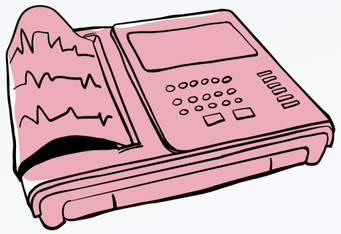
PROJECT

BIOMETRIC AUTHENTICATION BASED ON ECG

IOT DOMAIN ANALYST



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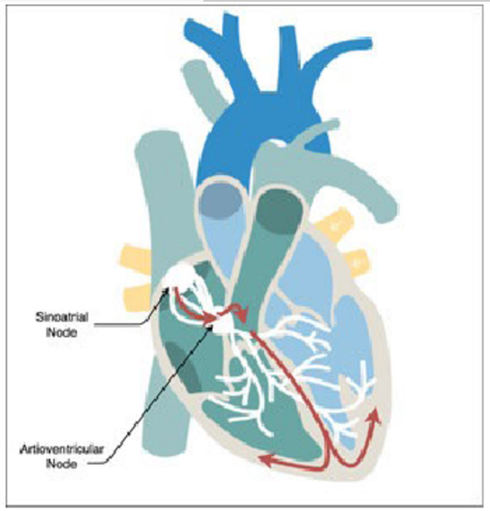
ABSTRACT:

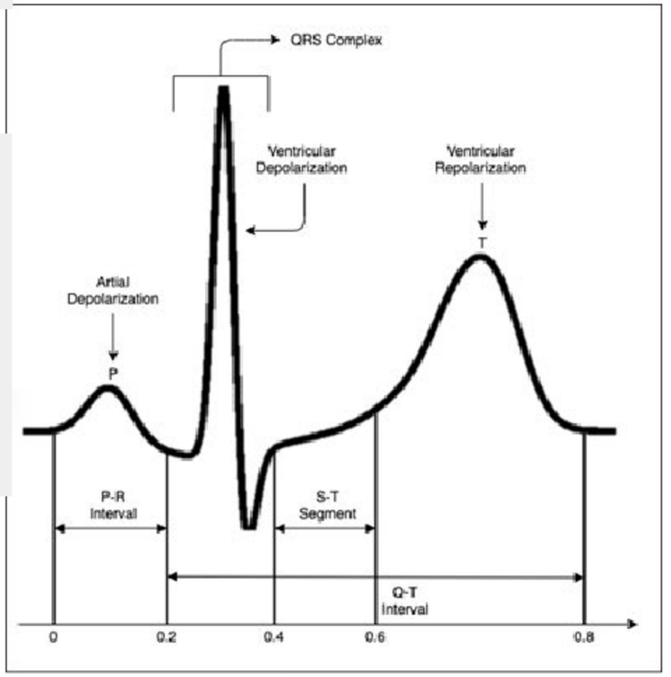
THE MAIN THEME OF THIS PROJECT IS TO AUTHENTICATE THE USER BY USING ECG SIGNALS. ELECTROCARDIOGRAM (ECG) IS AN ELECTRIC SIGNAL OF CARDIAC ACTIVITY POSING HIGHLY DISCRIMINATIVE PROPERTIES RELATED TO HUMAN RECOGNITION. ECG BASED AUTHENTICATION HAS GAINED MUCH SUCCESS IN RECENT TIMES HOWEVER DISCRIMINANT FEATURE EXTRACTION AND EFFICIENT PATTERN CLASSIFICATION STILL ENCOUNTER NUMEROUS CHALLENGES. IN THESE PRESENT SITUATIONS AUTHENTICATION METHODS BECAME AN INDISPENSABLE URGENT TASK TO PROTECT THE INTEGRITY OF THE DEVICES AND THE SENSITIVE DATA. PASSWORDS HAVE PROVIDED TO CONTROL THE IMPORTANT DATA, BUT HAVE SHOWN THEIR INHERENT VULNERABILITIES. WE PROPOSE AN AUTHENTICATION METHOD, WHICH CAN EFFECTIVELY PROVIDE THE ACCESS TO THE USER, WHICH IS KNOWN AS ‘ECG BIOMETRIC AUTHENTICATION’. THIS AUTHENTICATION MAINLY INVOLVES IN CNN CLASSIFICATION. BY USING CNN NETWORK, WE CAN EASILY DEFINE WHETHER USER HAS ACCESS OR NOT. IN THIS PROCESS, THE USER ECG SIGNALS ARE TAKEN AND TRAINED BY USING CNN NETWORK.

SOFTWARE AND HARDWARE

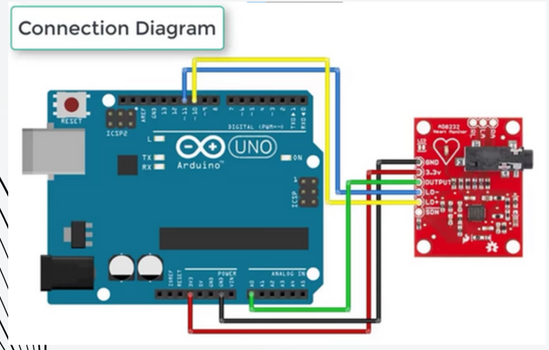
- Matlab
- Python
- Arduino

1.Arduino Uno microcontroller
2.ad8232 ecg sensor module
3 electrodes
4 Jumper Wires

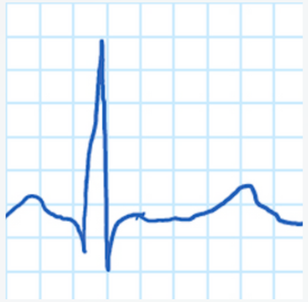




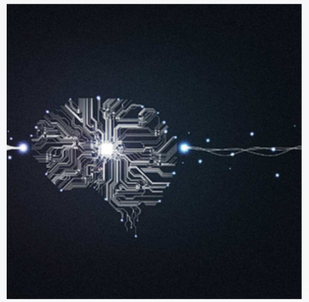
BLOCK DIAGRAM



HARDWARE



DATA
ACQUISITION



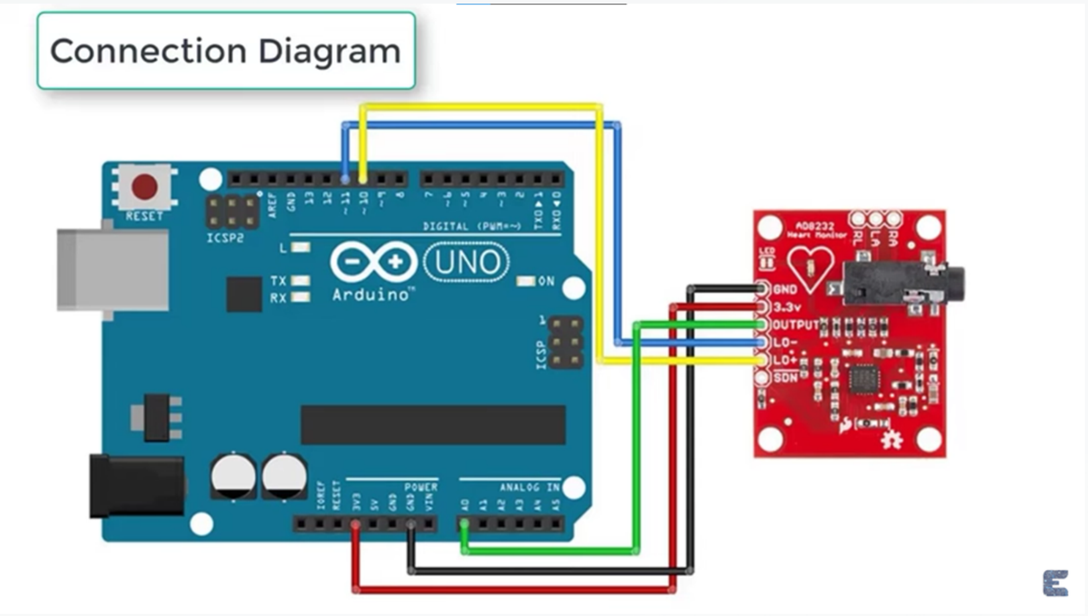
Pre processing

Authentication Algorithm

Authentication Results

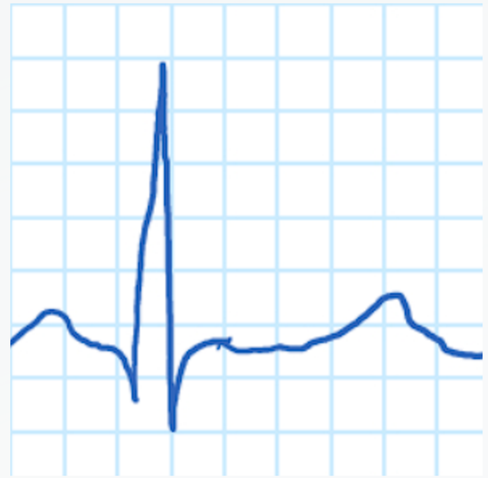
HARDWARE SETUP

The hardware components, including the Arduino Uno microcontroller, AD8232 ECG sensor module, electrodes, and breadboard, were assembled according to the circuit diagram. All connections were securely made, and power was supplied to the system.



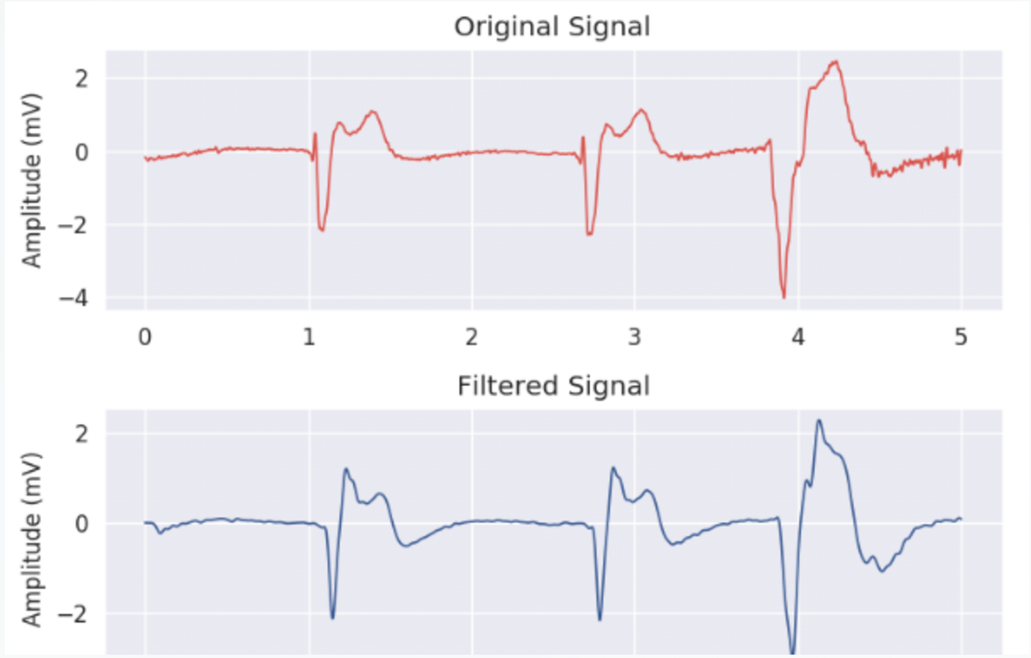
DATA ACQUISITION

The Arduino firmware was successfully programmed to interface with the AD8232 sensor and acquire raw ECG data. Analog readings from the sensor were sampled at a rate of 250 Hz and transmitted to the Python environment via serial communication.



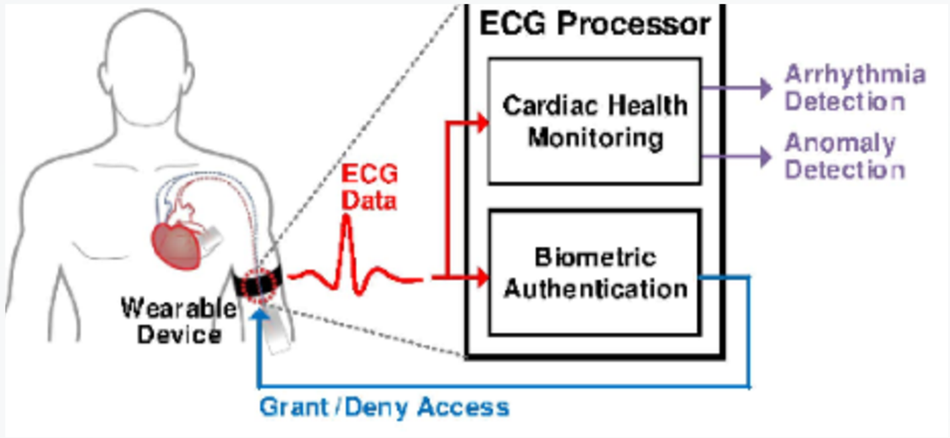
DATA PREPROCESSING

In Python, the raw ECG data received from Arduino underwent preprocessing steps, including median filtering with a kernel size of 5 for noise reduction and normalization to standardize signal amplitudes.



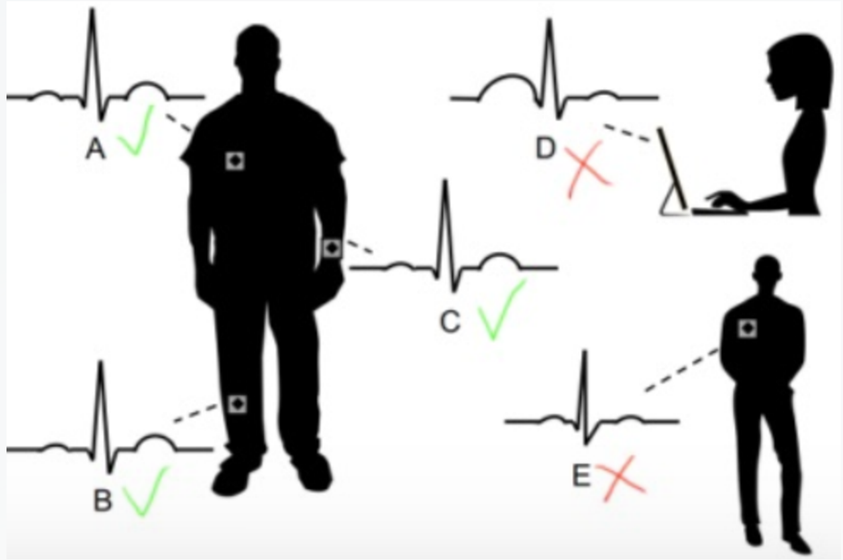
AUTHENTICATION ALGORITHM

An authentication algorithm was implemented in Python to compare the preprocessed live ECG data with pre-recorded reference ECG data. The algorithm calculated similarity scores using Pearson correlation coefficients and determined the authenticity of the live data based on a predefined threshold of 0.80.



AUTHENTICATION RESULTS

The system successfully authenticated authentic ECG signals, yielding similarity scores above the predefined threshold, while accurately flagging non-authentic signals with similarity scores below the threshold. Authentication results were displayed in real-time on the user interface, providing immediate feedback to the user.



OUTPUT

```
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Received data point: 201
Authentication failed. Access denied.
```

References and Sources

- Electrocardiogram (ECG)-Based User Authentication by Vibhav Agrawal (Published: 25 January 2023)

- Data sources are provided by - https://github.com/dhirajhr/ECG-based-Biometric-Authentication