A Project Report

On

Smart Health Monitoring System

Submitted in partial fulfilment of the requirement of

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For the Degree of

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in

COMPUTER ENGINEERING

Submitted by

Shruthi Nair
Nimmy Augustine
Leo Varghese

Supervised by

Asst.Prof Sandhya Pati

Department of Computer Engineering

Fr. Conceicao Rodrigues Institute of Technology
Sector 9A, Vashi, Navi Mumbai - 400703

UNIVERSITY OF MUMBAI

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APPROVAL SHEET

This is to certify that the project entitled

"Smart Health Monitoring System"

Submitted by

Shruthi Nair	**101633**
Nimmy Augustine	**101634**
Leo Varghese	**101530**

Supervisors : ____________________

Project Coordinator : ____________________

Examiners : 1. ____________________

2. ____________________

Head of Department : ____________________

Date :

Place :

Declaration

We declare that this written submission for B.E. Declaration entitled "**Smart Health Monitoring System**" represent our ideas in our own words and where others' ideas or words have been included. We have adequately cited and referenced the original sources. We also declared that we have adhere to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any ideas / data / fact / source in our submission. We understand that any violation of the above will cause for disciplinary action by institute and also evoke penal action from the sources which have thus not been properly cited or from whom paper permission have not been taken when needed.

Project Group Members:

1. Shruthi Nair,101633

2. Nimmy Augustine,101634

3. Leo Varghese,101530

Abstract

Monitoring and keeping track of the health status of a patient at home is a difficult task. Especially old age patients should be periodically monitored and their health status needs to be informed to the concerned doctor from time to time so that an immediate required action can be taken. There are various apps providing different home related medical services such as providing information related to medicines, booking appointments depending upon the availability of the doctor in the specific hospital/clinic, delivery services of medical equipment and medicines prescribed by the concerned doctor specialized in the required medical field, emergency ambulance services and home nurse services. We propose a system that put forward a system that uses sensors to track patient's health and uses internet to inform their respective doctor or family members in case of any emergency issues. The system is developed for home use by patients who are not in critical condition but need to be constantly or periodically monitored by the doctor or any family member. The system monitors the bpm readings of the patient from the pulse sensor and the room temperature which can be monitored by the doctor and the nurses from the hospital. If there are any abnormalities in the readings of the sensors data ,an alert will be sent to the doctor through the IoT device. Depending upon the current situation about the patient , as per tracked by the system, the doctor can take the required action and can provide the necessary immediate medical treatment to the patient .The health related data of the patient is stored in blockchain using smart contract.

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Chapter 1

Introduction

1.1 Background

In traditional methods, the health of a human body is monitored using thermometer, oximeter, etc. A basal thermometer is a thermometer used to take the basal (base) body temperature, the temperature upon waking. Basal body temperature is much less affected than daytime temperature by environmental factors such as exercise and food intake. This allows small changes in body temperature to be detected . Pulse oximeters are clip-on devices that measure oxygen saturation. The device may be attached to a finger, a wrist, a foot, or any other area where the device can read blood flow. A heart rate monitor(HRM) is a personal monitoring device that allows one to measure/display heart rate in real time . Fitbit tracks every part of your day, including activity, exercise, food, weight and sleep, pulse rate and steps. Doctors play an important role in health check up .

The process requires a lot of time for registration, appointment and then check up. Due to this lengthy process working people tend to ignore the check ups.

1.2 Motivation

Present-day systems use health monitoring devices which are connected to the patients at the hospital. The use of these machines detects the conditions of the patient and the data is collected and transferred to the connected monitoring systems. Doctors and nurses need to visit the patient frequently to examine his/her current condition.

The smart health monitoring system can provide information required to monitor the health parameters of the patient. Wireless sensors are used to collect and transmit the data and to display the data on the web page. This system can be useful for the following people:-

1. A patient who has undergone certain treatment and due to which it is required to monitor certain health parameters.

2. A patient who has suffered from a heart attack before and to prevent it to occur in the future, the required health parameters can be monitored remotely.

3. A patient who is paralytic can use the system to monitor the required health parameters as advised by the doctor.

4. Athletics during the training period can check their current health parameters.

5. The people at an advanced age and maybe having failing health conditions can use this system to monitor the current health conditions [6].

1.3 Aim and Objective

The aim is to develop a smart health monitoring system to monitor the health parameters of the patient securely. A doctor or health specialist can use the system to monitor remotely of all vital health parameters of the patient. This can also be viewed by the patient's family member [7].Giving care and health assistance to the bedridden patients at critical stages with advanced medical facilities have become one of the major problems in the recent times. In hospitals where many patients whose physical conditions must be monitored frequently as a part of a diagnostic procedure, the need for a cost-effective and fast responding alert mechanism has become difficult. Proper implementation of such systems can provide timely warnings to the medical doctors and their service can be activated in case of medical emergencies.

Chapter 2

Study Of the System

2.0.1 Health Care system

A health system is an organization of people, institutions and resources that deliver health care services to meet the health needs of people . Health has prime importance in our day-to-day life. A good health is necessary to do the everyday work properly. In rural hospitals, the facilities for health care are limited. The poor quality of health management enables issues in health care system. Biomedical is one of the recent trends to provide better healthcare.

2.0.2 Health Care System using IoT

Internet of Things (IoT)-enabled devices have made remote monitoring in the healthcare sector possible. It has reduced the costs and improved the health treatment of patients.IOT helps in collecting the information from various sensors and analyzing the data in real time. Connecting these devices to the patient's body will allow easy monitoring by the staff and can save lives in any emergencies. Users can access the data resulting in better analysis of the patient.

2.0.3 Health Care System using Blockchain

Blockchain introduces security of health care information.Depending upon the current situation about the patient as per tracked by the smart patient health monitoring system, the doctor can take the required action and can provide the necessary immediate medical treatment. The health related information of the patient that has been sent to the doctor can be made secured by making the system decentralized in such a way that the information sent to a particular doctor from a hospital can only be accessed by that doctors who are part of the decentralized system.

2.0.4 Related Work

2.0.4.1 Wireless Health Monitoring System For Patients

Author- Salman Ahmed, Sabrin Millat, MD. Aymanur Rahman, Sayeda Naeyna Alam, Md. Saniat Rahman Zishan

The project was to observe patients without having to be physically present at their bedside, be it in the hospital or in their home. A patient's body temperature, heart rate and electrocardiography (ECG) are transferred wirelessly through Bluetooth technology. The temperature sensor chosen was LM35 IC. The ECG had three electrodes that can monitor heart from three different angles.

The heart rate monitoring was a follow up to the system for obtaining the electrocardiograph. After obtaining the electrocardiograph, the Arduino Uno was programmed to obtain the heart beat rate of that particular reading.[1]

The purpose of the Arduino was to show the result in the local PC and the Bluetooth is to transfer the same data wirelessly to the server PC or smartphone. Xoscillo software helped to observe the waveshape of the ECG. The project was to overcome the difficulty that is encountered by experts in monitoring multiple patients at a time [4].

2.0.4.2 Patient Health Monitoring System Based on Internet Of Things

Author- Roshan Jayswal, Rahul Gupta, K. K. Gup

In this paper, a circuit was developed which can sense the temperature and heart-beat of the human body, and if it exceeds a certain set limit, then an alarm would be raised over IOT Gecko platform on the Internet.

In this paper, a circuit was developed which can sense the temperature and heart-beat of the human body, and if it exceeds a certain set limit, then an alarm would be raised over IOT Gecko platform on the Internet [2]

- Power supply circuit
- Micro Controller unit
- Heart beat sensor
- Temperature sensor
- Heart beat sensor
- 16x2 LCD Display

LM35 sensor was used to read temperature values whereas heartbeat sensor module gave heart rate of patient which was sent to micro controller unit which thereby use to send this data to LCD for display as well as to ESP8266 WiFi protocol to display the measured readings over IOT Gecko Internet Platform. During an emergency, an alarm would be raised over the internet platform notifying the doctor about critical status of patient over internet. The doctors were able to monitor the health-related data of patient using the unique IP and login id over the IOT gecko platform over which the instantaneous health related data of the patient used to be updated.

2.0.4.3 Smart health monitoring system of patient through IoT

Author -Vemuri Richard Ranjan Samson, U Bharath Sai, P L S D Malleswara Rao, K Kedar Eswar @Potti Sriramulu Chalavadi Mallikarjunarao College of Engineering and Technology, Vijayawada, India. (A paper written under the guidance of Prof. S Pradeep Kumar

The general design of IoT applications can be partitioned into three layers: the detecting layer,the transport layer and the application layer. In the Detecting layer, to measure the body temperature DS18B20 body water resist body temperature sensor is used. To measure the heart beat rate of the patient, pulse sensor amped are used. To recognize the Electrocardiogram, AD8232 Heart-Rate observing sensor are used. This Bio data from the sensors is checked persistently in Arduino utilizing the serial monitor.In the Transport layer the information is sent to the cloud by utilizing the Arduino with the assistance of an Ethernet shield or Wi-Fi Module ESP8266. Here the system utilize an open cloud server i.e. “Thingspeak” to make it accessible in cloud. Through ThingsSpeak an API key is generated. This API key is utilized while programming in Arduino with the end goal that the information is put in the server through the API key and at the application layer the information can be recovered by the utilization of an API key. The information of the patient including the location and the health parameters can be viewed in a graphical format with the help of Thingspeak [3].

2.0.4.4 Internet of things (IoT) based smart health care system

Vikas Vippalapalli and Snigdha Ananthula, ETM Dept.,GNITS, Hyderabad, India.

For monitoring health parameters like temperature, pulse rate and blood pressure respectively, three sensors are connected to the Arduino Fio transmitter board. The xbee module is connected to the board. The sensed values are wirelessly transmitted to the arduino receiver which is connected to the patient side computer and the values are read in labVIEW which is connected to the Internet. A URL is generated by labVIEW which can be accessed from any computer .In this paper, tele-monitoring application is presented which allows the doctor to view the patient’s vital parameters remotely and dynamically in a Web page in real time and doesn’t need to have any special requirement on the PC; through an Internet access. For the patient side, a home based LabVIEW application which is embedded in home PC is required [4]

Table 2.1: **Existing Systems**

Name	**Location**	**Description**	**Disadvantages**	**Publication**
Wireless Health Monitoring System For Patients	American International University-Bangladesh, Dhaka, Bangladesh	Health Monitoring System using sensors and Bluetooth technology	The system does not store the patient health related information securely. The system is restricted to web page only .	2015 IEEE International WIE Conference on Electrical and Computer Engineering
Patient Health Monitoring System Based on Internet Of Things	Birla Institute of Technology and Science (BITS), Pilani, Rajasthan	A circuit which can sense the temperature and heart-beat of the human body, and if it exceeds a certain set limit, then an alarm would be raised over IOT Gecko platform on internet	.The system does not store the patient health related information securely. The system is restricted to web page only.	2017 Fourth International Conference on Image Information Processing (ICIIP)
Smart health monitoring system of patient through IoT	Potti Sriramulu Chalavadi Mallikarjunaro College of Engineering and Technology, Vijayawada, India.	Smart health Monitoring System monitoring health parameters like blood pressure, temperature, ECG by using Thingspeak software.	The system does not store the patient health related information securely. The system is restricted to web page only.	International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2017)
Internet of things (IoT) based smart health care system	GNITS, Hyderabad, India	Smart health monitoring application which allows the doctor to view the patient's vital parameters Remotely and dynamically in a Web page in real time through an Internet access.	The system does not store the patient health related information securely. The system is restricted to web page only.	International conference on Signal Processing, Communication, Power and Embedded System (SCOPES)-2016

Chapter 3

Proposed System

3.1 Problem Statement

Our system is designed to get the data from the health monitoring sensors connected to the patient through IoT and make it available to the concerned doctor so that the doctor can monitor the health parameters remotely. The system can be made secure through the blockchain technology by creating individual blocks for a patient consulting a particular doctor.

3.2 Scope

The proposed system monitors health parameters such as heart beat rate of the patient and the room temperature using IoT technology. The proposed system will be made secured by storing health information of a patient consulting a particular doctor of the hospital in a Blockchain. The system can be further improved by monitoring more health parameters like Blood pressure, sugar level and more.The security features of the system can be further extended where a particular patient is consulting doctors from multiple hospitals.

3.3 Proposed System

Our propose system is a system that uses sensors to track patient's health and uses internet to inform their respective doctor or family members in case of any emergency issues. The system is developed for home use by patients who are not in critical condition but need to be constantly or periodically monitored by the doctor or any family member. The system monitors the bpm readings of the patient from the pulse sensor and the room temperature which can be monitored by the doctor and the nurses from the hospital. If there are any abnormalities in the readings of the sensors data ,an alert will be sent to the doctor through the IoT device. Depending upon the current situation about the patient , as per tracked by the system, the doctor can take the required action and can provide the necessary immediate medical treatment to the patient .The health related data of the patient is stored in blockchain using smart contract.

Chapter 4

Design Of the System

4.1 Requirement Engineering

4.1.1 Requirement Elicitation

The doctor wants to monitor the BPM (heart beat) readings of the patient from a distant location. According to the health readings, the doctor can update the patient with the required treatment details. Patient's health information should be stored in the real time database. If there are any abnormalities in the patient's BPM readings, the doctor and the family members should be notified, so that the doctors can provide the necessary treatment to the patient based on the reading values.

4.1.2 Software lifecycle model

Agile software model is used for developing software applications where project implementation is done iteratively or incrementally. This model helps to make changes or modification as per the user requirement. The cycle stages are executed in parallel.[5] The system explained in the report has been developed based on the agile framework model.

4.1.3 Requirement Analysis

Patient's health information can be made secured by storing the data in a blockchain . Monitoring patient's BPM readings can be displayed on the firebase web application and android app where the sensor data can be stored in the firebase real time database. Notification of the health status can be sent to the android app.

4.1.3.1 UML diagrams

4.1.4 Use Case Diagram

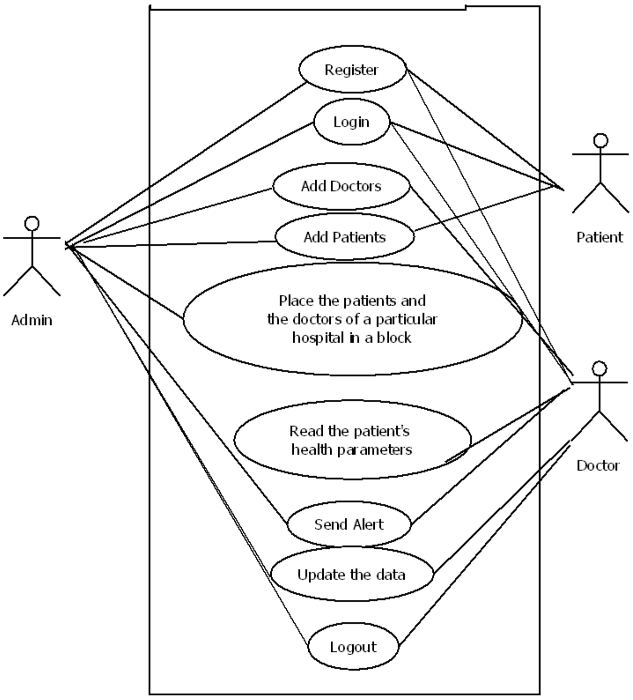

Register
Login
Add Doctors
Add Patients
Place the patients and the doctors of a particular hospital in a block
Read the patient's health parameters
Send Alert
Update the data
Logout
Admin
Patient
Doctor

Figure 4.1: **Use Case Diagram**

Patient and the Doctor can login into the web page and android app through their login details. Patient and Doctor can fill in the details provided in the web page. Doctor can monitor the health status of the patient.

4.1.5 Sequence Diagram

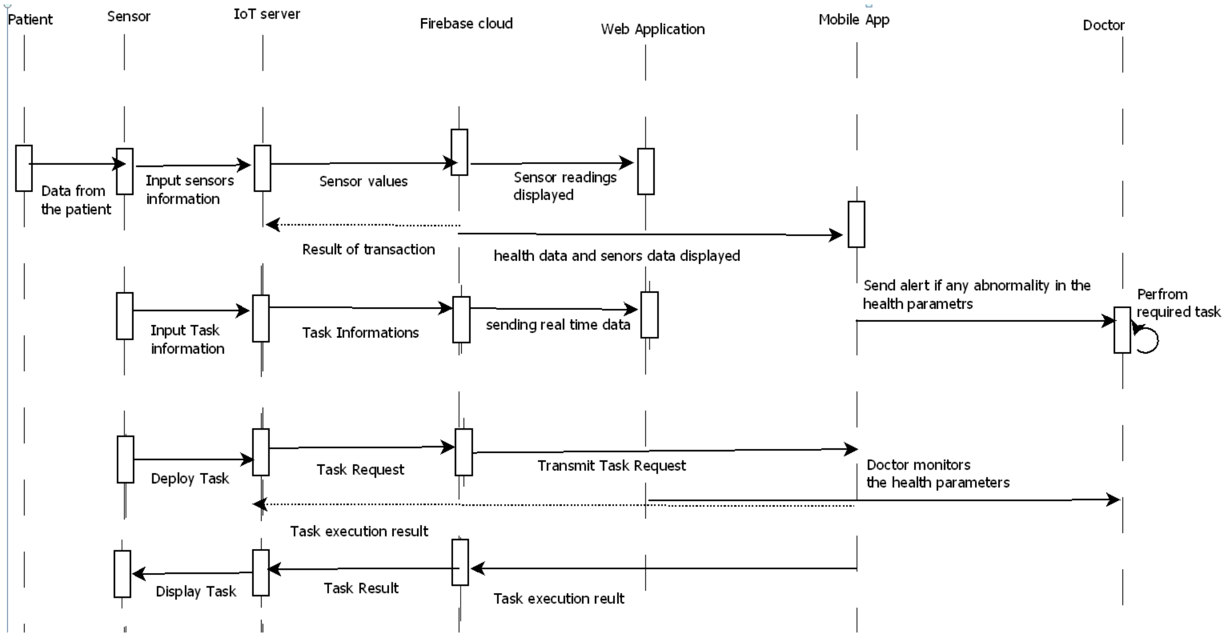


Figure 4.2: **Sequence Diagram**
Sequence diagram of various operations within the proposed system

4.1.5.1 Cost Analysis

In rural hospitals, the facilities for health caring are limited. A common person cannot afford the expensive and daily check up for his/her health. Everyone should get the knowledge of their own health as soon as possible. For this purpose, in our project, patients with abnormal health conditions are monitored through a smart health care system and provide a fast solution for the patients in case of emergencies. Also, it took a cheap price to build our project. So, everyone can afford it without having financial issues.

To build our project, we have used Arduino Uno, Node MCU, Temperature sensor, Pulse sensor, LCD display, breadboard and wires.

Table 4.1: **Components Cost**

Component	**Unit Price**
Arduino Uno	Rs 385
Node MCU	Rs 330
Pulse Sensor	Rs 200
Temperature Sensor	Rs 75
LCD Display	Rs 225

Total cost :- Rs 1215

4.1.5.2 Hardware and software requirement

1. LM35
2. Arduino Uno
3. Pulse Sensor
4. Potentiometer
5. Esp8266 NodeMCU
6. BreadBoard
7. Jumper Wires

4.1.6 Software requirements

1. Arduino Ide
2. Firebase
3. Android Studio
4. Ethereum

4.2 System architecture

4.2.1 Flowchart

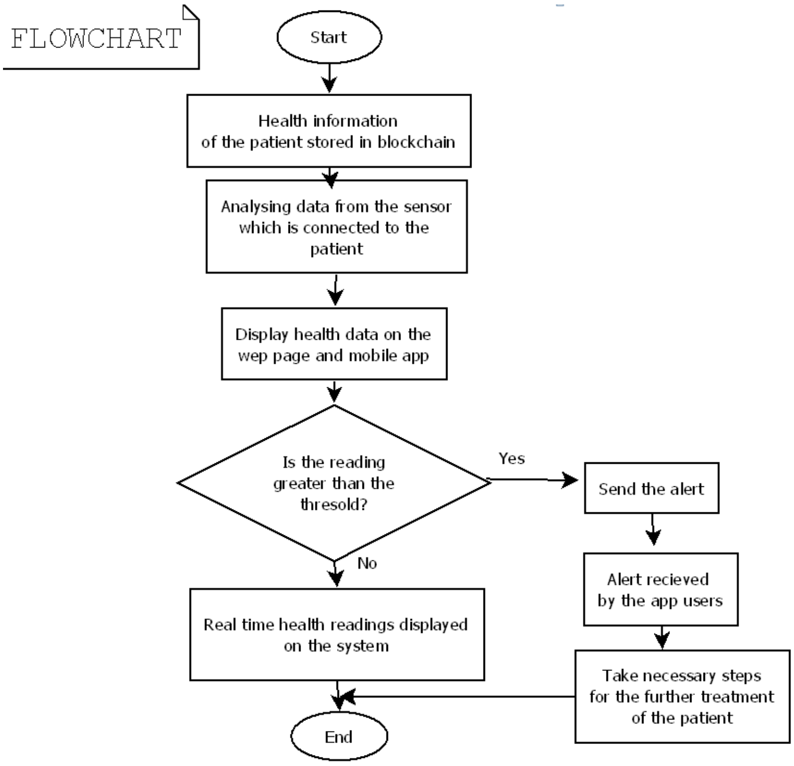

FLOWCHART
Start
Health information of the patient stored in blockchain
Analysing data from the sensor which is connected to the patient
Display health data on the wep page and mobile app
Is the reading greater than the thresold?
Yes
No
Send the alert
Alert recieved by the app users
Take necessary steps for the further treatment of the patient
Real time health readings displayed on the system
End

Figure 4.3: **Flowchart of the proposed system**
The health parameters are analyzed and if there is any abnormality in the readings then the system sends an alert

4.2.2 Block Diagram

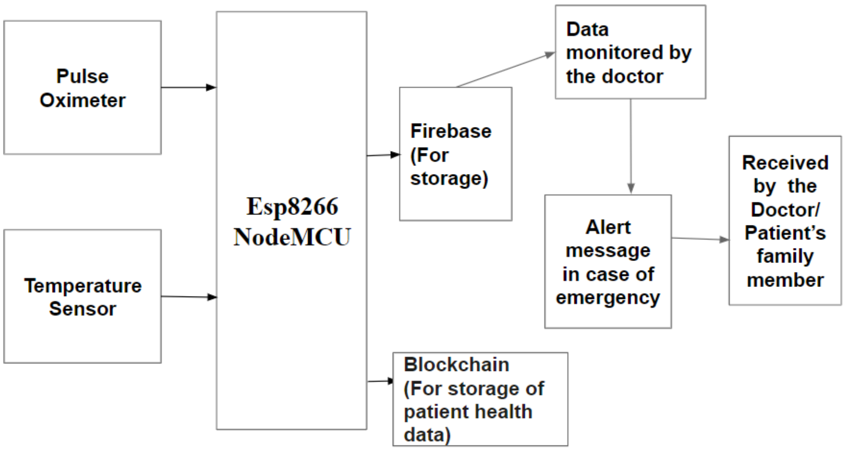

Pulse Oximeter
Temperature Sensor
Esp8266 NodeMCU
Firebase (For storage)
Blockchain (For storage of patient health data)
Data monitored by the doctor
Alert message in case of emergency
Received by the Doctor/ Patient's family member

Figure 4.4: **Block Diagram**

Sensors are connected to the patients
health parameter readings are analyzed by the doctor.

Chapter 5

Result and Discussion

5.1 Screenshots of the System

5.1.1 Firebase Web App

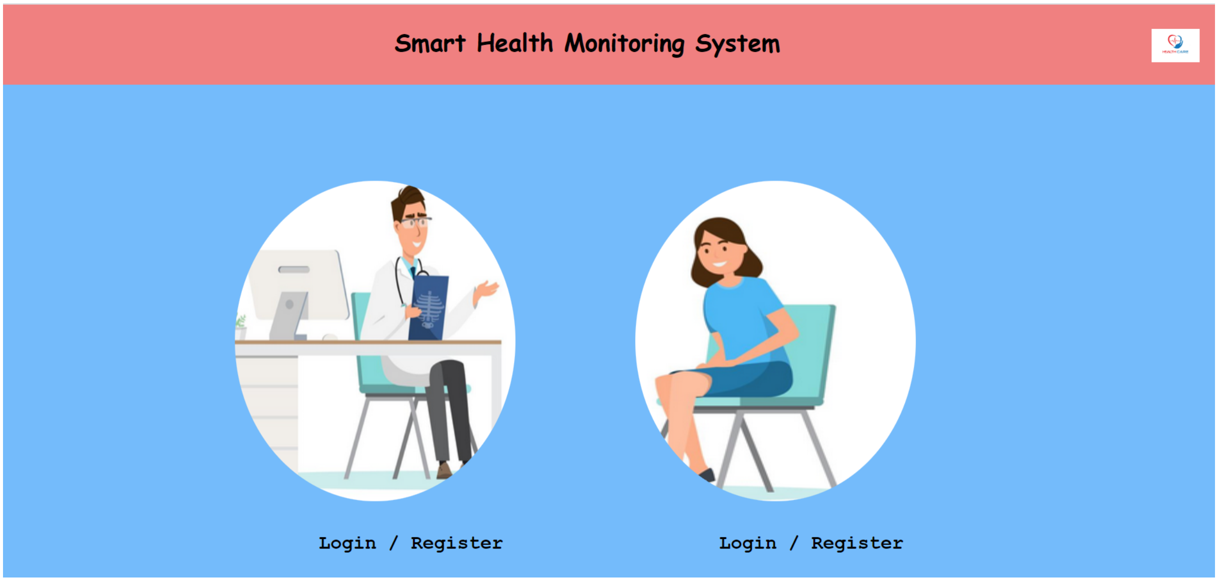
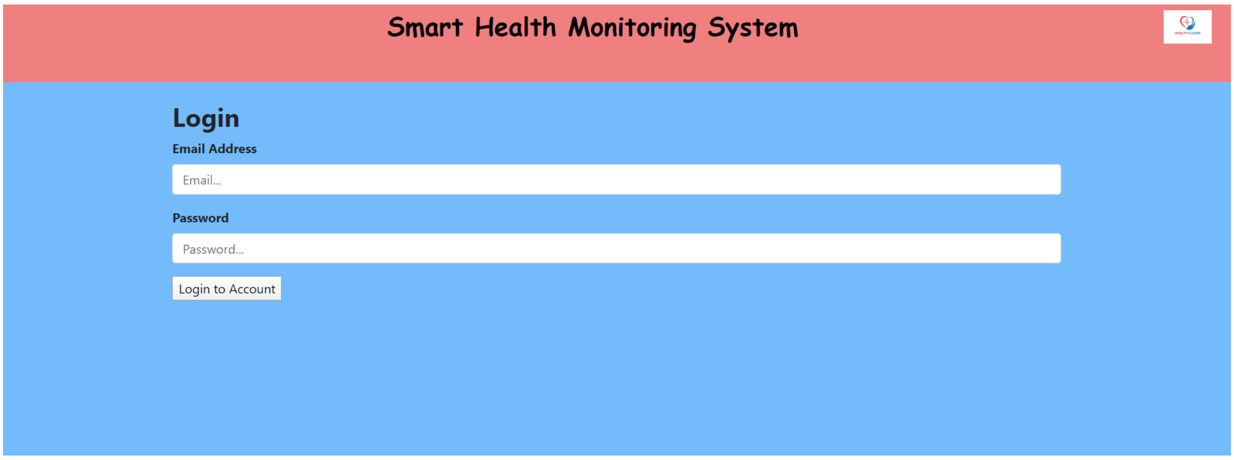


Figure 5.1: **Home Page**
Patient and Doctor Home Page


Smart Health Monitoring System

Login

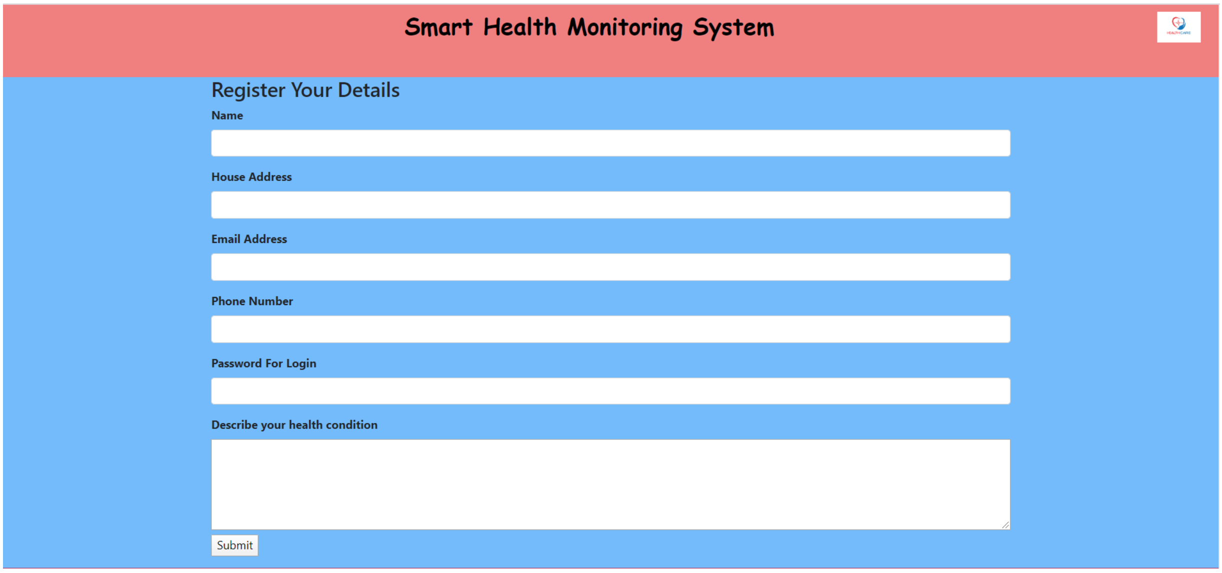
Email Address

Email...

Password

Password...

Figure 5.2: **Login Page**
Patient and Doctor's Login Page



Smart Health Monitoring System

Register Your Details

Name

House Address

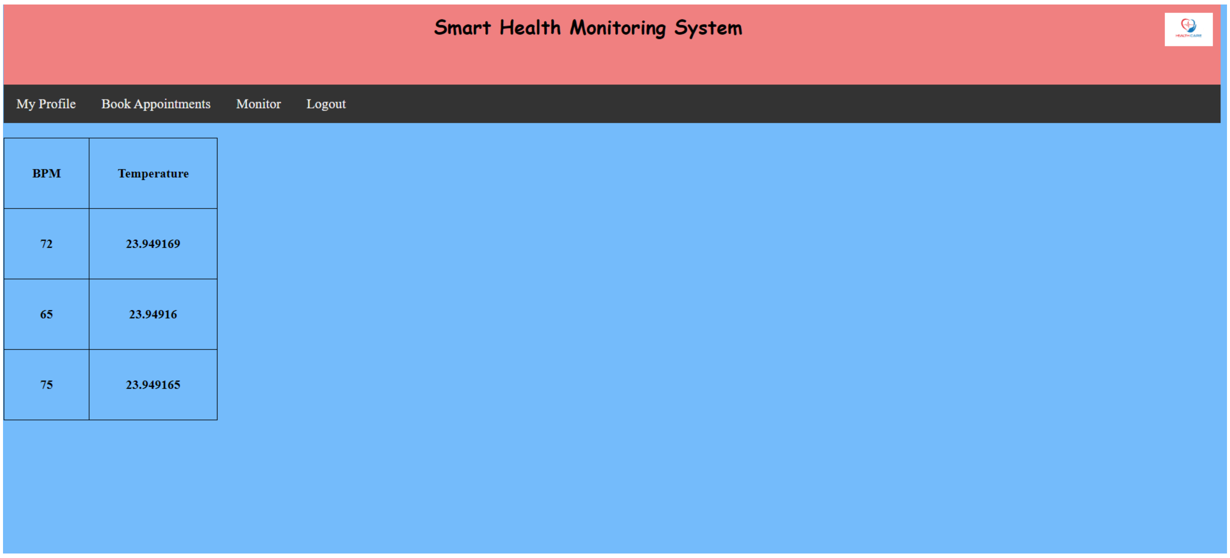
Email Address

Phone Number

Password For Login

Describe your health condition

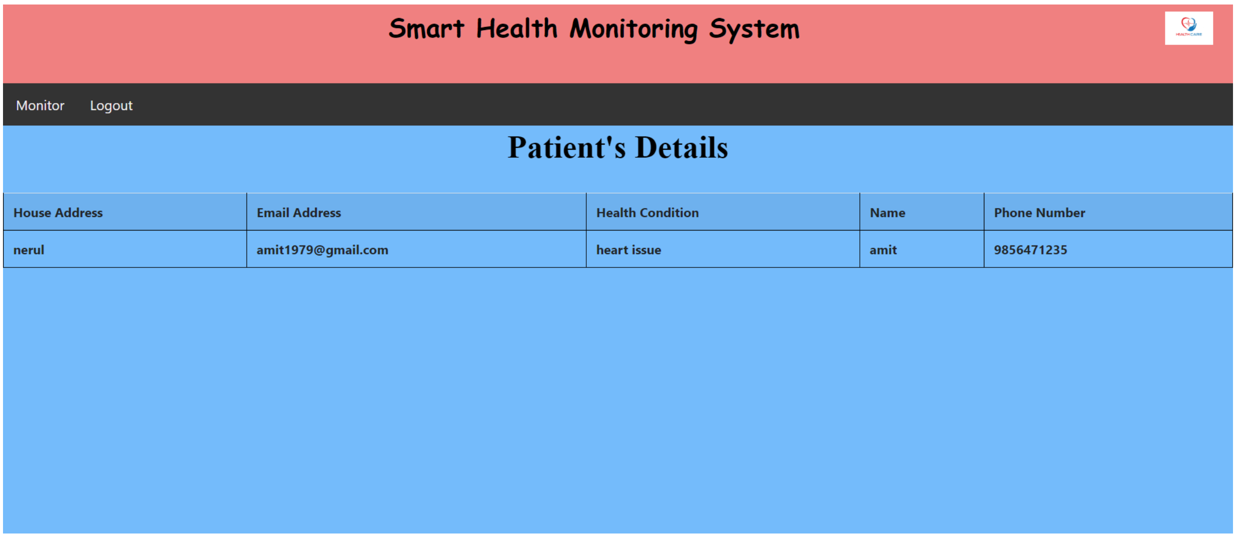
Figure 5.3: **Patient Register Page**
Patient has to register with the required details inorder to use the system.



Smart Health Monitoring System

BPM	Temperature
72	23.949169
65	23.94916
75	23.949165

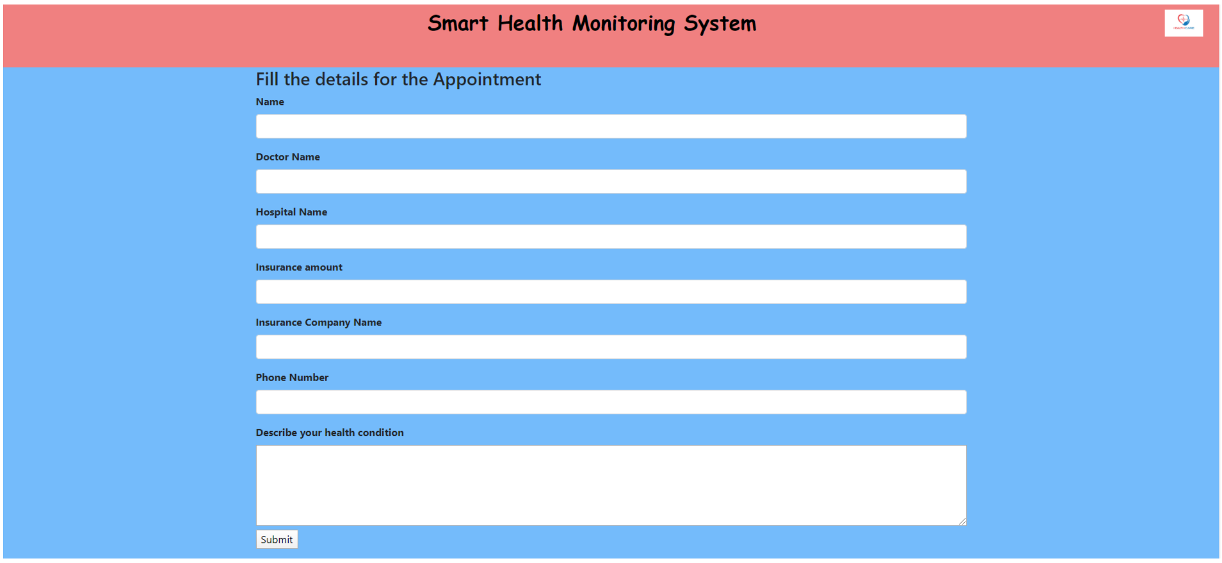
Figure 5.4: **Health Monitoring Page**
Doctor and the nurses can monitor the health status of the patient



Patient's Details

House Address	Email Address	Health Condition	Name	Phone Number
nerul	amit1979@gmail.com	heart issue	amit	9856471235

Figure 5.5: **Patients Profile**
Doctor can check patients profile for their health history on patients tab.



Fill the details for the Appointment

Figure 5.6: **Appointment Page**
Patient can book an appointment to consult doctor through this page

5.1.2 Android App

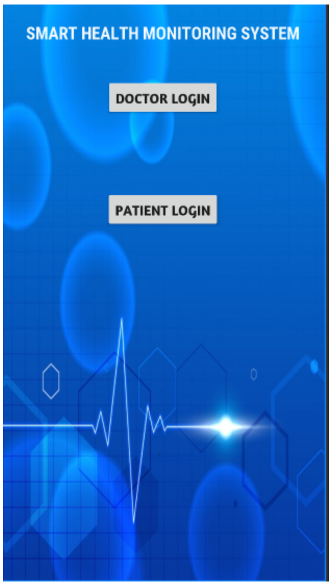


Figure 5.7: **Main Screen**
Patient and Doctor Main Screen

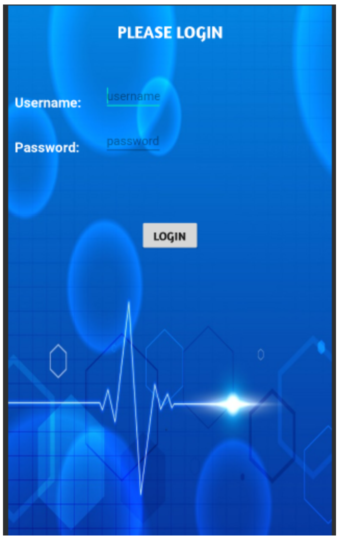
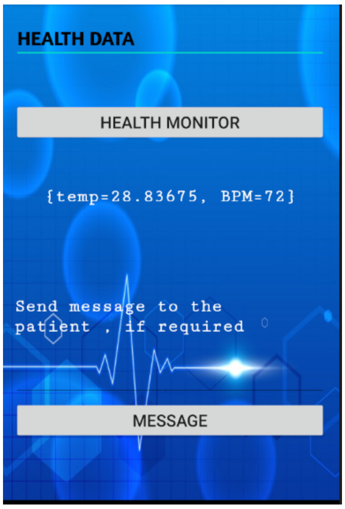


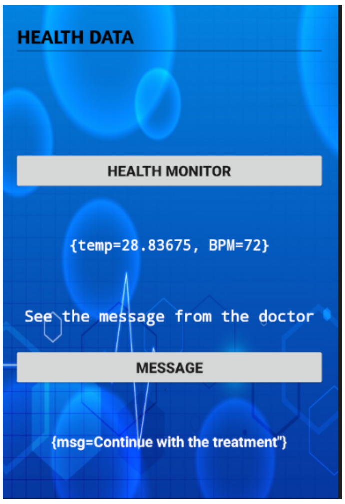
Figure 5.8: **Login Screen**
Patient and Doctor Login Screen



{temp=28.83675, BPM=72}

Send message to the patient , if required

Figure 5.9: **Monitoring Screen for Doctor**
Doctor can monitor the health status of the patient and send the message to the patient accordingly

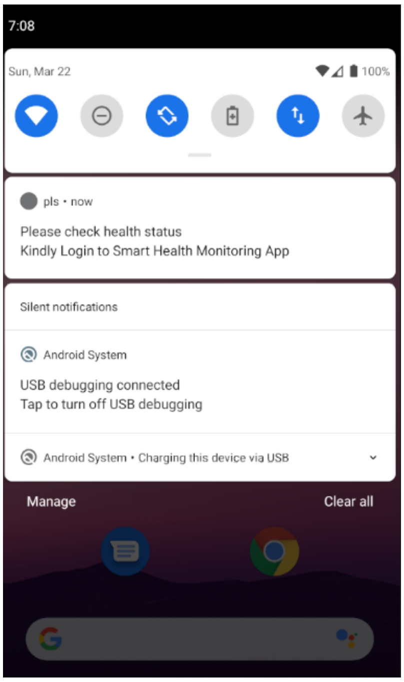


{temp=28.83675, BPM=72}

See the message from the doctor

{msg=Continue with the treatment"}

Figure 5.10: **Monitoring Screen for Patient's Family Members**
Patient's family members can see the health status of the patient and can see the message from the doctor



7:08

Sun, Mar 22

100%

pls • now

Please check health status
Kindly Login to Smart Health Monitoring App

Silent notifications

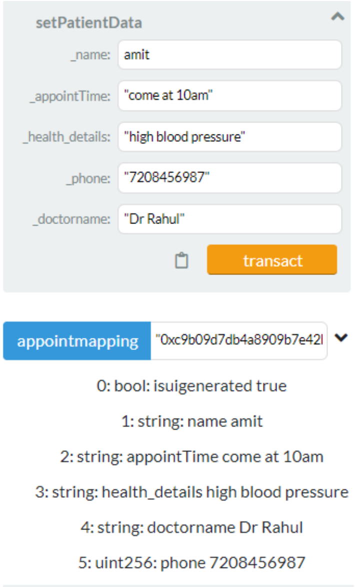
Android System

USB debugging connected
Tap to turn off USB debugging

Android System • Charging this device via USB

Figure 5.11: **Alert Message**
Alert when there is any abnormality in the health readings.

5.1.3 Blockchain



setPatientData

_name: amit

_appointTime: "come at 10am"

_health_details: "high blood pressure"

_phone: "7208456987"

_doctorname: "Dr Rahul"

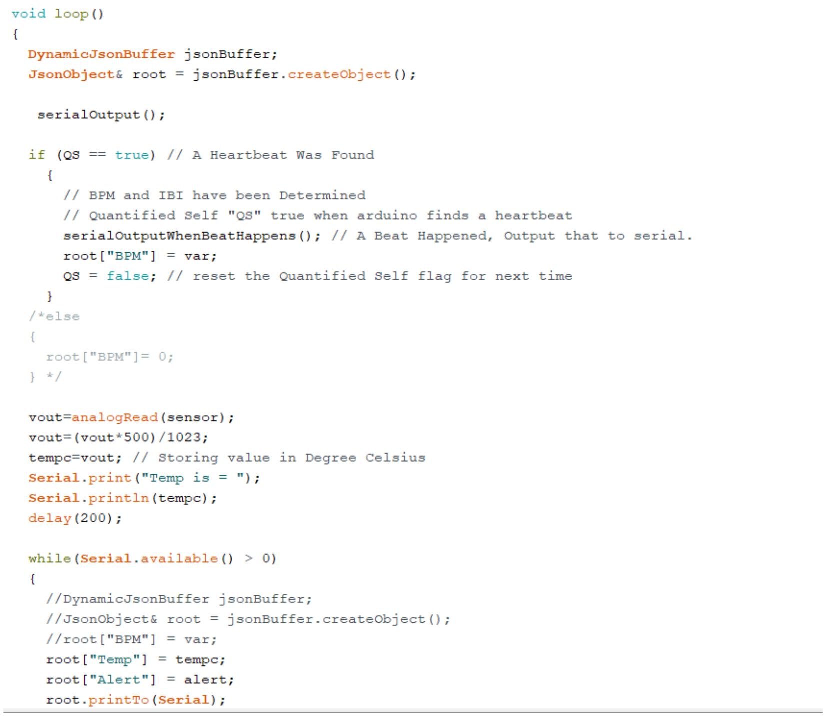
appointmapping "0xc9b09d7db4a8909b7e42

```
0: bool: isuigenerated true
1: string: name amit
2: string: appointTime come at 10am
3: string: health_details high blood pressure
4: string: doctorname Dr Rahul
5: uint256: phone 7208456987
```

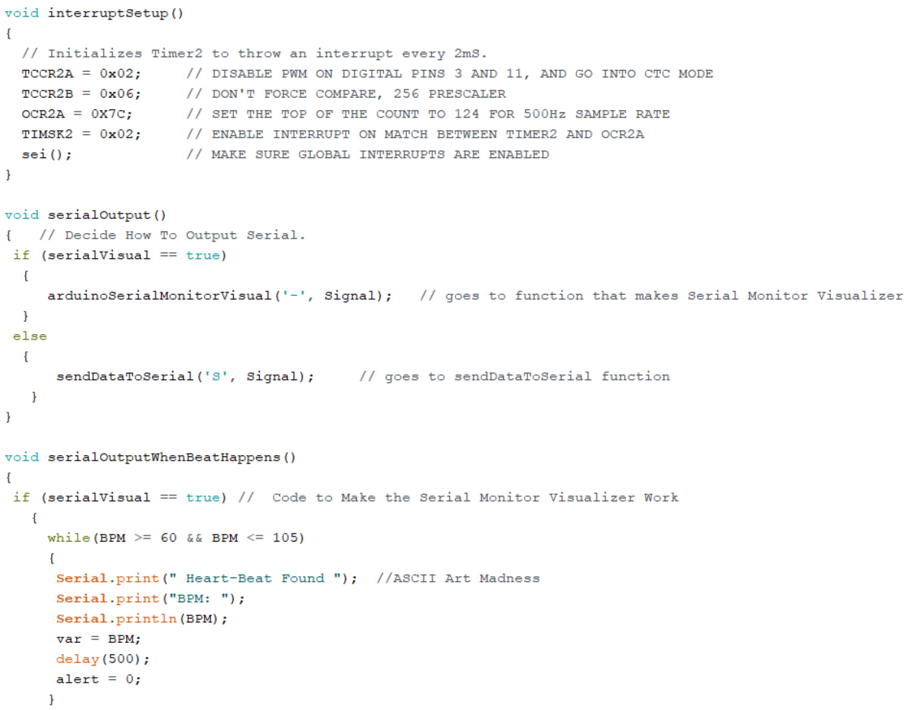
Figure 5.12: **Patient's Information Block**
Patient's information is stored in a block.

5.2 Sample Code

5.2.1 Arduino

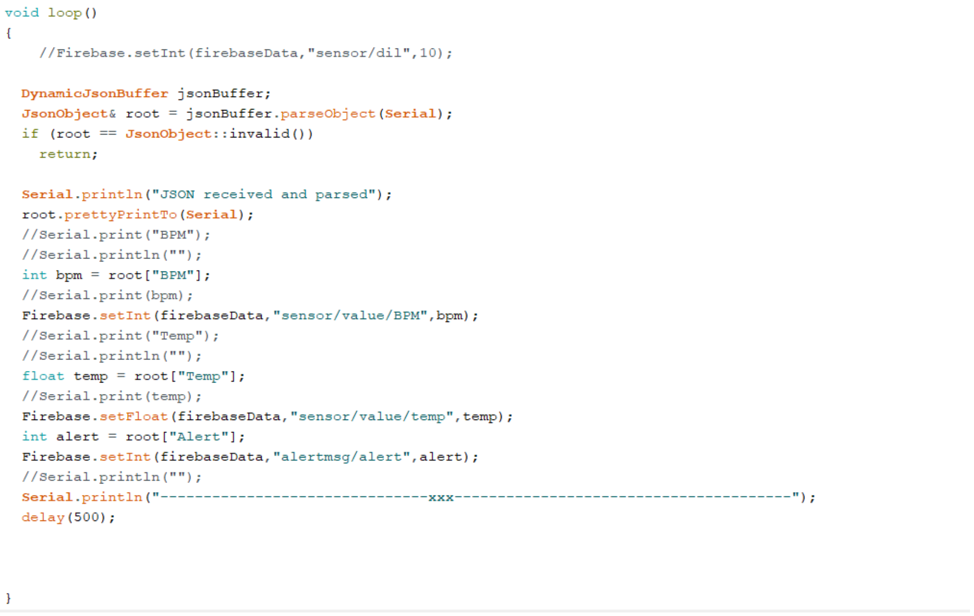


```
void loop()
{
  DynamicJsonBuffer jsonBuffer;
  JsonObject& root = jsonBuffer.createObject();

   serialOutput();

  if (QS == true) // A Heartbeat Was Found
    {
      // BPM and IBI have been Determined
      // Quantified Self "QS" true when arduino finds a heartbeat
      serialOutputWhenBeatHappens(); // A Beat Happened, Output that to serial.
      root["BPM"] = var;
      QS = false; // reset the Quantified Self flag for next time
    }
  /*else
  {
    root["BPM"]= 0;
  } */

  vout=analogRead(sensor);
  vout=(vout*500)/1023;
  tempc=vout; // Storing value in Degree Celsius
  Serial.print("Temp is = ");
  Serial.println(tempc);
  delay(200);

  while(Serial.available() > 0)
  {
    //DynamicJsonBuffer jsonBuffer;
    //JsonObject& root = jsonBuffer.createObject();
    //root["BPM"] = var;
    root["Temp"] = tempc;
    root["Alert"] = alert;
    root.printTo(Serial);
```



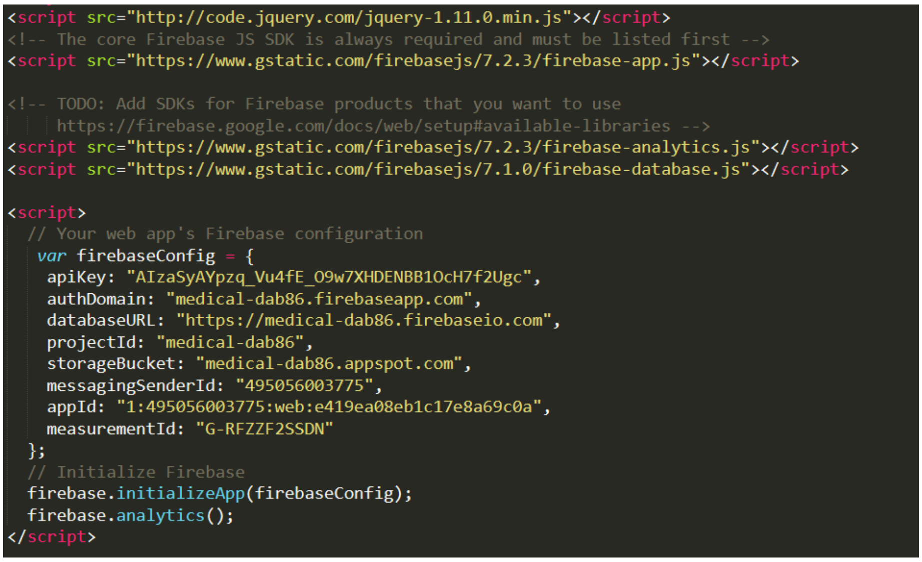
```
void interruptSetup()
{
  // Initializes Timer2 to throw an interrupt every 2mS.
  TCCR2A = 0x02;     // DISABLE PWM ON DIGITAL PINS 3 AND 11, AND GO INTO CTC MODE
  TCCR2B = 0x06;     // DON'T FORCE COMPARE, 256 PRESCALER
  OCR2A = 0X7C;      // SET THE TOP OF THE COUNT TO 124 FOR 500Hz SAMPLE RATE
  TIMSK2 = 0x02;     // ENABLE INTERRUPT ON MATCH BETWEEN TIMER2 AND OCR2A
  sei();             // MAKE SURE GLOBAL INTERRUPTS ARE ENABLED
}

void serialOutput()
{   // Decide How To Output Serial.
 if (serialVisual == true)
  {
     arduinoSerialMonitorVisual('-', Signal);   // goes to function that makes Serial Monitor Visualizer
  }
 else
  {
      sendDataToSerial('S', Signal);     // goes to sendDataToSerial function
   }
}

void serialOutputWhenBeatHappens()
{
 if (serialVisual == true) //  Code to Make the Serial Monitor Visualizer Work
   {
     while(BPM >= 60 && BPM <= 105)
     {
      Serial.print(" Heart-Beat Found ");  //ASCII Art Madness
      Serial.print("BPM: ");
      Serial.println(BPM);
      var = BPM;
      delay(500);
      alert = 0;
     }
```

5.2.2 NodeMcu Esp8266



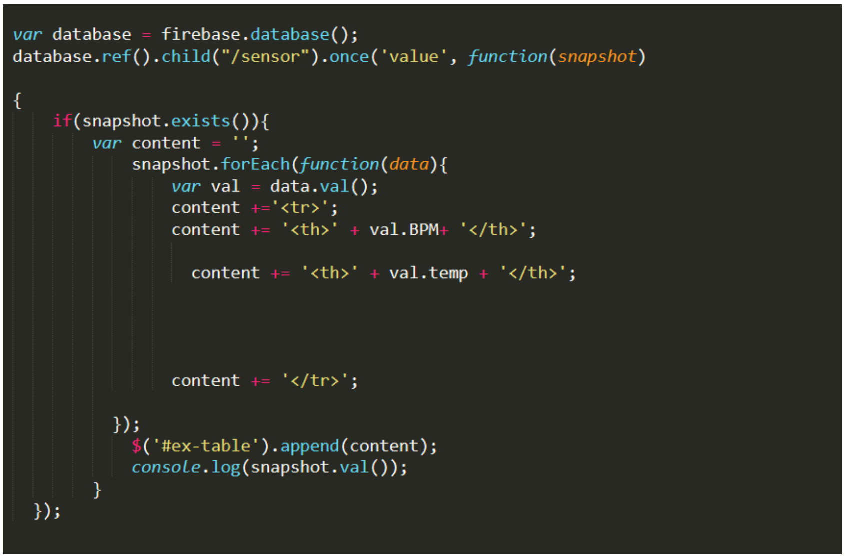
```
void loop()
{
    //Firebase.setInt(firebaseData,"sensor/dil",10);

  DynamicJsonBuffer jsonBuffer;
  JsonObject& root = jsonBuffer.parseObject(Serial);
  if (root == JsonObject::invalid())
    return;

  Serial.println("JSON received and parsed");
  root.prettyPrintTo(Serial);
  //Serial.print("BPM");
  //Serial.println("");
  int bpm = root["BPM"];
  //Serial.print(bpm);
  Firebase.setInt(firebaseData,"sensor/value/BPM",bpm);
  //Serial.print("Temp");
  //Serial.println("");
  float temp = root["Temp"];
  //Serial.print(temp);
  Firebase.setFloat(firebaseData,"sensor/value/temp",temp);
  int alert = root["Alert"];
  Firebase.setInt(firebaseData,"alertmsg/alert",alert);
  //Serial.println("");
  Serial.println("-------------------------------xxx--------------------------------------");
  delay(500);


}
```

5.2.3 Web Page Code for Monitoring health status



```html
<script src="http://code.jquery.com/jquery-1.11.0.min.js"></script>
<!-- The core Firebase JS SDK is always required and must be listed first -->
<script src="https://www.gstatic.com/firebasejs/7.2.3/firebase-app.js"></script>

<!-- TODO: Add SDKs for Firebase products that you want to use
     https://firebase.google.com/docs/web/setup#available-libraries -->
<script src="https://www.gstatic.com/firebasejs/7.2.3/firebase-analytics.js"></script>
<script src="https://www.gstatic.com/firebasejs/7.1.0/firebase-database.js"></script>

<script>
  // Your web app's Firebase configuration
   var firebaseConfig = {
    apiKey: "AIzaSyAYpzq_Vu4fE_O9w7XHDENBB1OcH7f2Ugc",
    authDomain: "medical-dab86.firebaseapp.com",
    databaseURL: "https://medical-dab86.firebaseio.com",
    projectId: "medical-dab86",
    storageBucket: "medical-dab86.appspot.com",
    messagingSenderId: "495056003775",
    appId: "1:495056003775:web:e419ea08eb1c17e8a69c0a",
    measurementId: "G-RFZZF2SSDN"
  };
  // Initialize Firebase
  firebase.initializeApp(firebaseConfig);
  firebase.analytics();
</script>
```

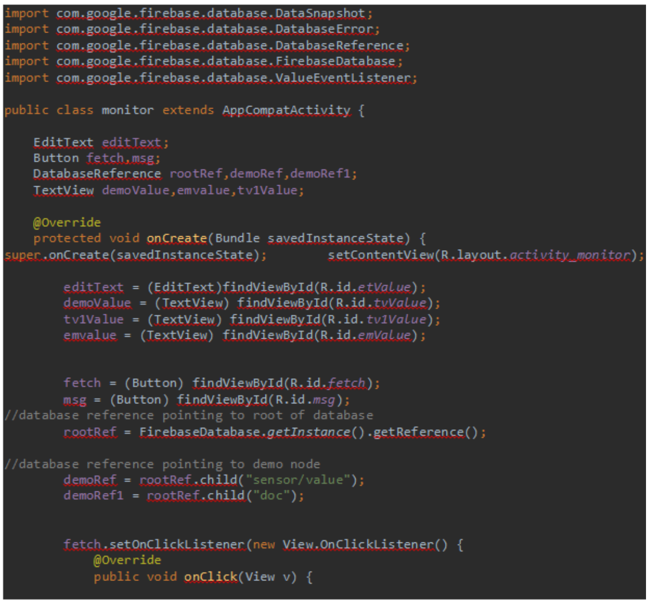
Figure 5.13: **Scripts to be included for Firebase Web App configuration**



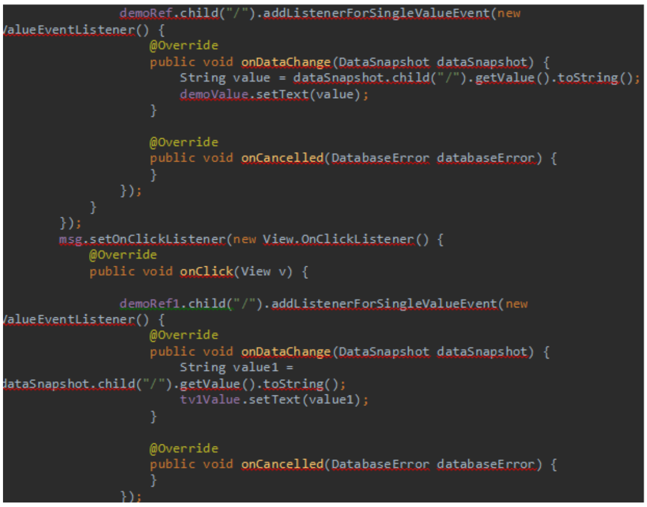
```javascript
var database = firebase.database();
database.ref().child("/sensor").once('value', function(snapshot)

{
    if(snapshot.exists()){
        var content = '';
            snapshot.forEach(function(data){
                var val = data.val();
                content +='<tr>';
                content += '<th>' + val.BPM+ '</th>';

                  content += '<th>' + val.temp + '</th>';




                content += '</tr>';

          });
            $('#ex-table').append(content);
            console.log(snapshot.val());
        }
  });
```

Figure 5.14: **JavaScript Code for getting data from firebase database**

5.2.4 Android code for Monitoring health status

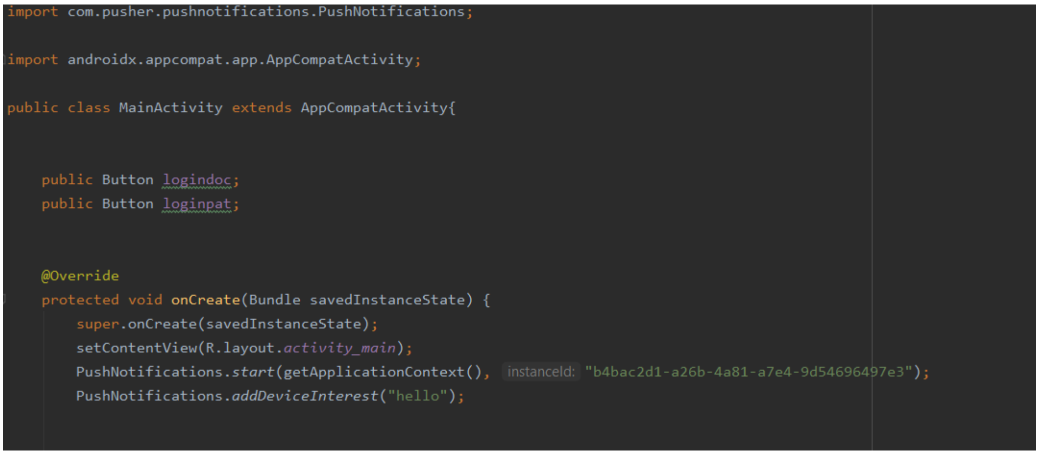


```java
import com.google.firebase.database.DataSnapshot;
import com.google.firebase.database.DatabaseError;
import com.google.firebase.database.DatabaseReference;
import com.google.firebase.database.FirebaseDatabase;
import com.google.firebase.database.ValueEventListener;

public class monitor extends AppCompatActivity {

    EditText editText;
    Button fetch,msg;
    DatabaseReference rootRef,demoRef,demoRef1;
    TextView demoValue,emvalue,tv1Value;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
super.onCreate(savedInstanceState);        setContentView(R.layout.activity_monitor);

        editText = (EditText)findViewById(R.id.etValue);
        demoValue = (TextView) findViewById(R.id.tvValue);
        tv1Value = (TextView) findViewById(R.id.tv1Value);
        emvalue = (TextView) findViewById(R.id.emValue);


        fetch = (Button) findViewById(R.id.fetch);
        msg = (Button) findViewById(R.id.msg);
//database reference pointing to root of database
        rootRef = FirebaseDatabase.getInstance().getReference();

//database reference pointing to demo node
        demoRef = rootRef.child("sensor/value");
        demoRef1 = rootRef.child("doc");


        fetch.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
```



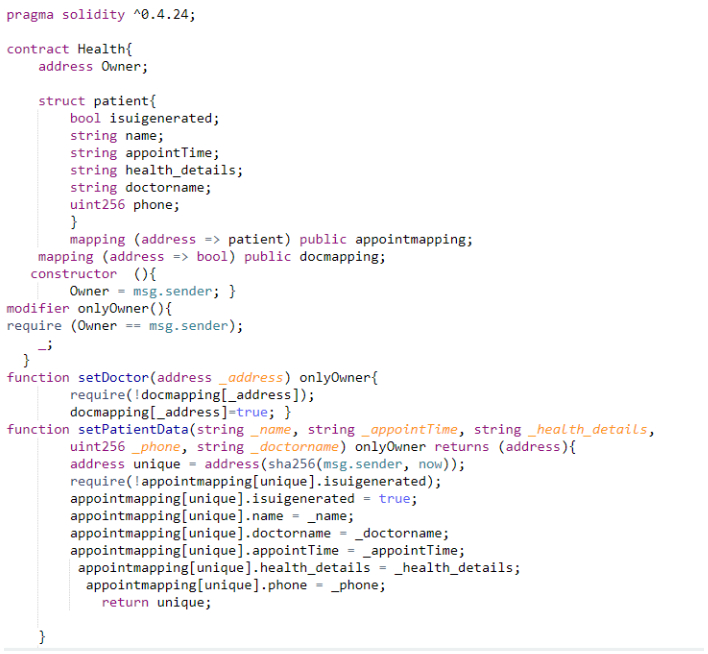
```java
                demoRef.child("/").addListenerForSingleValueEvent(new
ValueEventListener() {
                    @Override
                    public void onDataChange(DataSnapshot dataSnapshot) {
                        String value = dataSnapshot.child("/").getValue().toString();
                        demoValue.setText(value);
                    }

                    @Override
                    public void onCancelled(DatabaseError databaseError) {
                    }
                });
            }
        });
        msg.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {

                demoRef1.child("/").addListenerForSingleValueEvent(new
ValueEventListener() {
                    @Override
                    public void onDataChange(DataSnapshot dataSnapshot) {
                        String value1 =
dataSnapshot.child("/").getValue().toString();
                        tv1Value.setText(value1);
                    }

                    @Override
                    public void onCancelled(DatabaseError databaseError) {
                    }
                });
```

5.2.5 Alert Code



```
import com.pusher.pushnotifications.PushNotifications;

import androidx.appcompat.app.AppCompatActivity;

public class MainActivity extends AppCompatActivity{


    public Button logindoc;
    public Button loginpat;


    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        PushNotifications.start(getApplicationContext(), instanceId: "b4bac2d1-a26b-4a81-a7e4-9d54696497e3");
        PushNotifications.addDeviceInterest("hello");
```

5.2.6 Solidity



```
pragma solidity ^0.4.24;

contract Health{
    address Owner;

    struct patient{
        bool isuigenerated;
        string name;
        string appointTime;
        string health_details;
        string doctorname;
        uint256 phone;
        }
        mapping (address => patient) public appointmapping;
    mapping (address => bool) public docmapping;
   constructor  (){
        Owner = msg.sender; }
modifier onlyOwner(){
require (Owner == msg.sender);
    _;
  }
function setDoctor(address _address) onlyOwner{
        require(!docmapping[_address]);
        docmapping[_address]=true; }
function setPatientData(string _name, string _appointTime, string _health_details,
        uint256 _phone, string _doctorname) onlyOwner returns (address){
        address unique = address(sha256(msg.sender, now));
        require(!appointmapping[unique].isuigenerated);
        appointmapping[unique].isuigenerated = true;
        appointmapping[unique].name = _name;
        appointmapping[unique].doctorname = _doctorname;
        appointmapping[unique].appointTime = _appointTime;
         appointmapping[unique].health_details = _health_details;
          appointmapping[unique].phone = _phone;
            return unique;

    }
```

Figure 5.15: **Solidity code to store patient's details**

5.3 Testing

5.3.1 Unit Testing

Unit Testing: The goal of unit testing to separate each part of the program and test that the individual parts are working correctly and as intended.
Test Objectives: Sending sensor values to Serial Monitor

Table 5.1: **Unit Testing**

Test Condition	**Input Specification**	**Output Specification**	**Success/Fail**
Sensor value to be shown on the serial monitor	User makes the connections	Sends values to the serial monitor	Success

5.3.2 Integration Testing

Integration Testing: Combine the unit tested module one by one and test the functionality of the combined unit.
Test Objectives: Reading sensor values from mobile app and web application

Table 5.2: **Integration Testing**

Test Condition	**Input Specification**	**Output Specification**	**Success/Fail**
Monitoring of the patient.	Patient keeps his finger on the sensor	App and web app receives the sensor values	Success

5.3.3 Blackbox Testing

BlackBox Testing: In BlackBox Testing, we just focus on inputs and output of the software system without bothering about internal knowledge of the software program.
Test Objectives: Sending alert in case of any abnormality

Table 5.3: **BlackBox Testing**

Test Condition	**Input Specification**	**Output Specification**	**Success/Fail**
Monitoring of the patient.	Patient keeps his finger on the sensor.	Alert is notified in the app.	Success

Chapter 6

Conclusion & Future Scope

In this report, the study of how a doctor can monitor the heart rate of the patient from a distant location is explained.The patient and doctor can view the monitoring updates on the firebase web application and also in mobile application of the system through their respective login details.The health information of the patient consulting a particular doctor has been stored in the blockchain. If there are any abnormalities in the health parameters , an alert is sent to the respective doctor and the patient's family members.Accordingly, the further treatments can be provided to the patient as instructed by the doctor. This system can be further extended by using other medical related sensors for monitoring other health parameters.The health block can be increased further for other patients consulting other doctors of different hospitals.

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Project Group Members:

1.Shruthi Nair, 101633

____

2.Nimmy Augustine, 101634

____

3.Leo Varghese, 101530

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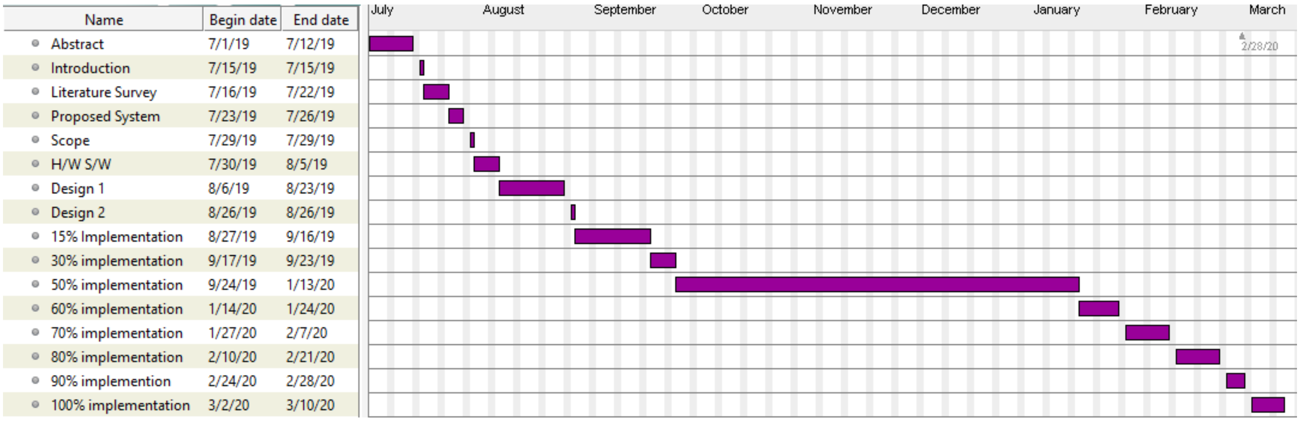
Appendix A : Timeline Chart



Name	Begin date	End date
Abstract	7/1/19	7/12/19
Introduction	7/15/19	7/15/19
Literature Survey	7/16/19	7/22/19
Proposed System	7/23/19	7/26/19
Scope	7/29/19	7/29/19
H/W S/W	7/30/19	8/5/19
Design 1	8/6/19	8/23/19
Design 2	8/26/19	8/26/19
15% Implementation	8/27/19	9/16/19
30% implementation	9/17/19	9/23/19
50% implementation	9/24/19	1/13/20
60% implementation	1/14/20	1/24/20
70% implementation	1/27/20	2/7/20
80% implementation	2/10/20	2/21/20
90% implemention	2/24/20	2/28/20
100% implementation	3/2/20	3/10/20

Figure 6.1: **Project Timeline**

Appendix B : Publication Details

6.0.1 Publication Details

Smart Health Monitoring System, IJERT Publication, Volume 09, Issue 01 (January 2020),
https://www.ijert.org/smart-health-monitoring-system