ES333 - MICROPROCESSORS AND EMBEDDED SYSTEMS - PROJECT

Heart Attack Predictor

Predicting heart attacks from human heart beat behaviour

Under the guidance of Prof. Jhuma Saha and Ayush Srivastava

Overview

- Measuring the user's heartbeat using a pulse sensor.
- Compare their heartbeat to the heartbeat of a healthy person.
- Applied Data Analysis and statistical techniques to analyze measured heart rate.
- Displayed results using STM32 board and webpage.

The Process

01 Identify the goals of the project, the hardware components and software required.

02 Selecting the components required, including the STM32 microcontroller, sensor modules (e.g., pulse sensor), and USB connector.

03 Testing the pulse sensor and other components using softwares to get desired results.

04 Analyzing and comparing the data collected in STM32 microcontroller.

05 Displaying the prediction in the microcontroller and web page-based UI along with the heartbeat trends.

Testing Pulse Sensor

- Pulse sensor is connected to the STM32 board to take analog input [PA0 -> Input of Sensor]
- Analog values of pulses transmitted through ADC in continuous conversion mode [ADC1 IN0]
- Continuous conversion mode allows us to read and convert the data from the sensor continuously.
- Digital values of pulses are transmitted to serial terminal via another external USB.
- Values received were shown on the web-page using Flask framework.

Result Analysis

1. Using MMSE statistical analysis method to predict the risk of a heart attack.
2. Using threshold values to detect low or high heart rate.

Data Analysis using MMSE

- Once we had the input heartbeat, we conducted a statistical technique called Maximum mean square error (MMSE) which is commonly used in data analysis.
- MMSE is used to estimate a parameter or predict a value based on observed data.
- It minimizes the expected value of the squared difference between the predicted value and the true value of the parameter.

Detection using threshold values

- For a healthy heart, the heart rate is between 60-100 bpm.

- We used a lower threshold value of 50 bpm. If this is crossed more than 10 times, the user has a low heart rate.

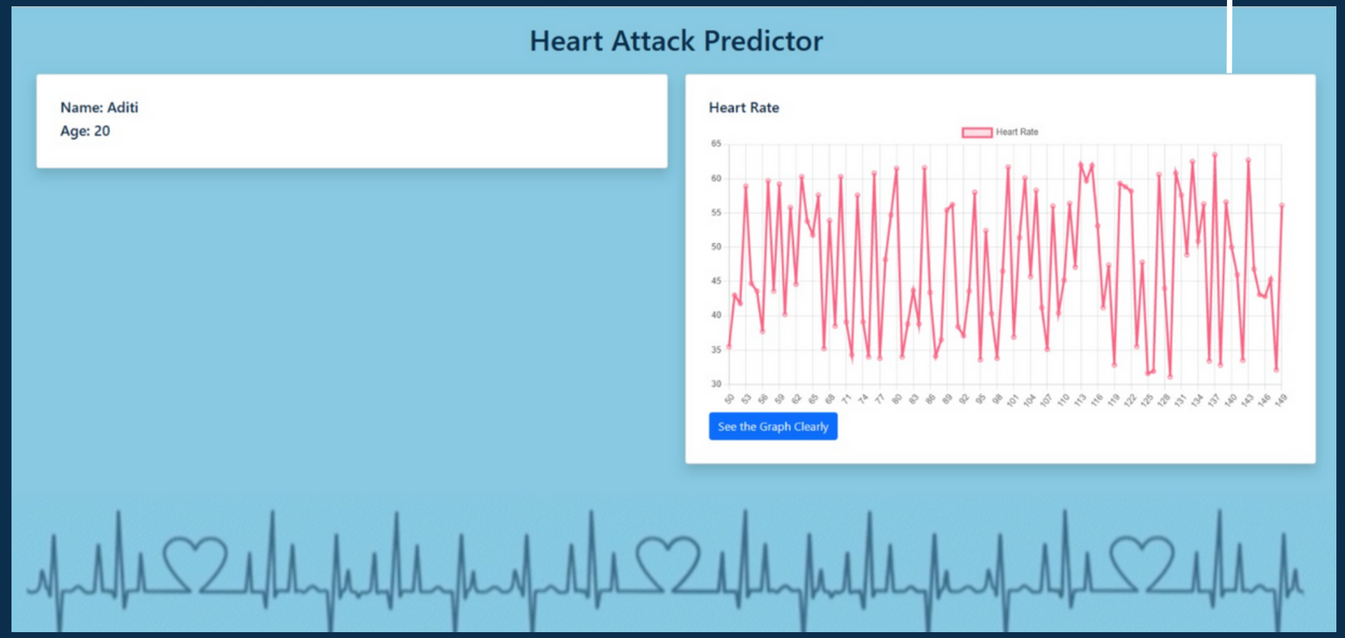
- Similarly, we used an upper threshold of 110 bpm. If this was crossed more than 10 times, the user has a high heart rate.

Final Result

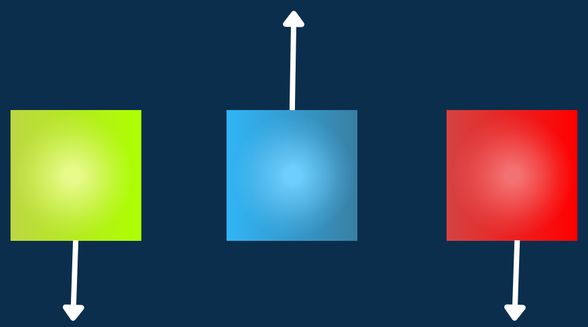
Low heart rate

High heart rate

ECG Signal plot on webpage



Active input



No/Less Risk of Heart Attack

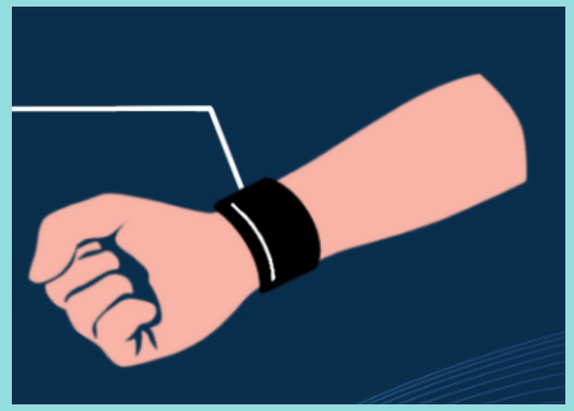
Risk of Heart Attack

Challenges faced

- While testing the pulse sensor, we were initially getting the same repeated value. This was solved by using the continuous conversion mode instead of single conversion mode.
- In the data analysis, we had to fine-tune the threshold values and limits to get more accurate results.
- As the number of samples increased, we noticed increased discrepancies in the output.

Future Scope

- Collect data for healthy heart rates in various age groups. Then analyze data for multiple age groups to predict the heart age.
- Can connect other types of sensors to measure and analyze based on other health factors (like cholesterol levels, blood pressure, etc).
- Wifi module-based sensors to make it more portable. The sensor can also be attached to wearable devices.
- More complex machine learning algorithms can be used for more accurate results like Decision Trees and Random Forest.
- UI can be improved.



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