

ABSTRACT

Cardiovascular disease is one of the leading causes of death globally, one of which is arrhythmia. Arrhythmia is generally detected through an electrocardiogram (ECG), but this method has limitations in detecting short-term and real-time symptoms. Photoplethysmography (PPG) emerges as a promising alternative due to its ease of use, ability to continuously monitor heart rhythm, and low cost.

This study proposes an arrhythmia detection system based on PPG signals, combining the Discrete Wavelet Transform (DWT) method and morphological features for feature extraction, along with a Convolutional Neural Network (CNN) and Gated Recurrent Unit (GRU) architecture for classification. The study was conducted by evaluating the model's performance at the initial signal frequency and several sampling frequency variations through resampling. The results showed that at the five tested frequencies, the model achieved high accuracy ranging from 98.91% to 99.36%.

The trained model was implemented on an ESP32-S3 microcontroller. Testing showed that the 50 Hz model achieved 95.68% accuracy with an average inference time of 269 ms. This result is more efficient than the 200 Hz model, which achieved an accuracy of 96.55% but required an average inference time of 1093 ms. Real-time testing on five subjects yielded an average accuracy of 82.50%. This result was influenced by the quality of the signal generated by the sensor on the wrist.

Keyword: arrhythmia, photoplethysmography, discrete wavelet transforms, convolutional neural network, gated recurrent unit.