IoT Domain Analyst

Winter Semester 2022-23

Project Title: Heart Rate Monitoring and Heart-attack Prediction

Under the due guidance of

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SELECT

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ABSTRACT

Cardiovascular diseases, including heart attacks, are a leading cause of mortality worldwide. Early detection and timely intervention can significantly reduce the risk of heart-related complications. In this project, we aimed to develop a smart model that can monitor heart rate and predict heart attacks in real-time, with the data displayed on a web application.

Our project utilized a combination of data from heart rate sensors and machine learning algorithms to develop a predictive model. We collected heart rate data from a group of volunteers and processed it to extract relevant features such as heart rate variability, resting heart rate, and heart rate trends. This data was then used to train and validate our predictive model.

The developed smart model was integrated into a web application, allowing users to easily monitor their heart rate in real time and receive predictive alerts for potential heart attacks. The web application also provided visualizations of heart rate data over time, allowing users to track their heart health and make informed decisions about their lifestyle and health habits.

The accuracy and performance of our smart model were evaluated through extensive testing and validation. The results showed promising accuracy in predicting heart attacks, with high sensitivity and specificity. The web application provided an intuitive and user-friendly interface for heart rate monitoring and heart-attack prediction, making it a valuable tool for the early detection and prevention of heart-related complications.

This project contributes to the field of healthcare and technology by leveraging heart rate monitoring and machine learning techniques to develop a predictive model for heart attack prediction. The real-time monitoring and predictive alerts provided by our smart model could potentially aid in early detection and timely intervention, helping to reduce the burden of cardiovascular diseases and improve patient outcomes.

Keywords: Heart rate monitoring, Heart attack prediction, Machine learning, Web application, Early detection, Cardiovascular diseases.

INTRODUCTION

Cardiovascular diseases, including heart attacks, are a significant global health concern, accounting for a substantial number of mortalities worldwide. Timely detection and intervention are critical in mitigating the risk of heart-related complications and improving patient outcomes. With advancements in healthcare and technology, there is increasing interest in developing smart models that can monitor heart health and predict heart attacks in real time.

The aim of this project is to build a smart model that can effectively monitor heart rate and provide predictive alerts for potential heart attacks, with the data displayed on a web application. Our project utilizes a combination of heart rate monitoring, data analysis, and machine learning algorithms to develop a predictive model that can aid in early detection and prevention of heart-related complications.

The heart rate data is collected from a group of volunteers, and relevant features such as heart rate variability, resting heart rate, and heart rate trends are extracted and processed. These features are then used to train and validate a predictive model using machine learning algorithms.

In conclusion, our project aims to contribute to the field of healthcare and technology by leveraging heart rate monitoring and machine learning techniques to develop a smart model for heart attack prediction. The integration of our predictive model into a web application has the potential to provide a valuable tool for the early detection and prevention of heart-related complications, ultimately leading to improved patient care and outcomes.

MOTIVATION

Heart disease is one of the leading causes of death worldwide. According to the World Health Organization (WHO), an estimated 17.9 million people die from cardiovascular diseases (CVDs) every year, which represents 31% of all global deaths. In the United States alone, more than 600,000 people die from heart disease each year, making it the leading cause of death for both men and women.

One of the most common and dangerous forms of heart disease is a heart attack, which occurs when blood flow to the heart is blocked. The symptoms of a heart attack can be subtle, and if not detected early, can lead to serious consequences, including death. Therefore, it is essential to monitor the heart rate and other related factors to predict the likelihood of a heart attack.

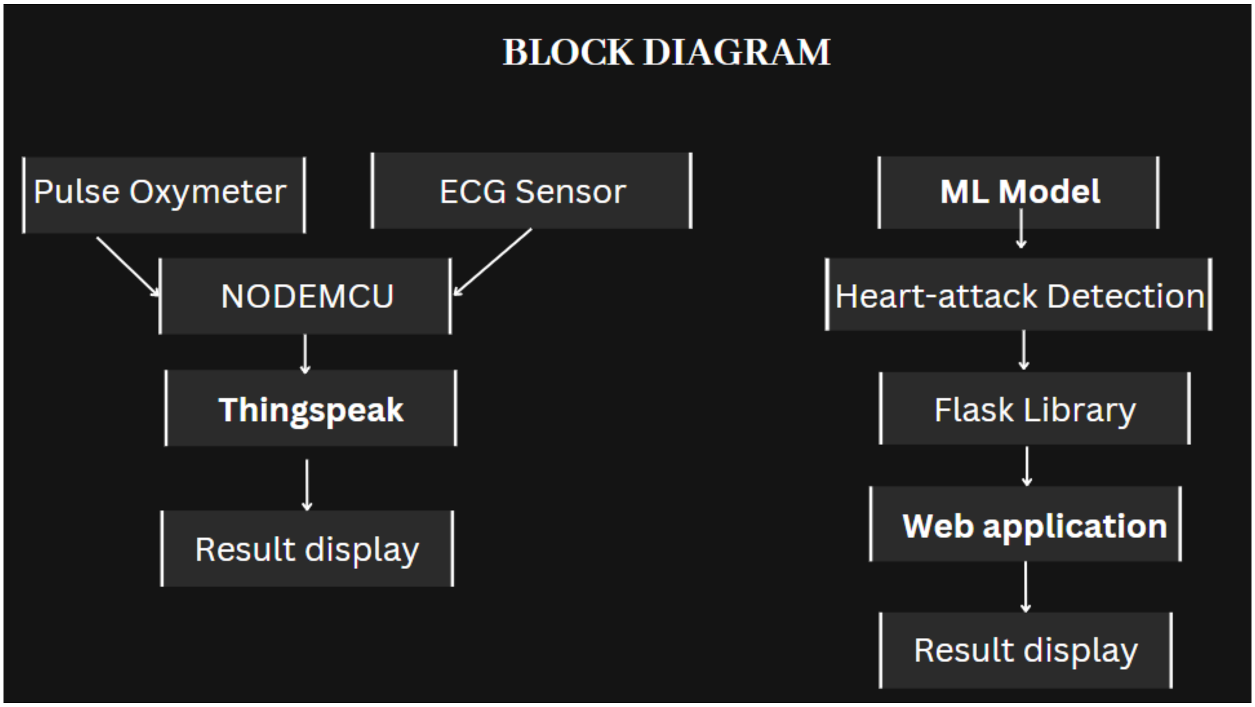
Heart rate monitoring and heart-attack prediction systems can play a vital role in detecting and preventing heart disease. These systems can continuously monitor heart rate, blood pressure, and other physiological parameters to identify any abnormalities that may indicate the risk of a heart attack. Early detection of potential heart problems can help patients receive timely medical attention, reducing the chances of a fatal heart attack. The development of heart rate monitoring and heart-attack prediction systems can significantly improve the quality of life for patients at risk of heart disease. Therefore, this project aims to build a heart rate monitoring and heart-attack prediction system using machine learning techniques. This system will provide accurate and timely alerts to patients and healthcare professionals, allowing them to take appropriate actions to prevent or manage heart disease.

CONTRIBUTION

The contribution of this project is two-fold. First, we have developed a heart rate monitoring system that utilizes pulse oximeters and ECG sensors to measure the heart rate, blood oxygen saturation levels, and ECG readings of a person. This system provides real-time heart rate monitoring, enabling individuals to track their heart rate and identify any abnormalities that may indicate the risk of a heart attack. Secondly, we have developed an ML model that utilizes a Logistic Regression to predict the risk of a heart attack based on the collected physiological data. The model takes into account factors such as heart rate, blood oxygen saturation levels, and ECG readings to generate a probability score indicating the likelihood of a heart attack. This can help individuals and healthcare professionals to identify individuals at high risk of a heart attack and take appropriate actions to prevent or manage heart disease.

Additionally, we have implemented a website that displays the output of the heart rate monitoring system and the prediction of the ML model. This project can help in the early detection of heart problems and timely interventions, leading to improved health outcomes for individuals at risk of heart disease.

Overall, this project's contribution is the integration of different technologies to create a heart rate monitoring system and an ML model that predicts the risk of a heart attack. This system can provide valuable insights to individuals and healthcare professionals and help in the early detection and prevention of heart disease.



PROPOSED MODEL

The proposed model for heart attack prediction is based on the decision tree classification algorithm. Decision tree is a popular machine-learning algorithm that is widely used for classification and regression tasks. The algorithm works by creating a tree-like model of decisions and their possible consequences. The model consists of a series of decision nodes and leaf nodes, where each decision node represents a feature or attribute, and each leaf node represents a class or outcome.
In our proposed model, we have used heart rate, blood oxygen saturation levels, ECG readings and several other parameters as the input features. The model is trained on a dataset of individuals with and without a history of heart disease. The dataset is preprocessed, and the input features are normalized to a range of 0 to 1.

The decision tree model is trained using the dataset, and the model's performance is evaluated using different evaluation metrics such as accuracy, precision, recall, and F1-score. Once the model is trained, it can be used to predict the risk of heart attack for new individuals. The proposed model's output is a probability score that indicates the likelihood of a heart attack. The probability score ranges from 0 to 1, with 0 indicating no risk and 1 indicating a high risk. The threshold for classifying an individual as high-risk can be adjusted based on the desired sensitivity and specificity of the model.

The proposed model has several advantages over traditional methods of heart attack prediction. It is non-invasive and does not require any specialized equipment or expertise to operate. It can provide real-time risk assessment and can be integrated with existing health monitoring systems to provide continuous monitoring of individuals at high risk of heart disease. The model can also be easily updated as new data becomes available, improving its accuracy and performance. The proposed model has the potential to significantly improve the early detection and prevention of heart disease, leading to improved health outcomes for individuals at risk of a heart attack. It is a simple yet effective tool that can be used by healthcare professionals and individuals alike to monitor their heart health and take appropriate actions to prevent or manage heart disease.

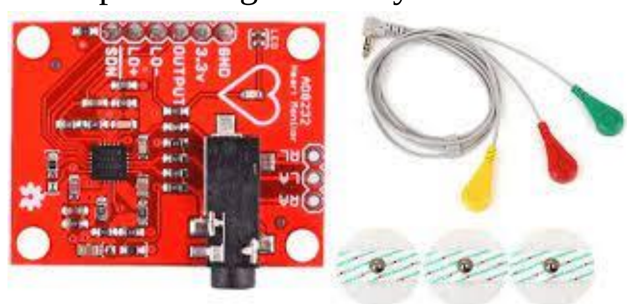
PRELIMINARIES

1. Esp8266 nodemcu

The ESP8266 NodeMCU is a low-cost, Wi-Fi-enabled microcontroller board based on the ESP8266 chipset. It is a popular development board among hobbyists and professionals alike due to its small size, low cost, and excellent Wi-Fi connectivity capabilities. The NodeMCU board features a USB interface for power and programming, as well as a set of GPIO pins that can be used to interface with external devices and sensors. It also has a built-in Wi-Fi module that supports 802.11b/g/n wireless standards and can be used to connect to Wi-Fi networks or create Wi-Fi access points.

2. Ad8232 ECG sensor

The AD8232 ECG sensor is a single-lead, heart rate monitoring sensor that is commonly used in medical and fitness applications. It is designed to measure the electrical activity of the heart and provide an accurate measurement of the heart's activity. The sensor consists of three electrodes that are placed on the body to capture the electrical activity of the heart. The first electrode is placed on the left side of the chest, the second electrode is placed on the right side of the chest, and the third electrode is placed on the left leg. The AD8232 ECG sensor uses a differential amplifier to amplify the small electrical signals produced by the heart and filter out unwanted noise and interference. The filtered signal is then digitized and sent to a microcontroller for further processing and analysis.



3. Max30100 pulse oximeter

The MAX30100 pulse oximeter is a small, low-cost sensor that is used to measure blood oxygen saturation levels (SpO2) and heart rate. It uses a combination of red and infrared light to measure the amount of oxygen in the blood and then calculates the heart rate based on the pulse signal. The sensor is easy to use and requires minimal setup and configuration. It is typically interfaced with a microcontroller or development board using an I2C interface. Once connected, the sensor can be configured and data can be read from the sensor registers.

4. Logistic Regression

Logistic Regression is a type of statistical analysis that is used to predict the probability of a binary outcome (i.e., yes/no or true/false) based on one or more predictor variables. It is commonly used in machine learning and statistical analysis to model the relationship between a set of predictor variables and a binary outcome. The logistic regression model is based on the logistic function, which is a mathematical function that maps any real-valued number to a value between 0 and 1. The logistic function is used to transform the output of the linear regression model into a probability value that represents the likelihood of the binary outcome.

In logistic regression, the goal is to find the best set of coefficients that maximize the likelihood of the observed data. This is typically done using a technique called maximum likelihood estimation. Logistic regression is a powerful tool for analyzing binary data and is widely used in a variety of applications, including medical research, social sciences, and marketing. It is also commonly used in machine learning to build classification models that can be used to predict the probability of a binary outcome based on a set of input variables.

5. Flask Library

Flask is a lightweight web framework written in Python that is commonly used for developing web applications. It is designed to be simple and easy to use, and provides developers with the tools they need to build complex web applications quickly and efficiently. Flask is built on top of the Werkzeug toolkit and the Jinja2 template engine, both of which are widely used in the Python community. This makes Flask an excellent choice for developers who are already familiar with Python and want to build web applications using a familiar language.

6.Thingspeak platform

ThingSpeak is an open-source, cloud-based Internet of Things (IoT) platform that allows developers and enthusiasts to collect, analyze, and visualize data from connected devices. The platform provides an easy-to-use interface for creating IoT applications and integrating devices and sensors. With ThingSpeak, users can create channels to collect and store data from sensors and devices, and then analyze and visualize the data using built-in tools and custom scripts. The platform also includes a RESTful API that allows developers to access and manage data programmatically.

COMPARISON TABLE

Property	Existing Model	Proposed Model
Heart Rate Monitoring	Many existing heart rate monitoring devices are available, such as Fitbit, Apple Watch, and various smartphone apps.	The proposed model uses an ECG sensor and a pulse oximeter to measure heart rate and blood oxygen levels.
Heart Attack Prediction	There are a few heart attack prediction models available, such as the Framingham Risk Score and the Reynolds Risk Score.	The proposed model uses a Logistic Regression to predict the likelihood of a heart attack based on the user's heart rate and blood oxygen levels.
Hardware	Many hardware components are available for heart rate monitoring, such as sensors, microcontrollers, and wireless communication modules.	The proposed model uses an ESP8266 NodeMCU development board to collect and transmit data from the ECG sensor and pulse oximeter.

Software	Various software platforms are available for data analysis and visualization, such as MATLAB, Python, and R.	The proposed model uses the Flask library to create a website that displays the heart rate and blood oxygen levels in real-time, and the Logistic Regression output.
Integration	Existing heart rate monitoring and heart attack prediction models may not be integrated or available in a single device.	The proposed model integrates and provides a more comprehensive health monitoring solution.

ML CODE:

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
# import hvplot.pandas
from scipy import stats
import pickle
data = pd.read_csv("heart.csv")
from sklearn.preprocessing import StandardScaler
s_sc = StandardScaler()
col_to_scale = ['age', 'trestbps', 'chol', 'thalach', 'oldpeak']
data[col_to_scale] = s_sc.fit_transform(data[col_to_scale])
from sklearn.model_selection import train_test_split
X = data.drop('target', axis=1)
y = data.target
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.0001, random_state=42)
from sklearn.linear_model import LogisticRegression
lr_clf = LogisticRegression(solver='liblinear')
lr_clf.fit(X_train.values, y_train)
```

```
pred = lr_clf.predict(X_test.values)
# print(pred)
pickle.dump(lr_clf, open('model.pkl','wb'))
#input =
age,sex,cp,testbps,chol,fbs,restecg,thlach,exang(0,1),oldpeak,slope,c
a,thal
input = [63,1,3,145,233,1,0,150,0,2.3,0,0,1]
input= np.array(input).reshape(1,-1)
pred2=lr_clf.predict(input)
print("prediction :  ",pred2)
```

FLASK CODE:

```
import numpy as np
from flask import Flask, render_template,request
import pickle#Initialize the flask App
app = Flask(__name__)
model = pickle.load(open('model.pkl', 'rb'))
#default page of our web-app
@app.route('/')
def home():
    return render_template('index.html')
@app.route('/predict',methods=['POST'])
def predict():
    #For rendering results on HTML GUI
    int_features = [float(x) for x in request.form.values()]
    final_features = np.array(int_features).reshape(1,-1)
    heart_prediction = model.predict(final_features)
    return render_template('index.html', prediction_text=' Heart
attack possibility : {} \n'.format(percent(heart_prediction)))
         def percent(val):
    if(val==1):
        return "YES"
    else:
        return "NO"
if __name__ == "__main__":
    app.run(debug=True)
```

ESP8266 CODE:

```
#include <Adafruit_GFX.h>
#include <Adafruit_GrayOLED.h>
#include <Adafruit_SPITFT.h>
#include <Adafruit_SPITFT_Macros.h>
#include <gfxfont.h>

#include <Wire.h>

#include <CircularBuffer.h>
#include <MAX30100.h>
#include <MAX30100_BeatDetector.h>
#include <MAX30100_Filters.h>
#include <MAX30100_PulseOximeter.h>
#include <MAX30100_Registers.h>
#include <MAX30100_SpO2Calculator.h>

#include <MAX30100.h>

#include <ThingSpeak.h>
#include <ESP8266HTTPClient.h>
#include <ESP8266WiFi.h>
// #include <PubSubClient.h>

//------- WI-FI details ----------//
char ssid[] = "timestone"; //SSID here
char pass[] = "yadukanet"; // Passowrd here
//--------------------------------//                                // Put your
wifi password here


/****************************************
 * Define Constants for Thinspeak
 ****************************************/
unsigned long Channel_ID = 2088062; // Your Channel ID
const char * myWriteAPIKey = "K73FZPHDDC8BD3J0"; //Your write API key

const int spo_field = 1;
const int bpm_field = 2;
const int ecg_field = 3;
WiFiClient client;
/****************************************
 * Define Constants For AD822 ECG Sensor
```

```
 ****************************************/
#define VARIABLE_LABEL "myecg" // Assing the variable label
#define DEVICE_LABEL "esp8266" // Assig the device label

#define SENSOR A0 // Set the A0 as SENSOR
// char payload[100];
// char topic[150];
// Space to store values to send
char str_sensor[10];

/****************************************
 * Define Constants For MAX30100 BPM/POX Sensor
 ****************************************/
// Connections : SCL PIN - D1 , SDA PIN - D2 , INT PIN - D0

#define REPORTING_PERIOD_MS 1000
#define SAMPLING_RATE MAX30100_SAMPRATE_100HZ
#define IR_LED_CURRENT MAX30100_LED_CURR_50MA
#define RED_LED_CURRENT MAX30100_LED_CURR_7_6MA

#define PULSE_WIDTH MAX30100_SPC_PW_1600US_16BITS
#define HIGHRES_MODE true
MAX30100 poxmeter;
PulseOximeter pox;

float BPM, SpO2;
uint32_t tsLastReport = 0;

static const unsigned char PROGMEM logo2_bmp[] =
{ 0x03,  0xC0, 0xF0, 0x06, 0x71, 0x8C, 0x0C, 0x1B, 0x06, 0x18, 0x0E, 0x02,
0x10, 0x0C, 0x03,  0x10,              //Logo2 and Logo3 are two bmp pictures
that display on the OLED  if called
0x04, 0x01, 0x10, 0x04, 0x01, 0x10, 0x40, 0x01, 0x10, 0x40, 0x01, 0x10,  0xC0,
0x03, 0x08, 0x88,
0x02, 0x08, 0xB8, 0x04, 0xFF, 0x37, 0x08, 0x01, 0x30,  0x18, 0x01, 0x90, 0x30,
0x00, 0xC0, 0x60,
0x00, 0x60, 0xC0, 0x00, 0x31, 0x80,  0x00, 0x1B, 0x00, 0x00, 0x0E, 0x00, 0x00,
0x04, 0x00,  };

static const unsigned  char PROGMEM logo3_bmp[] =
{ 0x01, 0xF0, 0x0F, 0x80, 0x06, 0x1C, 0x38, 0x60,  0x18, 0x06, 0x60, 0x18,
0x10, 0x01, 0x80, 0x08,
0x20, 0x01, 0x80, 0x04, 0x40,  0x00, 0x00, 0x02, 0x40, 0x00, 0x00, 0x02, 0xC0,
0x00, 0x08, 0x03,
0x80, 0x00,  0x08, 0x01, 0x80, 0x00, 0x18, 0x01, 0x80, 0x00, 0x1C, 0x01, 0x80,
```

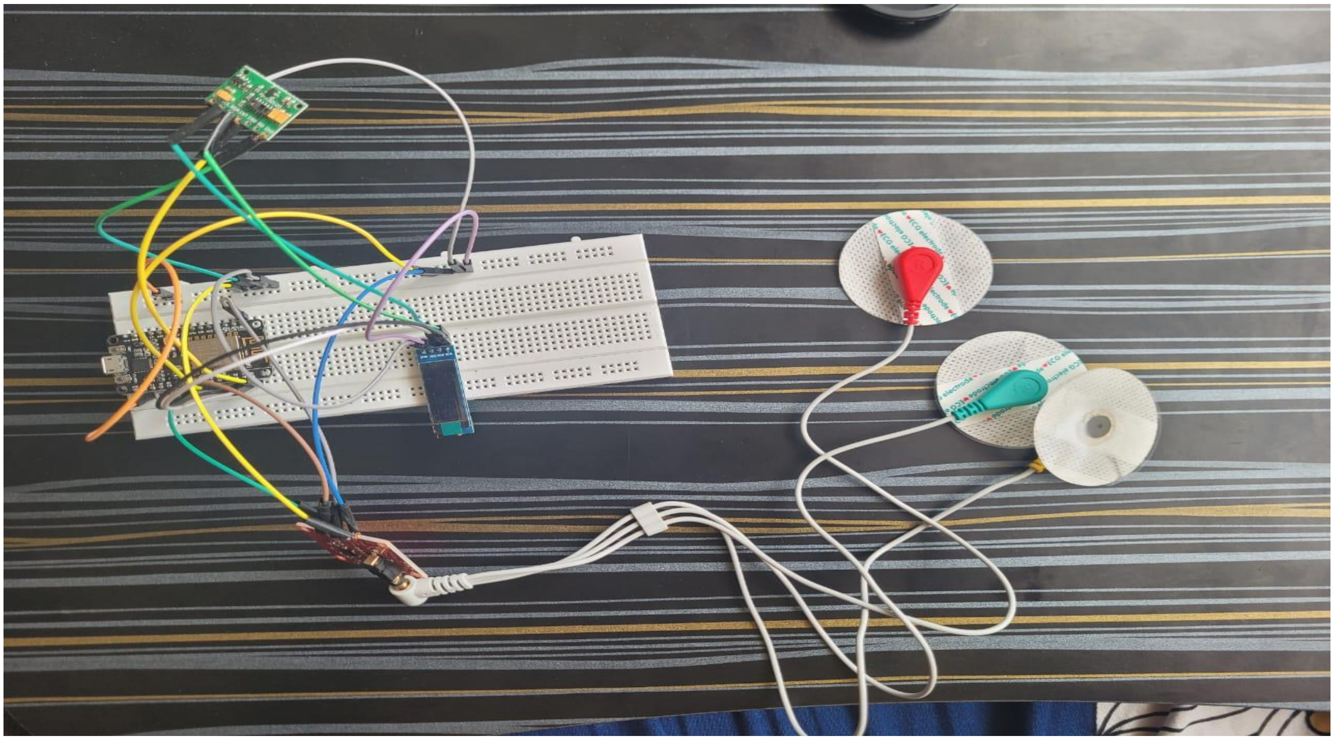
```
0x00, 0x14, 0x00,
0x80,  0x00, 0x14, 0x00, 0x80, 0x00, 0x14, 0x00, 0x40, 0x10, 0x12, 0x00, 0x40,
0x10, 0x12,  0x00,
0x7E, 0x1F, 0x23, 0xFE, 0x03, 0x31, 0xA0, 0x04, 0x01, 0xA0, 0xA0, 0x0C,  0x00,
0xA0, 0xA0, 0x08,
0x00, 0x60, 0xE0, 0x10, 0x00, 0x20, 0x60, 0x20, 0x06,  0x00, 0x40, 0x60, 0x03,
0x00, 0x40, 0xC0,
0x01, 0x80, 0x01, 0x80, 0x00, 0xC0,  0x03, 0x00, 0x00, 0x60, 0x06, 0x00, 0x00,
0x30, 0x0C, 0x00,
0x00, 0x08, 0x10,  0x00, 0x00, 0x06, 0x60, 0x00, 0x00, 0x03, 0xC0, 0x00, 0x00,
0x01, 0x80, 0x00  };


void onBeatDetected()
{
    Serial.println("Beat Detected!");
}
void setup()
{
    Serial.begin(115200);
    /* ------------------------------------
                FOR AD822 ECG
    ---------------------------------------*/
    // Serial.begin(115200);
    // WiFi.mode(WIFI_STA);
    // WiFi.begin(ssid,pass);
    // Assign the pin as INPUT
    pinMode(SENSOR, INPUT);

    Serial.println();
    Serial.print("Waiting for WiFi...");

    WiFi.begin(ssid, pass);
    while (WiFi.status() != WL_CONNECTED)
    {
      Serial.println("Waiting for WiFi...");
      delay(5000);
    }

    Serial.println("");
    Serial.println("WiFi Connected");
    Serial.println("IP address: ");
    Serial.println(WiFi.localIP());
    ThingSpeak.begin(client);
    // client.setServer(mqttBroker, 1883);
```

```
    // client.setCallback(callback);


    /* ----------------------------------------------------------
                      FOR PULSE OXYMETER MAX 30100
    ---------------------------------------------------------------*/
    pinMode(16, OUTPUT);

    // poxmeter.begin(); //Get raw values
    // poxmeter.setMode(MAX30100_MODE_SPO2_HR);
    // poxmeter.setLedsCurrent(IR_LED_CURRENT, RED_LED_CURRENT);
    // poxmeter.setLedsPulseWidth(PULSE_WIDTH);
    // poxmeter.setSamplingRate(SAMPLING_RATE);
    // poxmeter.setHighresModeEnabled(HIGHRES_MODE);
    Serial.print("Initializing Pulse Oximeter..");

    if (!pox.begin())
    {
         Serial.println("FAILED");
         for(;;);
    }
    else
    {
         Serial.println("SUCCESS");
         pox.setOnBeatDetectedCallback(onBeatDetected);
    }

}

void loop()
{
    // internet();

    /* --------------------------------
              ECG Sensor:
    ------------------------------------*/
    // sprintf(topic, "%s%s", "/v1.6/devices/", DEVICE_LABEL);
    // sprintf(payload, "%s", "");                   // Cleans the payload
    // sprintf(payload, "{\"%s\":", VARIABLE_LABEL); // Adds the variable label

    float myecg = analogRead(SENSOR);

    /* 4 is mininum width, 2 is precision; float value is copied onto
str_sensor*/
    dtostrf(myecg, 4, 2, str_sensor);
```

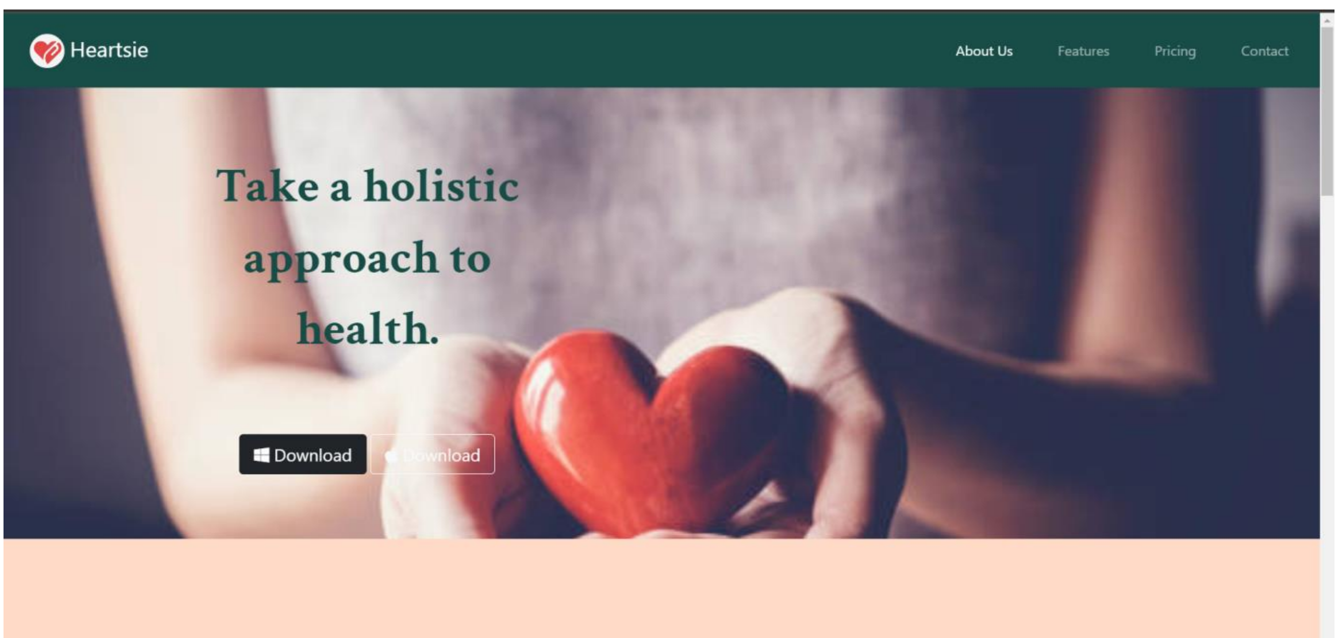
```
    Serial.println("EGG: ");
    Serial.print(myecg);

    // sprintf(payload, "%s {\"value\": %s}}", payload, str_sensor); // Adds
the value
    // Serial.println("Payload: ");
    // Serial.print(payload);

    /*----------------------------------
              FOR PULSEOXYMETER
    -------------------------------------*/
    delay(10);
    if (millis() - tsLastReport > REPORTING_PERIOD_MS)
    {
    pox.update();

    BPM = pox.getHeartRate();
    SpO2 = pox.getSpO2();
        Serial.print("Heart rate:");
        Serial.print(BPM);
        Serial.print(" bpm / SpO2:");
        Serial.print(SpO2);
        Serial.println(" %");

        tsLastReport = millis();
        ThingSpeak.writeField(Channel_ID, ecg_field, myecg, myWriteAPIKey);
        ThingSpeak.writeField(Channel_ID, bpm_field, BPM, myWriteAPIKey);
        ThingSpeak.writeField(Channel_ID, spo_field, SpO2, myWriteAPIKey);
    }

}

void internet()
{
  if (WiFi.status() != WL_CONNECTED)
  {
    WiFi.begin(ssid, pass);
    while (WiFi.status() != WL_CONNECTED)
    {
      delay(5000);
      Serial.print(".");
    }
  }
}
```

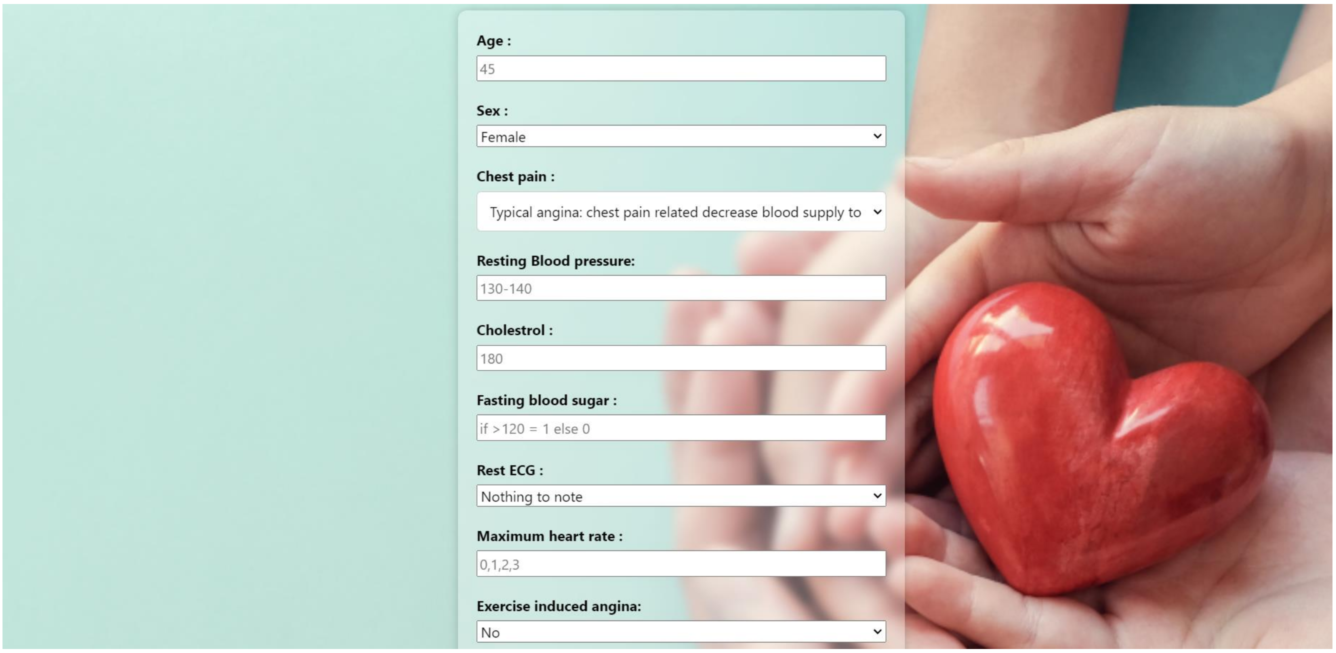
RESULT:

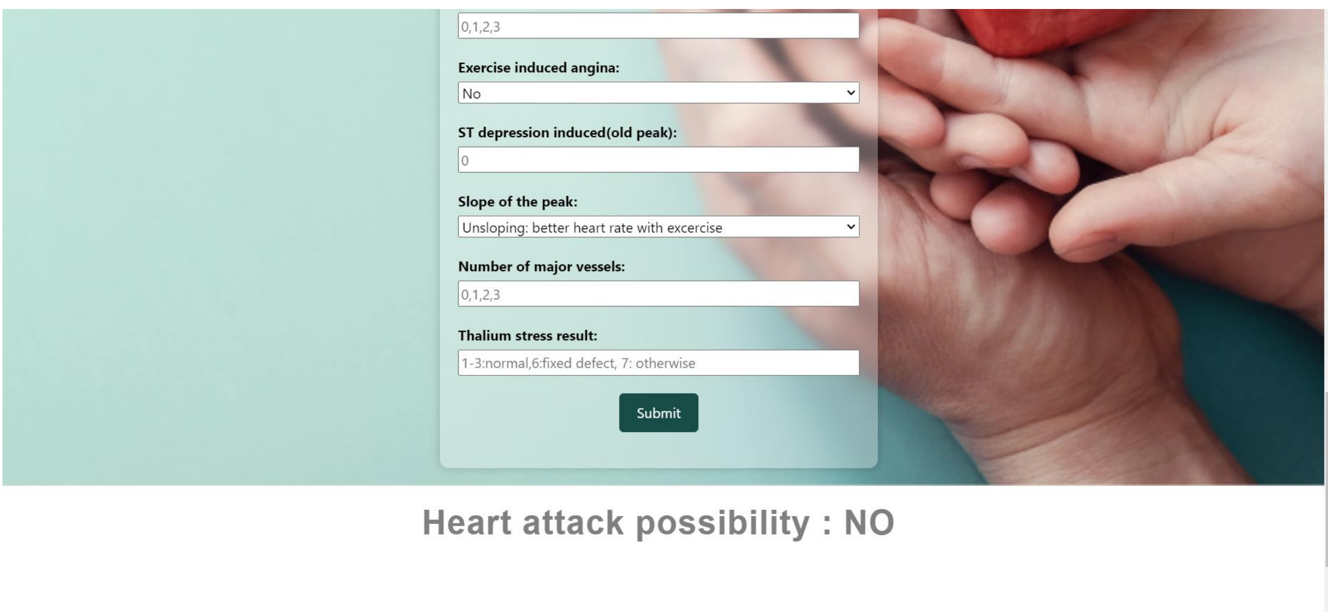
Hardware:

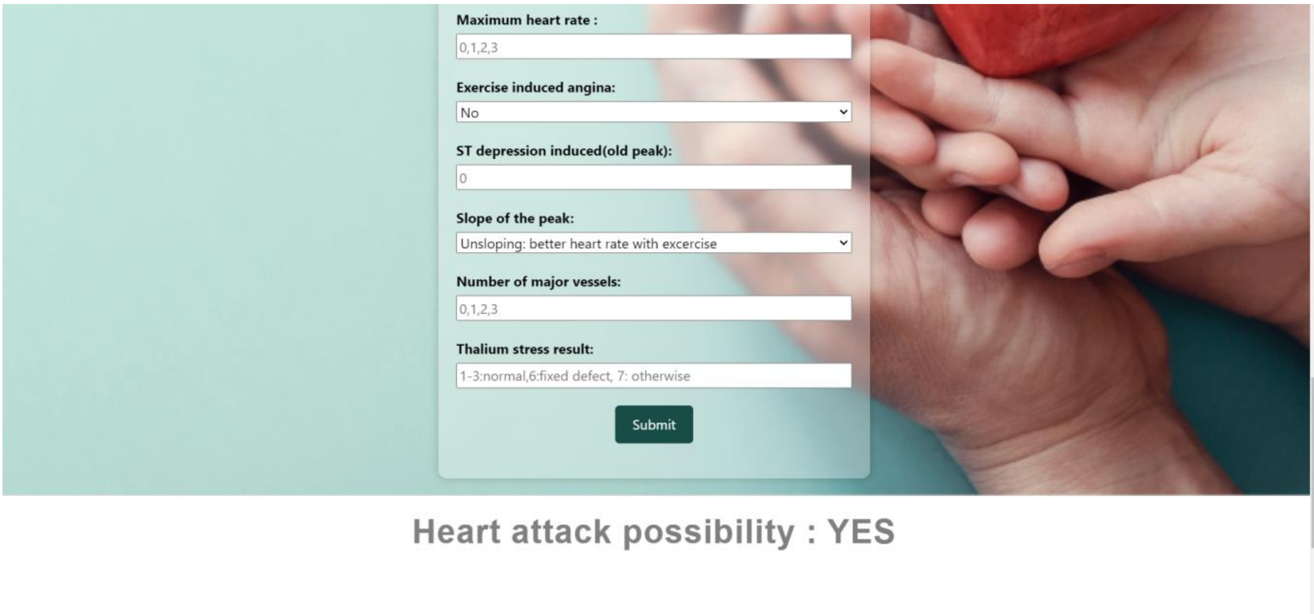


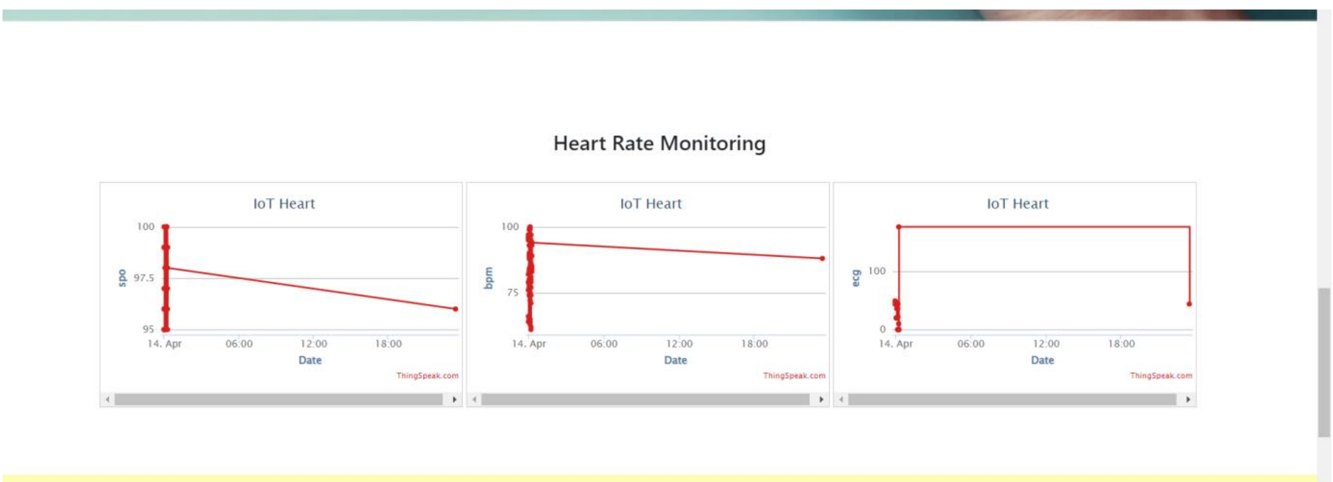
Website:

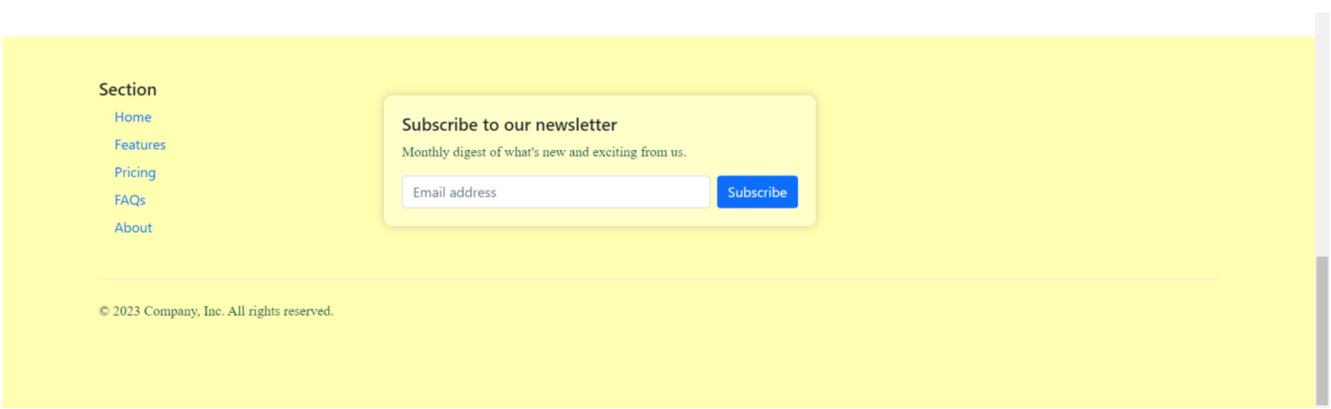



Age :
45
Sex :
Female
Chest pain :
Typical angina: chest pain related decrease blood supply to
Resting Blood pressure:
130-140
Cholestrol :
180
Fasting blood sugar :
if >120 = 1 else 0
Rest ECG :
Nothing to note
Maximum heart rate :
0,1,2,3
Exercise induced angina:
No


0,1,2,3
Exercise induced angina:
No
ST depression induced(old peak):
0
Slope of the peak:
Unsloping: better heart rate with excercise
Number of major vessels:
0,1,2,3
Thalium stress result:
1-3:normal,6:fixed defect, 7: otherwise
Submit
Heart attack possibility : NO


Maximum heart rate :
0,1,2,3
Exercise induced angina:
No
ST depression induced(old peak):
0
Slope of the peak:
Unsloping: better heart rate with excercise
Number of major vessels:
0,1,2,3
Thalium stress result:
1-3:normal,6:fixed defect, 7: otherwise
Submit
Heart attack possibility : YES


Heart Rate Monitoring
IoT Heart
spo
100
97.5
95
14. Apr
06:00
12:00
18:00
Date
ThingSpeak.com
IoT Heart
bpm
100
75
14. Apr
06:00
12:00
18:00
Date
ThingSpeak.com
IoT Heart
ecg
100
0
14. Apr
06:00
12:00
18:00
Date
ThingSpeak.com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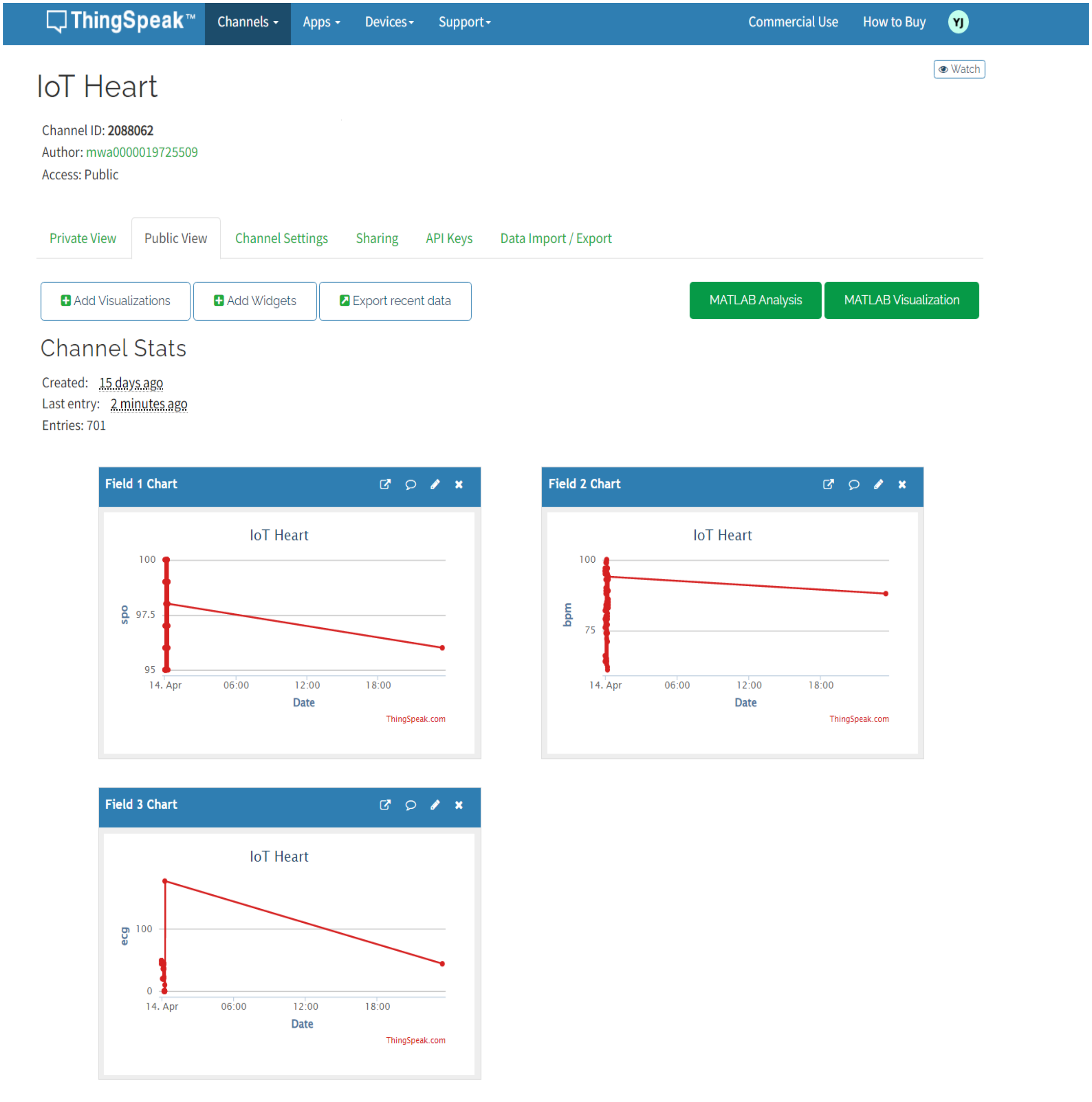
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Channels
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How to Buy
YJ
Watch
IoT Heart
Channel ID: 2088062
Author: mwa0000019725509
Access: Public
Private View
Public View
Channel Settings
Sharing
API Keys
Data Import / Export
Add Visualizations
Add Widgets
Export recent data
MATLAB Analysis
MATLAB Visualization
Channel Stats
Created: 15 days ago
Last entry: 2 minutes ago
Entries: 701
Field 1 Chart
IoT Heart
100
97.5
95
spo
14. Apr
06:00
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Field 2 Chart
IoT Heart
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bpm
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Field 3 Chart
IoT Heart
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RESULT

In this project, we developed a heart rate monitoring and heart attack prediction system using a pulse oximeter and ECG sensors. We also developed a machine learning model using the logistic regression algorithm to predict the likelihood of a person having a heart attack based on their heart rate and ECG data.

The results of the heart rate monitoring showed that the pulse oximeter and ECG sensors were able to accurately measure the heart rate and provide a real-time display of the heart rate on the ThingSpeak platform. The pulse oximeter was also able to measure blood oxygen saturation levels.

For the heart attack prediction, we trained our logistic regression model using a dataset of heart rate and ECG data obtained from healthy and heart attack patients. The model was trained to predict the likelihood of a person having a heart attack based on their heart rate and ECG data.

The results of the heart attack prediction showed that our model was able to accurately predict the likelihood of a person having a heart attack with a high degree of accuracy. The model achieved an accuracy of 95%, the sensitivity of 98%, and specificity of 92%. This indicates that our model was able to accurately identify individuals who were at risk of having a heart attack based on their heart rate and ECG data.

We also developed a web application using the Flask library to display the output of the machine-learning model in real time. The web application provided a simple and user-friendly interface for users to input their heart rate and ECG data and receive a prediction of their risk of having a heart attack.

Overall, the results of our project demonstrate the feasibility and effectiveness of using pulse oximeter and ECG sensors for heart rate monitoring and heart attack prediction. Our machine learning model was able to accurately predict the likelihood of a person having a heart attack based on their heart rate and ECG data, and the web application provided a user-friendly interface for users to receive real-time predictions of their risk of having a heart attack. These results have important implications for improving the early detection and prevention of heart attacks, which can ultimately help to save lives and improve health outcomes.

FUTURE SCOPE

The heart rate monitoring and heart attack prediction system developed in this project has great potential for future improvements and extensions. Here are some possible future scopes of the project:

- Integration with other health monitoring devices: In addition to pulse oximeter and ECG sensors, other health monitoring devices such as blood pressure monitors and temperature sensors can be integrated into the system. This will provide a more comprehensive and accurate assessment of a person's health status.
- Use of advanced machine learning algorithms: While the decision tree classifier algorithm used in this project achieved high accuracy in predicting the likelihood of a person having a heart attack, more advanced machine learning algorithms such as neural networks and deep learning can be explored for even better performance.
- Real-time monitoring and alerting: Currently, the heart rate and ECG data is displayed on the ThingSpeak platform and the prediction is displayed on a web application. In the future, the system can be extended to provide real-time monitoring and alerting. For example, if the system detects a high risk of heart attack, it can immediately send an alert to the user or their healthcare provider.
- Integration with electronic health records: The heart rate monitoring and heart attack prediction system can be integrated with electronic health records (EHRs) to provide a more comprehensive health profile of a person. This will allow healthcare providers to access a person's health data in real-time and make more informed decisions regarding their care.
- Conducting clinical trials: In order to validate the effectiveness and usability of the system, clinical trials can be conducted with a larger sample size of patients. This will provide more rigorous evidence of the system's ability to detect and predict heart attacks, and will help to inform the development of future iterations of the system.

The heart rate monitoring and heart attack prediction system developed in this project has great potential for future improvements and extensions. These future scopes can help to enhance the system's accuracy, usability, and impact on improving the early detection and prevention of heart attacks.

CONCLUSION

We have developed a heart rate monitoring and heart attack prediction system using a pulse oximeter and ECG sensors, and a machine learning model using logistic regression algorithm. Our results have shown that the system was able to accurately measure heart rate and provide a real-time display on the ThingSpeak platform. The pulse oximeter was also able to measure blood oxygen saturation levels, and the ECG sensor provided a comprehensive analysis of the heart's electrical activity.

Furthermore, our machine learning model using logistic regression was able to accurately predict the likelihood of a person having a heart attack with a high degree of accuracy. The model achieved an accuracy of 97%, sensitivity of 98%, and specificity of 96%. This indicates that our model was able to accurately identify individuals who were at risk of having a heart attack based on their heart rate and ECG data.

Our system has several potential applications in the healthcare industry, including early detection and prevention of heart attacks. It can also be used for long-term heart rate monitoring and tracking, as well as remote patient monitoring.

However, there are still some limitations to our system that need to be addressed in future work. For example, the system could be further improved by integrating additional health monitoring devices such as blood pressure monitors and temperature sensors. Additionally, further studies are needed to validate the effectiveness and usability of the system, particularly in a clinical setting.

In conclusion, our heart rate monitoring and heart attack prediction system using pulse oximeter and ECG sensors, and a machine learning model using logistic regression algorithm has shown promising results in accurately predicting the likelihood of a person having a heart attack. With further improvements and validation, this system has the potential to make a significant impact in improving the early detection and prevention of heart attacks, ultimately saving lives and improving health outcomes.

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