Utilizing Wavelet Transform and Fourier Transform to Detect Cardiac Arrest Through Electrocardiogram Analysis

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There are over 400,000 cases of Sudden Cardiac Arrest (SCA) recorded annually, with over 90% of these events being fatal. The current detection system used to detect cardiac arrest in hospitals, the modified early warning system (MEWS), is limited because it relies on periodic vital sign measurement which fails to capture trends and provides only intermittent monitoring. As a solution, the researcher created a mathematical signal processing that employs Fourier and Wavelet Transform to detect frequency features within electrocardiogram (ECG) signals. ECG recordings from patients were collected from the MIT-BIH arrhythmia database and preprocessed using filters to reduce noise and extract features, namely the QRS complex. Using the discrete wavelet transform, multiple wavelets and different detail levels - which analyze different frequencies - were processed onto the signal. Statistical analysis such as a t-test, found all groups to be statistically significant, demonstrating the model's viability in detecting early indicators of cardiac arrest. This model not only improves upon the limitations of MEWS by enabling continuous, real-time monitoring but also optimizes computational efficiency through discrete frequency bands while preserving the ability to accurately detect subtle abnormalities leading up to arrhythmias and cardiac arrest. The primary application of this project is the models' integration into a real-time, wearable device for out-of-hospital cardiac arrest, which could dramatically increase survival rates by facilitating earlier emergency intervention.

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