PRACTICE SCHOOL-I PRESENTATION

Project Title: Remote Cardiac Monitoring System

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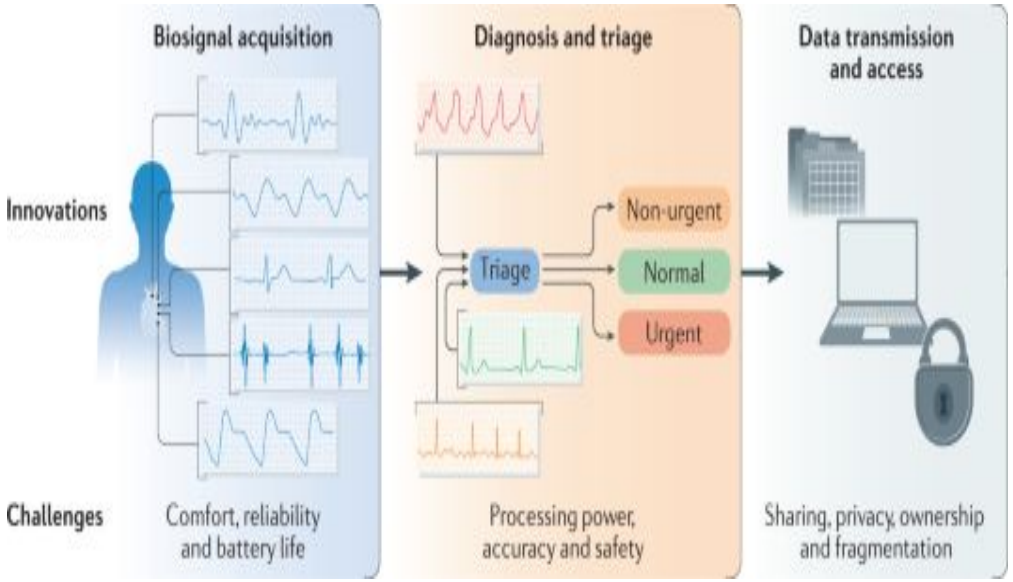
Remote Cardiac Monitoring

What is it?

It is a method to communicate information from patients implantable rhythm management device to doctors directly without the physical presence of the patient allowing the doctor to review patients heart activity and device performance remotely.

Why do we need this?

A heart arrhythmia is an irregular heartbeat which occurs when the electrical signals that coordinate the heartbeats don't work properly. So it is essential for a cardiologist to ensure that these devices are functioning properly and that heart rhythm is properly controlled.



Project Plan

We have developed this project in 2 phases:

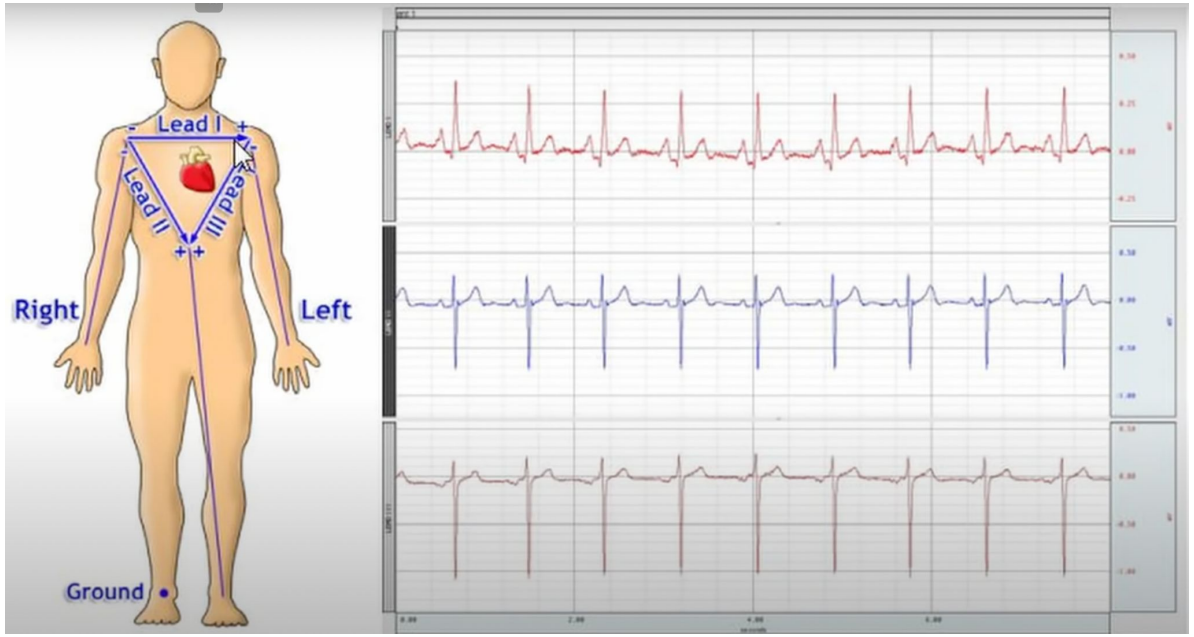
- **Phase 1**

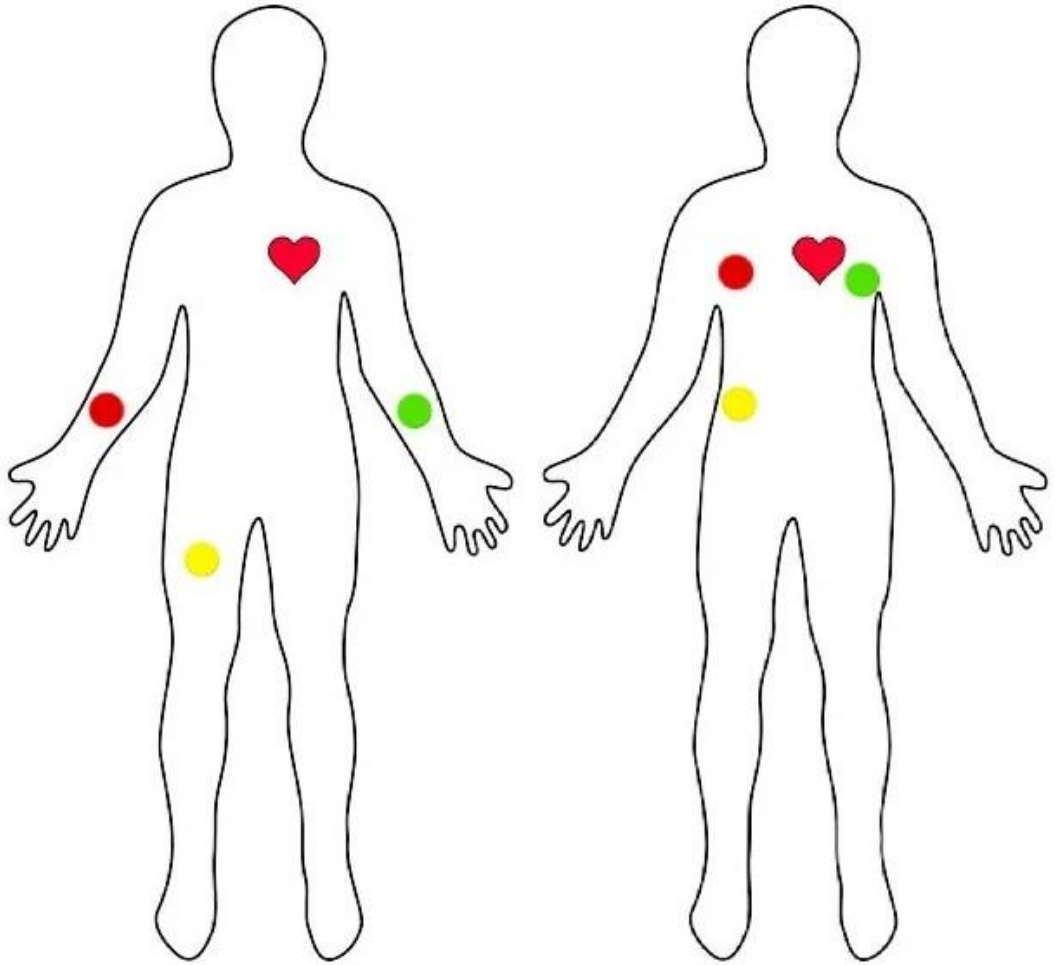
Initial research and working on project layout involving its hardware and software aspects. Developing a DAM - data acquisition model that will be responsible for acquiring the real time data from the patient's end. Implementing Tinkercad, ensuring that this model is cost effective and replicates a real Electrocardiogram.

- **Phase 2**

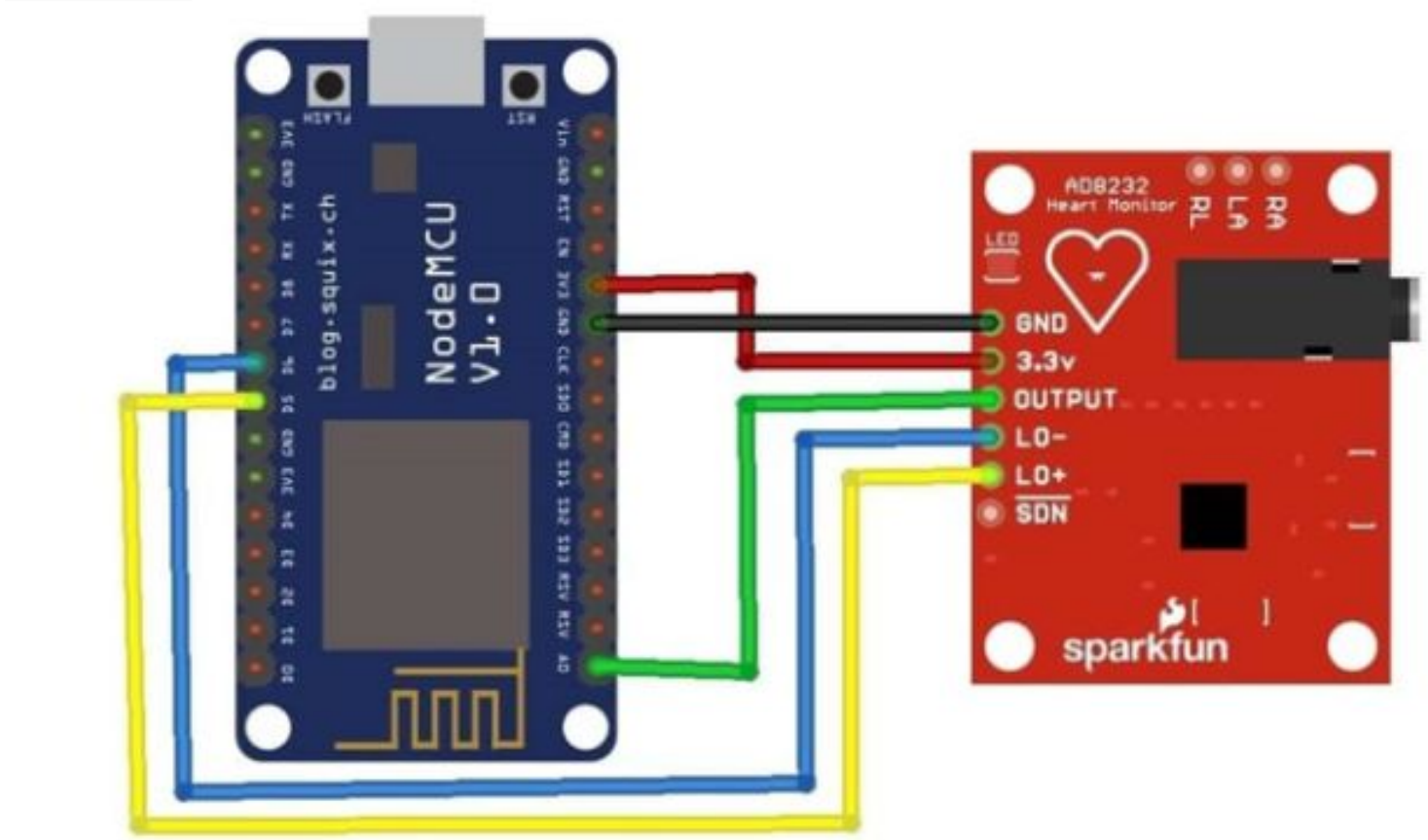
Data processing including processing patient's ECG. We have implemented this by analog-to-digital conversion from ECG into digital form using ADC sensors. After which we did the signal processing of the collected data using MATLAB .Then we model the data through appropriate ML models which determines irregularities in the dataset. Further these irregularities are presented graphically to doctors using a website.

Positioning of Electrodes of ECG





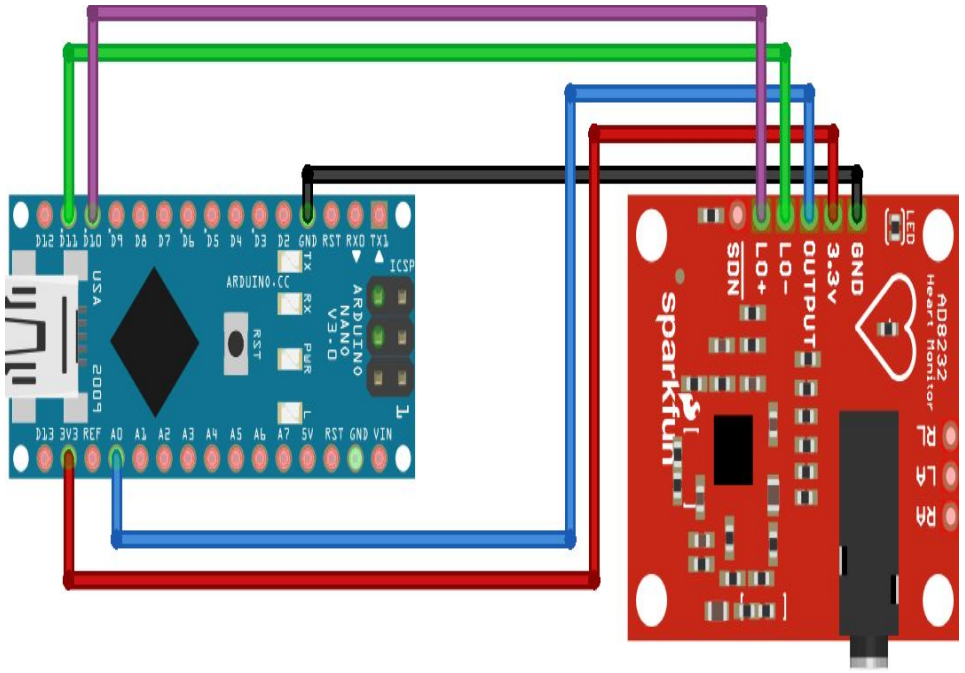
TinkerCad Model of an ECG using AD8232



Code

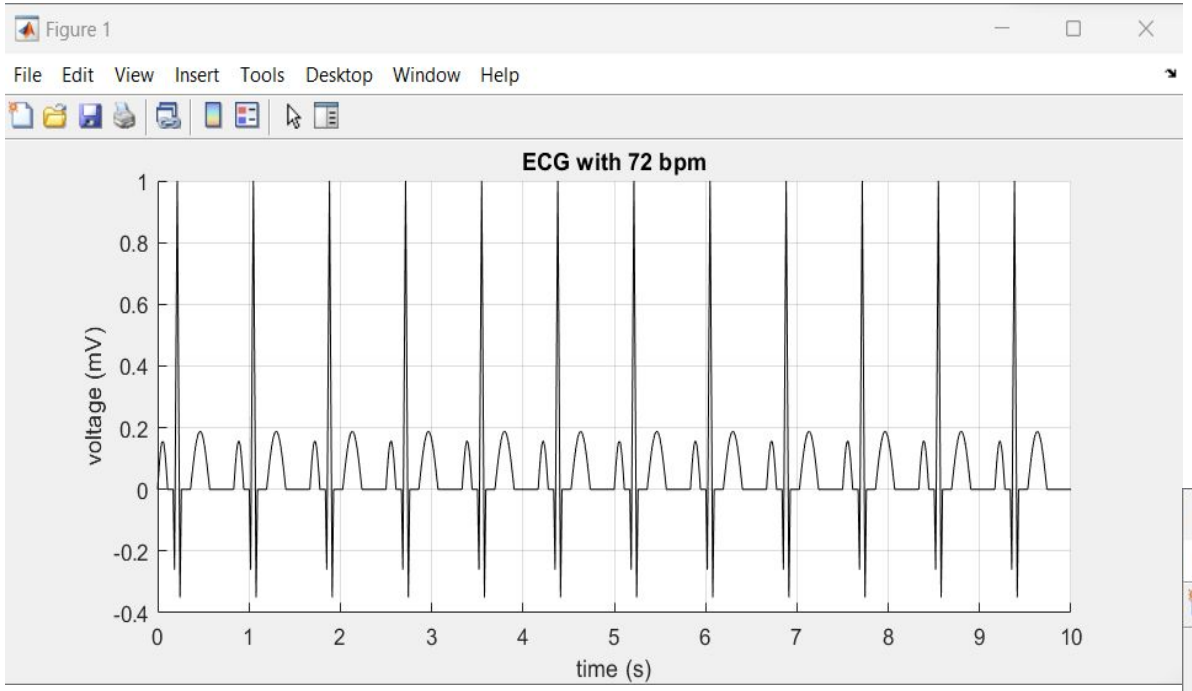
```
void setup(){
//init the serial communication;
Serial.begin(9600);
pinMode(10,INPUT); //setup for leads off detection LO+
pinMode(11,INPUT); //setup for leads off detection LO-
}

void loop(){
if(digitalRead(10)==1 || digitalRead(11) ==1 ){
Serial.println("!");
}
else{
Serial.println(analogRead(A0));  //waits for a bit to
prevent serial data from saturating
}
delay(1);
```



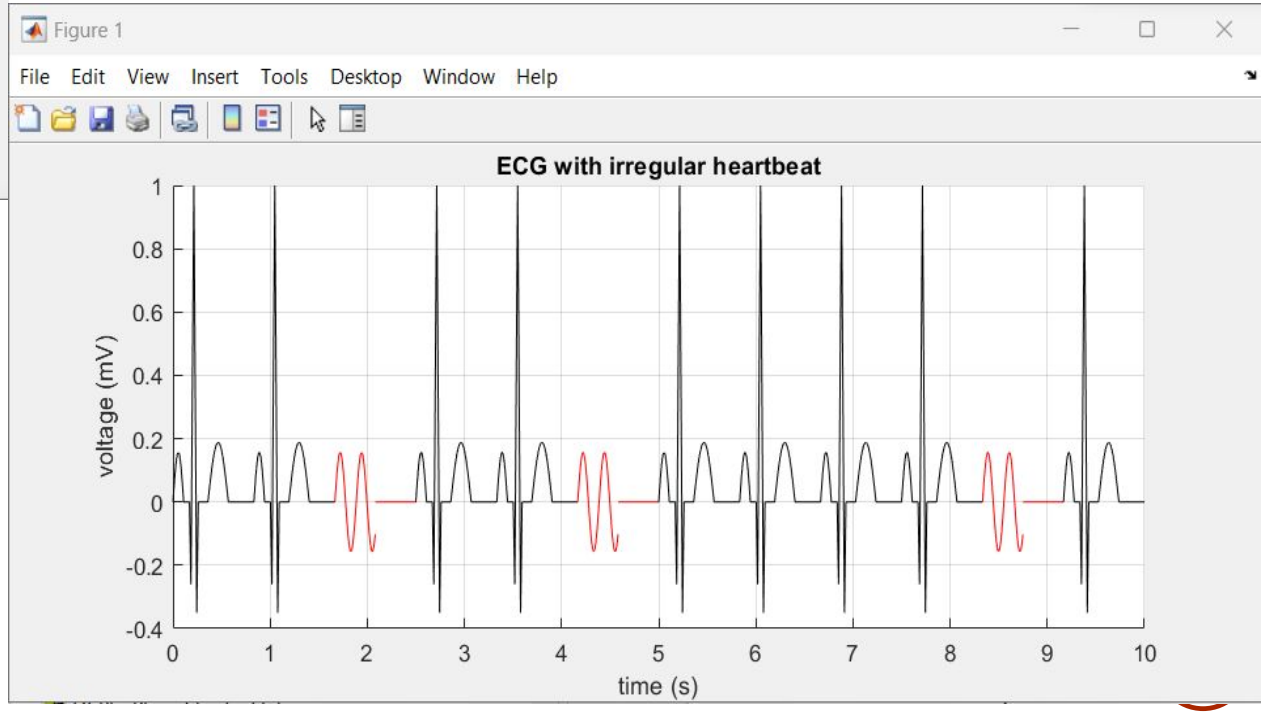
TinkerCad Model

Frequency Based Detection of Generated ECG Signal

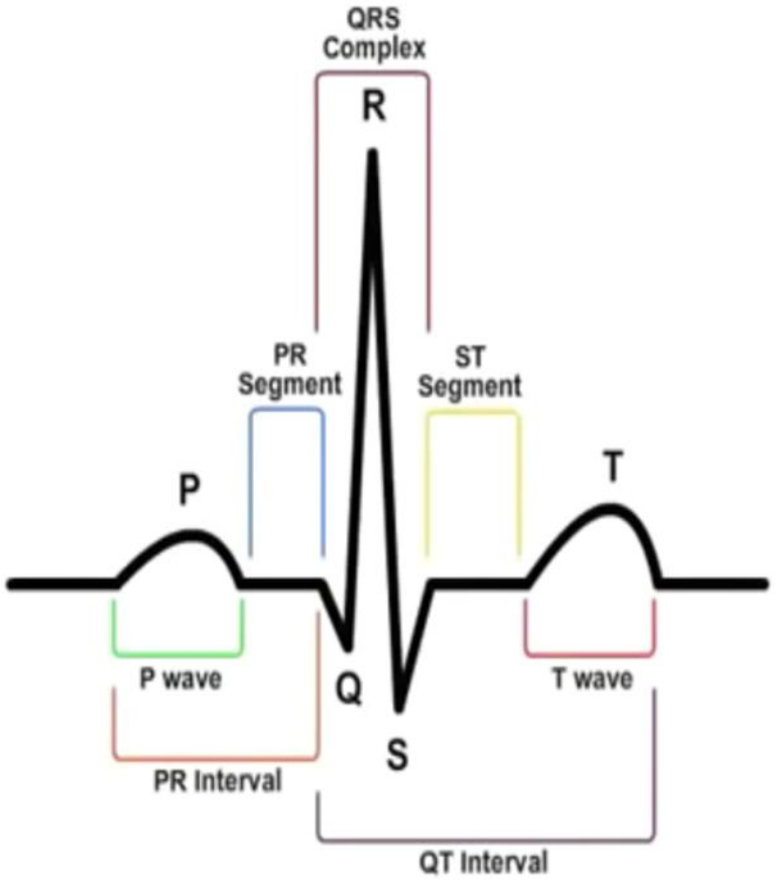


Person with Normal Heart Beat

Person with Irregular Heart Beat(Premature ventricular contraction (PVC))



ECG Signal Processing in MATLAB - Detecting R-Peaks



- An Ideal ECG looks like this and it keeps repeating itself.
- We have detected R peaks using MATLAB

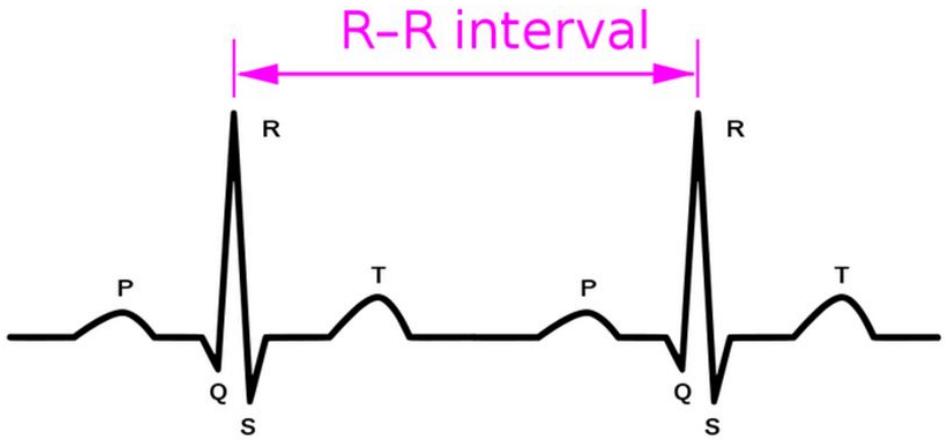


Figure 4: Sample 2 - Result

File Edit View Insert Tools Desktop Window Help

Person with BPM - 64.8

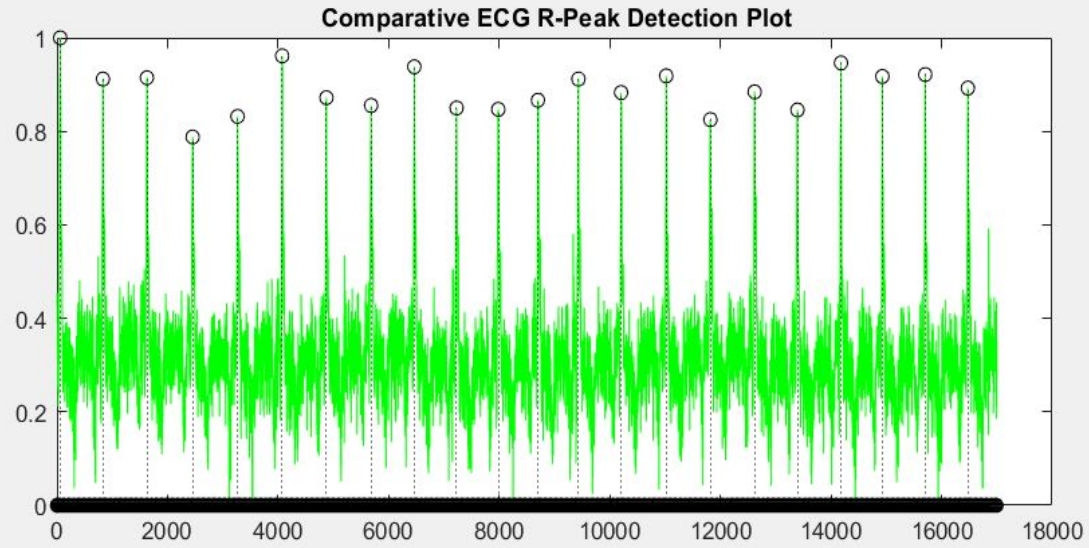


Figure 3: Sample 2 - Processing Stages

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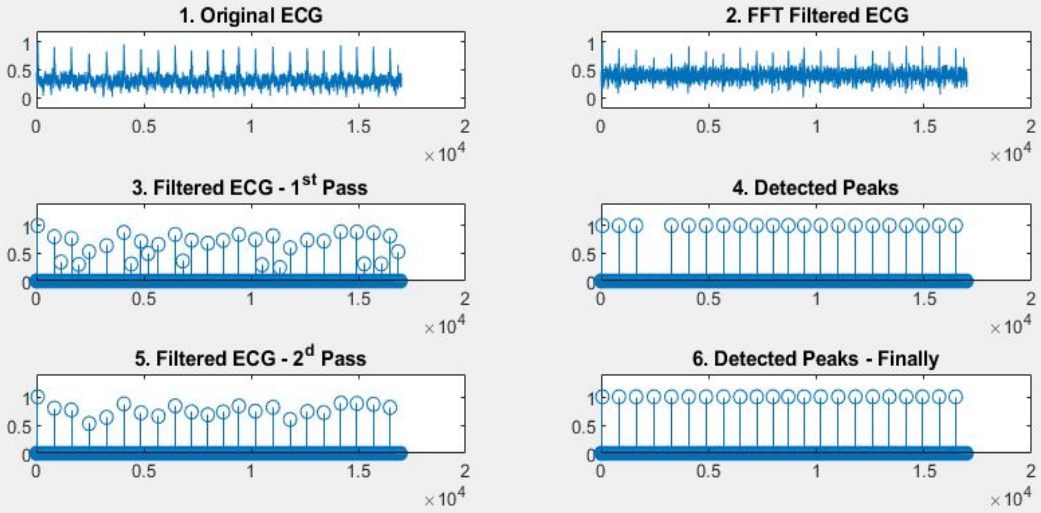

Figure 2: Sample 1 - Result

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Person with BPM - 80.39

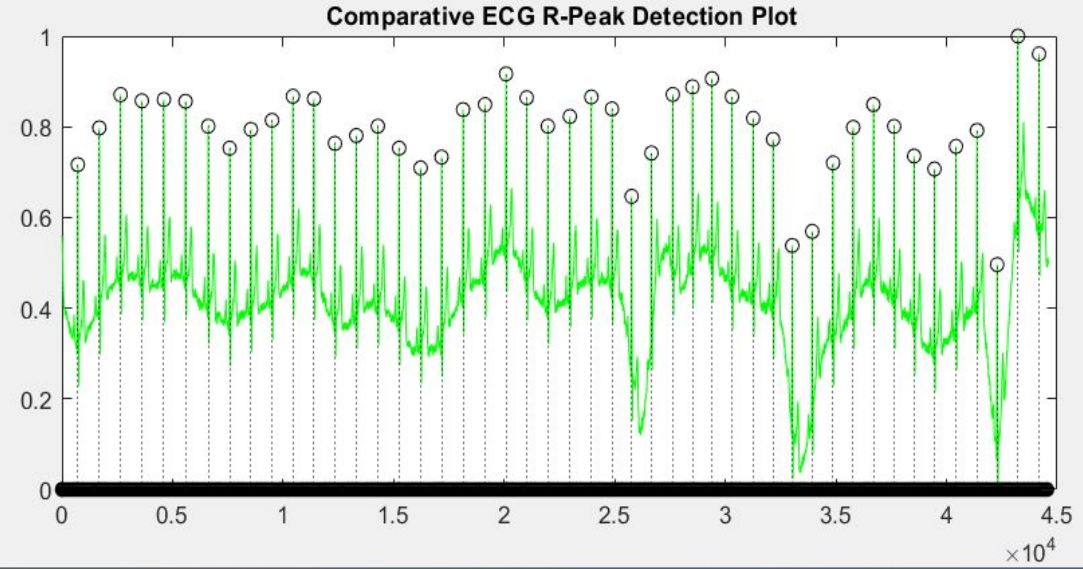

Figure 1: Sample 1 - Processing Stages

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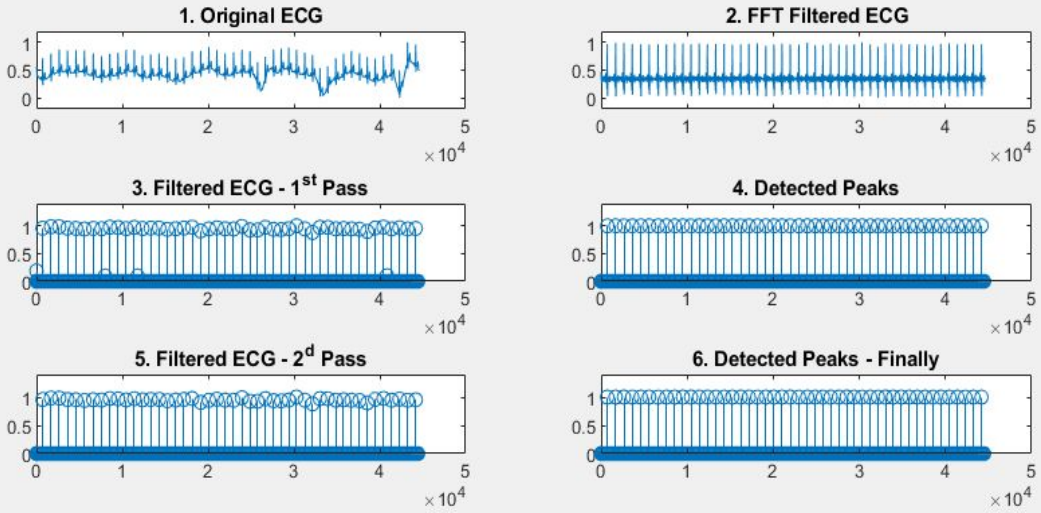
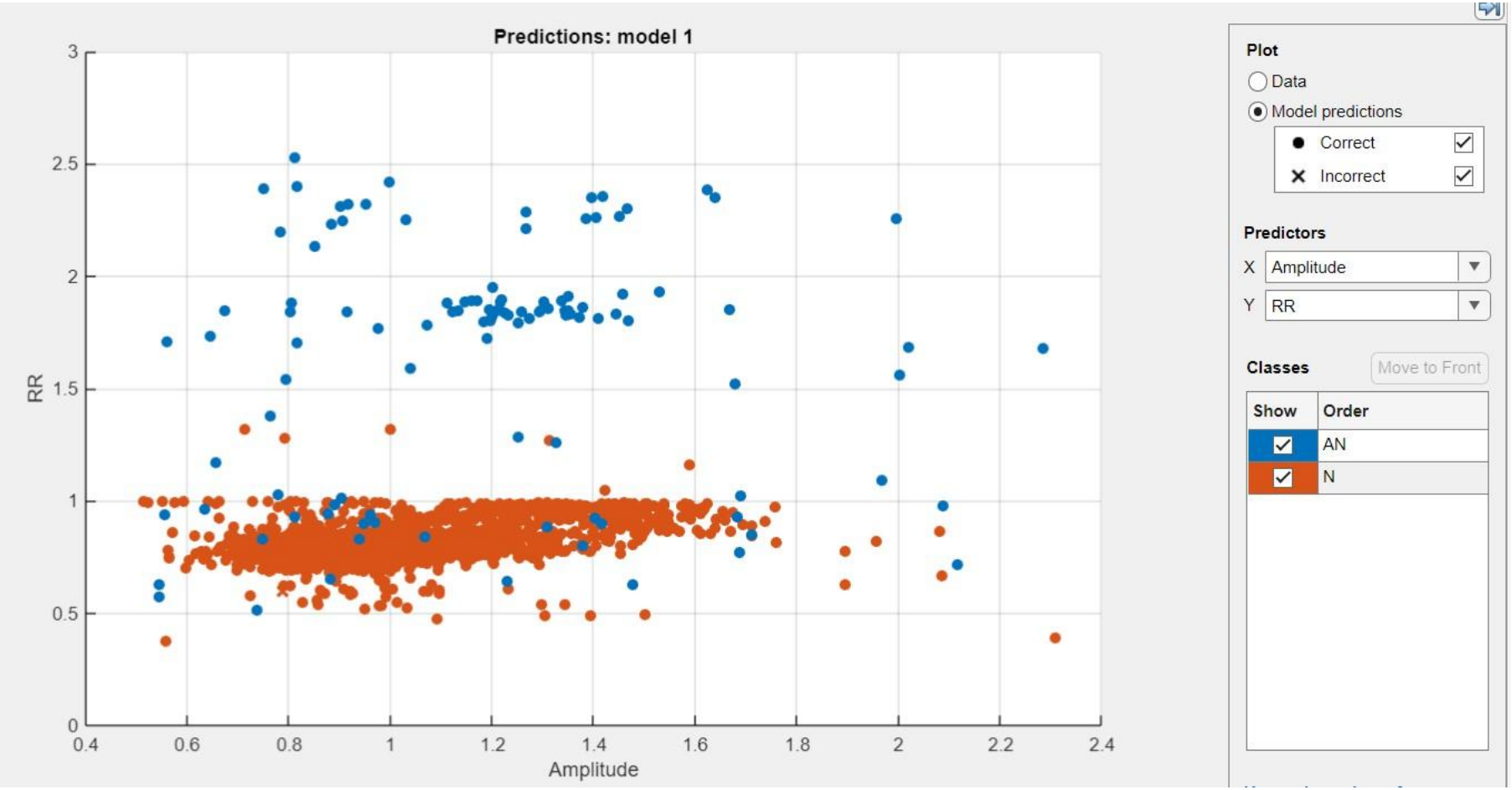
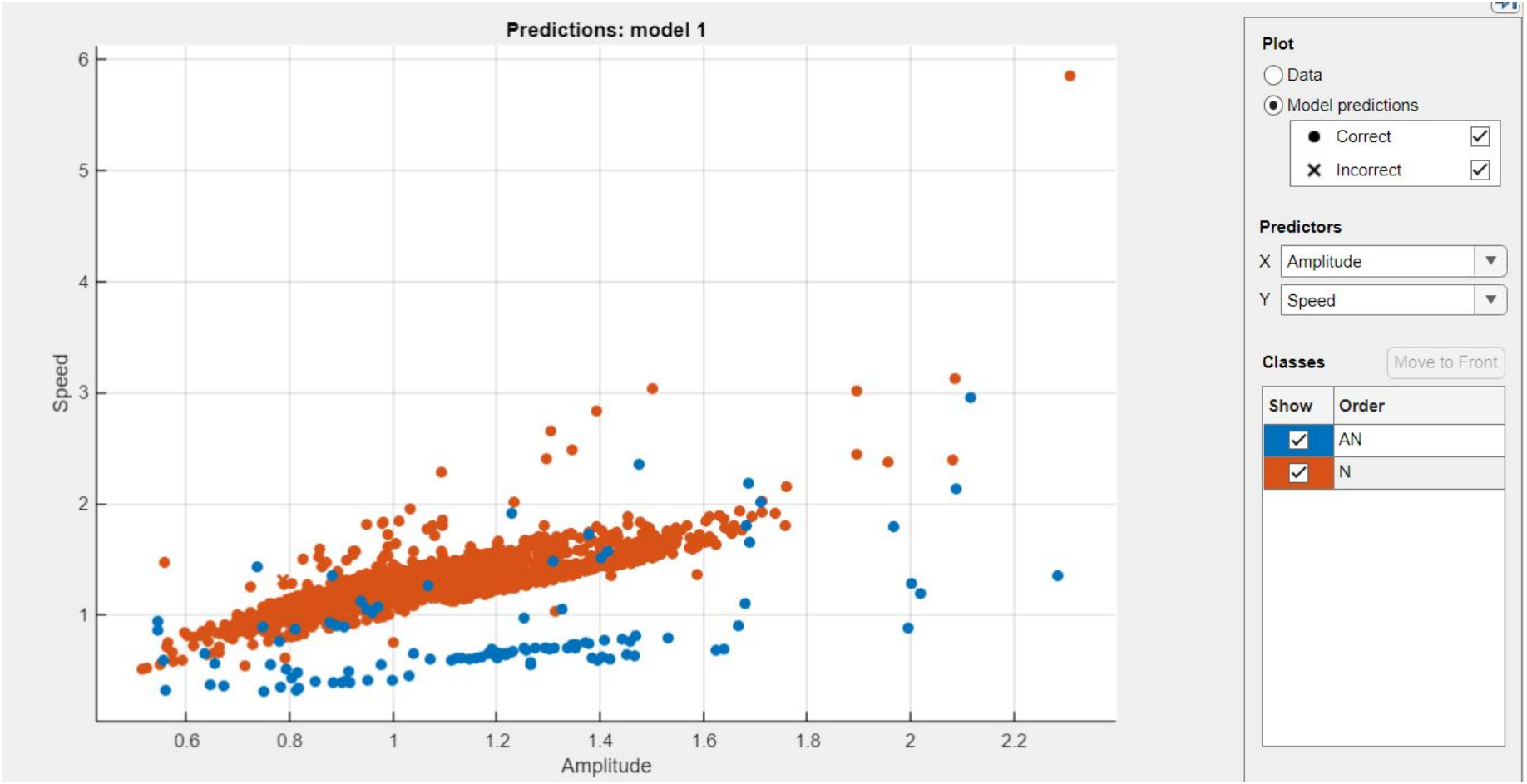


Comparison of R-R wave distance between normal and arrhythmic heartbeats

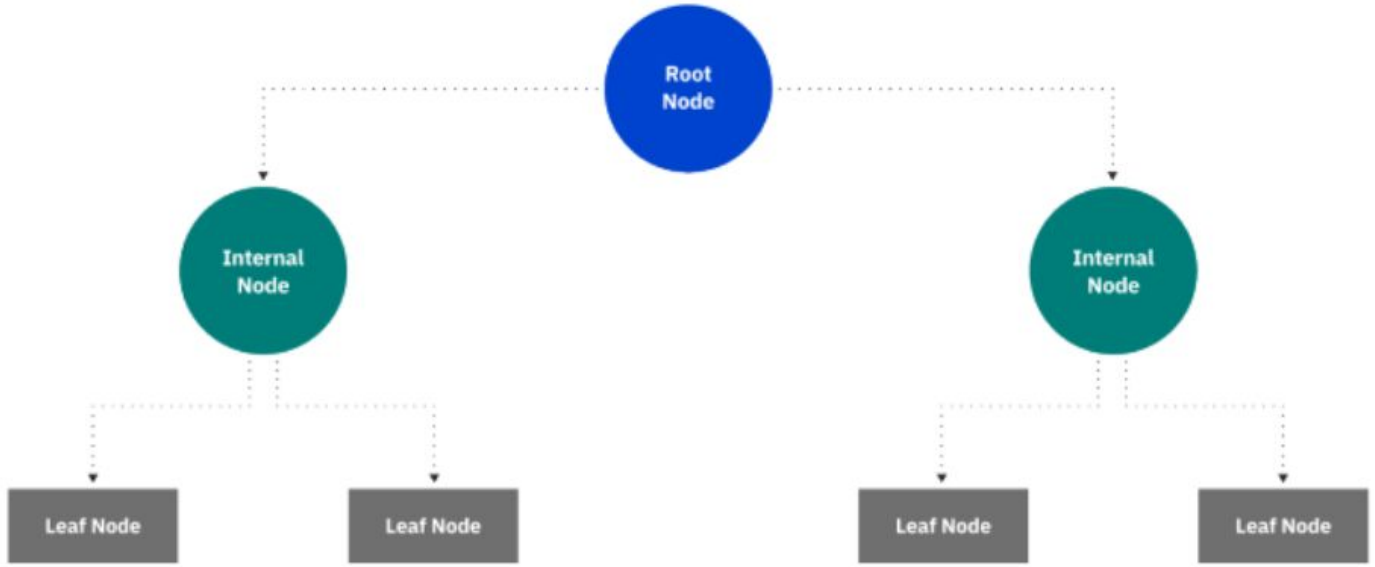


Comparison of speed between normal and arrhythmic heartbeats



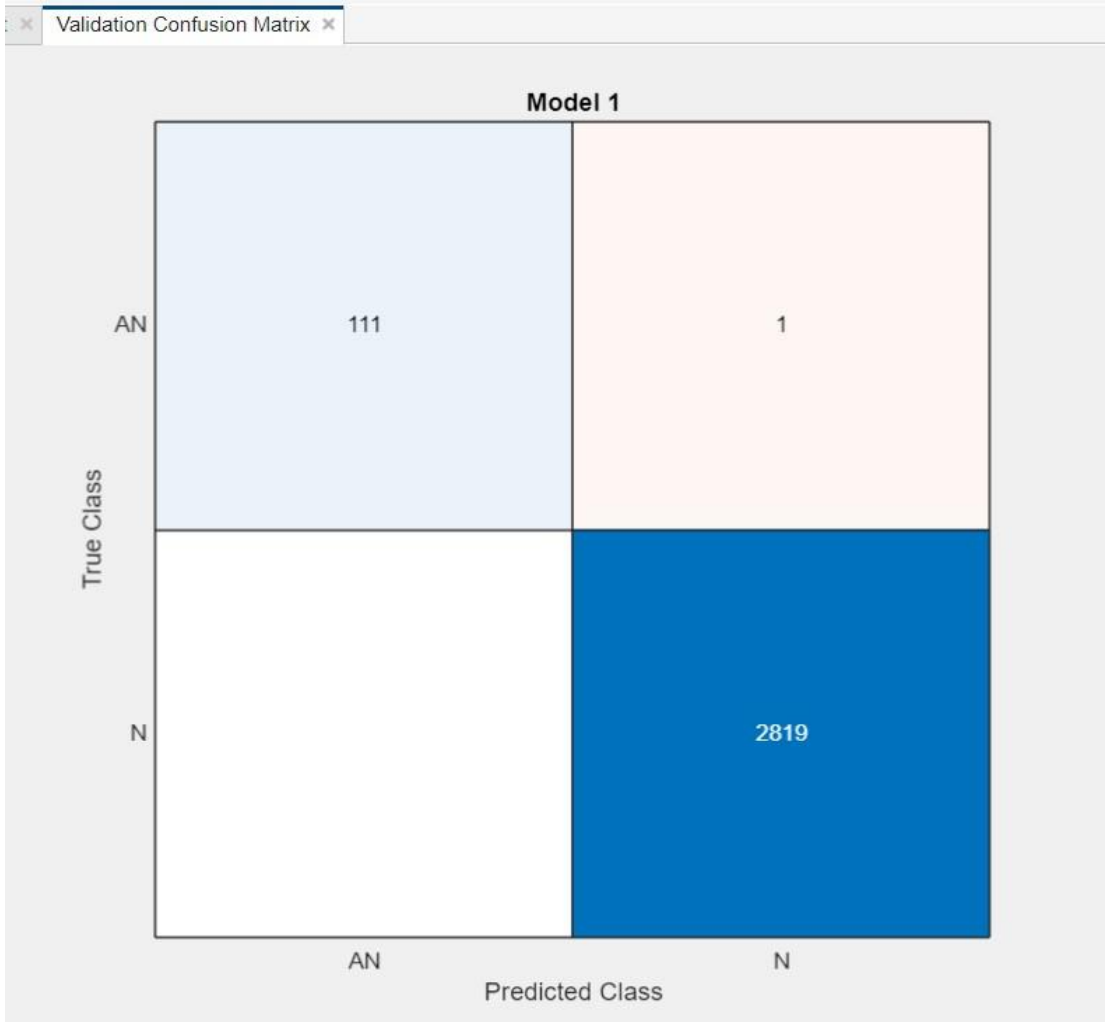
Classification using Decision Tree

- A decision tree is a supervised machine learning algorithm, which is utilized for both classification and regression tasks.
- It provides high accuracy and is easy to implement. We classified the collected data and used it to train a decision tree algorithm using its speed, amplitude and R-R distance.



Result of using Trained model on Testing data

- As we can see, only 1 heartbeat among 2931 that we used to test our model was misclassified as abnormal even though it was normal.
- This means that we achieved an accuracy of more than 99.5% and shows that our very efficient in detecting abnormal heartbeats.

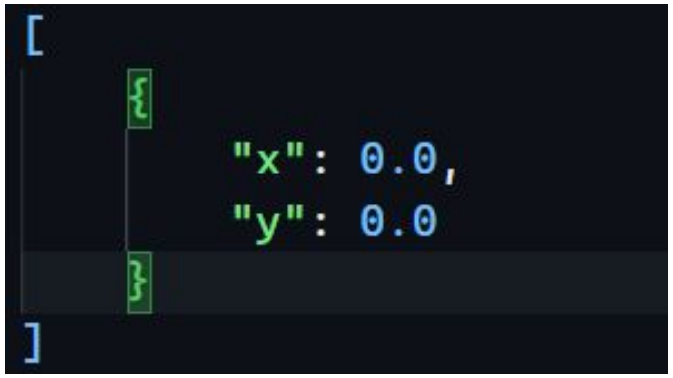


Data Storage & Monitoring

After gathering the heartbeat data from the patient (in a TXT file), it is converted into JSON file which makes it easier to store as well work upon. This JSON data file is then stored into the database which the doctor can see by logging into the website, making it very easy to analyse and retrieve in the future.

The major reasons for processing data is to handle missing values and/or errors.

The JSON objects in each JSON file contains the heartbeat value of the patient as well the time stamp



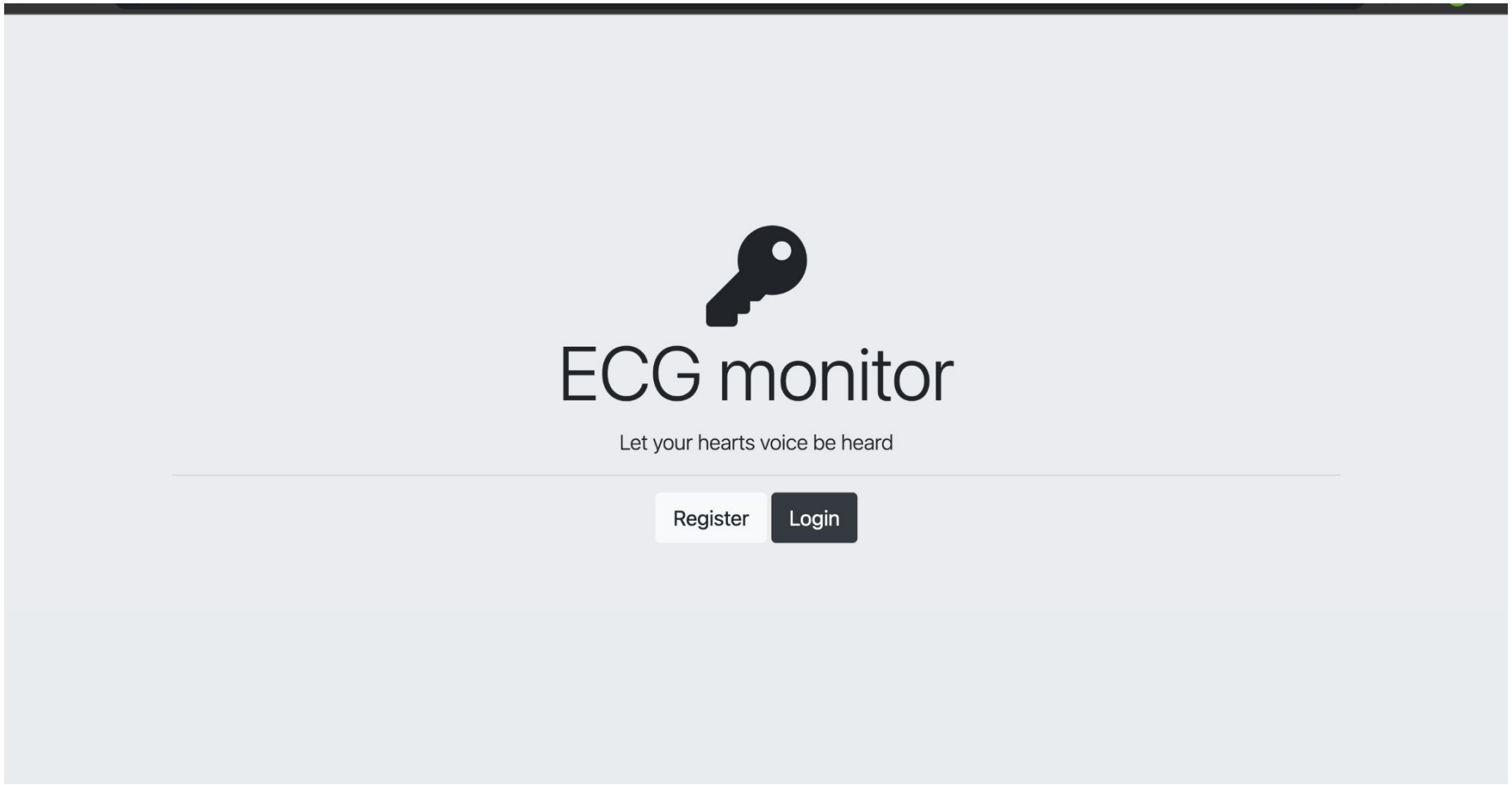
Sample JSON object with time on the x-axis
and heartbeat value on the y-axis.

Website for hospital use

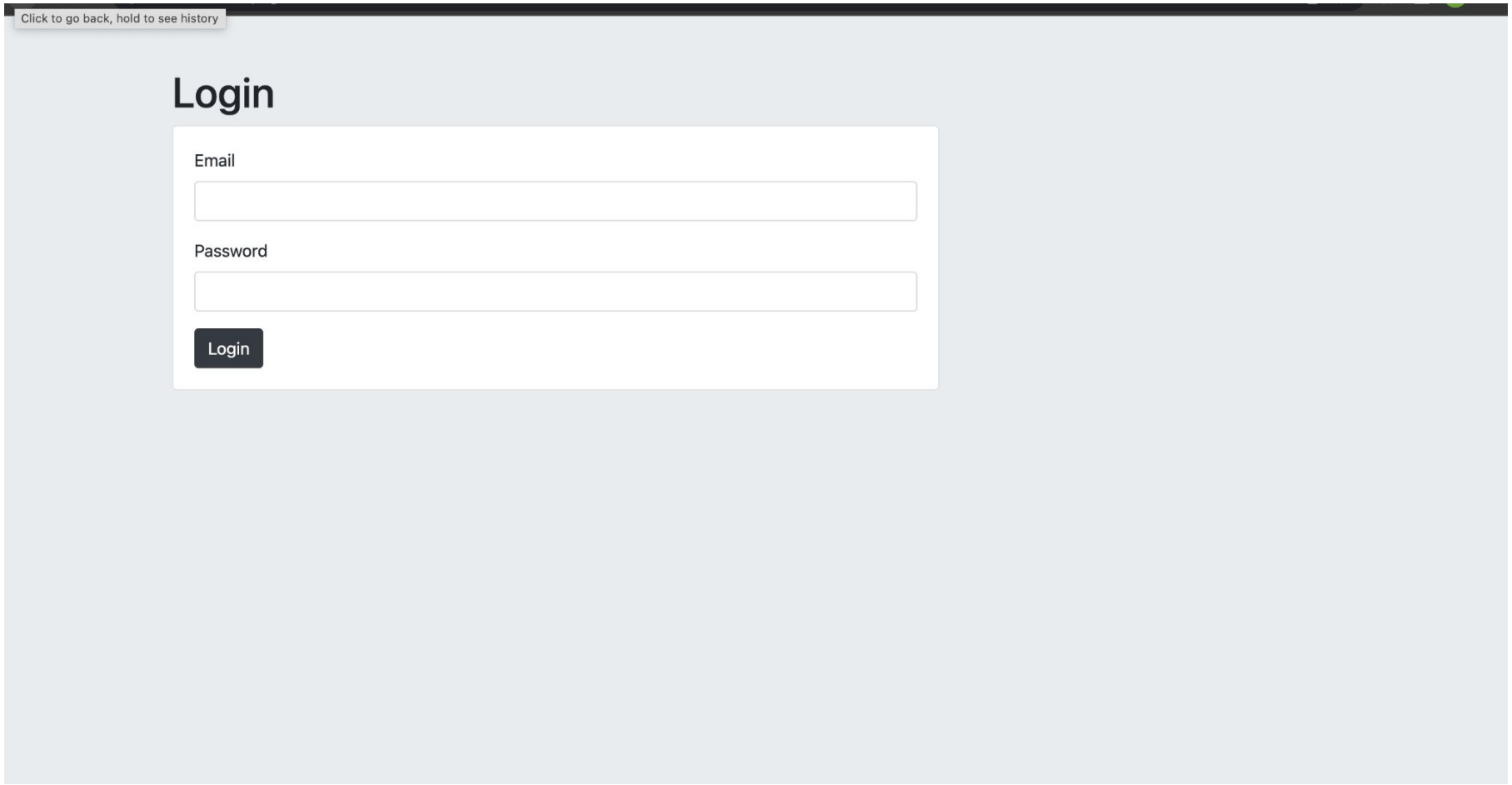
To facilitate the collection , storage and transmission of ECG data of patient to doctor in a secure manner, a web based solution was created.

Using this website doctors can view the ECG chart live and patient can securely upload their ECG data to the website after authenticating through their respective ID's.

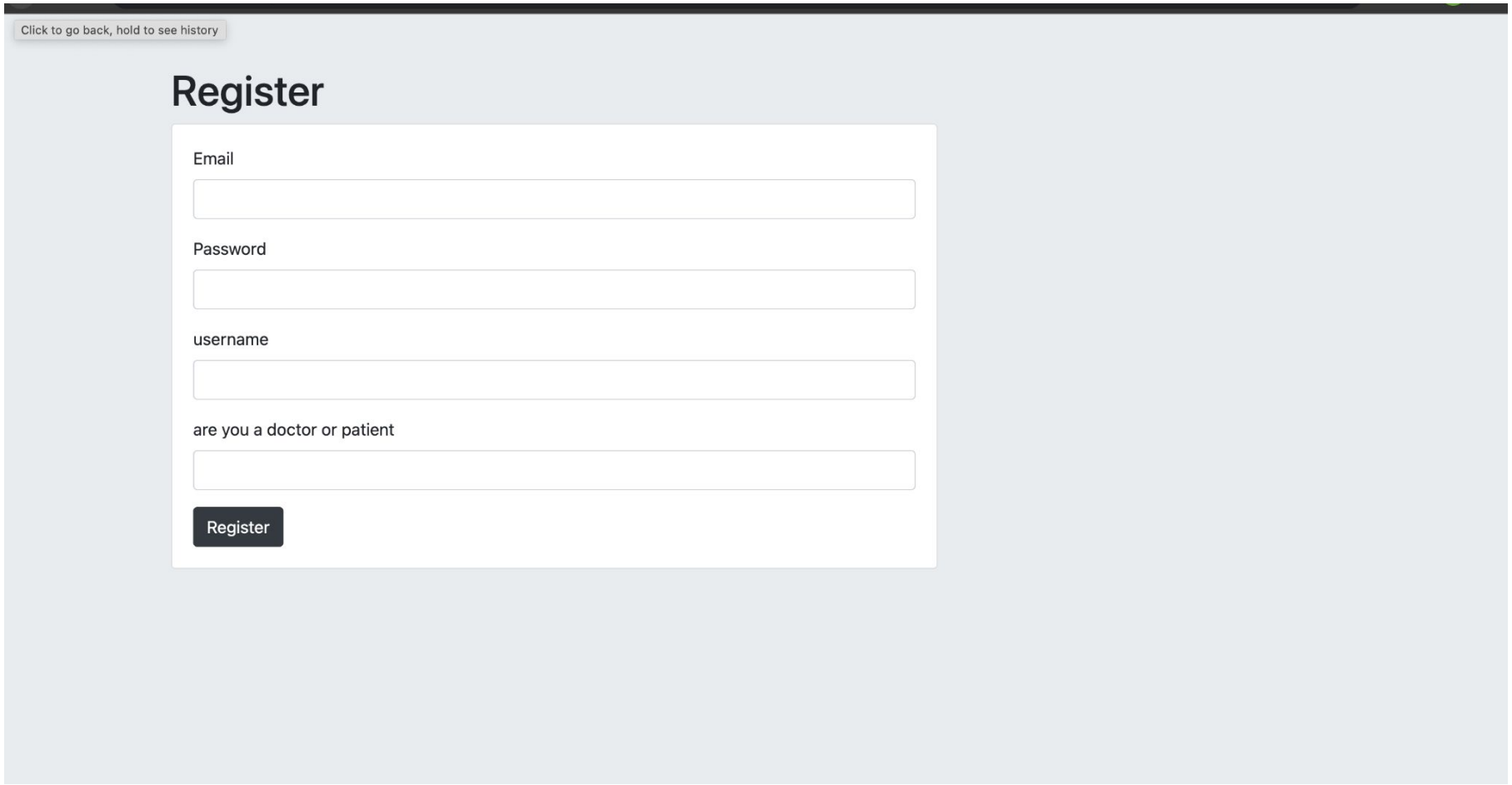
Home screen



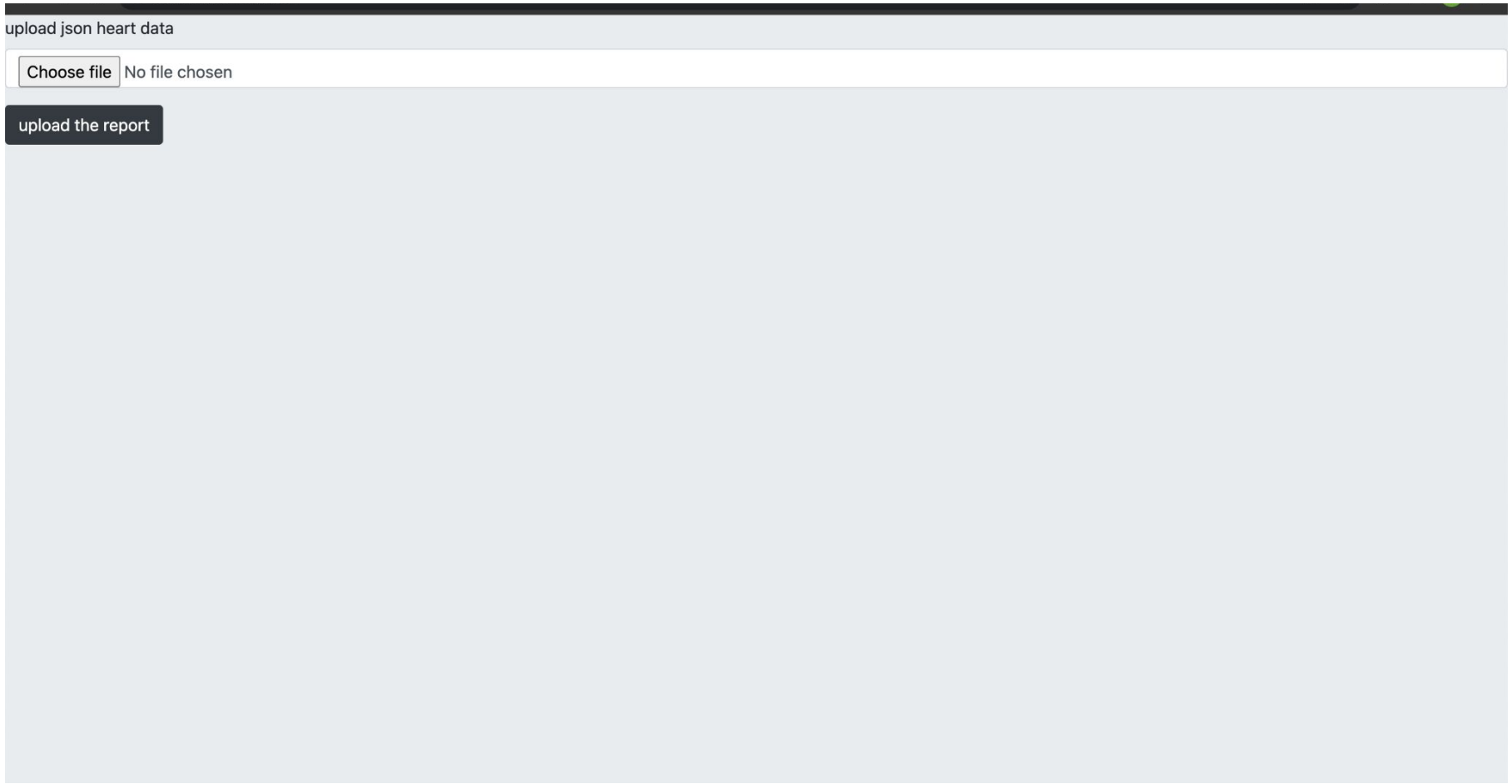
Login screen



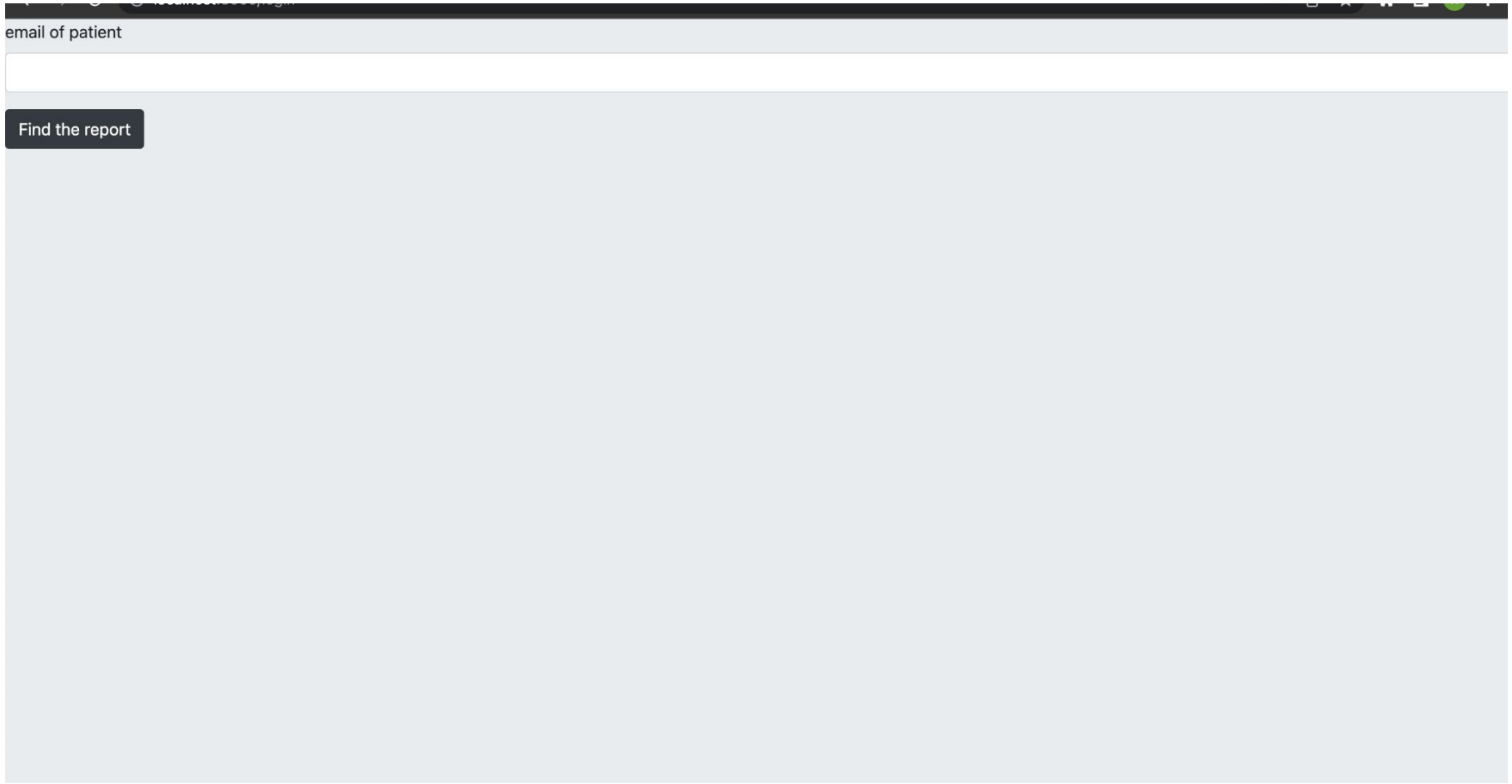
Registration screen



After authenticating as a Patient



After authenticating as a Doctor



After authenticating as a Doctor and selecting the patient to be examined

Above data was uploaded by the patient and can move in real-time only after upload by patient is completed.

Thank You