HEART BEAT ANOMALY CLASSIFIER

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Heart disease remains a leading cause of mortality worldwide, with heart failure posing a particularly high risk due to its complex progression and challenging early detection. Predicting heart failure and classifying heartbeat anomalies accurately are crucial for timely intervention, allowing healthcare providers to implement preventive and personalized care strategies. This study proposes a machine learning-based approach for heart failure prediction and heartbeat anomaly classification, leveraging both structured clinical data and ECG signal analysis to assess patient risk and identify abnormal heart rhythms. The heart failure prediction model utilizes structured clinical data, such as patient demographics, medical history, and vital statistics, to estimate the probability of heart failure. This model combines logistic regression and ensemble techniques, such as random forests and gradient boosting, to capture patterns and interactions among key risk factors, including age, blood pressure, cholesterol levels, and comorbidities. The ensemble model provides a robust, interpretable solution that enables healthcare providers to assess the underlying contributors to heart failure risk with high accuracy. For heartbeat anomaly classification, the system employs a Convolutional Neural Network (CNN) trained on labeled ECG data to detect and classify abnormal heart rhythms, such as atrial fibrillation, tachycardia, and bradycardia. By analyzing the ECG signal's waveform, the CNN detects subtle irregularities and distinguishes between normal and abnormal patterns in real-time. Converting ECG signals into spectrograms allows the CNN to identify temporal and frequency-based patterns unique to each type of arrhythmia, resulting in a high-performance classifier that aids in the early detection and diagnosis of cardiac abnormalities. Experimental evaluations demonstrate that the proposed models achieve high accuracy and sensitivity in predicting heart failure and classifying heartbeat anomalies across multiple datasets. These results underscore the potential of machine learning in cardiovascular healthcare, offering a scalable, data-driven solution that can be integrated into clinical workflows for proactive heart health management. The study also highlights the need for further research and model finetuning to adapt to diverse patient populations and evolving medical knowledge, paving the way for improved predictive and diagnostic capabilities in cardiac care.

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