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Detection of Cardiovascular Conditions on ECG Signals via Deep Learning Methods

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Recent advancements in deep learning have significantly improved electrocardiogram analysis for early and accurate detection of cardiovascular diseases. Unlike traditional ECG interpretation methods, which depend heavily on expert judgment and are prone to variability, machine learning models automatically identify complex patterns within large ECG datasets, offering enhanced diagnostic accuracy. Convolutional neural networks and transformer-based architectures demonstrate superior sensitivity and specificity, facilitating real-time monitoring and continuous risk assessment through wearable technology.

Machine learning effectively addresses ECG signal challenges, including noise reduction and variability management, by automatically extracting relevant clinical features. Explainability techniques further enhance clinical interpretability and trust among healthcare providers. Additionally, the adoption of federated learning in ECG analysis allows collaborative model training across distributed data sources, ensuring patient privacy and improved model generalization across different clinics and devices.

We propose an end-to-end deep neural network-based tool specifically designed for cardiovascular disease detection, integrating advanced preprocessing techniques, deep feature extraction, and robust classification algorithms. The proposed solution demonstrates high diagnostic accuracy validated across diverse patient cohorts and varied clinical settings. Furthermore, it includes intuitive visualization and interpretability modules, enabling clinicians to clearly understand model predictions. This comprehensive tool is designed for seamless integration into clinical workflows, enhancing efficiency, enabling timely clinical decisions, and contributing to improved patient outcomes.

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