PATIENT MONITORING AND ANALYSIS USING IOT.

Submitted in partial fulfilment of the requirements for the degree of

Bachelor of Technology

in Programme

Computer Science Engineering

By

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VIT, Vellore.

NOVEMBER - 2019

DECLARATION

I hereby declare that the thesis entitled “Patient monitoring and analysis using IOT” submitted by me, for the award of the degree of *Bachelor of Technology in Programme* to VIT is a record of bonafide work carried out by me under the supervision of Rajkumar.R

I further declare that the work reported in this thesis has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

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Date : 15-11-19

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CERTIFICATE

This is to certify that the thesis entitled "Patient monitoring and analysis using IOT." submitted by **ROHIN SRI KUMAR (16BCE0544), GORINTA JAYANTH (16BCE0620), SURYADEVARA RAMDEV (16BCE0530) SCOPE**, VIT University, for the award of the degree of *Bachelor of Technology in Computer Science engineering*, is a record of bonafide work carried out by him under my supervision during the period, 10.07.19 to 26.11.19, as per the VIT code of academic and research ethics.

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Signature of the Guide

Internal Examiner

External Examiner

Head of the Department

SCOPE

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EXECUTIVE SUMMARY

In our current days people are busy with their own lifestyles, most people are owning the unhealthy lifestyle because of their work, unhealthy food and other habits. This may cause of many diseases like heart attacks. For these reasons we need more software's and apps to monitor and mobilize the health issues for users. By the taking advantage of machine learning concepts and advanced medical embedded components we can apply the prediction results in heart diseases. In other part it is very difficult to monitor the coma patients, because coma patients need continues monetization by the medical staff which is very difficult and costly. So here in our system we are also proposing the Monetization of Coma Patient (MCP) using advanced medical embedded components and web technologies. For prediction of the heart attacks we are using machine learning algorithms like Naïve Bayes and KNN algorithms. We found best results by comparing with the other ML algorithms. By this we propose an IoT based application collaborate with Machine Learning concepts to monitor and mobilize the health issues for users. By the taking advantage of machine learning concepts and advanced medical embedded components we can apply the prediction results in heart diseases. We also proposed the Monetization of Coma Patient (MCP) using advanced medical embedded components and web technologies. We conducted several successful testing cases and we got the as expected results.

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ABBREVIATIONS

IOT	Internet Of Things
KNN	K-Nearest neighbour
NB	Naïve bayes
GRNN	General regression neural network
GND	Ground
RX	Reception
AT commands	Attention commands
JSP	Java server pages
GDP	Gross domestic product
SQL	Standardized query language
RST	Reset

1. INTRODUCTION

1.1 OBJECTIVE

Generally existing patient records has the several records like patient heart rate, cholesterol level etc. But there is problem in analyzing the data like we can't analyze the huge records with different types parameter ranges. For example as per human records cholesterol level is 100 to 400, and patient age can be 20 to 100. So probability of the analyzing the records will be more with multiple combinations of ranges. For this reason we need cluster the data before analyze the data. For clustering the data we are using K-Nearest Neighbour (KNN) analyzing rages of the data. After clustering the data we need classification algorithm which can get accuracy more by comparing other classification algorithms. Naïve Bayes algorithm proved best classification algorithm by comparing with Support Vector Machine (SVM), Random Forest and Logistic Regression in many researches. Many weather prediction apps, spam filtering in mails are using Naïve Bayes algorithm. So In our research we are taking the Naïve Bayes algorithm for classification of the existing patient's data. So here in our system we are also proposing the Monetization of Coma Patient (MCP) using advanced medical embedded components and web technologies. For prediction of the heart attacks we are using machine learning algorithms like Naïve Bayes and KNN algorithms. We found best results by comparing with the other ML algorithms.

1.2 MOTIVATION

Our Motivation is to find the main problem in medical related research. Coma is un-conscious state of human body, coma patients can't respond to the environment but they live. We need to track their body movements, heart rate etc. Monitoring the patients is very expensive due to experts need to monitor with different time intervals, that's very much problem for hospitals and patient guardians. We need to focus this part of research also. So in our paper we are research the IoT concept that we can monitor patient body movements and heart rate in our web application.

1.3 BACKGROUND

As per research of World Health Organization of SEARO heart attacks are is becoming a very common disease in all over world because of our lifestyles. Heart attack may cause to sudden death for people. That's the reason many MNC companies research on the prediction of the heart disease before attacks. Many gadgets came for analyzing our heart beat rate. But all these research not enough to handle the present situation. By the taking advantages of the Machine Learning we can train the existing patient records and predict the results. Machine Learning concepts is almost become the software kind of applications, in our research we are integrating the ML concepts with advanced medical embedded sensors, by this way we can achieve predictions in more real time way.

2. PROJECT DESCRIPTION AND GOALS

2.1 PROJECT DESCRIPTION

In our current days people are busy with their own lifestyles, most people are owning the unhealthy lifestyle because of their work, unhealthy food and other habits. This may cause of many diseases like heart attacks. For these reasons we need more software's and apps to monitor and mobilize the health issues for users. By the taking advantage of machine learning concepts and advanced medical embedded components we can apply the prediction results in heart diseases. In other part it is very difficult to monitor the coma patients, because coma patients need continues monetization by the medical staff which is very difficult and costly. So here in our system we are also proposing the Monetization of Coma Patient (MCP) using advanced medical embedded components and web technologies. For prediction of the heart attacks we are using machine learning algorithms like Naïve Bayes and KNN algorithms. We found best results by comparing with the other ML algorithms.

2.2 GOALS

1. The main goal of this project is to predict the heart attack of a patient depending various attributes and to display the result whether he is going to get a heart attack or not.

2. The second goal of this project is to monitor a coma patient and send alerts if that person is having any movement in his body.

3. The final goal is to integrate all the sensors with micro-processor, therefore making the work easy.

3. TECHNICAL SPECIFICATION

3.1 PRODUCT FEATURES

- **Login –** The admin needs to first login to upload the dataset.

- **Data Upload –**The uploaded data can be viewed only by the admin .

- **Live values –** The system takes the live values from the different type of sensors by connecting through the GSM module.

- **Machine learning algorithm –** The system analyses the information given and predicts whether the person is going to get a heart attack or not by using KNN and Naïve bayes algorithm.

- **Prediction –** The system by running the algorithm in the backend predicts whether the person is prone to heart attack or not.

- **Uniqueness –** Our system is unique as we present the IOT based hardware prototype consisting of heart rate, humidity, temperature sensors which takes live values and analyses along with the message alerts for the coma patient.

- **Database –** Our system can handle large amounts of data sets and here in our project we are focusing on the heart rate data available in a particular location.

3.2 FUNCTIONAL REQUIREMENTS

1) Admin authentication is a must to login into the web page.

2) Unauthenticated user will not be able to login.

3) Our web page requires a very good database support.

4) Data is being uploaded into the server.

5) We can view the uploaded data as well as live values can be obtained from the hardware prototype.

6) The results are always updated only the latest taken live values are compared and predicted.

3.3 NON FUNCTIONAL REQUIREMENTS

- **Usability:**

Based on usage patterns we prioritize the important functions. In past times people were not connected to technology and analysis in hospitals, so we develop a solution to improve usability that is efficient which reduces the digital gap between patients and technology.

- **Reliability:**

Our main goal is to ensure that hospitals trust our system, even after using it for a long time. We created a requirement without changing the data by the system that will be retained for many years.

- **Performance:**

Under every circumstance our system responses are high measured from any point. But the accuracy of our project becomes unusually high only when Naïve bayes algorithm is used.

3.4 USER CHARECTERISTICS

In our project there is only one user named admin. So admin characteristics are as follows,

1) Can login into the web page.

2) Can view and upload the data into the website.

3) Can add the manual values of the present condition of the patient or live values are directly added from sensors.

4) Can look into the only latest live values and predict the heart attack.

5) Can make the analysis and look into the results and probabilities of heart attack.

3.5 ASSUMPTION AND DEPENDENCIES

The assumptions are:-

1) The code should be error free.

2) The system should be user-friendly so that it is easy for the users.

3) The information of all the patients that are being analysed should be stored in a database that is accessible only by the admin.

4) The system should run 24*7.

5) Users may access from any device that has internet browsing capabilities and an internet connection.

6) Users must have their correct usernames and passwords to enter into their online accounts.

7) The live values from sensors should be taken properly without any error in the values.

The dependencies are:-

1) The specific hardware and software due to which the product will run.

2) On the basis of listing requirements and specifications the project will be developed and run.

3) The admin should have the complete understanding of the project.

4) The system should have the general report stored.

5) The information of all the patient data must be stored in a database that is accessible by the admin.

6) Any update that is either uploading the data or taking the live values form sensors should be recorded or values entered should be error free.

3.6 DOMAIN REQUIREMENTS

- **Machine learning**

  It is basically a sub part kind of artificial intelligence application which provides the ability to learn and improve from the experience without being physically programmed. The learning process starts with the data, to look for the patterns in it and make better decisions in future. Our primary aim is to learn automatically without any interference of human assistance. We used two basic data mining or Machine learning algorithms named KNN and Naïve bayes in our project.

- **Internet of things**

  IOT is a simple network of internet which is connected to objects named things through which data can be collected and exchanged. So things sense the data and collect it using different kind of sensors and send it to the internet through different modules present in it. In our project we have used sensors like PH, humidity and temperature through which data is being sensed and collected. And using modules such as Wifi module data is sent to internet. This is how IOT works.

3.7 HARDWARE REQUIREMENTS

3.7.1 Arduino Microcontroller

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

3.7.2 Heartbeat Sensor

Heart Beat sensor is used to know the heart rate of the patient in the Heart Diseases detection and coma patient monitoring in the proposed system. Heart beat can be detected like normal procedure. This sensor will have IR transmitter and IR Receiver which are placed in the hand clip. Heart Pulse is detected by this sensor.

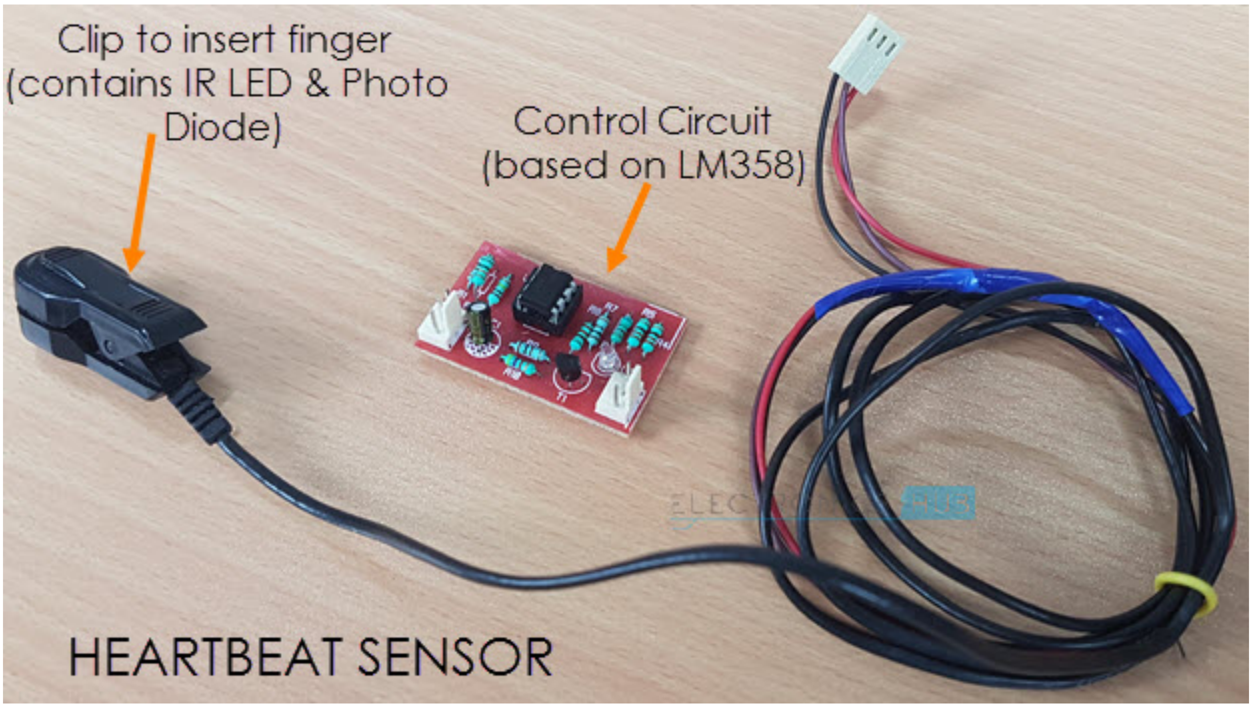


Fig.1 Heart Rate Sensor.

This sensor clip is placed to the figure of the patient. Sensor gives the HIGH pulse to the controller when beat occurred, controller counts the number of beats occurred in a minute.

Schematic Diagram of the Heart Beat Sensor:

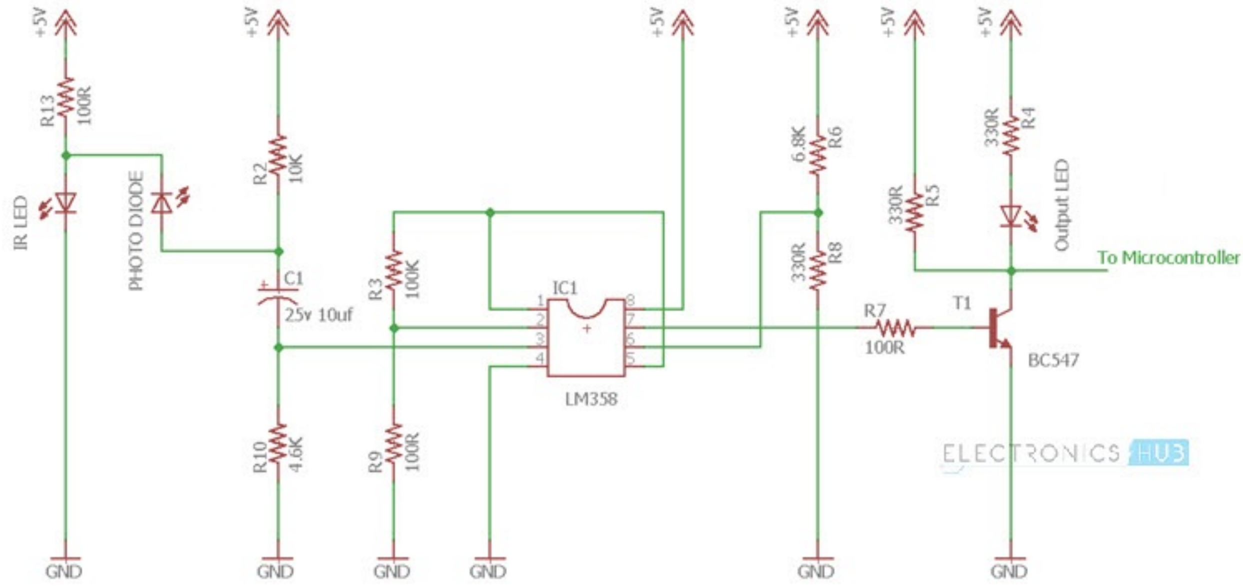


Fig.2

3.7.3 DHT11 Digital Temperature and Humidity Sensor

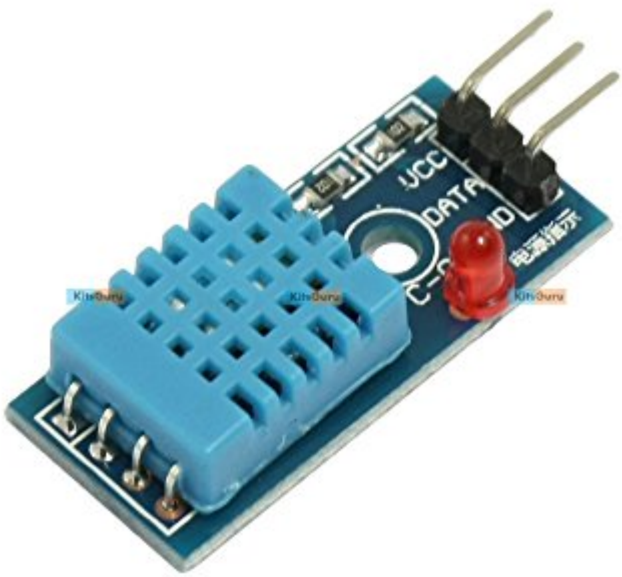
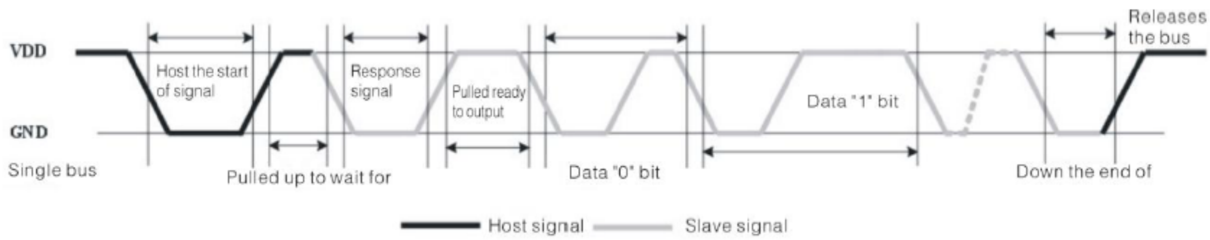
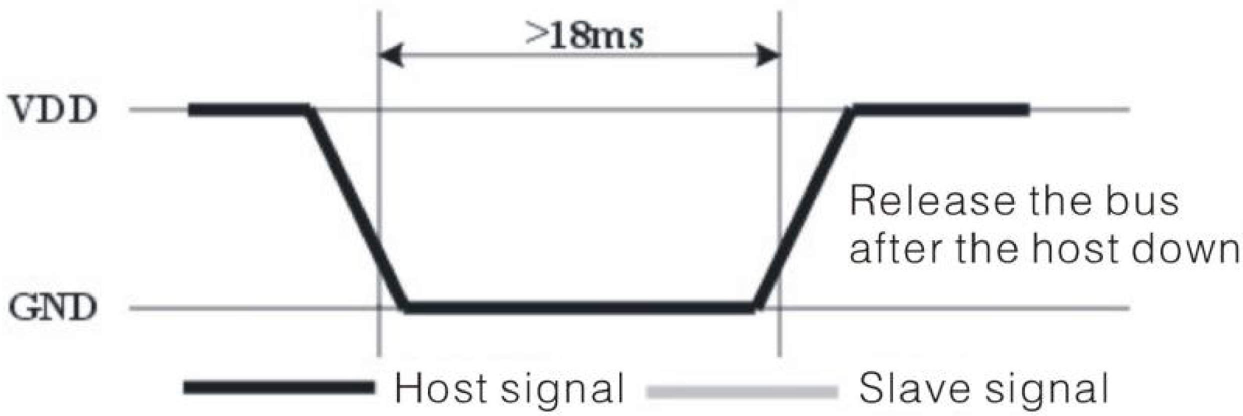


Fig.3

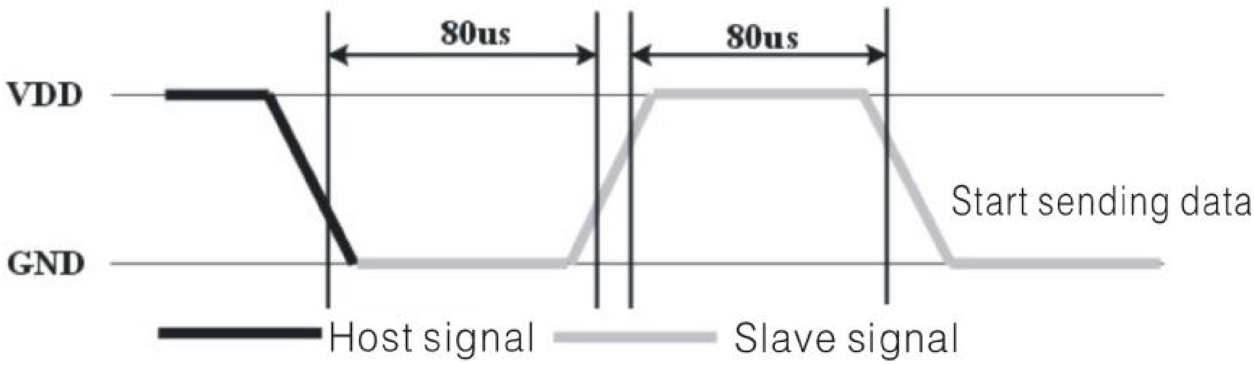
This Sensor will give the Temperature and Humidity values to the controller with the single bus line. This sensor can be activated and receives data with same pin. Sensor produces the 40 pulses which represent the Humidity, Temperature and Parity bits.



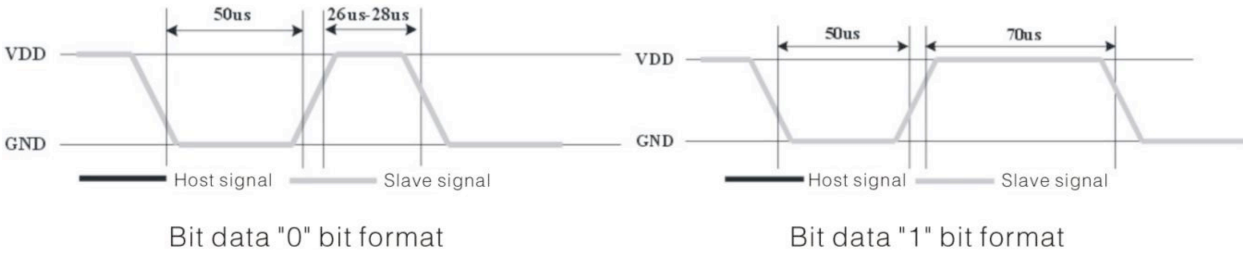
Sensor can activated by giving the LOW to HIGH pulse of >18ms of time



Next to the host signal is the slave signal.



The pulse duration of 26us – 28us represent the Bit data '0' and the pulse duration of 50us – 70us is represent the Bit data '1'.



3.7.4 MPU 6050

The MPU-6050 sensor combination of a 3-axis gyroscope and a 3-axis accelerometer on the same silicon die, together with an onboard Digital Motion Processor (DMP), which processes complex 6-axis Motion Fusion algorithms. The device can access external magnetometers or other sensors through an auxiliary master I²C bus, allowing the devices to gather a full set of sensor data without intervention from the system processor.

The gyroscope measures rotational velocity or rate of change of the angular position over time, along the X, Y and Z axis.

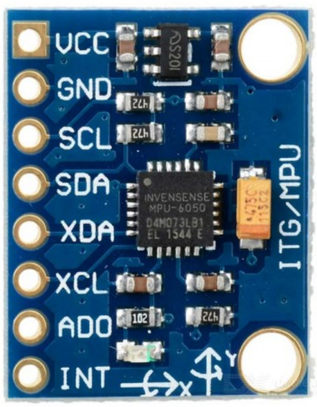


Fig.5 MPU6050

In proposed system accelerometer is used to detect the body movement of the patient in the coma monitoring.

3.7.5 IR SENSOR

IR sensor is used to detect the object in front the sensor by using Infrared rays. IR module will have four pins which are VCC, GND, DO and AO. This module is powered by the 5V DC and consists of Digital and analog pins. This module will have Infrared Transmitter and Receiver which capture the Infrared rays. The ray emitted by the infrared transmitter is reflected by an object and falls on the infrared Receiver.

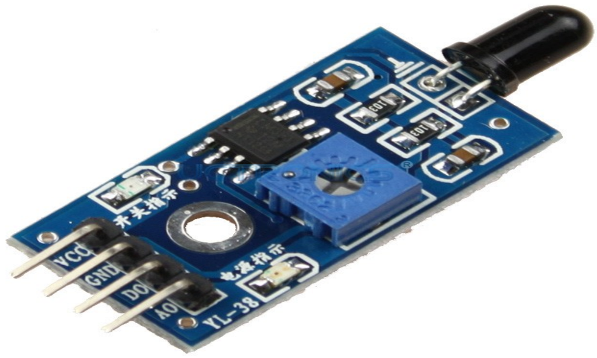


Fig.6

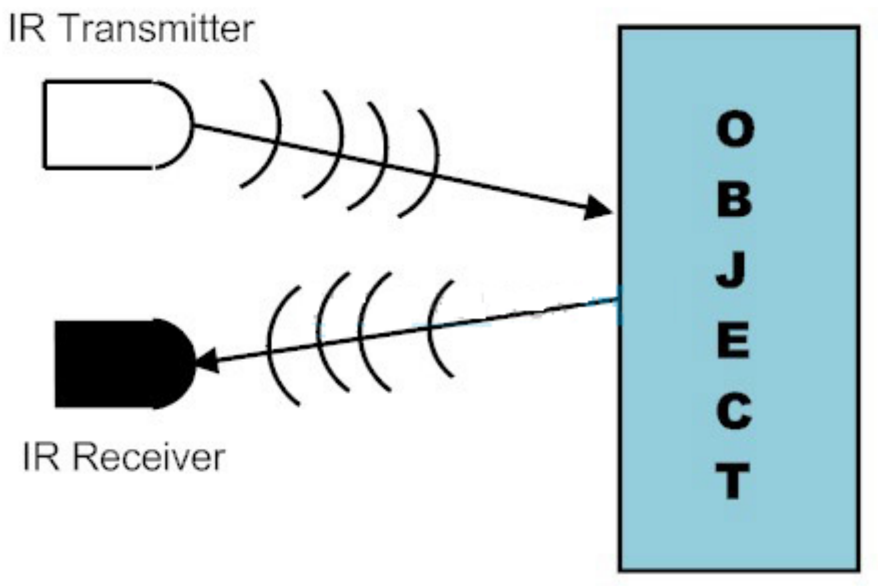


Fig.7

3.7.6 KEYPAD

In many Embedded applications require more keys to give the inputs by the user, mostly in which multiple inputs required in the system. Keypad can be design with the simple architecture and interact with the system easily. Keypad consists of multiple push buttons are arranged like a matrix form.

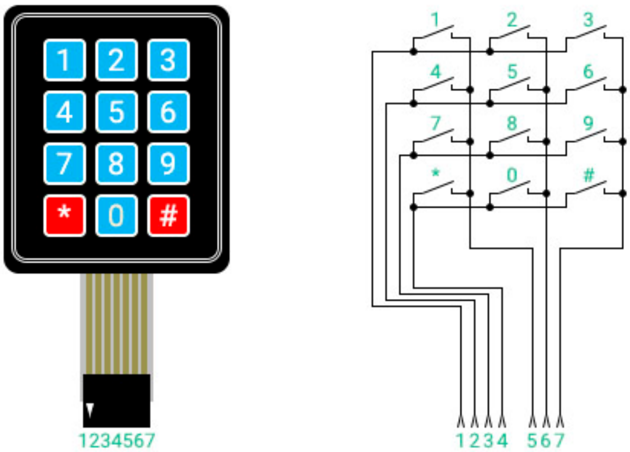


Fig.8

3.7.7 Slide Switch:

A Slide Switch is used to switch On or Off of an electrical circuit depends on the application. Slide switches are used in many applications of embedded system depend on the requirement in the application.

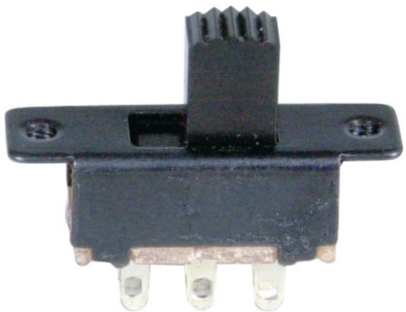


Fig.9

In the proposed system slide switch is used to select the Gender, Smoker and Selection (i.e., Heart diseases and Comma monitoring) by the user.

3.7.8 GSM MODULE:

GSM Module is like a 2G handset to which it will works like a mobile. This can be used for services like SMS, Call and GPRS. But the services can be done with AT commands. This is work with serial communication (UART). This module will sim holder which is like a mobile.

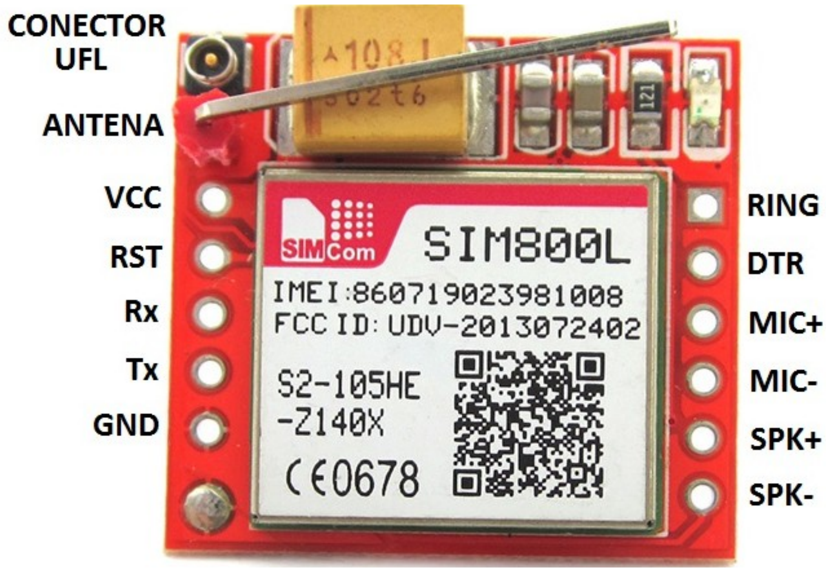


Fig.10

3.7.9 Flex Sensor

This flex sensor is a variable resistor which is used to detect the hand movement of the coma patient. When the hand bends the flux sensor produces a resistance. They can also be used as door sensors, robot whisker sensors, or a primary component in creating sentient stuffed animals.

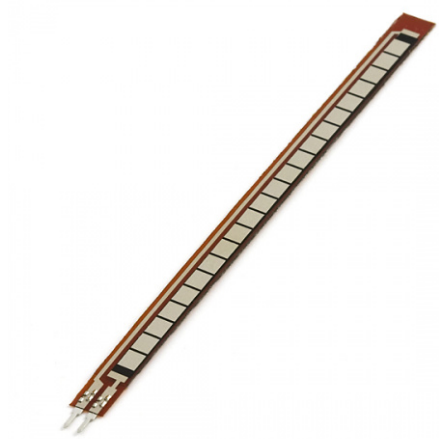


Fig.11

Flex sensor will connected to the Analog pin of controller because this sensor produces the analog value. When the flex strip bends the analog value produce by the sensor will vary. A threshold value is used to represent a greater movement where an alert will be sent. After crossing the threshold value we can consider that a hand movement is occurred by the patient.

3.8 SOFTWARE REQUIREMENTS

1) APACHE TOMCAT

Apache tomcat is mainly used to deploy JSP,s and Java servlets. The WAR files which we build in our java project are deployed here in tomcat. Tomcat is basically a servlet and JSP server which serves Java related technologies. And on the other hand Apache is an HTTP server.

2) JAVA and PYTHON

We used Java for KNN algorithm and python for Naïve bayes algorithm. And also we used both the languages for connecting to the database.

3) Arduino IDE

The Arduino integrated development environment needs to be setup for the usage of IOT. It is used to write and upload programs to arduino board.

4) MySQL database(SQL YOG)

SQL YOG is fast and easy to use. It has all the combined features of MYSQL query browser, PHP my admin and other MYSQL front ends. It is really a good manager, admin and GUI tool for MYSQL.

4. DESIGN APPROACH AND DETAILS

4.1 DESIGN APPROACH AND METHODS

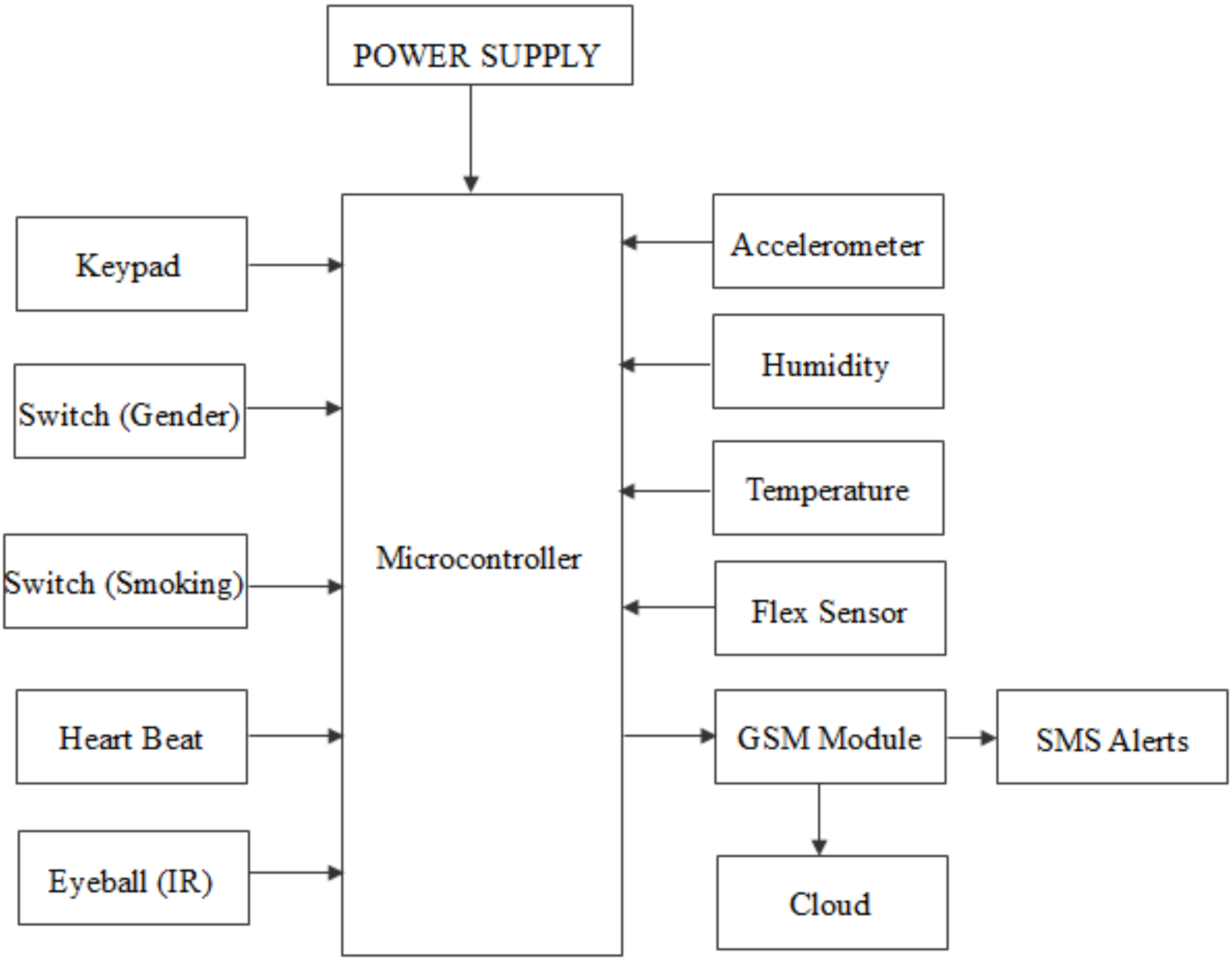


Fig.12

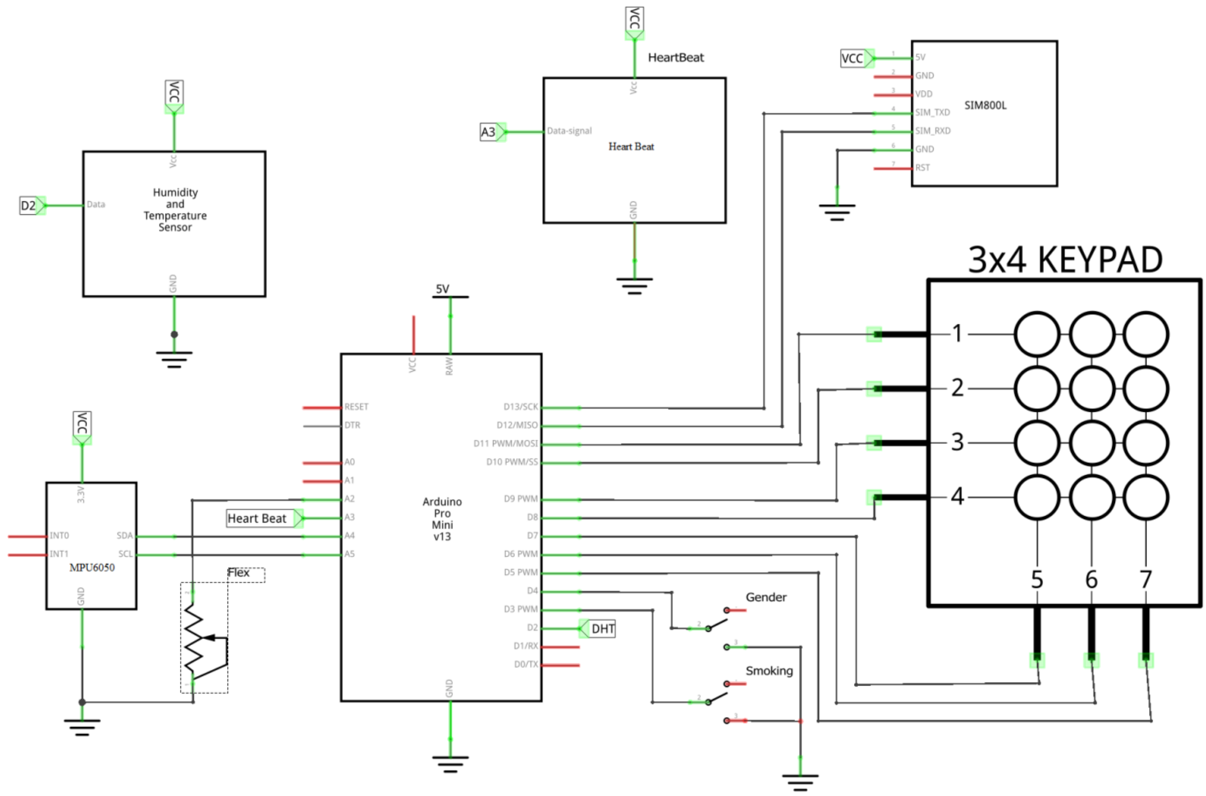


Fig.13

Pin Connections:

- DHT11 is interfaced to the Digital pin D2
- MPU6050 is interfaced to analog pin A4 and A5
- Flex sensor is interfaced to analog pin A2
- Heart beat sensor is interfaced to analog pin A3
- Gender switch is interfaced to digital pin D4
- Smoker switch is interfaced to digital pin D3
- Keypad is interfaced to digital pins of D5-D11
- GSM module is interfaced to digital pins of D12 and D13

4.2 CODES AND STANDARDS

1. Databasecon.java

```java
package databaseconnection;
import java.sql.*;

public class databasecon
{
    static Connection co;
    public static Connection getconnection()
    {


        try
        {
            Class.forName("com.mysql.jdbc.Driver");
            co = DriverManager.getConnection("jdbc:mysql://185.28.23.173:3306/ctcorphy_coma","ctcorphy_coma","comatest@12345");
        }
        catch(Exception e)
        {
            System.out.println("Database Error"+e);
        }
        return co;
    }

}

```

2. K_means.java

```java
package CT;
import java.util.*;
public class k_means
{
static int count1,count2,count3,count4,count5;
static int d[];
static int k[][];
static int tempk[][];
static double m[];
static double diff[];
static int n,p;

static int cal_diff(int a) // This method will
{
int temp1=0;
for(int i=0;i<p;++i)
{
if(a>m[i])
diff[i]=a-m[i];
else
diff[i]=m[i]-a;
}
int val=0;
double temp=diff[0];
for(int i=0;i<p;++i)
{
if(diff[i]<temp)
{
temp=diff[i];
val=i;
}
```

```
}
}//end of for loop
return val;
}

static void cal_mean() // This method will determi
{
for(int i=0;i<p;++i)
m[i]=0; // initializing means to 0
int cnt=0;
for(int i=0;i<p;++i)
{
cnt=0;
for(int j=0;j<n-1;++j)
{
if(k[i][j]!=-1)
{
m[i]+=k[i][j];
++cnt;
}}
m[i]=m[i]/cnt;
}
}

static int checkl() // This checks if previous k i
{
for(int i=0;i<p;++i)
for(int j=0;j<n;++j)
if(tempk[i][j]!=k[i][j])
{
```

3. Hardware Code

```
#include <SoftwareSerial.h>
#include <Keypad.h>
#include <DHT.h>
#include <MPU6050.h>

#define gender 9
#define smoke 10
#define choose 11

#define data A0
#define flex A1
#define eye A2
#define DHTPIN A3
#define DHTTYPE DHT11

SoftwareSerial gsm(12, 13);
MPU6050 accel;
DHT dht(DHTPIN, DHTTYPE);

String mob;

const byte ROWS = 4, COLS = 3;
char keys[ROWS][COLS] = {
  {'1','2','3'},
  {'4','5','6'},
  {'7','8','9'},
  {'*','0','#'}
};

byte rowPins[ROWS] = {8, 7, 6, 5};
byte colPins[COLS] = {4, 3, 2};
Keypad keypad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );
```

```
void setup()
{
  Serial.begin(9600);
  gsm.begin(9600);
  pinMode(gender,INPUT_PULLUP);
  pinMode(smoke,INPUT_PULLUP);
  pinMode(choose,INPUT_PULLUP);
  pinMode(eye,INPUT);
  Serial.println(F("Initializing All Modules"));
  Serial.println(F("Checking for GSM Module"));
  gsm_init();
  get_num();
  gsminit();
  accel.begin(MPU6050_SCALE_2000DPS, MPU6050_RANGE_2G);
  Serial.println(F("Setup Completed"));
  Serial.println(F("Press '*' Key to start"));
  while(get_key()!='*');
}

int beat()
{
  unsigned long temp = 0;
  int count = 0;
  temp = millis();
  Serial.println("\nTaking pulse count ...");
  while(millis()<(temp+10000))
  {
    if(analogRead(data)<150)
    {
      count = count+1;
      delay(300);
    }
  }
  count = count*6;
  Serial.print(F("Heart Beat: "));
  Serial.print(count);
  Serial.println(F(" BPM"));
  return count;
}

int flex_read()
{
  int val;
  val = analogRead(flex);
  if(val>850)
  {
    Serial.println(F("Alert: Hand Movement Occured"));
    sendmsg(2);
    return 1;
  }
  else
  {
    Serial.println(F("No Hand Movement"));
    return 0;
  }
}
```

```
void sendmsg(int val)
{
  String cmd, getstr;
  switch(val)
  {
   case 1: getstr = "Alert: Body Movement Occured";break;
   case 2: getstr = "Alert: Hand Movement Occured";break;
   case 3: getstr = "Alert: Eyeball Movement Occured";break;
   case 4: getstr = "Alert: Pulse rate above 100BPM";break;
   case 5: getstr = "Alert: Pulse rate below 40BPM";break;
  }
  cmd=  "AT+CMGS=\"";
  cmd+= String(mob);
  cmd+="\"";
  cmd+="\r";
  gsm.println("AT+CMGF=1");
  delay(1000);
  gsm.println(cmd);
  delay(1000);
  gsm.println(getstr);
  delay(100);
  gsm.println((char)26);
  delay(1000);
  Serial.println(F("sending msg..."));
  delay(3000);
}
void response()
{
  while(gsm.available()!=0)
  Serial.write(char (gsm.read()));
}

void showResponse(int waitTime)
{
    long t=millis();
    char c;
    while (t+waitTime>millis()){
      if (gsm.available()>0){
          c=gsm.read();
          Serial.print(c);
      }
    }
}
```

```
void gsminit()
{
  gsm.println("AT");
  delay(2000);
  gsm.println("AT+CSQ");
  delay(2000);
  response();
  gsm.println("AT+CGATT?");
  delay(500);
  response();
  gsm.println("AT+SAPBR=3,1,\"CONTYPE\",\"GPRS\"");
  delay(2000);
  response();
  gsm.println("AT+SAPBR=3,1,\"APN\",\"CMNET\"");
  delay(4500);
  response();
  gsm.println("AT+SAPBR=1,1");
  delay(2000);
  response();
  gsm.println("AT+SAPBR=2,1");
  delay(2000);
  response();
}
char get_key()
{
  char key = keypad.getKey();
  if (key != NO_KEY)
  {
    Serial.print(key);
    return key;
  }
  delay(100);
  get_key();
}
```

```
void get_num()
{
  String str;
  char get_no=1;
  int i,j;
  gsm.println("AT\r");
  delay(800);
  gsm.println("AT+CMGF=1");
  delay(1000);
  gsm.println("ATA\r");
  delay(800);
  gsm.println("AT+CLIP=1\r");
  delay(800);
  showResponse(2000);
  Serial.println(F("\nWaiting for CALL\n"));
  while(get_no)
  {
    while(!gsm.available());
    if(gsm.available()>15)
    {
    while(gsm.available()>0)
    {
      str += String(char (gsm.read()));
    }
      Serial.print(F("content: "));
      Serial.print(str);
    if(j=str.indexOf('"'))
    {
      for(i=j+4,j=0;j<10;i++,j++)
      {
        mob+=str[i];
      }
      mob[j]='\0';
      gsm.println("ATH\r");
      delay(1000);
      get_no=0;
      Serial.print(F("Mobile No.: "));
      Serial.println(mob);
    }
    }
  }
```

4. **To read the Heart Beat sensor values:**

```
int beat()
{
  unsigned long temp = 0;
  int count = 0;
  temp = millis();
  Serial.println("\nTaking pulse count ...");
  while(millis()<(temp+10000))
  {
    if(analogRead(data)<150)
    {
      count = count+1;
      delay(300);
    }
  }
  count = count*6;
  Serial.print(F("Heart Beat: "));
  Serial.print(count);
  Serial.println(F(" BPM"));
  return count;
}
```

5. **Reading values for MEMS Sensor:**

```
Vector sensor_data = accel.readNormalizeAccel();
int pitch_value = -(atan2(sensor_data.XAxis, sqrt(sensor_data.YAxis*sensor_data.YAxis + sensor_data.ZAxis*sensor_data.ZAxis))*180.0)/M_PI;
Serial.print(F("Side = "));
Serial.print(pitch_value);
int roll_value = (atan2(sensor_data.YAxis, sensor_data.ZAxis)*180.0)/M_PI;
Serial.print(F(" Roll = "));
Serial.println(roll_value);
if(pitch_value < -20 || pitch_value > 20)
{
  Serial.println(F("Alert: Body Movement Occured"));
  sendmsg(1);
  body = 1;
}
else if(roll_value < -20 || roll_value > 20)
{
  Serial.println(F("Alert: Body Movement Occured"));
  sendmsg(1);
  body = 1;
}
else
{
  Serial.println(F("No Body Movement"));
  body = 0;
}
```

6. **For selecting Gender:**

```
Serial.println(F("-> Select Gender"));
Serial.print(F("Gender: "));
delay(3000);
Serial.println(digitalRead(gender)==0?"Female":"Male");
```

7. Send SMS:

```
void sendmsg(int val)
{
  String cmd, getstr;
  switch(val)
  {
   case 1: getstr = "Alert: Body Movement Occured";break;
   case 2: getstr = "Alert: Hand Movement Occured";break;
   case 3: getstr = "Alert: Eyeball Movement Occured";break;
   case 4: getstr = "Alert: Pulse rate above 100BPM";break;
   case 5: getstr = "Alert: Pulse rate below 40BPM";break;
  }
  cmd=  "AT+CMGS=\"";
  cmd+= String(mob);
  cmd+="\"";
  cmd+="\r";
  gsm.println("AT+CMGF=1");
  delay(1000);
  gsm.println(cmd);
  delay(1000);
  gsm.println(getstr);
  delay(100);
  gsm.println((char)26);
  delay(1000);
  Serial.println(F("sending msg..."));
  delay(3000);
}
```

8. To check Module is Responding and Network:

```
void gsm_init()
{
  Serial.println(F("Finding Module.."));
  int at_flag=1;
  while(at_flag)
  {
    gsm.println("AT");
    while(gsm.available()>0)
    {
      if(gsm.find("OK"))
      at_flag=0;
      response();
    }
    delay(1000);
  }
  Serial.println(F("Module Connected.."));
  delay(1000);
  Serial.println(F("Finding Network.."));
  int net_flag=1;
  while(net_flag)
  {
    gsm.println("AT+CPIN?");
    while(gsm.available()>0)
    {
      if(gsm.find("+CPIN: READY"))
      net_flag=0;
      response();
    }
    delay(1000);
  }
  Serial.println(F("Network Found.."));
  delay(1000);
  Serial.println(F("Disabling ECHO"));
  int echo_flag=1;
  while(echo_flag)
  {
    gsm.println("ATE0");
    while(gsm.available()>0)
    {
      if(gsm.find("OK"))
      echo_flag=0;
      response();
    }
    delay(1000);
  }
  Serial.println(F("Echo OFF"));
  delay(1000);
}
```

9. To Switch ON the GPRS in the Module:

```
void gsminit()
{
  gsm.println("AT");
  delay(2000);
  gsm.println("AT+CSQ");
  delay(2000);
  response();
  gsm.println("AT+CGATT?");
  delay(500);
  response();
  gsm.println("AT+SAPBR=3,1,\"CONTYPE\",\"GPRS\"");
  delay(2000);
  response();
  gsm.println("AT+SAPBR=3,1,\"APN\",\"CMNET\"");
  delay(4500);
  response();
  gsm.println("AT+SAPBR=1,1");
  delay(2000);
  response();
  gsm.println("AT+SAPBR=2,1");
  delay(2000);
  response();
}
```

10. To see response of the GSM Module:

```
void showResponse(int waitTime)
{
     long t=millis();
     char c;
     while (t+waitTime>millis()){
       if (gsm.available()>0){
           c=gsm.read();
           Serial.print(c);
       }
     }
}
```

5. SCHEDULE, TASKS AND MILESTONES

Table1: Schedule

Task	Start Date	End Date	Duration(In Days)
Choosing a problem statement	01-Aug-2019	03-Aug-2019	2
Analysing the scope of the selected problem statement	04- Aug-2019	11-Aug-2019	7
Defining the objective for the problem statement	12- Aug-2019	17- Aug-2019	5
Review	18- Aug-2019	19- Aug-2019	1
Develop & Review Specifications	20-Aug-2019	01-Sep-2019	12
Assembling the hardware components	02-Sep-2019	03-Sep-2019	5
Backend	04-Sep-2019	23-Sep-2019	19
Frontend	24-Sep-2019	29-Sep-2019	5
Configuring the hardware and software	30-Sep-2019	15-Oct-2019	15
Phase1 testing & fixing bugs	16-Oct-2019	23-Oct-2019	7
Complete Testing	24-Oct-2019	27-Oct-2019	3
Review	28-Oct-2019	1-Nov-2019	4
Feedback	01-Nov-2019	07-Nov-2019	6

This is the breakdown of the undertakings and the timetables that were associated with the creating and fruition of the task. The total undertaking work is separated into 14 assignments which were finished between the days as referenced above in the breakdown.

Sl. No.	Tasks
1.	Identifying and justifying the Product
2.	Defining The Problem Statement
3.	Research on the chosen problem statement
4.	Collecting relevant Information from previously done research
5.	Coding and configuring hardware and software
6.	Complete Implementation of the project
7.	Testing
8.	Documentation

Table 2: Milestone

Milestone	Milestone Goal
The endorsement of idea	Achievable examination and fundamental learning have been checked by the guide and the undertaking is affirmed.
Exploring the requirements	Necessities satisfied, suitable and approved for the plan
Survey of the Design	The execution has fulfilled the requirements.
Coding and Trial implementations	Configuring both the hardware and software and doing trial runs on our system
Audit of test plan	Test plans are fitting for the testing of the framework and are approved for testing.
Task Analysis and final implementation	The venture is working productively in its condition which was a definitive point.

Table 3: Comparison

6. PROJECT DEMONSTRATION

Dataset

For training the dataset we have taken the existing patient records with following attributes. We have listed the attribute and min-max ranges.

Age	1 to 100
Gender	Male or Female
Smoking	Yer or No
Heart Rate	40 to 100
Chest Pain	0 to 9
Cholesterol	100 to 400
Blood Pressure	60 to 160
Blood Sugar	80 to 300
Disease	Yes or No

Table 4: Data Entry

Table:-1 Ranges of Attributes

6.1 Algorithms Used

K-Nearest Neighbors (KNN)

K-NN approach we are using for the clustering the all the heart attack patient attribute records. We find the couple of the clusters that we can make cluster the data for training the data. Algorithm works to form k- clusters by the Euclidean distance formula

$$D_e = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}$$

Naïve Bayes algorithm

Naïve Bayes algorithm is a popular prediction algorithm which is enhanced model of Bayes rule.

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}:$$

The updated Naïve Bayes formula,

For a data d and a class c, means P(c/d)

$$\boxed{P(c \mid d) = \frac{P(d \mid c)P(c)}{P(d)}}$$

6.2 System Execution flow

Heart Attack Prediction

1. Uploading data set:

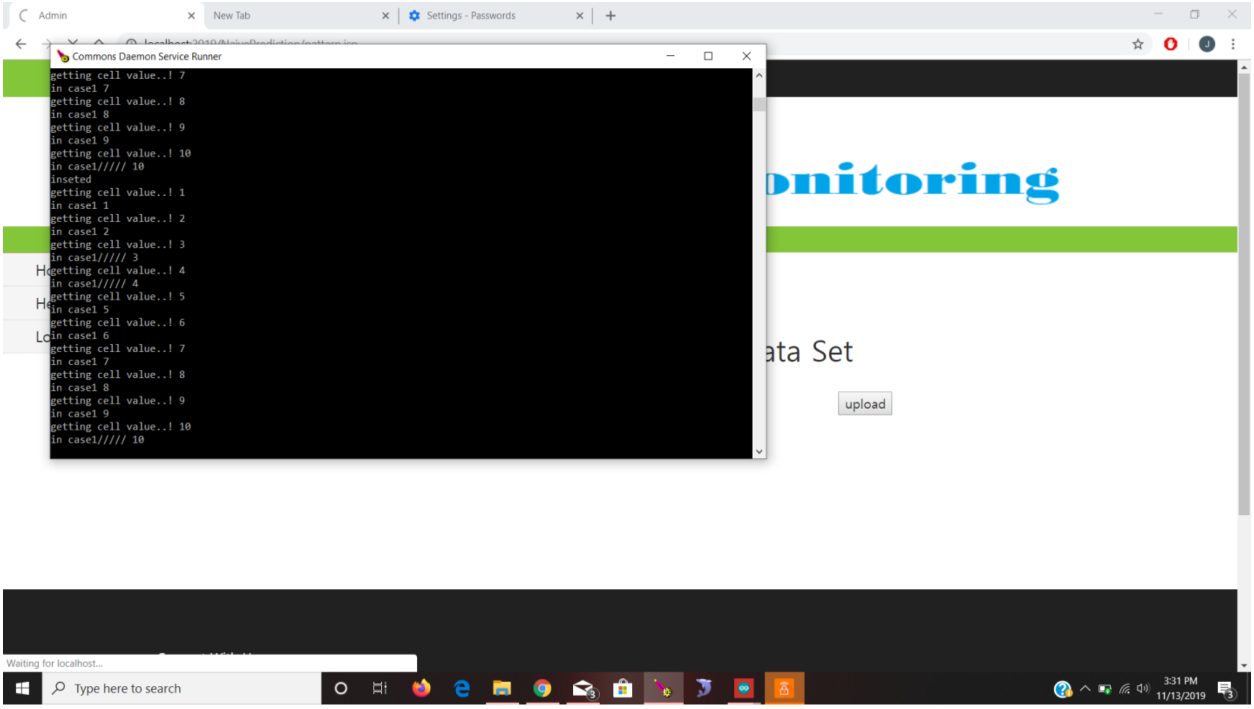
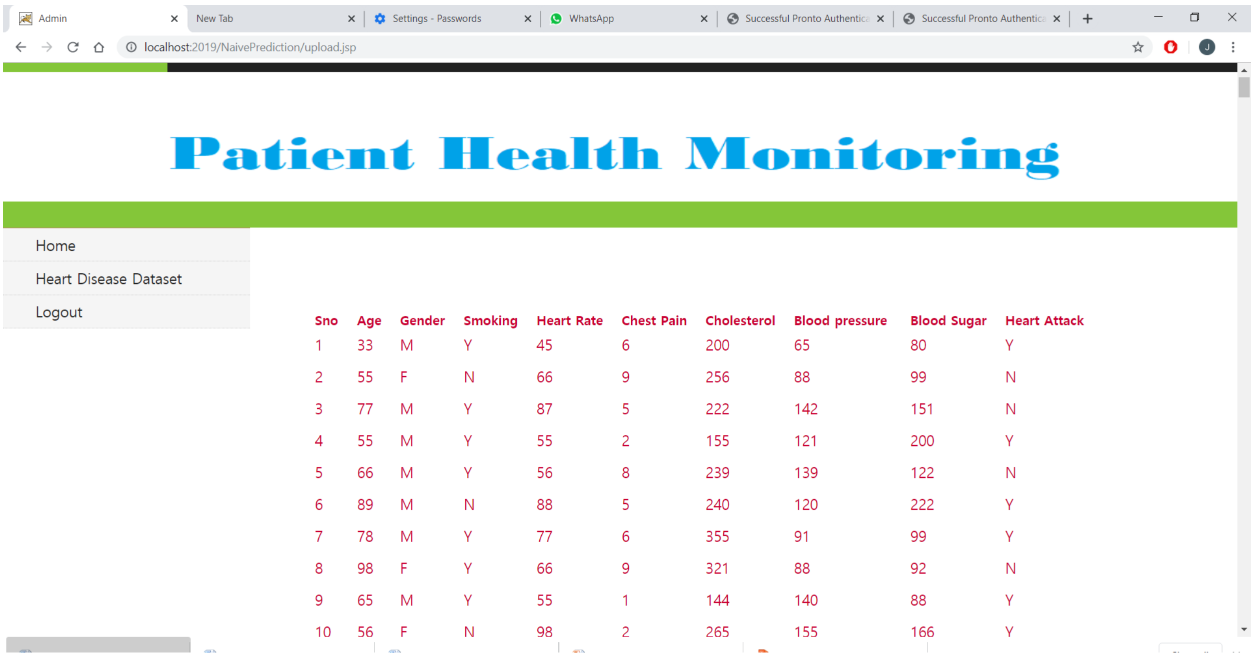


Fig.14

2. Display of uploaded data set in the webpage:



Sno	Age	Gender	Smoking	Heart Rate	Chest Pain	Cholesterol	Blood pressure	Blood Sugar	Heart Attack
1	33	M	Y	45	6	200	65	80	Y
2	55	F	N	66	9	256	88	99	N
3	77	M	Y	87	5	222	142	151	N
4	55	M	Y	55	2	155	121	200	Y
5	66	M	Y	56	8	239	139	122	N
6	89	M	N	88	5	240	120	222	Y
7	78	M	Y	77	6	355	91	99	Y
8	98	F	Y	66	9	321	88	92	N
9	65	M	Y	55	1	144	140	88	Y
10	56	F	N	98	2	265	155	166	Y

Fig.15

3. K – Means Clustering for classification of data:

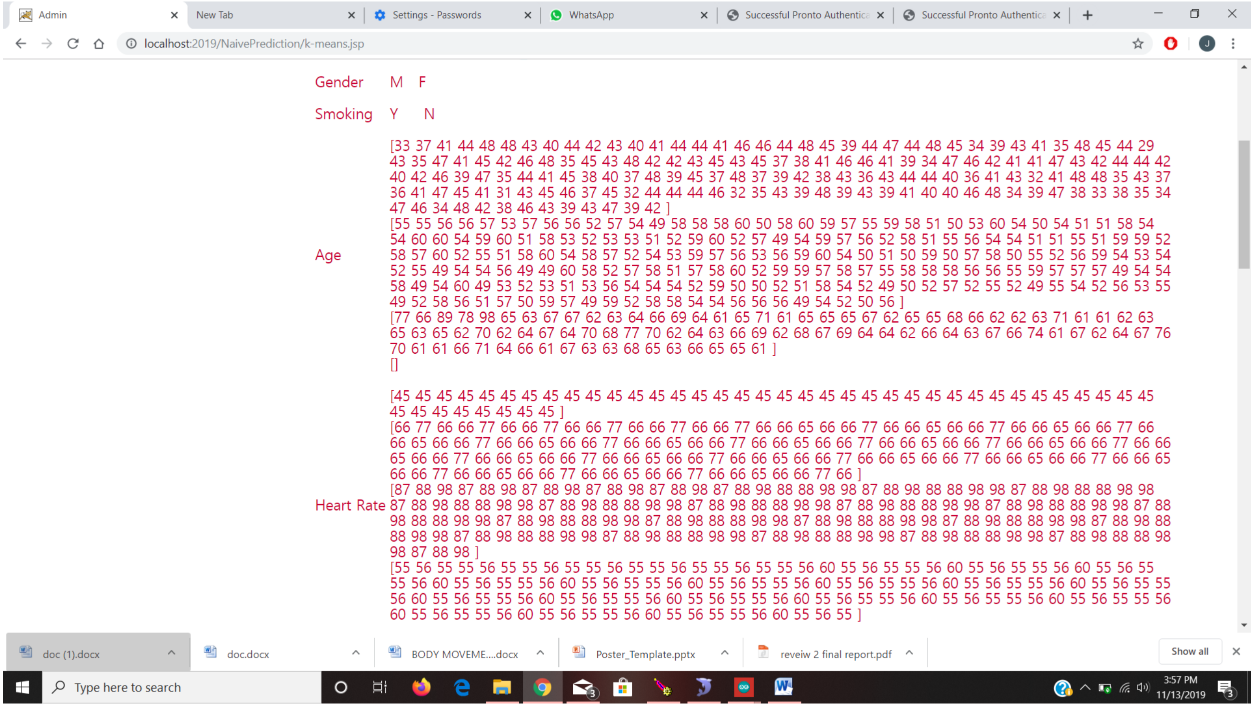


Fig.16

4. Forming into clusters:

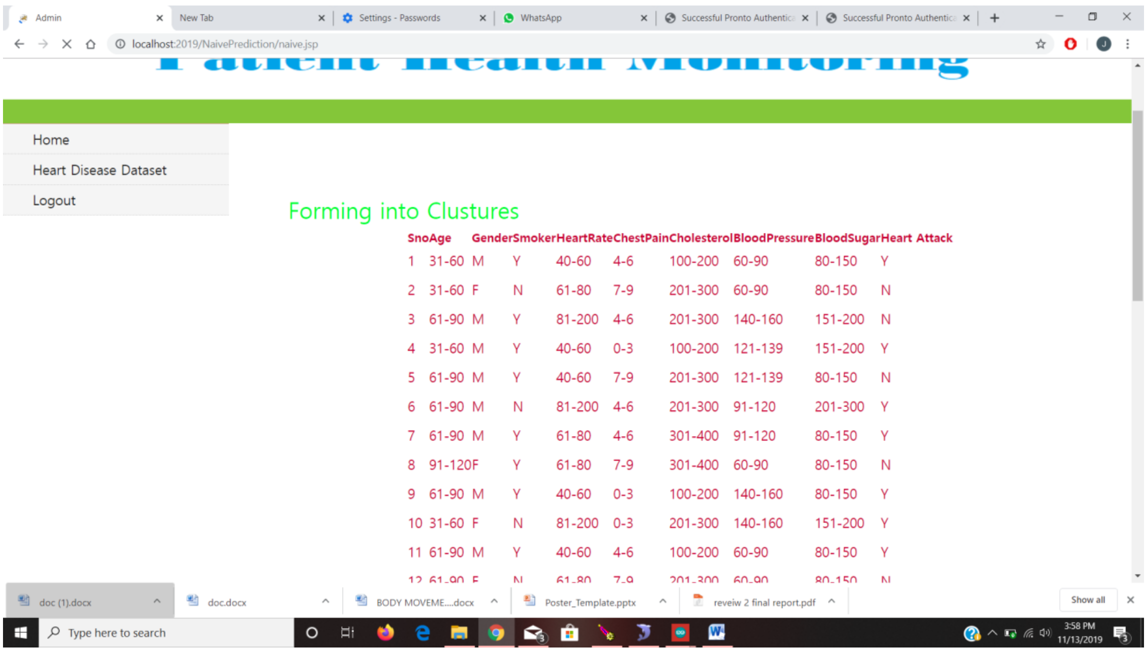


Fig.17

5. Frequency Tables:

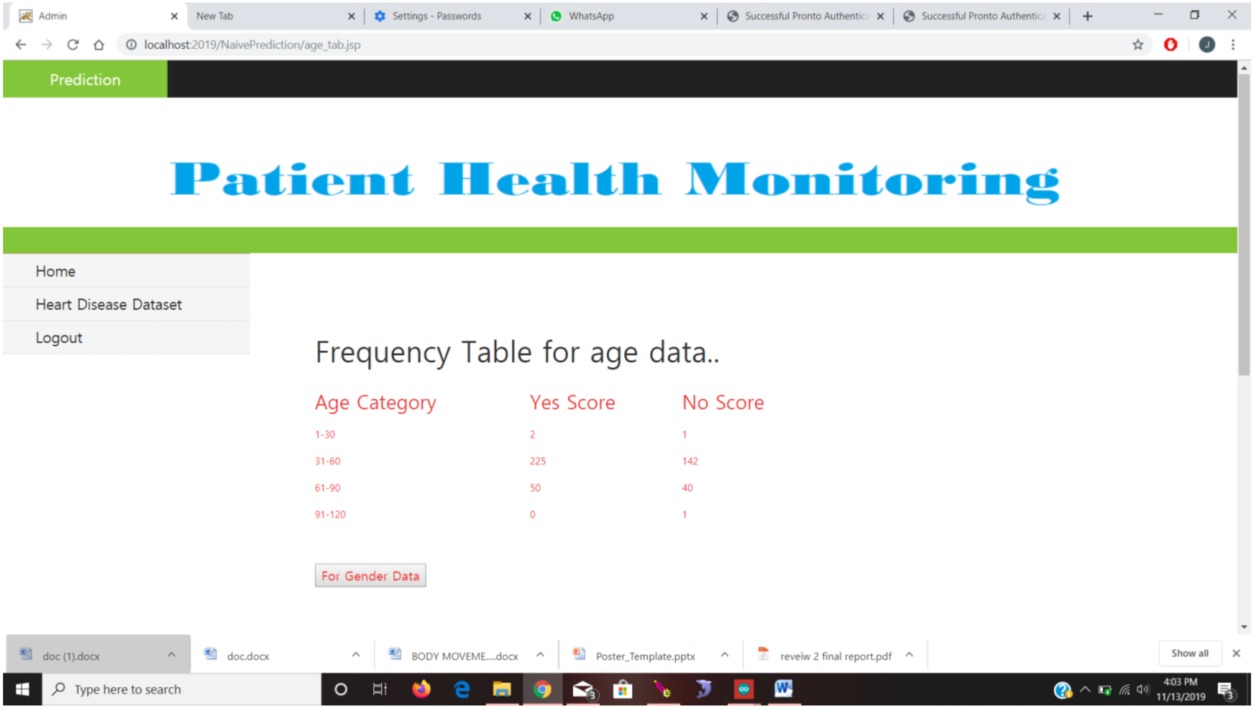


Fig.18

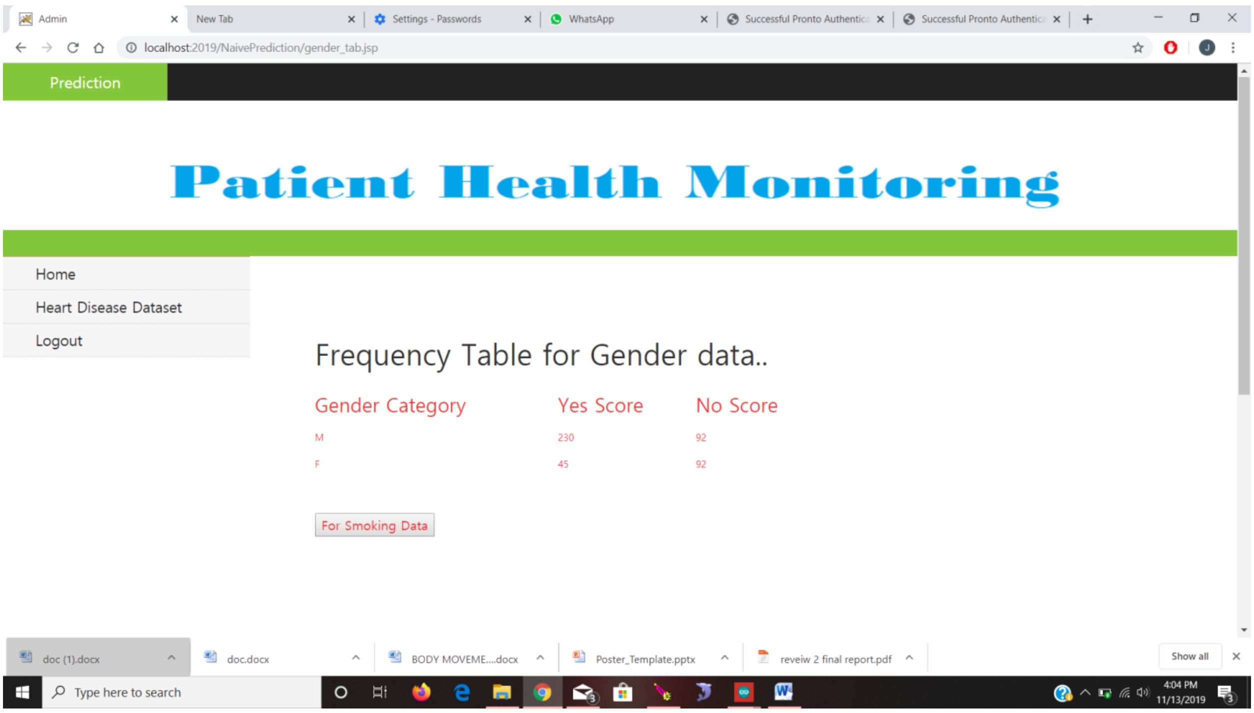


Fig.19

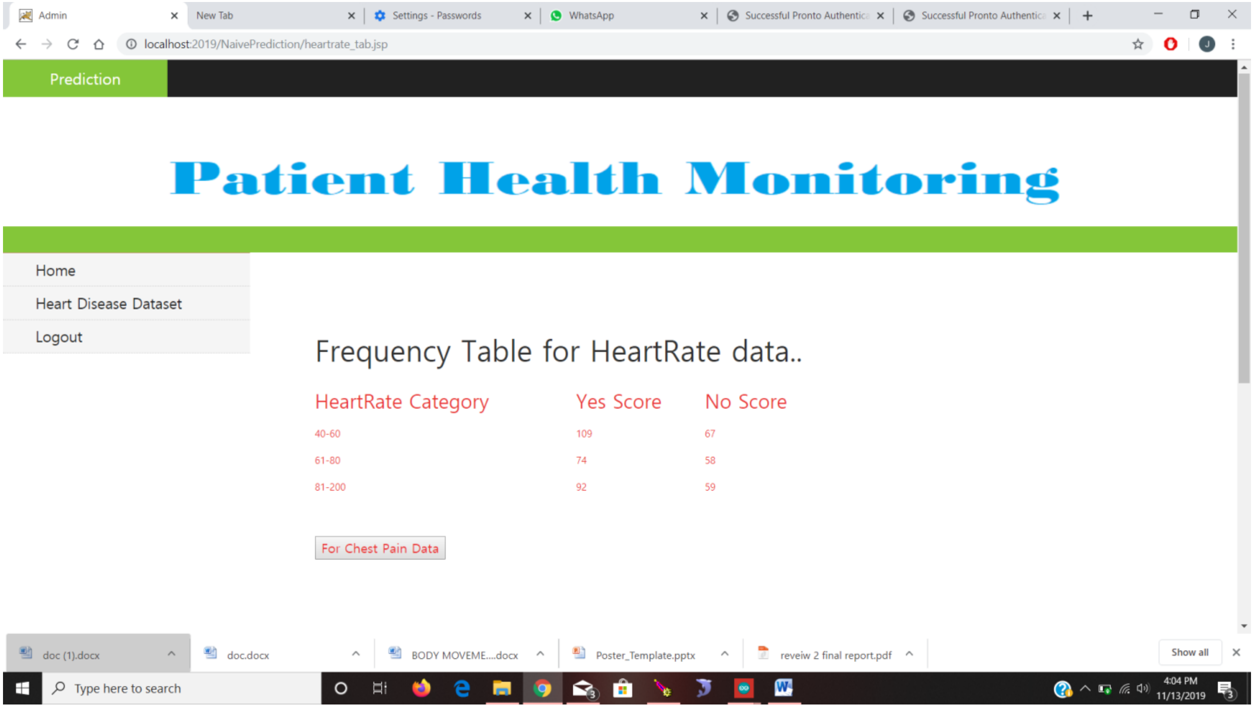

Admin
New Tab
Settings - Passwords
WhatsApp
Successful Pronto Authentic
localhost:2019/NaivePrediction/heartrate_tab.jsp
Prediction
Patient Health Monitoring
Home
Heart Disease Dataset
Logout
Frequency Table for HeartRate data..
HeartRate Category
Yes Score
No Score
40-60
109
67
61-80
74
58
81-200
92
59
For Chest Pain Data
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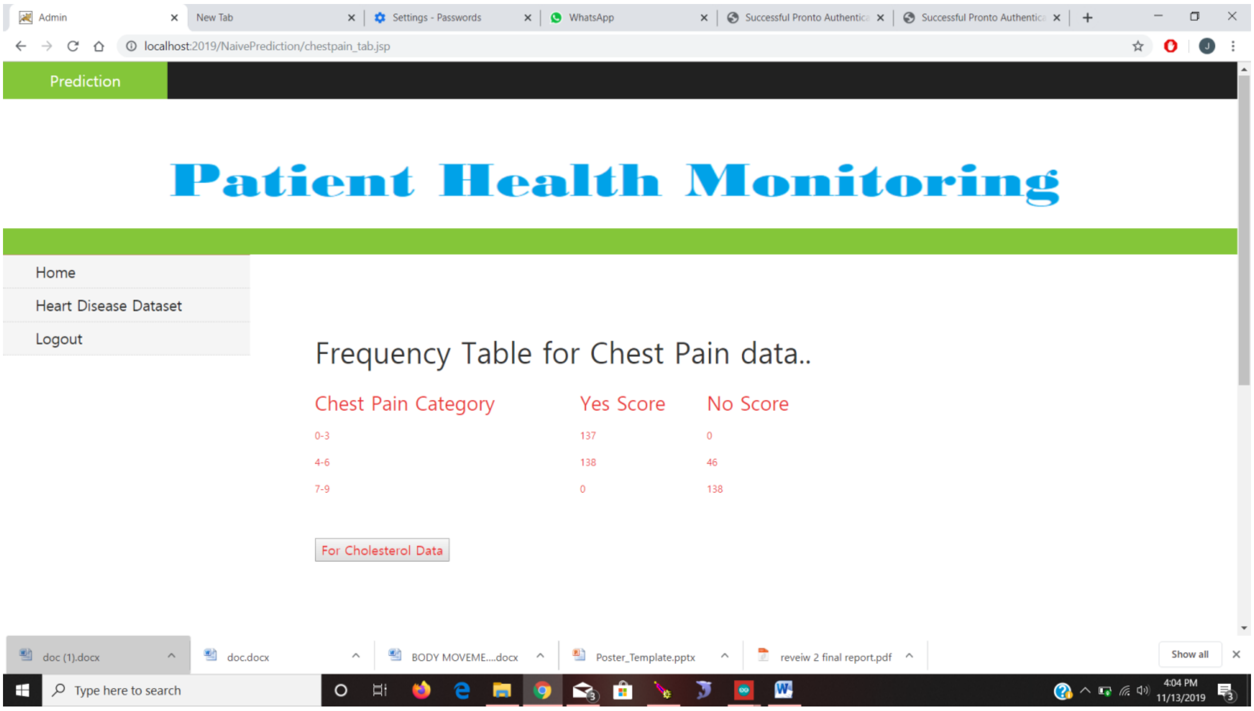
Fig.20


Admin
New Tab
Settings - Passwords
WhatsApp
Successful Pronto Authentic
localhost:2019/NaivePrediction/chestpain_tab.jsp
Prediction
Patient Health Monitoring
Home
Heart Disease Dataset
Logout
Frequency Table for Chest Pain data..
Chest Pain Category
Yes Score
No Score
0-3
137
0
4-6
138
46
7-9
0
138
For Cholesterol Data
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Poster_Template.pptx
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Show all
Type here to search
4:04 PM
11/13/2019

Fig.21

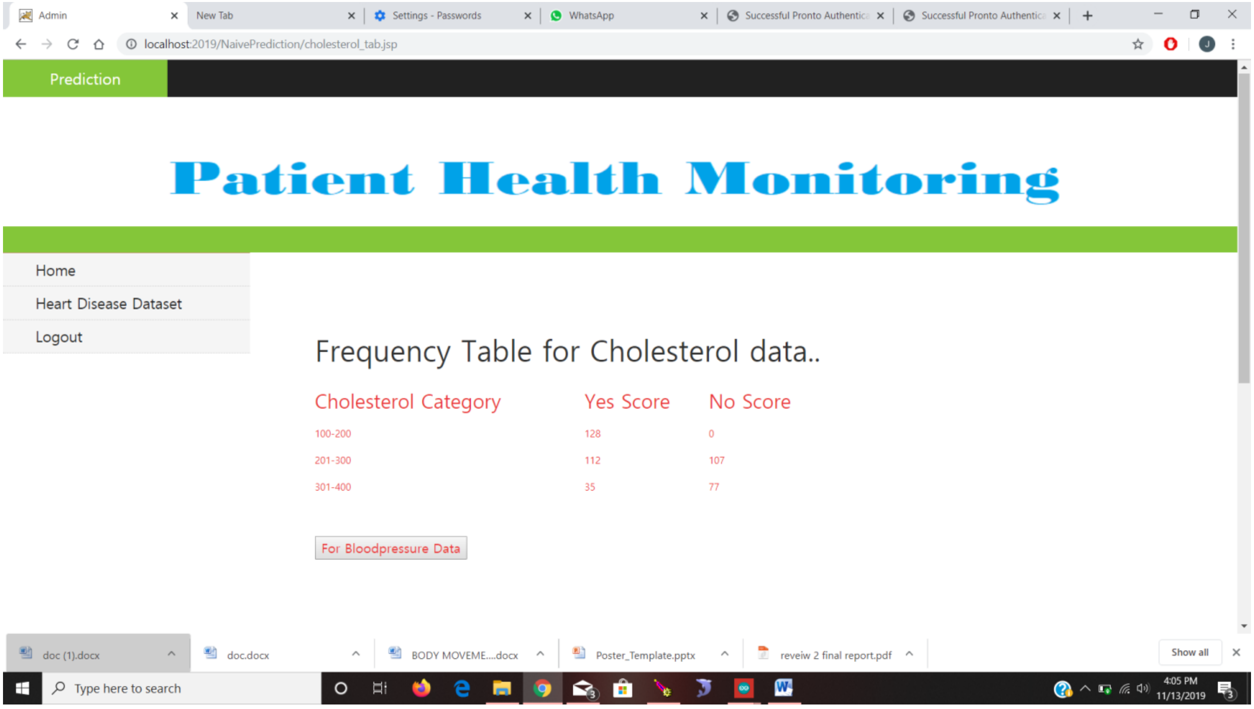
Prediction
Patient Health Monitoring
Home
Heart Disease Dataset
Logout
Frequency Table for Cholesterol data..
Cholesterol Category
Yes Score
No Score
100-200
128
0
201-300
112
107
301-400
35
77
For Bloodpressure Data

Fig.22

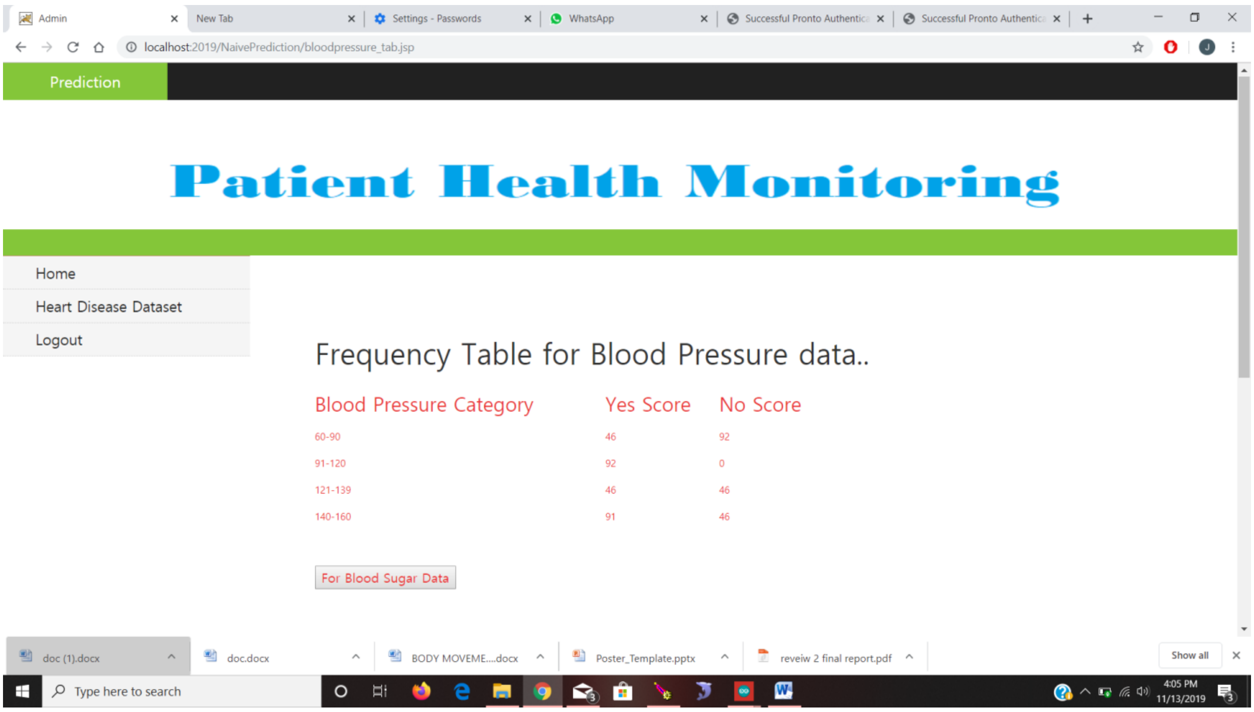
Prediction
Patient Health Monitoring
Home
Heart Disease Dataset
Logout
Frequency Table for Blood Pressure data..
Blood Pressure Category
Yes Score
No Score
60-90
46
92
91-120
92
0
121-139
46
46
140-160
91
46
For Blood Sugar Data

Fig.23


Admin
New Tab
Settings - Passwords
WhatsApp
localhost:2019/NaivePrediction/bloodsugar.jsp
Prediction
Patient Health Monitoring
Home
Heart Disease Dataset
Logout
Frequency Table for Blood Sugar data..
Blood Sugar Category
Yes Score
No Score
80-150
138
138
151-200
91
46
201-300
46
0
For Total Data
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Fig.24

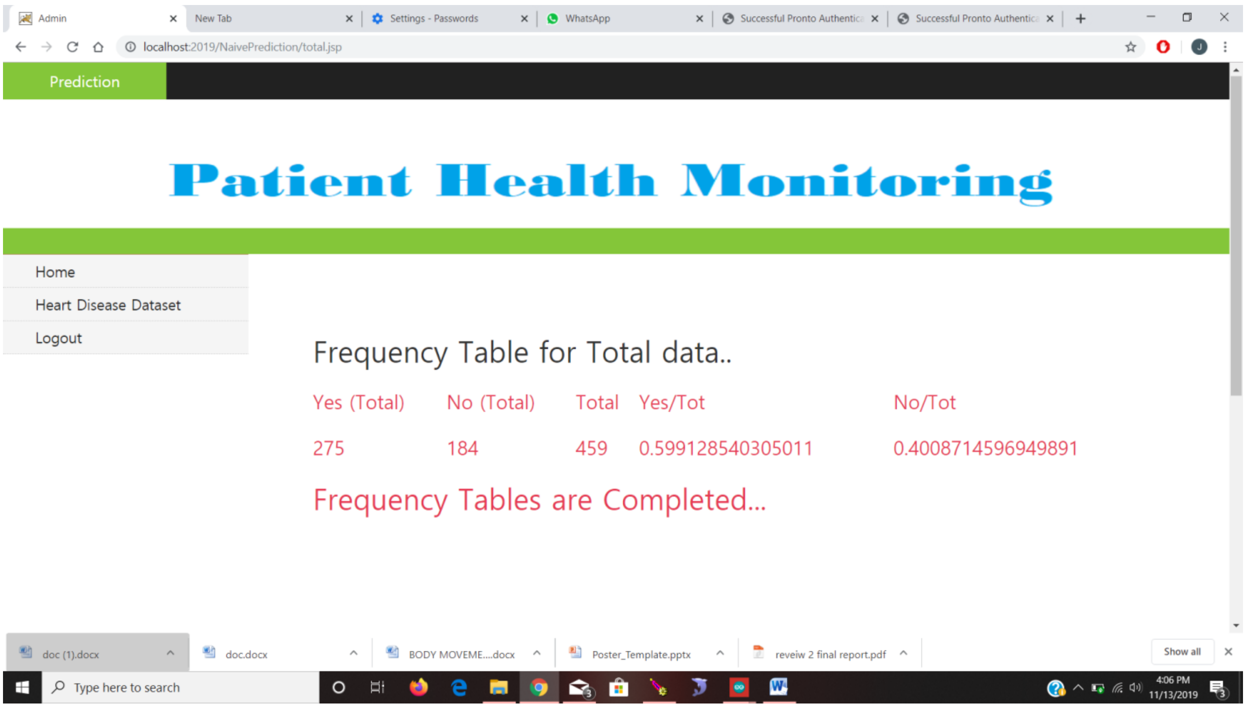
Admin
New Tab
Settings - Passwords
WhatsApp
localhost:2019/NaivePrediction/total.jsp
Prediction
Patient Health Monitoring
Home
Heart Disease Dataset
Logout
Frequency Table for Total data..
Yes (Total)
No (Total)
Total
Yes/Tot
No/Tot
275
184
459
0.599128540305011
0.4008714596949891
Frequency Tables are Completed...
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Fig.25

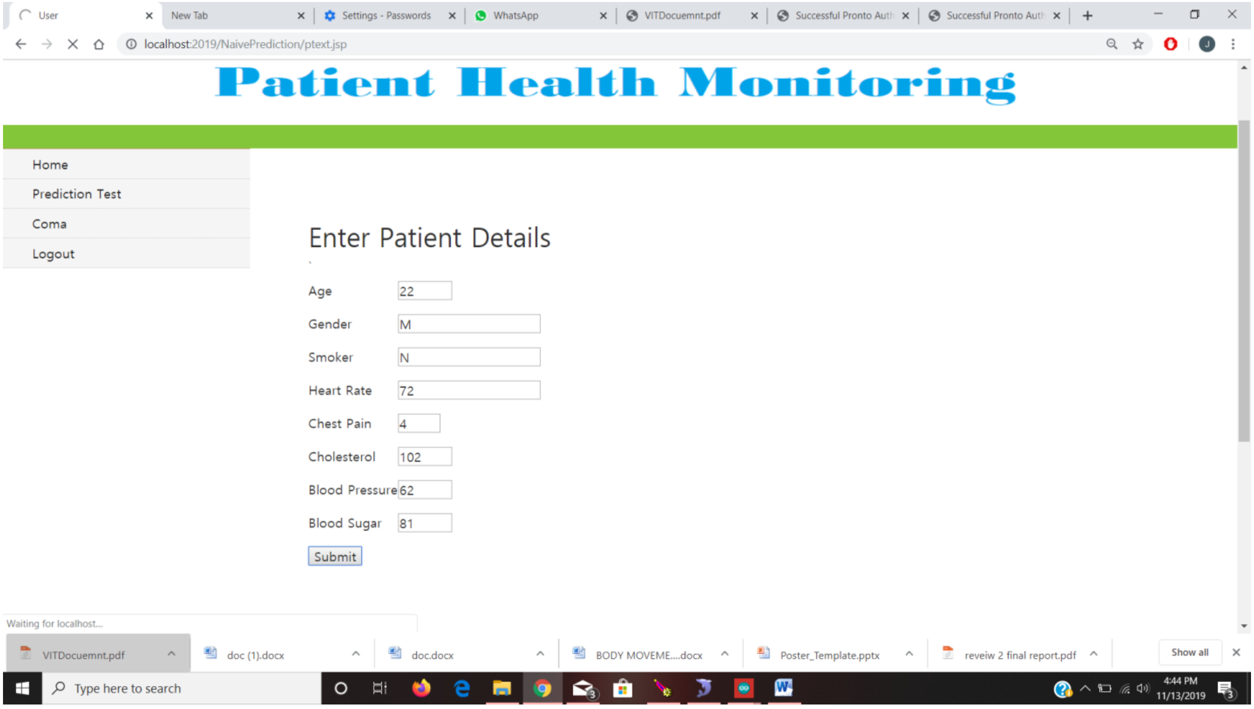

Fig.26

Coma Patient Monitoring:

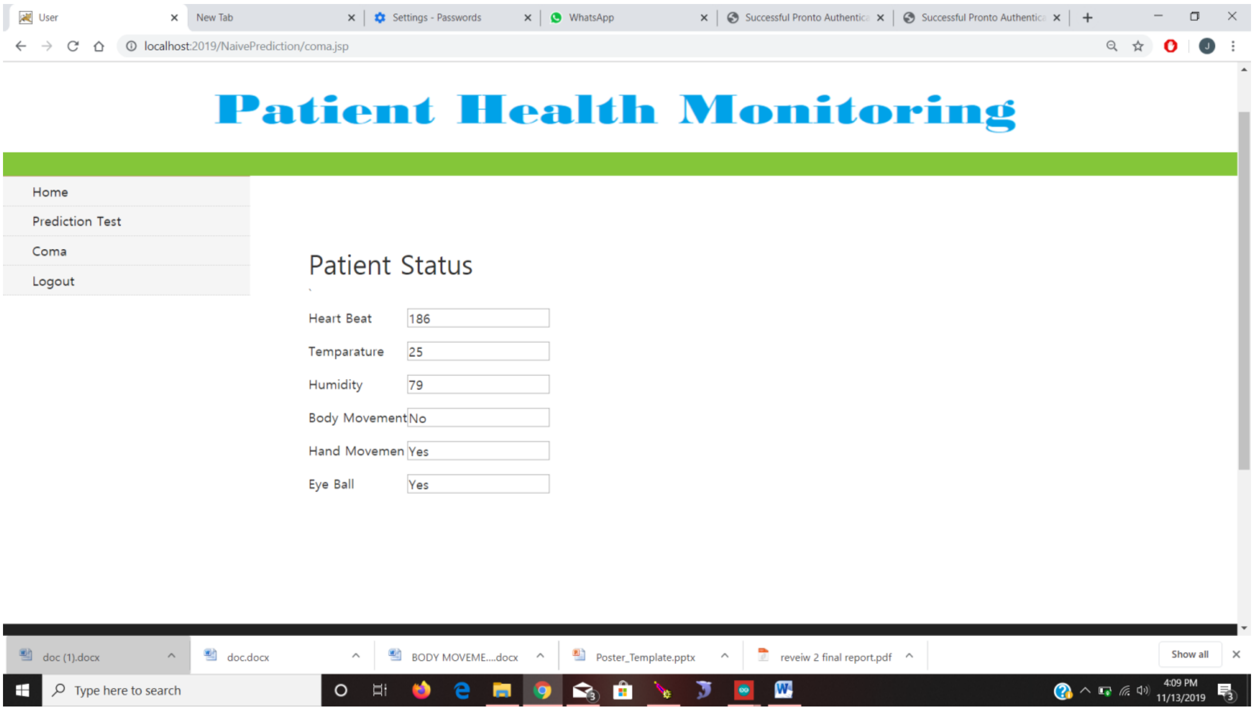

Fig.27

7. RESULTS AND DISCUSSIONS

In this paper we propose an IoT based application collaborate with Machine Learning concepts to monitor and mobilize the health issues for users. By the taking advantage of machine learning concepts and advanced medical embedded components we can apply the prediction results in heart diseases. We also proposed the Monetization of Coma Patient (MCP) using advanced medical embedded components and web technologies. We conducted several successful testing cases and we got the as expected results.

	A	B	C	D	E	F	G	H	I	J
1	1	33	M	Y	45	6	200	65	80	Y
2	2	55	F	N	66	9	256	88	99	N
3	3	77	M	Y	87	5	222	142	151	N
4	4	55	M	Y	55	2	155	121	200	Y
5	5	66	M	Y	56	8	239	139	122	N
6	6	89	M	N	88	5	240	120	222	Y
7	7	78	M	Y	77	6	355	91	99	Y
8	8	98	F	Y	66	9	321	88	92	N
9	9	65	M	Y	55	1	144	140	88	Y
10	10	56	F	N	98	2	265	155	166	Y
11	11	63	M	Y	45	6	200	65	80	Y
12	12	67	F	N	66	9	256	88	99	N
13	13	67	M	Y	87	5	222	142	151	N
14	14	37	M	Y	55	2	155	121	200	Y
15	15	41	M	Y	56	8	239	139	122	N
16	16	56	M	N	88	5	240	120	222	Y
17	17	62	M	Y	77	6	355	91	99	Y
18	18	57	F	Y	66	9	321	88	92	N
19	19	63	M	Y	55	1	144	140	88	Y
20	20	53	F	N	98	2	265	155	166	Y
21	21	57	M	Y	45	6	200	65	80	Y
22	22	56	F	N	66	9	256	88	99	N
23	23	56	M	Y	87	5	222	142	151	N
24	24	44	M	Y	55	2	155	121	200	Y
25	25	52	M	Y	56	8	239	139	122	N
26	26	57	M	N	88	5	240	120	222	Y
27	27	48	M	Y	77	6	355	91	99	Y
28	28	54	F	Y	66	9	321	88	92	N
29	29	48	M	Y	55	1	144	140	88	Y
30	30	49	F	N	98	2	265	155	166	Y
31	31	64	M	Y	45	6	200	65	80	Y
32	32	58	F	N	66	9	256	88	99	N

Fig.28 Heart attack data set.

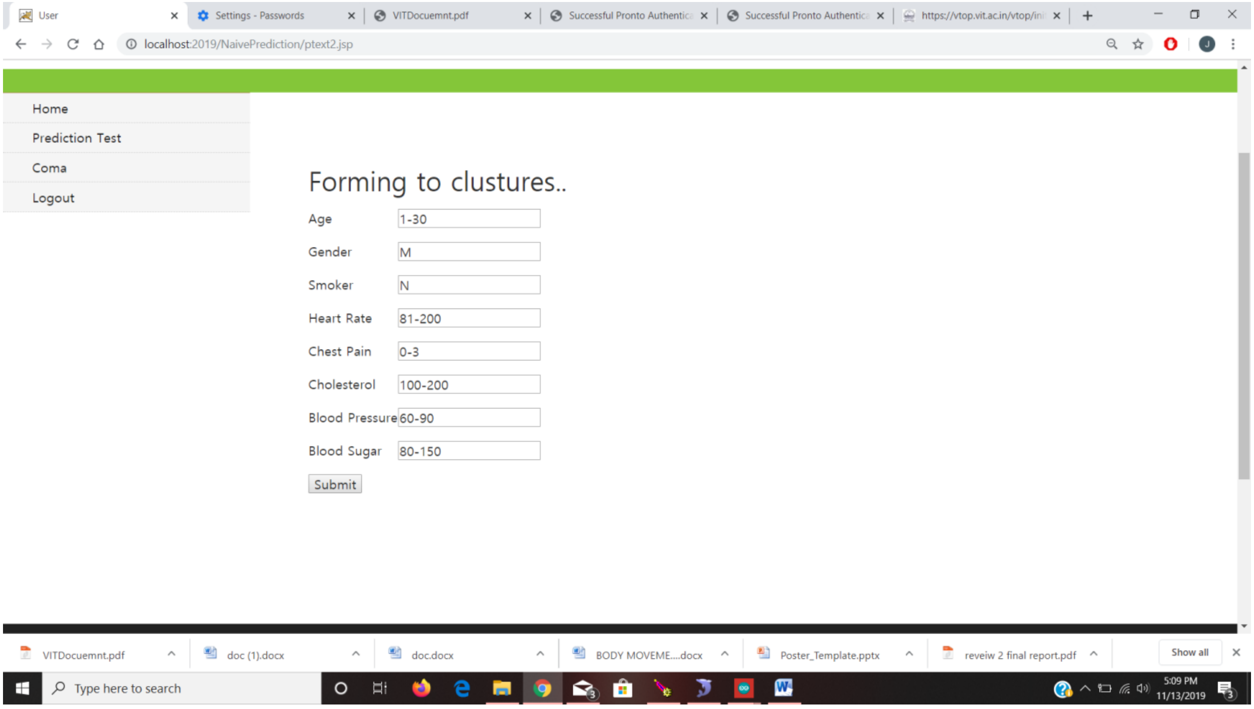
localhost:2019/NaivePrediction/ptext2.jsp
Home
Prediction Test
Coma
Logout
Forming to clustures..
Age 1-30
Gender M
Smoker N
Heart Rate 81-200
Chest Pain 0-3
Cholesterol 100-200
Blood Pressure 60-90
Blood Sugar 80-150
Submit

Fig.29


localhost:2019/NaivePrediction/ptext3.jsp
Patient Health Monitoring
Home
Prediction Test
Coma
Logout
Type Set Yes Score No Score
Age 1-30 3.0 4.0
Gender M 301.0 121.0
Smoker N 120.0 61.0
Heart Rate 81-200 121.0 79.0
ChestPain 0-3 180.0 1.0
Cholesterol 100-200 166.0 1.0
Bloodpressure 60-90 61.0 121.0
BloodSugar 80-150 181.0 181.0
p(yes)=(Yes_Score_of_age/Tot of Yes Score)*(Yes_Score_of_gen/Tot of Yes Score)*(Yes_Score_of_smoker/Tot of Yes Score)*(Yes_Score_of_hr/Tot of Yes Score)*(Yes_Score_of_cp/Tot of Yes Score)*(Yes_Score_of_ch/Tot of Yes Score)*(Yes_Score_of_bp/Tot of Yes Score)*(Yes_Score_of_bs/Tot of Yes Score)*(Yes Tot/Total)
p(yes)=9.396268260718133E-6
p(no)=(No_Score_of_age/Tot of No Score)*(No_Score_of_gen/Tot of No Score)*(No_Score_of_smoker/Tot of No Score)*(No_Score_of_hr/Tot of No Score)*(No_Score_of_cp/Tot of No Score)*(No_Score_of_ch/Tot of No Score)*(No_Score_of_bp/Tot of No Score)*(No_Score_of_bs/Tot of No Score)*(Tot No Score/Total)
p(no)=1.8593481617977382E-9
p(yes)+p(no)=9.39812760887993E-6
p(yes)/(p(yes)+p(no))=0.9998021575957279
p(no)/(p(yes)+p(no))=1.9784240427219902E-4
RESULT: POSSITIVE

Fig.30

Alerts for coma patient:

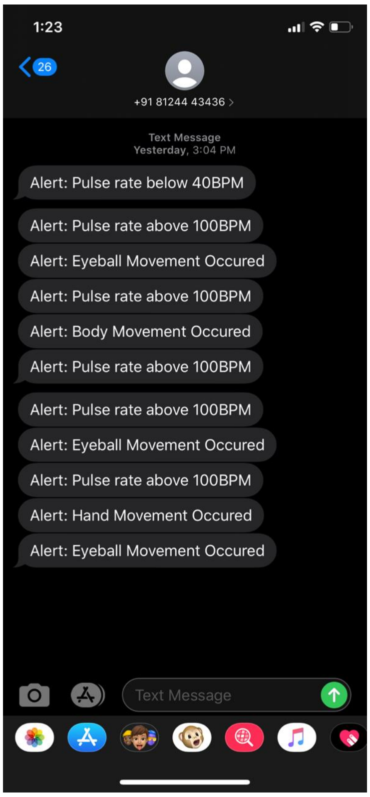

Fig.31

Hardware:

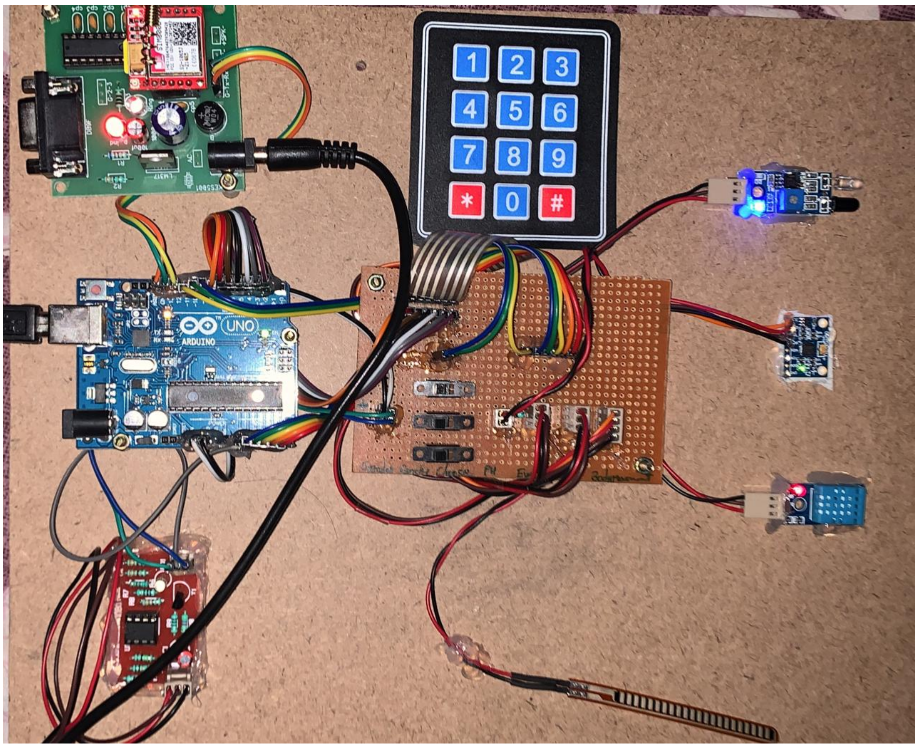

Fig.32

Comparison of algorithms

KNN

ADVANTAGES	DISADVANTAGES
Ease of understanding and implementing	It is lazy learners
Fast training	It is very sensitive to local data structure
It is strong with training set of data	Memory cost
It behaves best with sample of many class labels.	Runs slowly

Table 5- Comparison of algorithms

NAÏVE BAYES

ADVANTAGES	DISADVANTAGES
It Takes less computational time for training.	It requires really large number of records get good results.
High performance.	May be it is less accurate than other algorithms on few data sets.

Table 6

8. SUMMARY

The prototype we developed in this project we will be able to predict the heart attack which can be used at a particular time based on the parameters of the patient at that time. We will be using heart rate sensor, temperature and humidity sensor, flux sensor, motion sensor, GSM module to collect the readings of the patient and the Arduino microcontroller will send these reading to the server with the help of GSM module. Based on the data set available and the previous readings we will get the results with the help of two algorithms namely KNN and Naïve Bayes. By this we propose an IoT based application collaborate with Machine Learning concepts to monitor and mobilize the health issues for users. By taking this as an advantage of machine learning concepts and advanced medical embedded components we can apply the prediction results in heart diseases. We also proposed the Monetization of Coma Patient (MCP) using advanced medical embedded components and web technologies. We conducted several successful testing cases and we got the results.

\

9. REFERENCES

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10. APPENDIX

GROUP WORK

In this project we developed a prototype that can measure the heart attack and coma patient monitoring using the respective sensors and these readings will be sent to a server using GSM module. With the help of these reading and the available data set we use KNN and Naive Bayes algorithms. We predict if a person can get the heart attack depending upon various attributes. In this project, we designed a web application with the help of Arduino and TOMCAT server.

Firstly we found out the requirements for this project and based on this we divided and scheduled our work. We mainly concentrated on the selection of algorithms that would help us to find a better solution. I have gone through various research works of different authors and listed them out first. Later we collected the list from all of us a chose KNN and Naive Bayes. Then we had to choose the parameters that have to be considered in the determination of the heart attack. In this process, I have come up with nearly 3-4 parameters and my teammates suggested a few other.

Secondly, the collection of data set was a herculean task for us. We referred a number of websites articles for this and in the end with the help of our guide, we got the data set. Later we worked on designing the project such as knowing different software and hardware requirements. Then we finally chose Tom Cat server for the web application and Arduino as the microcontroller. Later we had to choose parameters which can be measured using sensors and we had to choose the ones that were economically feasible to us.

Later we have assembled the hardware components such as Arduino microcontroller, heart rate sensor, temperature and humidity sensor, flux sensor, motion sensor, GSM module with the help of our friends. Finally, we were left with the testing part which was done a number of times by each one of us.