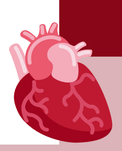
Deep Learning Approaches for Heart Disease Detection Using MAX30102 Sensor Data

Pham Thanh Dat, Huynh Kha Tu and Assoc. Prof Le Trung Quan
University of Information Technology, Viet Nam National University Ho Chi Minh City
20521175@gm.uit.edu.vn, 20522096@gm.uit.edu and quanlt@uit.edu.vn

1. INTRODUCTION



This study explores the application of deep learning through a Multilayer Perceptron model for the classification of heart rate data, aiming to identify abnormal patterns indicative of potential heart diseases. Utilizing a comprehensive dataset on heart rates and cardiovascular conditions, the model demonstrates the capacity for automated and precise analysis. Additionally, the integration of mobile technology is highlighted, with the development of a compact device incorporating the MAX30102 sensor.

This device, capable of real-time heart rate monitoring, interfaces directly with a mobile app to provide immediate health status feedback to users. This research underscores the potential of combining deep learning and mobile technology for enhanced cardiovascular disease diagnosis and monitoring.

2. PROPOSED SOLUTION

We have divided our implementation into the following key stages:

(1) Google Firebase Realtime Database: We establish a Firebase Realtime Database, employing email authentication and combining it with the Database API for ESP8266 usage, aimed at accessing and writing data into the Database.

(2) ESP8266 With MAX30102 Sensor: Necessary libraries are installed, utilizing code snippets and libraries to calculate the heart rate from signals received from the sensor. This is followed by configuring the ESP8266 to connect to Wi-Fi. The subsequent step involves configuring the device to connect to the Database, enabling it to write data into the database.

(3) Building Deep Learning Model: We search for reputable and suitable datasets, develop models optimized for low-resource devices, and employ techniques to reduce overfitting and increase accuracy.

(4) Building Android Application: Development of a mobile application is undertaken, incorporating authentication methods to differentiate between patients and doctors. Configuration for reading and retrieving data from the Firebase Database is established, along with setting up and deploying the model using TensorFlow into the application

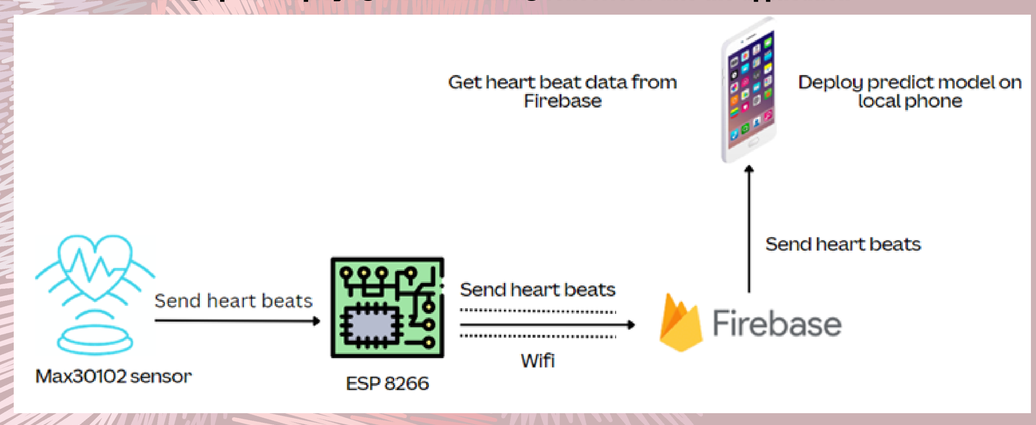


Fig 1. Our System Architecture

3. PRACTICAL APPLICATION

In this section, we present the approaches we propose to implement this project. The ESP8266 device will connect to Wi-Fi and then receive heart rate information from the MAX30102 sensor, process the data, and upload it to the Google Firebase Realtime Database.

Subsequently, an Android application will retrieve the data from the database, then utilize an integrated Machine Learning Model within the app to perform calculations for predicting the user's cardiovascular health condition.

1. Establishing Google Firebase Realtime Database

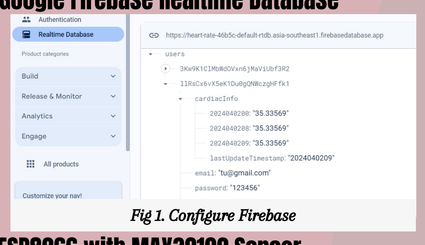


Fig 1. Configure Firebase

2. Establishing ESP8266 with MAX30102 Sensor

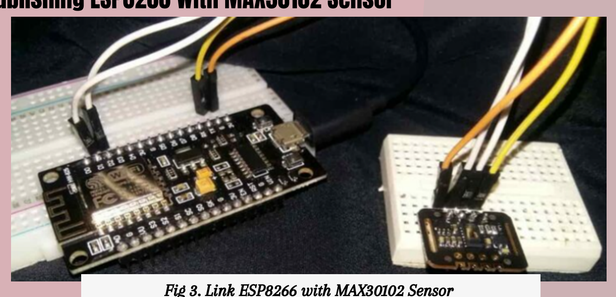


Fig 3. Link ESP8266 with MAX30102 Sensor

3. Building Deep Learning Model

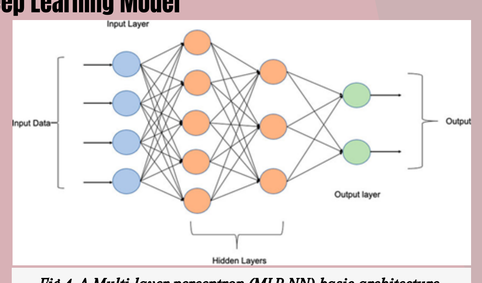


Fig 4. A Multi-layer perceptron (MLP-NN) basic architecture

4. Building Android Application

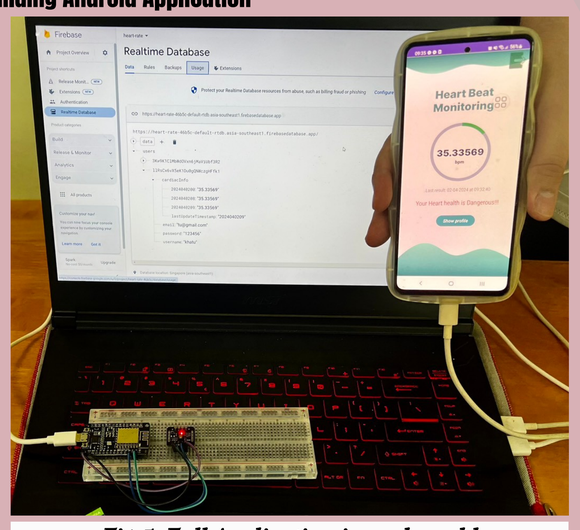


Fig 5. Full Application in real-world

4. RESULTS

During our experiments, we achieved some impressive results with the Multilayer Perceptron model. Specifically, we hit an accuracy rate of 88.66% and an error rate of 31.26%.

This shows that our model works well in identifying and predicting heart disease, and it also shows how tech can be used in healthcare. After we put the model into mobile devices, we were able to send and receive data smoothly. This means doctors and patients can now keep an eye on heart health from anywhere.

Table 1. Sample Predict values to check the results

```
8/8 [==============================] - 0s 4ms/step
 Real Values  Predicted Values  Check
           1                 1   True
           1                 1   True
           0                 0   True
           1                 1   True
           1                 1   True
           1                 1   True
           0                 0   True
           0                 0   True
           0                 0   True
           0                 0   True
           0                 0   True
           1                 0  False
           0                 0   True
           0                 0   True
           1                 1   True
```