RhythmTrack AI- A Cost-Effective Stationary Monitoring Device for the Detection of Atrial Fibrillation (AF) Using a Three-Electrodes Configuration on Einthoven's Triangle by CNN-LSTM-Based AI Model

Salem, Ammar (School: Sharkya STEM School)
Salah, Youssef (School: Sharkya STEM School)

Atrial fibrillation (AF), the most prevalent heart arrhythmia affecting over 60 million people globally, is expected to double by 2050. As a leading contributor to 15-20% of all strokes, AF increases the risk of stroke fivefold, making it a highly dangerous and underdiagnosed cardiac condition. The absence of accessible, affordable, and reliable diagnostic tools, coupled with the risk of misinterpretation in traditional methods, necessitates innovative solutions. This project introduces a novel, stationary, and cost-effective ECG system that harnesses a three-electrode configuration and a deep learning-based AI model for real-time AF detection. By leveraging the ESP32 microcontroller for signal acquisition and the MAX30003 ECG sensor for reliable preprocessing of heart signals, the system utilizes a CNN-LSTM-based AI deep learning model to achieve an accuracy of 92% in clinical validation on 50 patients, correctly identifying 46 cases. The model also achieved a sensitivity of 95%, a specificity of 93.1%, and a precision of 90.5%, demonstrating robust performance in distinguishing AF from normal heart rhythms. This breakthrough demonstrates the potential of AI-powered ECG analysis in enhancing AF diagnosis. By integrating real-time monitoring and automated detection, this approach offers a scalable solution for early intervention, reducing the risk of stroke and improving patient outcomes. This project presents a significant step towards making AF diagnosis more accessible, particularly in resource-limited settings, and contributes to the advancement of AI-driven cardiac healthcare.

Awards Won: