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Designing Efficient Multi-Class ML based ECG Arrhythmia Patterns Classification and Feature Extraction Approach

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Abstract: *This study presents a novel approach for multiclass electrocardiogram (ECG) arrhythmia classification using machine learning techniques. The proposed method employs the Pan-Tompkins algorithm for preprocessing and noise removal, followed by the extraction of time-domain features such as NN50, SDNN, mean heart rate variability (HRV), and root mean square of successive differences (RMSSD). These features are then used to train and evaluate the performance of support vector machine (SVM) classifiers. The study utilizes the MIT-BIH Arrhythmia ECG measurement database to classify three types of cardiac arrhythmias: normal sinus rhythm (NSR), atrial premature beat (APB), and atrial flutter (AFL). The results demonstrate that the proposed Bayesian optimization-based SVM classifier achieves the highest accuracy of 96.8%, outperforming both cubic and quadratic SVM classifiers. The optimized SVM offers a 6.5% improvement over cubic SVM and a 3.3% improvement over quadratic SVM, with a faster training speed of approximately 630 observations per second. The class-wise precision and recall analysis reveals that the optimized SVM achieves 100% precision for all three ECG classes, with a recall of 100% for NSR and APB, and 90.3% for AFL. The proposed method's effectiveness in accurately classifying ECG arrhythmia patterns highlights its potential for enhancing clinical decision-making processes and improving patient outcomes in cardiology*

Keywords: ECG, Peak Detection, SVM, HRV, Pan-Tompkins Algorithm, Arrhythmia Classification.

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