB 2.0 so that the data can be sent through the internet on the respective places, with this model he wants to detect the heart attacks specifically.

2. A LOW COST HEALTH MONITORING USING EHEALTH SENSOR AND EMBEDDED SYSTEM BOARDS

Four different sensors like Blood pressure, Temperature, Heart beat and GSR Sensors are used in this project to get all the physiological data of the patients and make the healthcare more patient centric or give more ownership to the patients about their physiological data, Raspberry pi and Arduino are used as the processing boards to process all the information.

3. Real-time Heart Rate Variability Detection on Sensor Node

In this research paper authors develop a small PBC board that can be integrated with the sensor nodes so that the data can be amplified 1000 times from the ECG sensors and then sent to ADC for the digital conversion this gave more accuracy to the evaluation. They also write about the enhancement of the resultant data so that the better decisions can be made as more accurate evaluation happened.

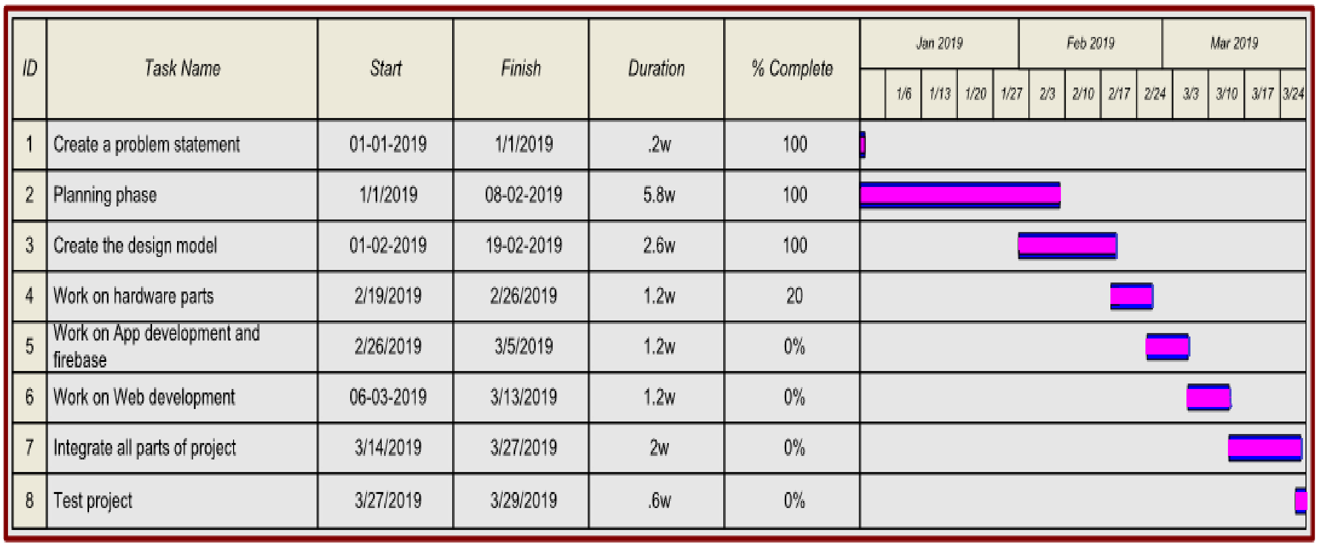
4. AN IOT BASED PATIENT MONITORING SYSTEM USING RASPBERRY PI

The paper discuss about the reduction of the health care monitoring cost as the use of Internet of things increases in the field of health care Industry. They are also suing Raspberry Pi and various sensor like Temperature, Respiratory, Heart rate and body movement sensor to get all the physiological data and send that data to the cloud to use it further in the analytics purpose.

They also talked about the future work, adding Raspberry Pi MAC address and Programs to the website. After connecting internet to the Raspberry Pi, it act as a server. Then the server is automatically sends patient’s health status to the website. Using this website link anybody can monitor patient’s health status anywhere in the world. So it is very useful for patient's to give first aid at any time. Add many devices like ECG, EEG to monitor patient's health status.

They talked about the use of Internet of things in various other fields other than Medical and Health care.

GANTT CHART SCHEDULE



ID	Task Name	Start	Finish	Duration	% Complete
1	Create a problem statement	01-01-2019	1/1/2019	.2w	100
2	Planning phase	1/1/2019	08-02-2019	5.8w	100
3	Create the design model	01-02-2019	19-02-2019	2.6w	100
4	Work on hardware parts	2/19/2019	2/26/2019	1.2w	20
5	Work on App development and firebase	2/26/2019	3/5/2019	1.2w	0%
6	Work on Web development	06-03-2019	3/13/2019	1.2w	0%
7	Integrate all parts of project	3/14/2019	3/27/2019	2w	0%
8	Test project	3/27/2019	3/29/2019	.6w	0%

PROPOSED MODEL

This project is actually be done into the three phases and then we have to integrate all the three parts to create a properly working model. The various phases of the project will be:
Phase 1: This is the hardware part of the project where we have to use the Heart beat sensor and the temperature sensor to sense the physiological data of the patients with the help of raspberry pi and analog to digital convertor. The heart beat and the temperature are sensed and are analog signals so this can be changed to the digital for to process because raspberry pi process only digital signals. The ADC will do this work for the raspberry pi. Then the digital signals can be fetched to the raspberry pi zero through various GPIO pins and then the raspberry pi did the other things with the signals like networking and sending the data to the applications or cloud.

Phase 2: In this part the data has to be sent to the cloud in the best format so that it can be used by the applications and other analytical needs. As the data has to be digitally recorded from the sensor so two or three cloud platforms can be used like Microsoft Azure for IoT, Google Firebase and Tiny DB. Firebase is the best option because it is freely available for IoT project works.

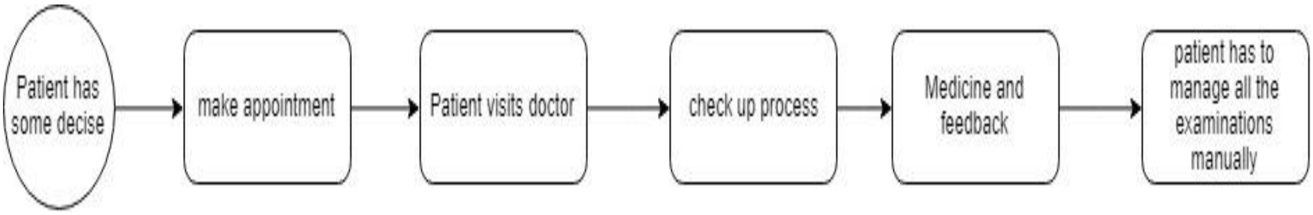
Phase 3: In this part we are going to create the user interfaces for the doctor.
For Doctors the best interface would be web the doctor can login and get all the information of his patients.

Workflow from Developers view:
1. Patient put his fingers on the device attached to the hand-rest.

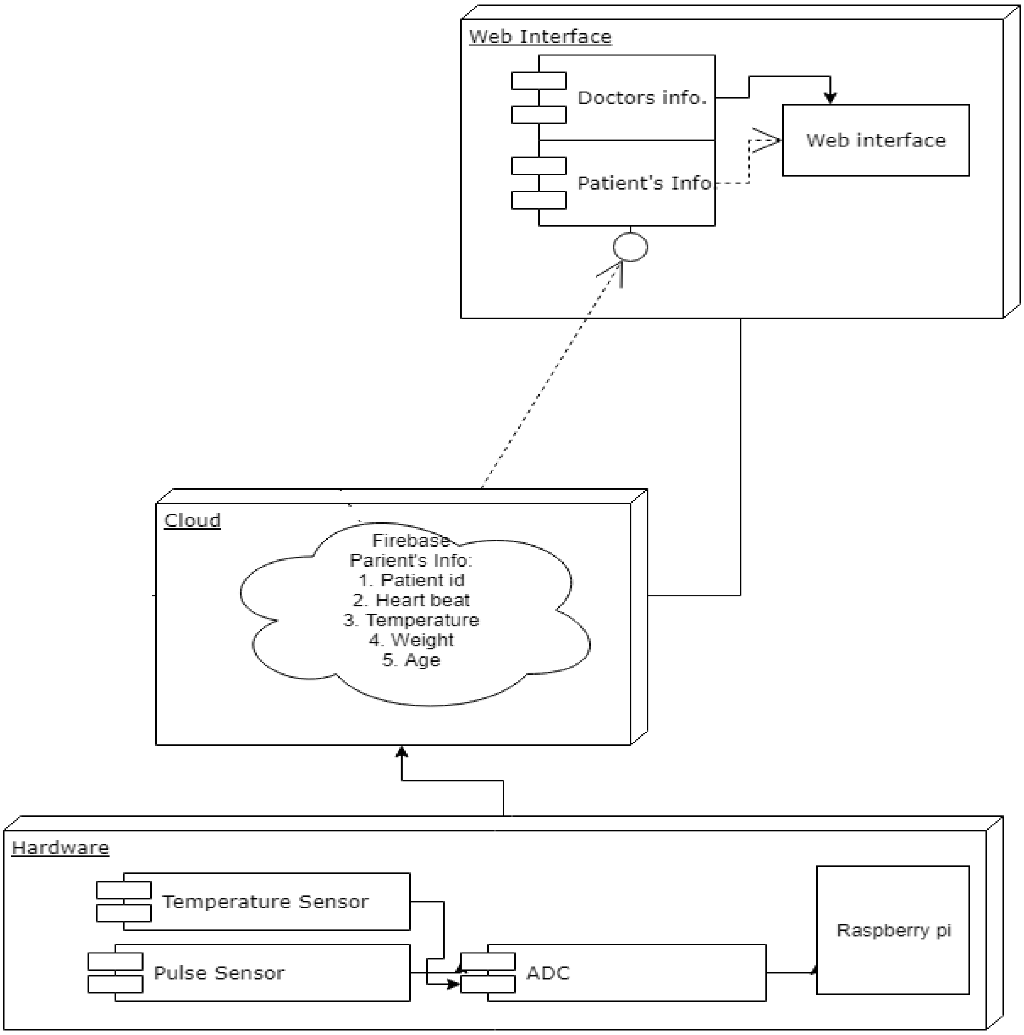
2. Heart beat sensor and Temperature sensor will record the data.
3. This data can be processed by Raspberry pi
4. Raspberry pi sent this data to the web interface to the doctor
5. Doctor validate it and data sent to firebase

The differences of the traditional and the proposed process can be seen from the following work flow diagram:

Traditional way to treat patients



BLOCK DIAGRAM OF PROPOSED MODEL:



WORKING PRINCIPLE

The project is divided in to small components that works in the integration to make the complete products. It is a reuse-based approach to defining, implementing and composing loosely coupled independent components into systems. This practice aims to bring about an equally wide-ranging degree of benefits in both the short-term and the long-term for the software. With regard to system-wide co-ordination, components communicate with each other via interfaces. When a component offers services to the rest of the system, it adopts a provided interface that specifies the services that other components can utilize, and how they can do so. This interface can be seen as a signature of the component - the client does not need to know about the inner workings of the component (implementation) in order to make use of it. The various components of the projects are:

Hardware Component: This component is made up of various hardware components like Sensors, Microcontroller, ADC that works together to get the patients vital values and send that data to the cloud.

Cloud Component: The data that was collected will be sent to the Firebase for the real-time use by the doctors and patients through there interfaces.

Web Interface: the doctor will use the data only in the clinics computers so web interface will be crucial to the doctors to get all the details of their patient along with their previous treatment history.

REQUIREMENTS

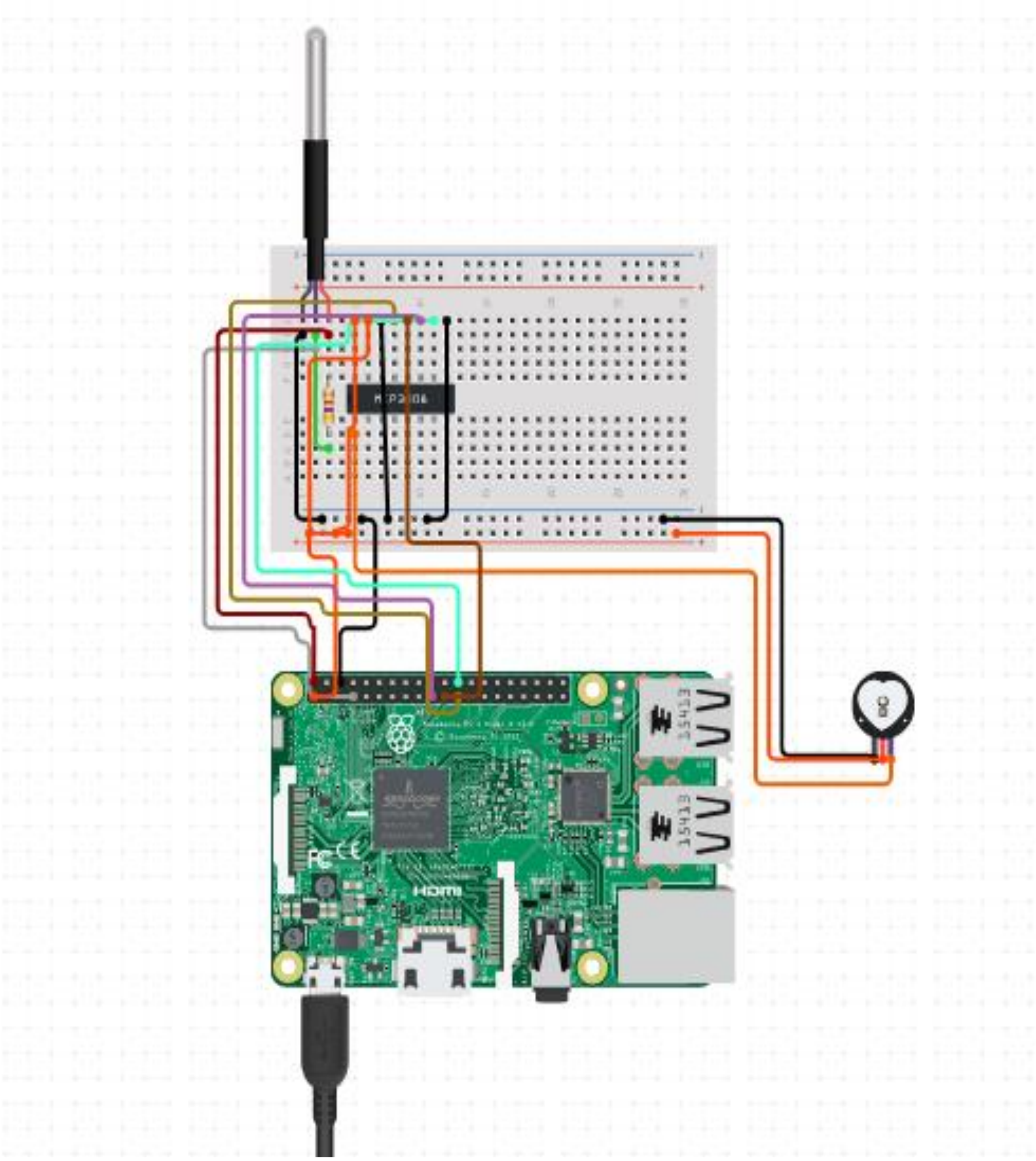
Hardware Requirements:

1. Raspberry pi Zero
2. Analog-to-digital Convertor
3. Heart beat sensor
4. Temperature sensor (DS18B20)
5. 32 GB Memory card
6. USB cable to power raspberry pi
7. Breadboard
8. Jumper wires

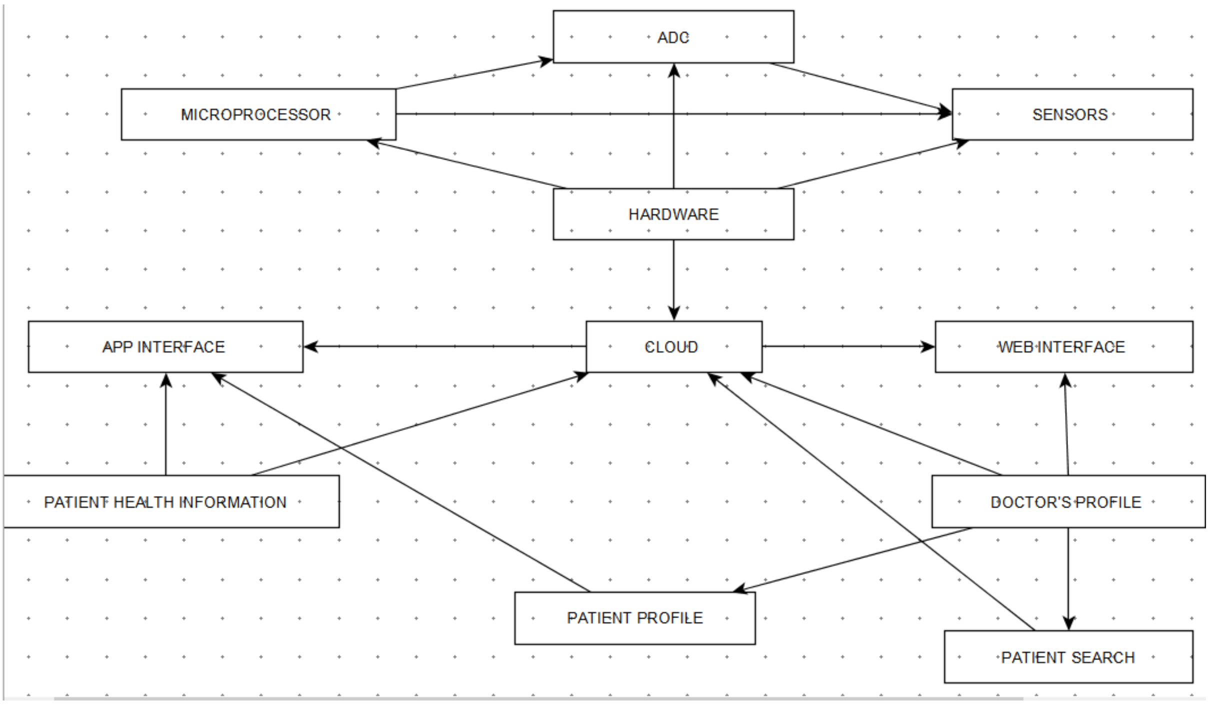
Software Requirements:

1. Raspbian OS
2. HTTP, CSS, JavaScript
3. Google Firebase
4. JSON
5. Python 3.6

CIRCUIT DIAGRAM



FLOW CHARTS



ALGORITHM

START

1. Import all the libraries required like time and wtemperature, firebase and GPIO

2. Initialize variable for heartbeat and temperature

3. Use time to get the data from the sensor for a particular time

4. Print that data

5. Sense the data to the specific fields on the cloud through post method

6. Get that data on the website through JavaScript get method

7. Put all other data relevant to the patient in the given field

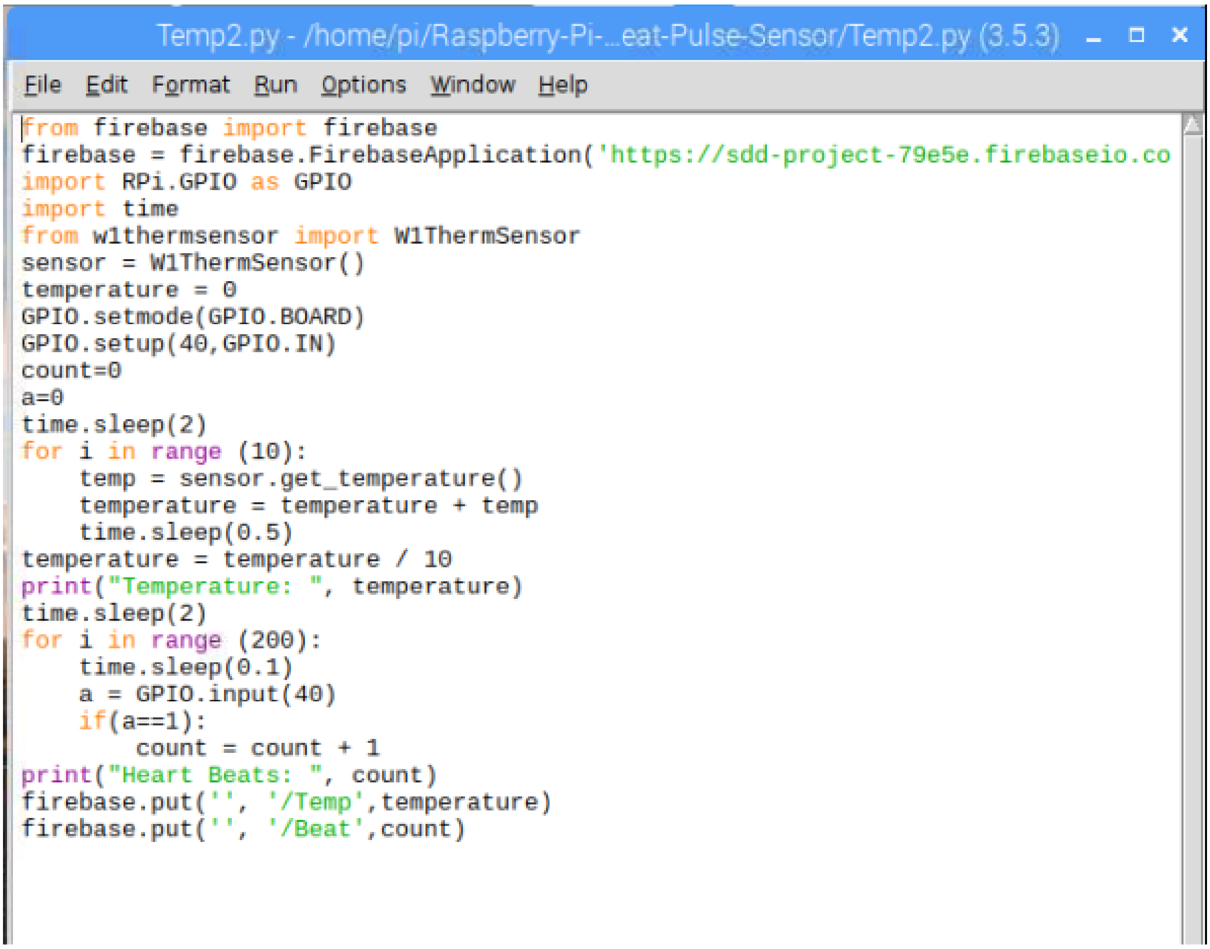
8. Send the data with a tag on the firebase

9. Call any data of any patient through the website

STOP

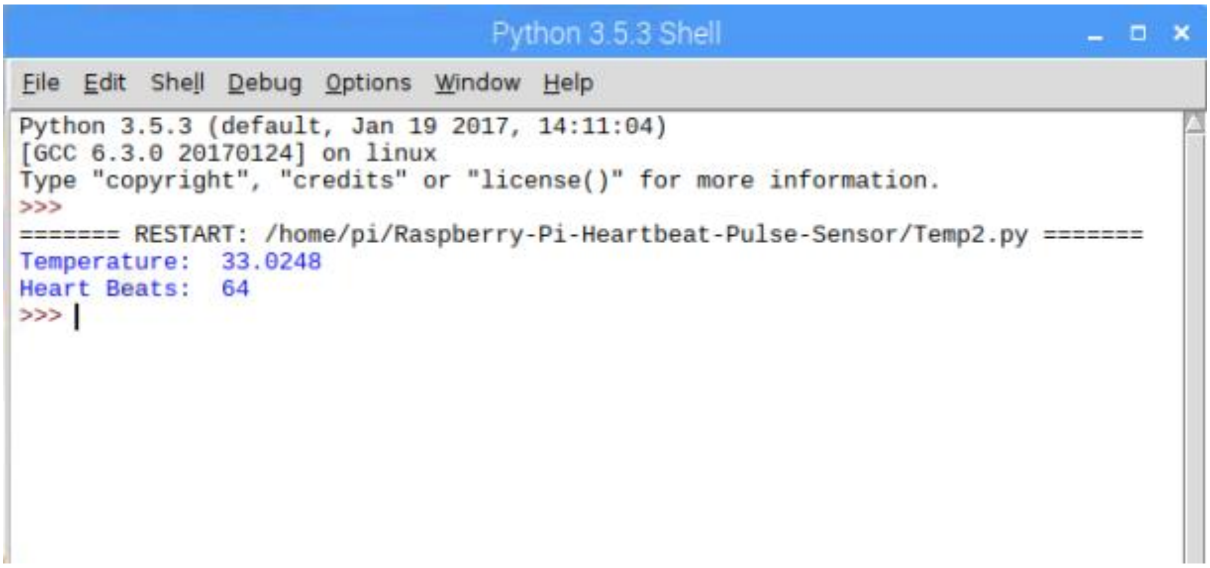
CODING:

Python code on hardware:


Temp2.py - /home/pi/Raspberry-Pi-...eat-Pulse-Sensor/Temp2.py (3.5.3)
File Edit Format Run Options Window Help

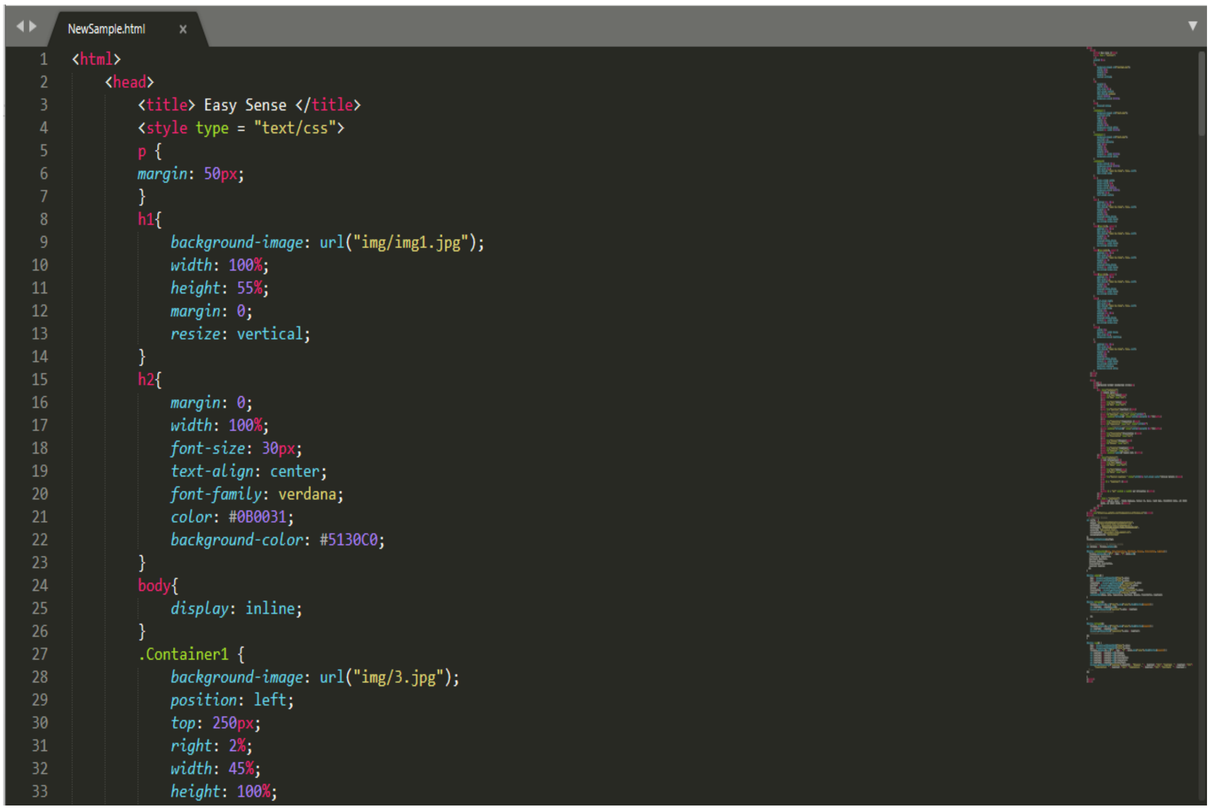
```
from firebase import firebase
firebase = firebase.FirebaseApplication('https://sdd-project-79e5e.firebaseio.co
import RPi.GPIO as GPIO
import time
from w1thermsensor import W1ThermSensor
sensor = W1ThermSensor()
temperature = 0
GPIO.setmode(GPIO.BOARD)
GPIO.setup(40,GPIO.IN)
count=0
a=0
time.sleep(2)
for i in range (10):
    temp = sensor.get_temperature()
    temperature = temperature + temp
    time.sleep(0.5)
temperature = temperature / 10
print("Temperature: ", temperature)
time.sleep(2)
for i in range (200):
    time.sleep(0.1)
    a = GPIO.input(40)
    if(a==1):
        count = count + 1
print("Heart Beats: ", count)
firebase.put('', '/Temp',temperature)
firebase.put('', '/Beat',count)
```

Execution:

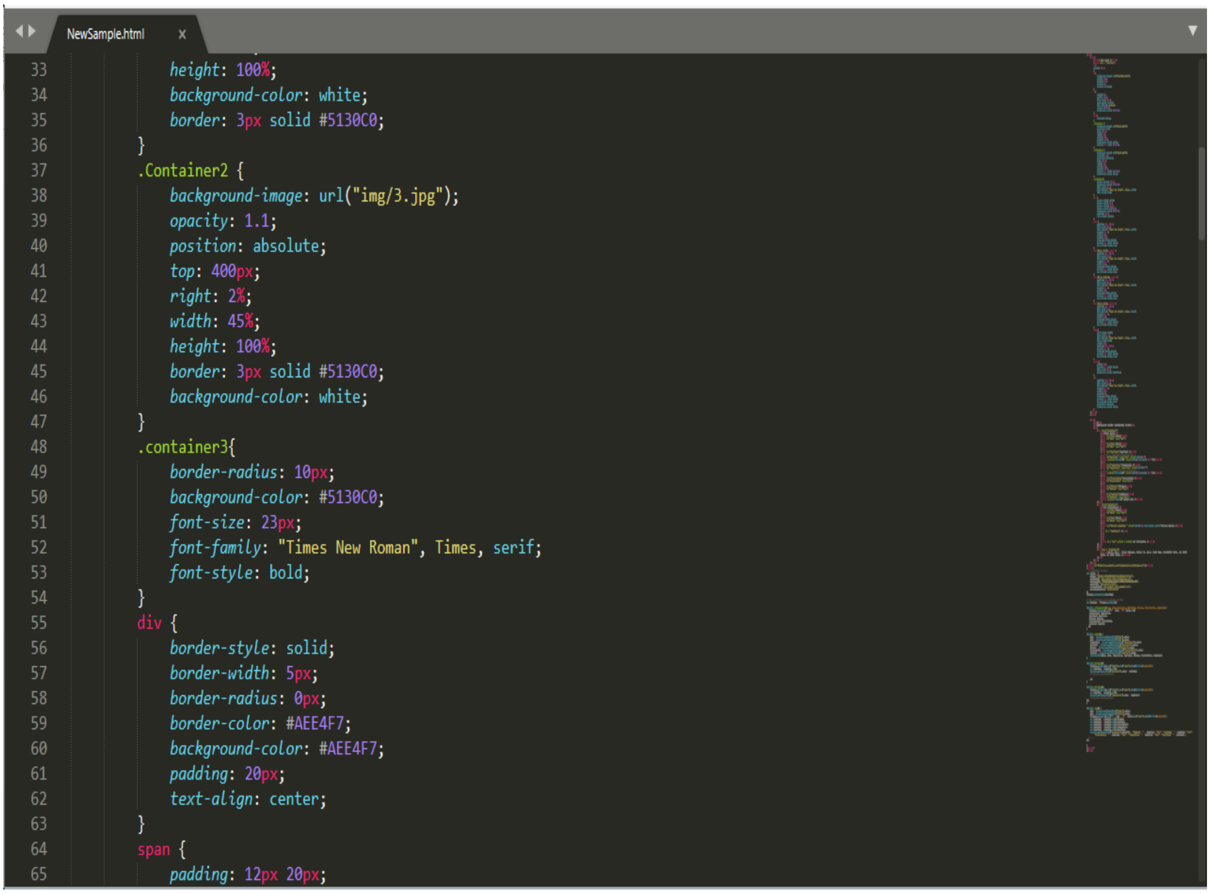


```
Python 3.5.3 (default, Jan 19 2017, 14:11:04)
[GCC 6.3.0 20170124] on linux
Type "copyright", "credits" or "license()" for more information.
>>>
======= RESTART: /home/pi/Raspberry-Pi-Heartbeat-Pulse-Sensor/Temp2.py =======
Temperature:  33.0248
Heart Beats:  64
>>> 
```

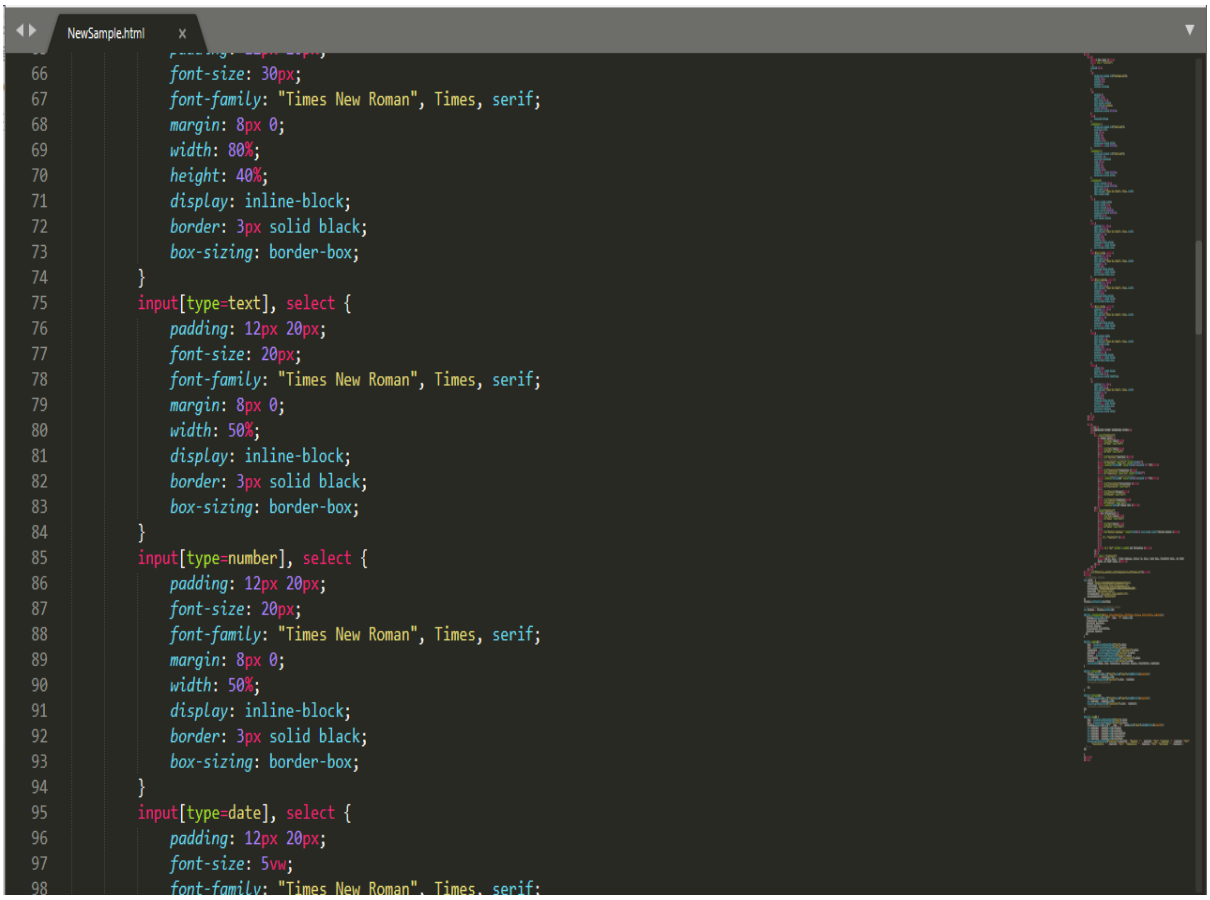
Web scripting code for website:



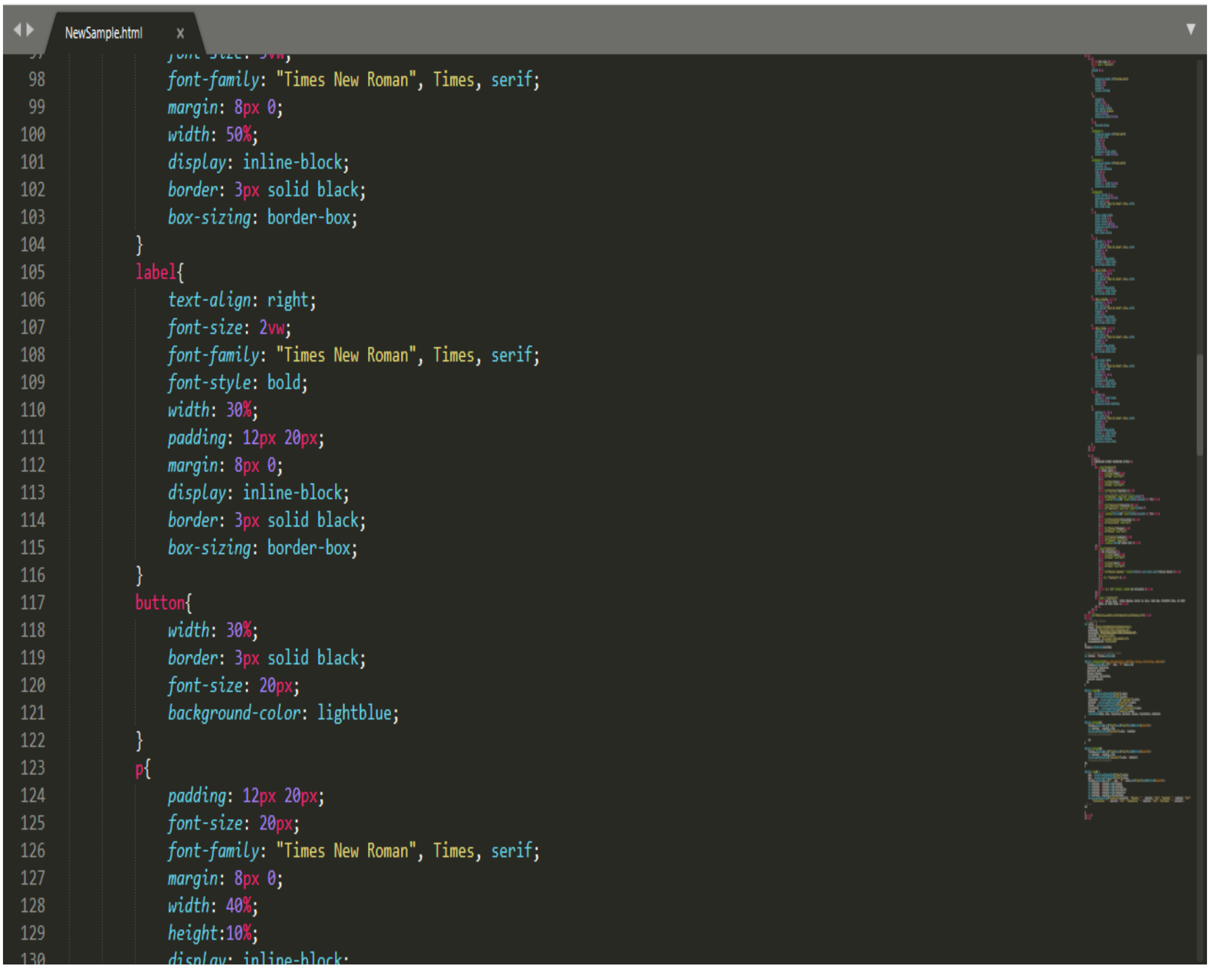
```
<html>
    <head>
        <title> Easy Sense </title>
        <style type = "text/css">
        p {
        margin: 50px;
        }
        h1{
            background-image: url("img/img1.jpg");
            width: 100%;
            height: 55%;
            margin: 0;
            resize: vertical;
        }
        h2{
            margin: 0;
            width: 100%;
            font-size: 30px;
            text-align: center;
            font-family: verdana;
            color: #0B0031;
            background-color: #5130C0;
        }
        body{
            display: inline;
        }
        .Container1 {
            background-image: url("img/3.jpg");
            position: left;
            top: 250px;
            right: 2%;
            width: 45%;
            height: 100%;
```



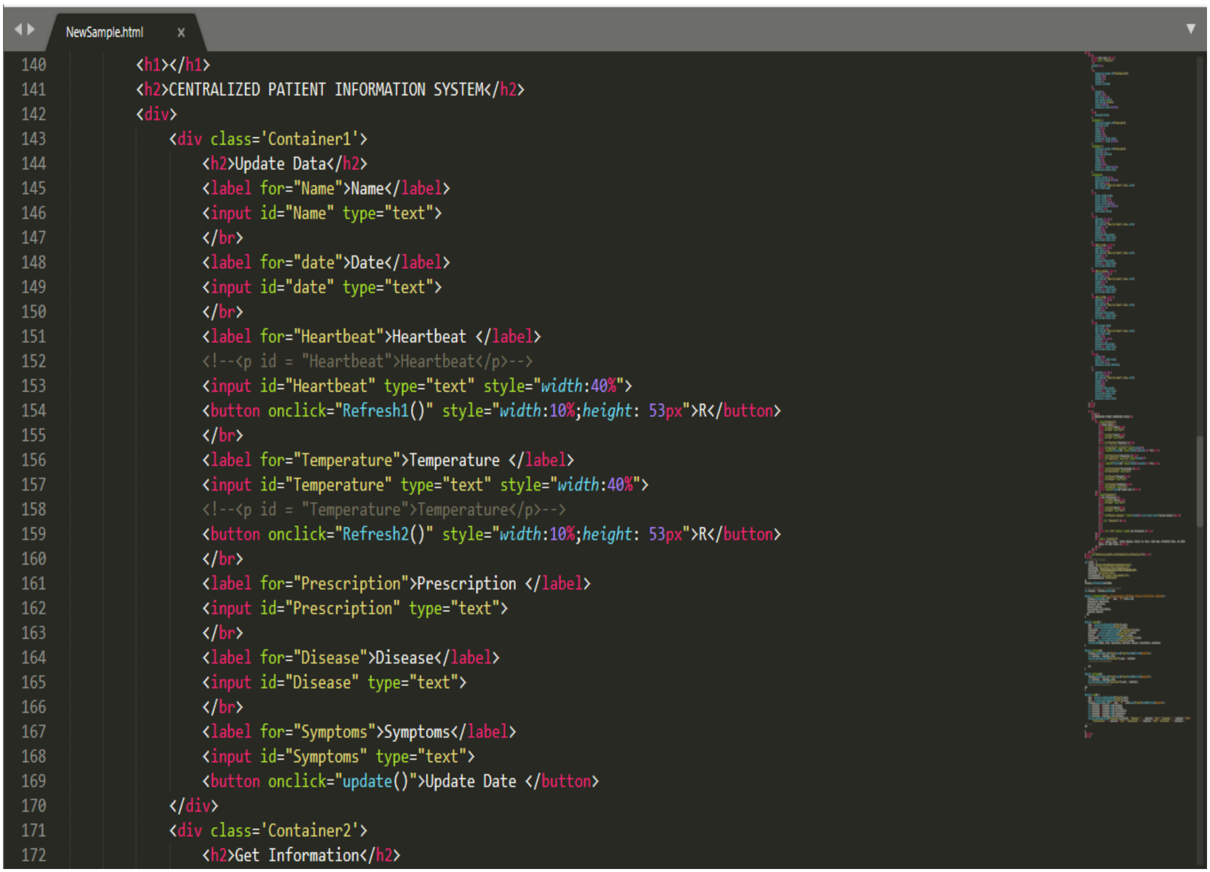
```
            height: 100%;
            background-color: white;
            border: 3px solid #5130C0;
        }
        .Container2 {
            background-image: url("img/3.jpg");
            opacity: 1.1;
            position: absolute;
            top: 400px;
            right: 2%;
            width: 45%;
            height: 100%;
            border: 3px solid #5130C0;
            background-color: white;
        }
        .container3{
            border-radius: 10px;
            background-color: #5130C0;
            font-size: 23px;
            font-family: "Times New Roman", Times, serif;
            font-style: bold;
        }
        div {
            border-style: solid;
            border-width: 5px;
            border-radius: 0px;
            border-color: #AEE4F7;
            background-color: #AEE4F7;
            padding: 20px;
            text-align: center;
        }
        span {
            padding: 12px 20px;
```



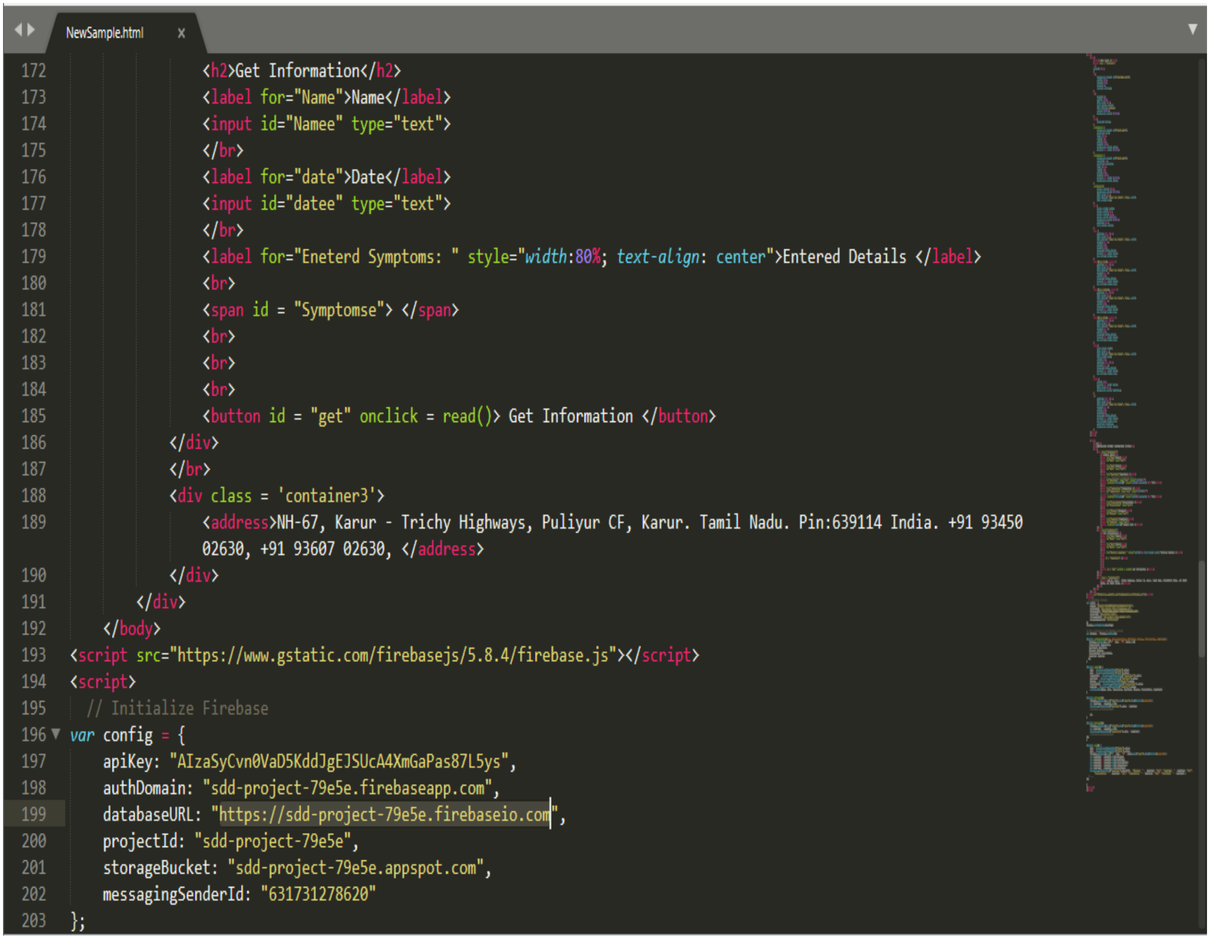
```
        padding: 12px 20px;
        font-size: 30px;
        font-family: "Times New Roman", Times, serif;
        margin: 8px 0;
        width: 80%;
        height: 40%;
        display: inline-block;
        border: 3px solid black;
        box-sizing: border-box;
    }
    input[type=text], select {
        padding: 12px 20px;
        font-size: 20px;
        font-family: "Times New Roman", Times, serif;
        margin: 8px 0;
        width: 50%;
        display: inline-block;
        border: 3px solid black;
        box-sizing: border-box;
    }
    input[type=number], select {
        padding: 12px 20px;
        font-size: 20px;
        font-family: "Times New Roman", Times, serif;
        margin: 8px 0;
        width: 50%;
        display: inline-block;
        border: 3px solid black;
        box-sizing: border-box;
    }
    input[type=date], select {
        padding: 12px 20px;
        font-size: 5vw;
        font-family: "Times New Roman", Times, serif;
```



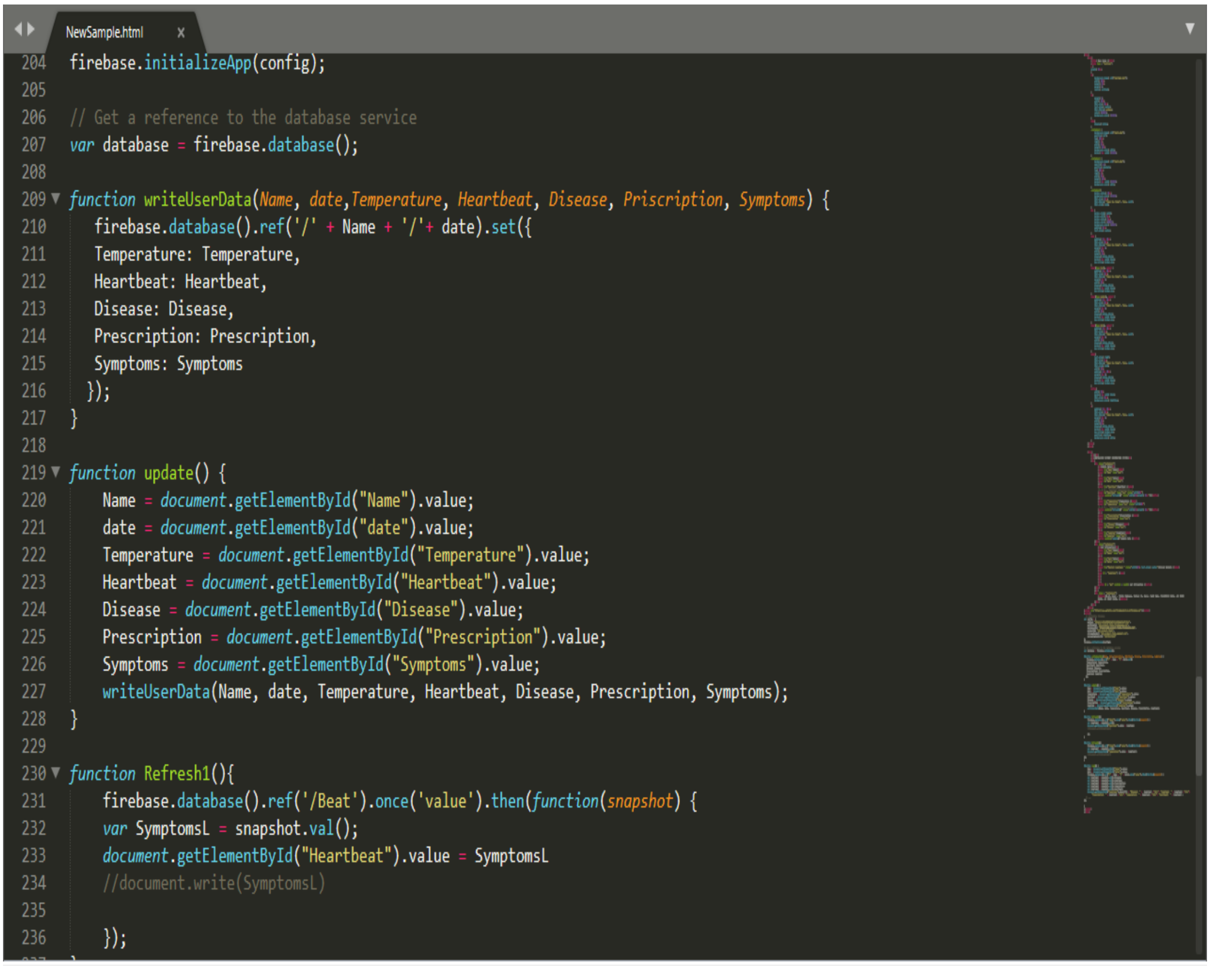
```
        font-size: 5vw;
        font-family: "Times New Roman", Times, serif;
        margin: 8px 0;
        width: 50%;
        display: inline-block;
        border: 3px solid black;
        box-sizing: border-box;
    }
    label{
        text-align: right;
        font-size: 2vw;
        font-family: "Times New Roman", Times, serif;
        font-style: bold;
        width: 30%;
        padding: 12px 20px;
        margin: 8px 0;
        display: inline-block;
        border: 3px solid black;
        box-sizing: border-box;
    }
    button{
        width: 30%;
        border: 3px solid black;
        font-size: 20px;
        background-color: lightblue;
    }
    p{
        padding: 12px 20px;
        font-size: 20px;
        font-family: "Times New Roman", Times, serif;
        margin: 8px 0;
        width: 40%;
        height:10%;
        display: inline-block;
```



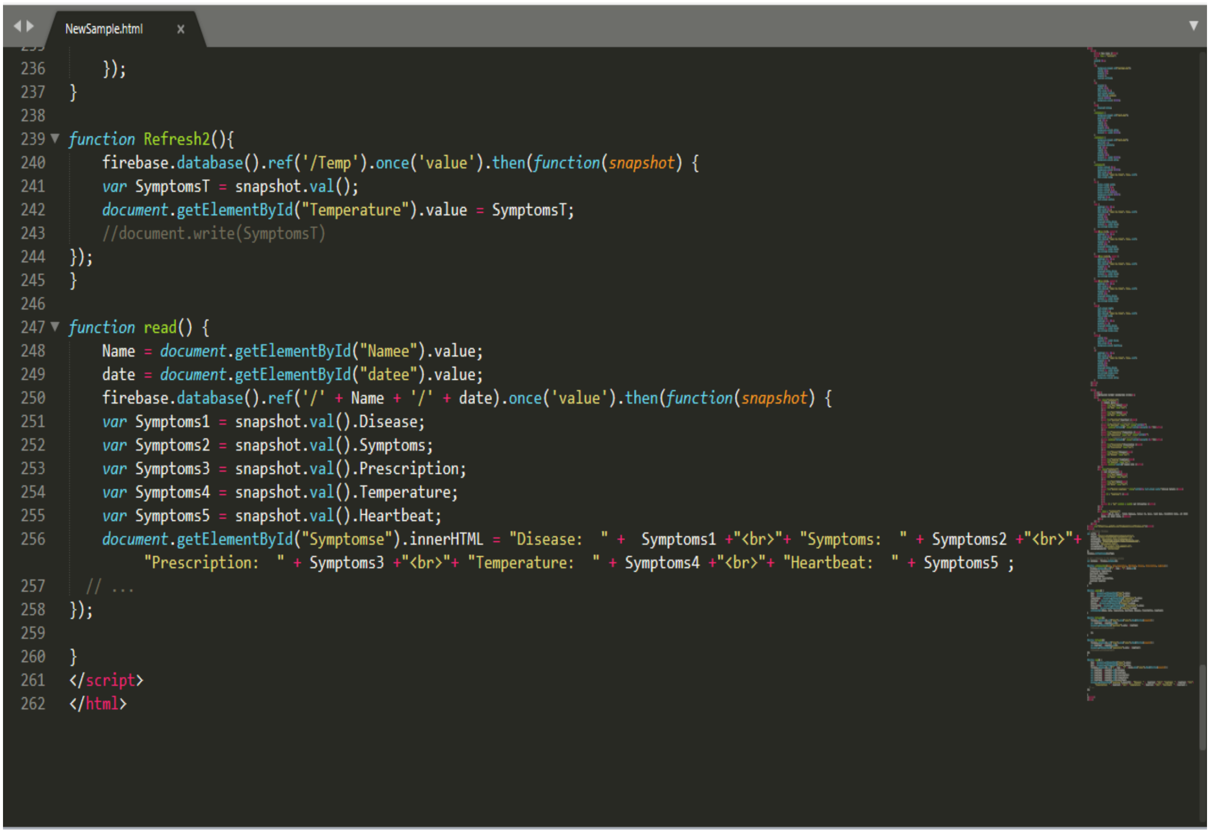
```
        <h1></h1>
        <h2>CENTRALIZED PATIENT INFORMATION SYSTEM</h2>
        <div>
            <div class='Container1'>
                <h2>Update Data</h2>
                <label for="Name">Name</label>
                <input id="Name" type="text">
                </br>
                <label for="date">Date</label>
                <input id="date" type="text">
                </br>
                <label for="Heartbeat">Heartbeat </label>
                <!--<p id = "Heartbeat">Heartbeat</p>-->
                <input id="Heartbeat" type="text" style="width:40%">
                <button onclick="Refresh1()" style="width:10%;height: 53px">R</button>
                </br>
                <label for="Temperature">Temperature </label>
                <input id="Temperature" type="text" style="width:40%">
                <!--<p id = "Temperature">Temperature</p>-->
                <button onclick="Refresh2()" style="width:10%;height: 53px">R</button>
                </br>
                <label for="Prescription">Prescription </label>
                <input id="Prescription" type="text">
                </br>
                <label for="Disease">Disease</label>
                <input id="Disease" type="text">
                </br>
                <label for="Symptoms">Symptoms</label>
                <input id="Symptoms" type="text">
                <button onclick="update()">Update Date </button>
            </div>
            <div class='Container2'>
                <h2>Get Information</h2>
```



```
                <h2>Get Information</h2>
                <label for="Name">Name</label>
                <input id="Namee" type="text">
                </br>
                <label for="date">Date</label>
                <input id="datee" type="text">
                </br>
                <label for="Eneterd Symptoms: " style="width:80%; text-align: center">Entered Details </label>
                <br>
                <span id = "Symptomse"> </span>
                <br>
                <br>
                <br>
                <button id = "get" onclick = read()> Get Information </button>
            </div>
            </br>
            <div class = 'container3'>
                <address>NH-67, Karur - Trichy Highways, Puliyur CF, Karur. Tamil Nadu. Pin:639114 India. +91 93450 02630, +91 93607 02630, </address>
            </div>
        </div>
    </body>
<script src="https://www.gstatic.com/firebasejs/5.8.4/firebase.js"></script>
<script>
  // Initialize Firebase
var config = {
    apiKey: "AIzaSyCvn0VaD5KddJgEJSUcA4XmGaPas87L5ys",
    authDomain: "sdd-project-79e5e.firebaseapp.com",
    databaseURL: "https://sdd-project-79e5e.firebaseio.com",
    projectId: "sdd-project-79e5e",
    storageBucket: "sdd-project-79e5e.appspot.com",
    messagingSenderId: "631731278620"
};
```



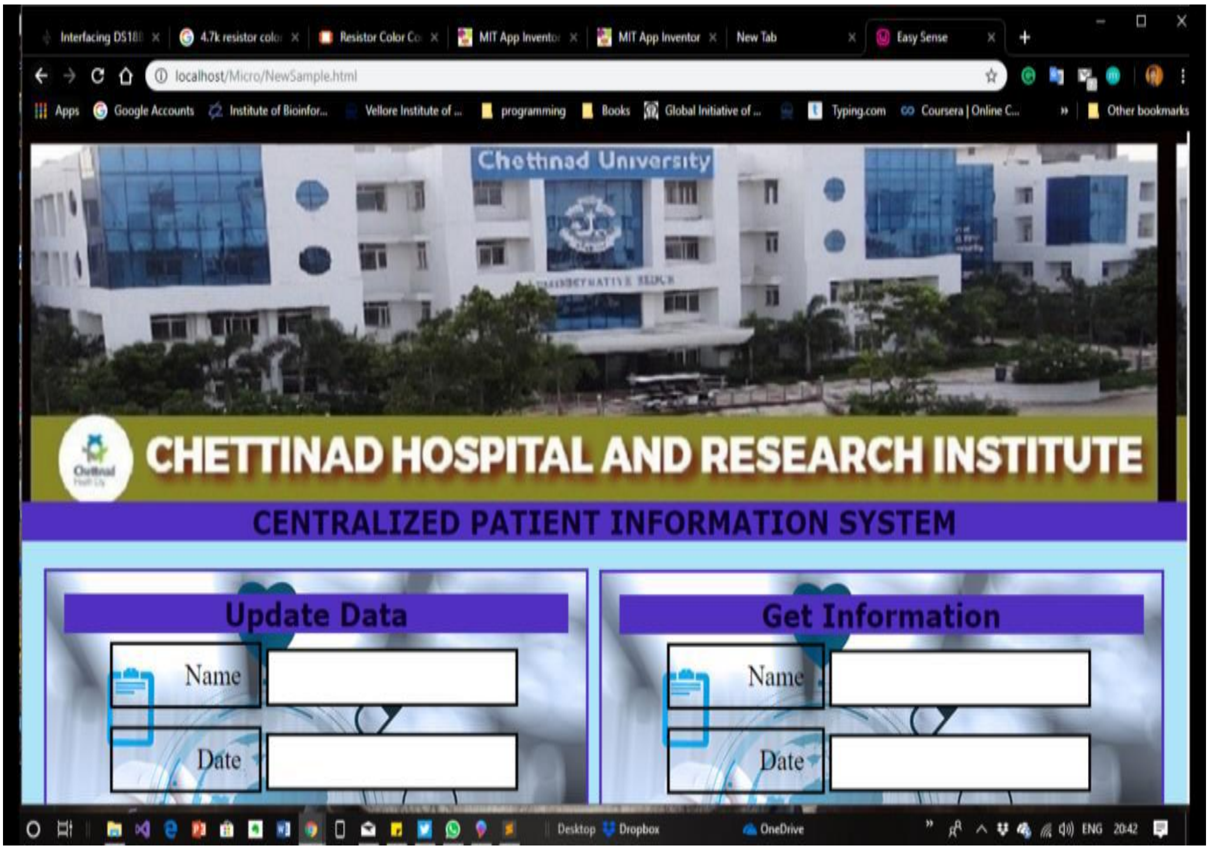
```
firebase.initializeApp(config);

// Get a reference to the database service
var database = firebase.database();

function writeUserData(Name, date,Temperature, Heartbeat, Disease, Priscription, Symptoms) {
   firebase.database().ref('/' + Name + '/'+ date).set({
   Temperature: Temperature,
   Heartbeat: Heartbeat,
   Disease: Disease,
   Prescription: Prescription,
   Symptoms: Symptoms
  });
}

function update() {
    Name = document.getElementById("Name").value;
    date = document.getElementById("date").value;
    Temperature = document.getElementById("Temperature").value;
    Heartbeat = document.getElementById("Heartbeat").value;
    Disease = document.getElementById("Disease").value;
    Prescription = document.getElementById("Prescription").value;
    Symptoms = document.getElementById("Symptoms").value;
    writeUserData(Name, date, Temperature, Heartbeat, Disease, Prescription, Symptoms);
}

function Refresh1(){
    firebase.database().ref('/Beat').once('value').then(function(snapshot) {
    var SymptomsL = snapshot.val();
    document.getElementById("Heartbeat").value = SymptomsL
    //document.write(SymptomsL)

    });
```

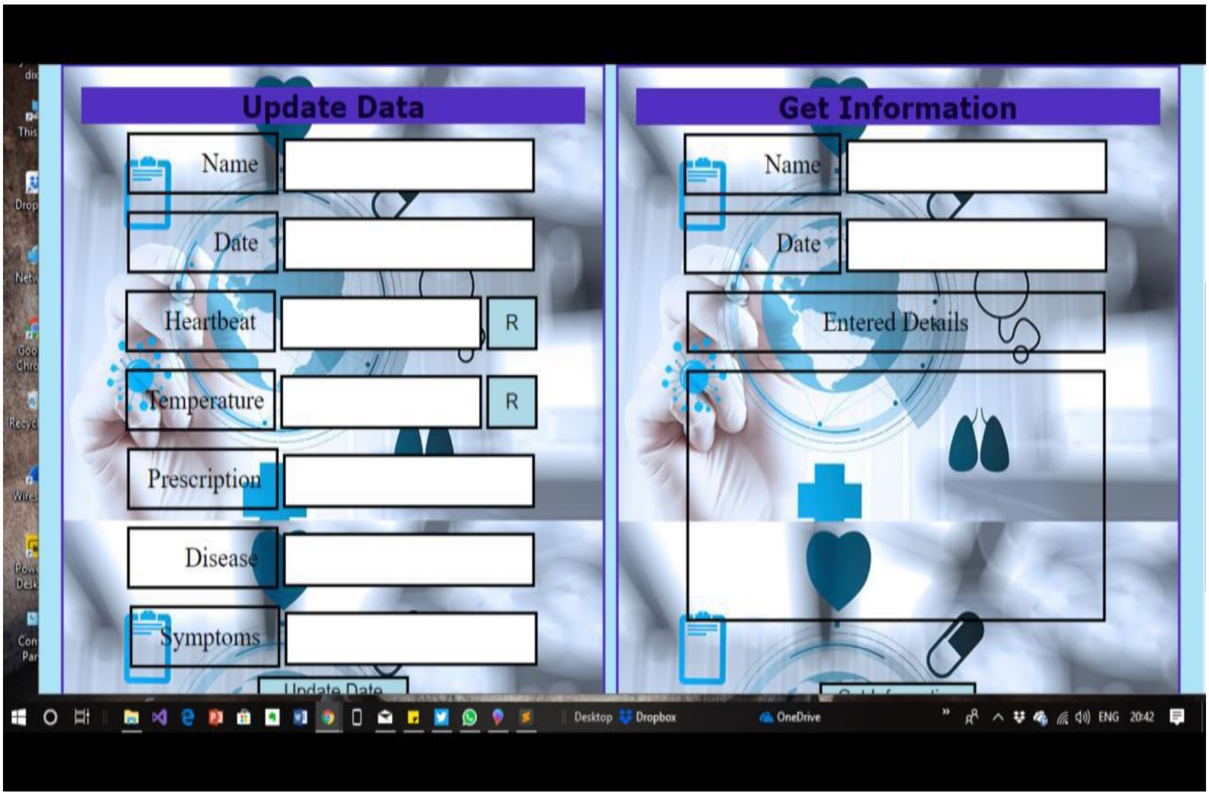


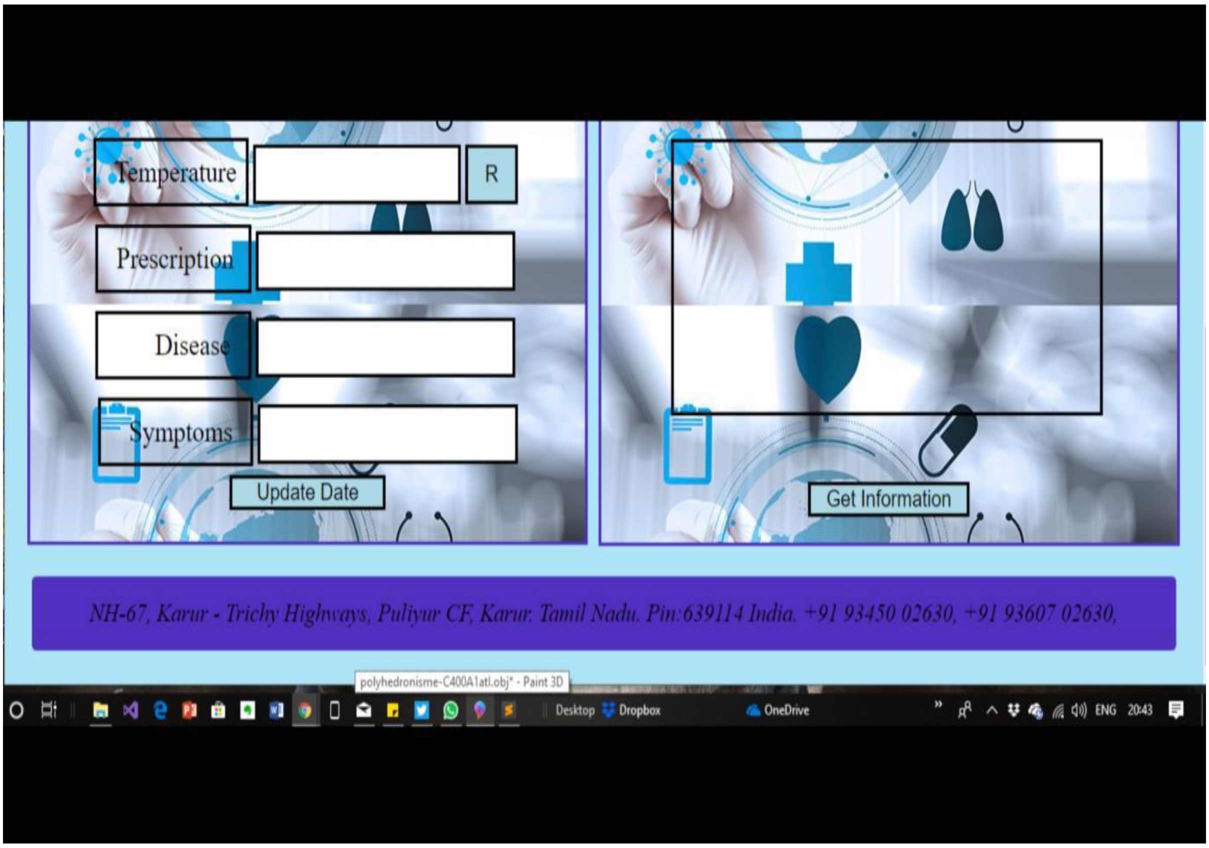
```
    });
}

function Refresh2(){
    firebase.database().ref('/Temp').once('value').then(function(snapshot) {
    var SymptomsT = snapshot.val();
    document.getElementById("Temperature").value = SymptomsT;
    //document.write(SymptomsT)
});
}

function read() {
    Name = document.getElementById("Namee").value;
    date = document.getElementById("datee").value;
    firebase.database().ref('/' + Name + '/' + date).once('value').then(function(snapshot) {
    var Symptoms1 = snapshot.val().Disease;
    var Symptoms2 = snapshot.val().Symptoms;
    var Symptoms3 = snapshot.val().Prescription;
    var Symptoms4 = snapshot.val().Temperature;
    var Symptoms5 = snapshot.val().Heartbeat;
    document.getElementById("Symptomse").innerHTML = "Disease:  " +  Symptoms1 +"<br>"+ "Symptoms:  " + Symptoms2 +"<br>"+
         "Prescription:  " + Symptoms3 +"<br>"+ "Temperature:  " + Symptoms4 +"<br>"+ "Heartbeat:  " + Symptoms5 ;
  // ...
});

}
</script>
</html>
```

SIMULATION RESULTS

Website Interface:

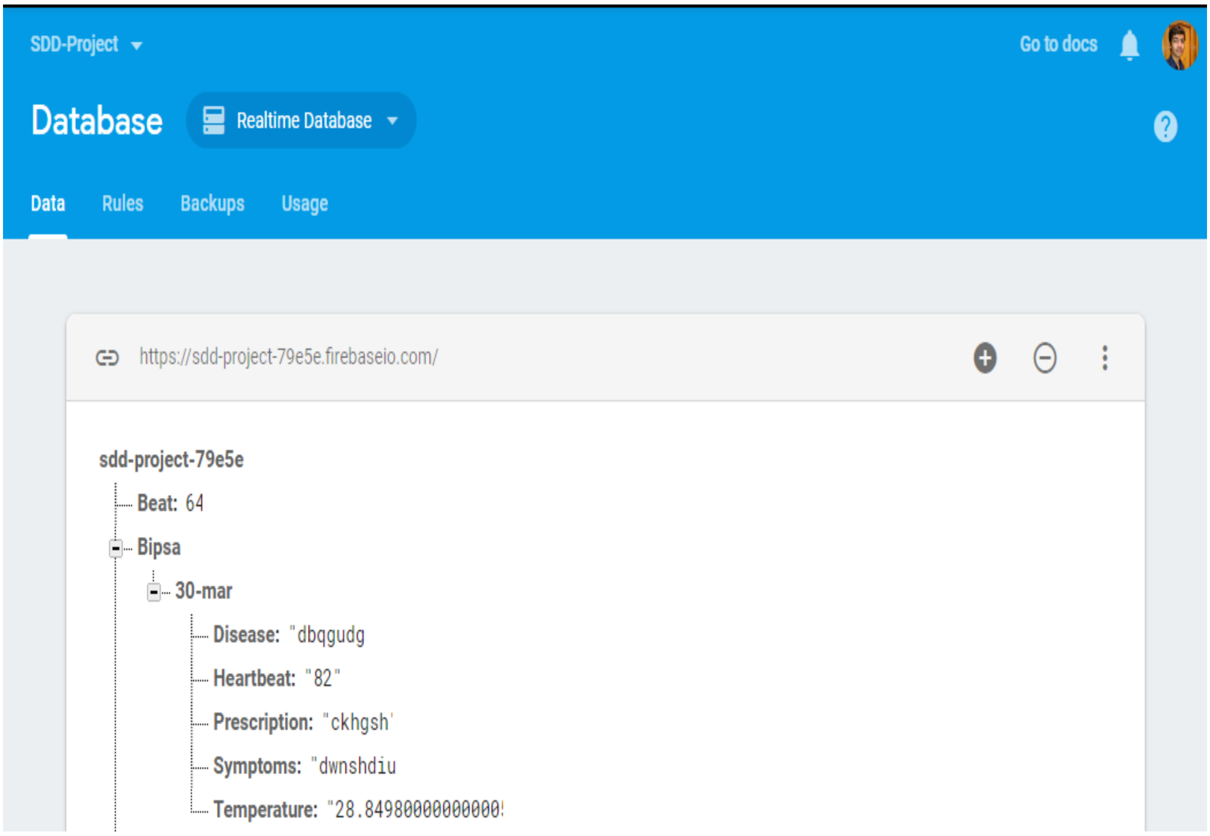






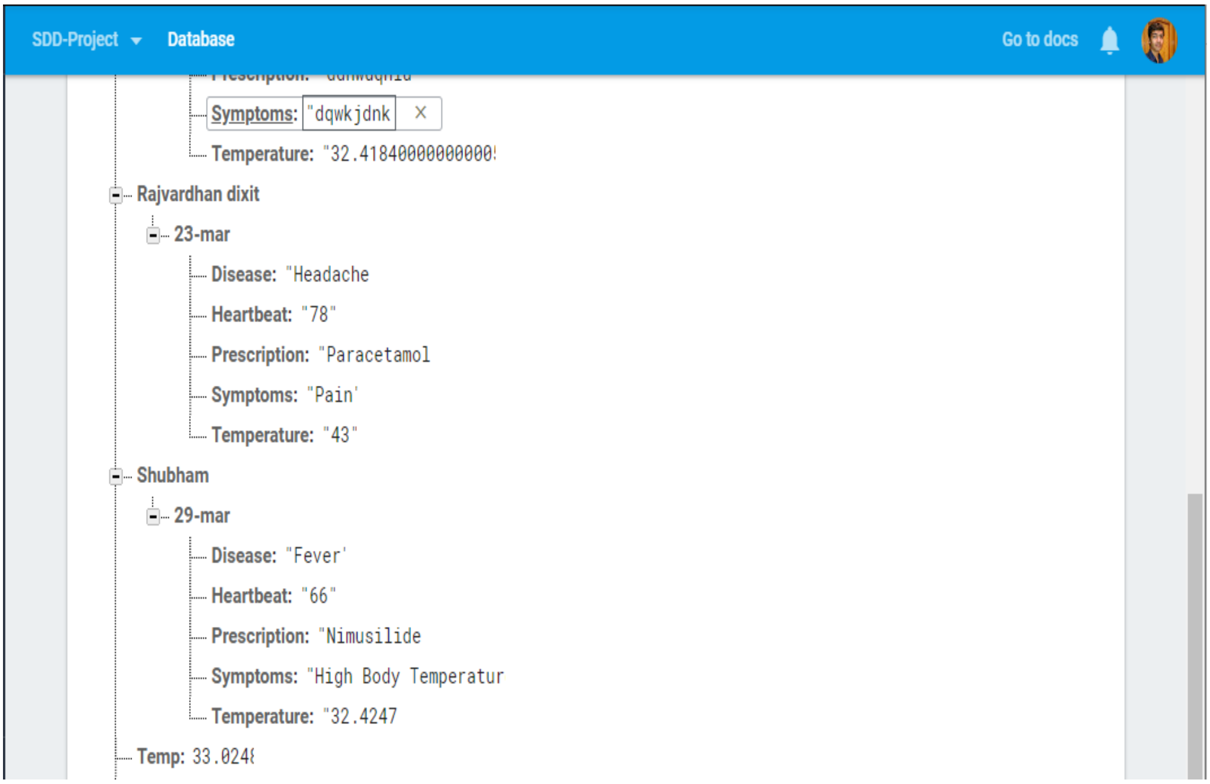
NH-67, Karur - Trichy Highways, Puliyur CF, Karur. Tamil Nadu. Pin:639114 India. +91 93450 02630, +91 93607 02630,

Firebase:



https://sdd-project-79e5e.firebaseio.com/

```
sdd-project-79e5e
 ├ Beat: 64
 ⊟ Bipsa
    ⊟ 30-mar
        ├ Disease: "dbqgudg
        ├ Heartbeat: "82"
        ├ Prescription: "ckhgsh'
        ├ Symptoms: "dwnshdiu
        └ Temperature: "28.84980000000000!
```



```
            Prescription: "ddnwdqnid
            Symptoms: "dqwkjdnk
            Temperature: "32.4184000000000!
    Rajvardhan dixit
        23-mar
            Disease: "Headache
            Heartbeat: "78"
            Prescription: "Paracetamol
            Symptoms: "Pain'
            Temperature: "43"
    Shubham
        29-mar
            Disease: "Fever'
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            Symptoms: "High Body Temperatur
            Temperature: "32.4247
    Temp: 33.024{
```
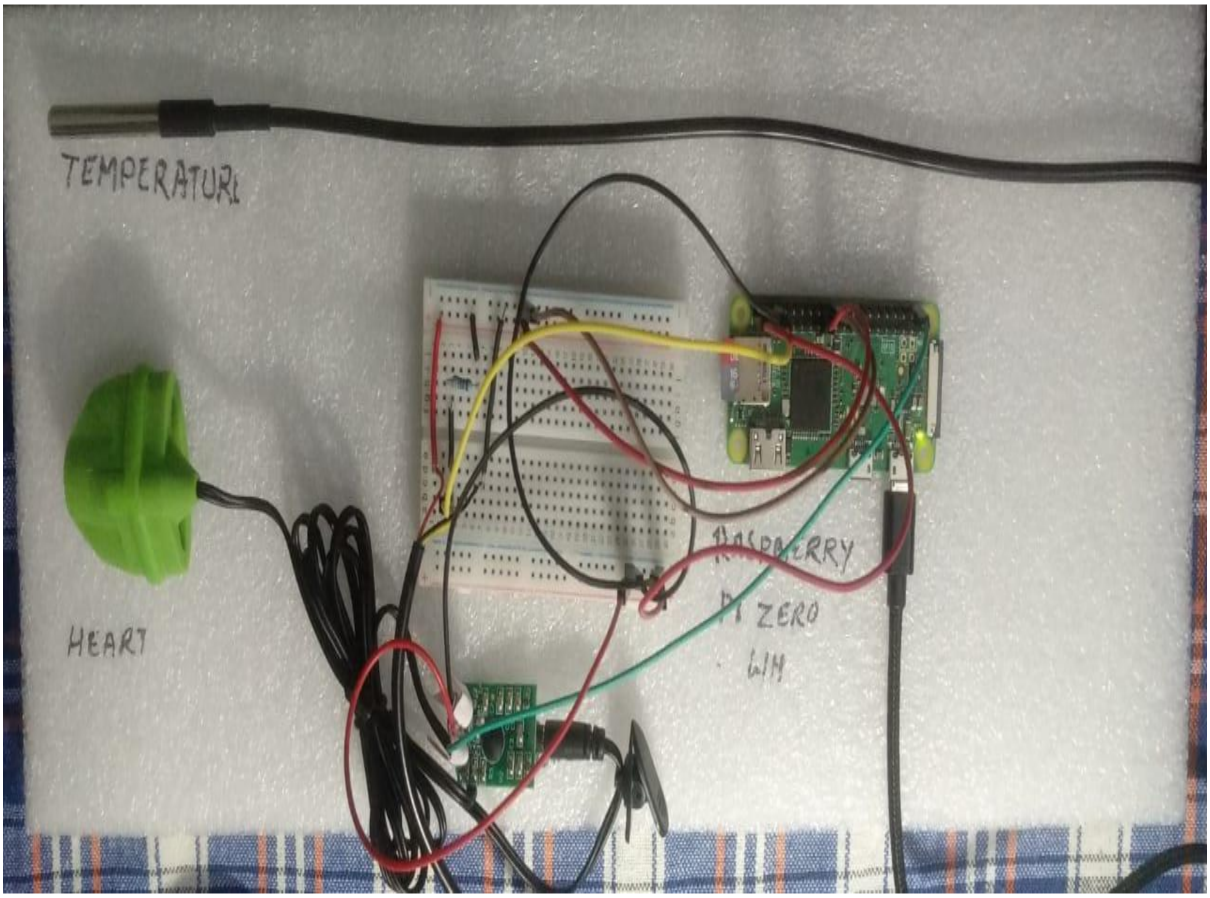

Hardware:



RESULT ANALYSIS AND OBSERVATIONS

As a whole, our project deals with detecting the physiological data of a patient, and sending it over to the cloud. The entire data is stored there, and is made available to both the Doctor and the Patient via an application solely made for this purpose. This eases the process of communication to doctor for the patients and helps them to create a prescription and having a track record of one's own medical history. We aim to keep these data decentralized to make it accessible anywhere and at the same time immutable and secure. With an ongoing increase in patient numbers, healthcare providers have to manage more and more health data on a regular basis. As the data volume increases each year, it becomes harder for hospitals and clinics to process and store information.

Data managed by medical organizations includes:-Patient health information (PHI); · Electronic health records;-Data collected from IoT devices (Internet of Things) or monitoring systems; and, Medical insurance claims. Secure information sharing methods, which allow both healthcare providers and their covered entities to verify the correctness of data, are crucial for ensuring proper medical services.

The sensors used here are the Heartbeat sensor and the DB18B20 (Heartbeat sensor/Pulse Sensor – Analog). The heartbeat sensor is based on the principle of photo plethysmography. In case of applications where heart pulse rate is to be monitored, the timing of the pulses is more important. The flow of blood volume is decided by the rate of heart pulses and since light is absorbed by blood, the signal pulses are equivalent to the heart beat pulses. The DS18B20 is a 1-wire programmable Temperature sensor from maxim integrated. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from -55°C to +125° with a decent accuracy of ±5°C. Each sensor has a unique address and requires only one pin of the MCU to transfer data so it a very good choice for measuring temperature at multiple points without compromising much of the digital pins on the microcontroller. Raspberry pi zero has been used to make the system less expensive and complete the project in time. The data from the sensors are sent to the Cloud. The Storing healthcare data in the cloud gives users the ability to access it across a variety of electronic devices while eliminating the costs and technical challenges associated with maintaining an infrastructure system on site. Many health providers would prefer to move their infrastructure to the cloud so they can focus on what they perform best, which is provide healthcare services. Also, the capital cost of managing a data center can vary each year due to hardware refreshes. But hosting data in the cloud can provide more static cost each year, which makes the budget for managing it simpler and more predictable. Cloud services allow data to be stored in multiple locations. This can be beneficial if there is a fire, natural disaster or power outage and can provide reassurance that critical business functions or operations will not be interrupted. The patient data can then be viewed in an application by both the Doctor and the Patient. The advantage of this is that the Doctor can have the necessary information, required for diagnosing and future prescriptions. When the same patient comes in, the Doctor only needs to refer to the physiological data collected from the cloud, which would ensure a speedy treatment, and hence, efficient recovery. The patient will have the data accessible to him/her as well, thus keeping them updated. Thus, from our project, we have managed to create an efficient system that reduces time of communication between Doctor and Patient, and eases treatment of patients by making the patient data available securely.

FUTURE ENHANCEMENT

I Created this project as a general physiological data sensing and management system however this can be used in the various ways in a more customize way, like if it has to be used in the cardiology center than not much difficulties will came as we have to add a new EEG sensor to the ADC to read that data, Similarly if we want to sense brain waves then EEG sensor will be used with ADC and small change in the python functions will be sufficient to use it anywhere. However miniaturization of the devise can be done and more powerful and better sensors can be used to acquire more precise data in the future.

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