Deep Learning-based Signal Quality Assessment in Wearable ECG Monitoring

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Wearable electrocardiogram (ECG) monitoring is an effective method of screening for occult arrhythmia. However, signals from the wearable ECG monitoring device are often disturbed by various artifacts and noises originating from daily activities and which can significantly affect peak detection and ECG morphological feature extraction, leading to frequent false alarms for arrhythmia detection. Therefore, it is crucial to exclude ECG fragments with poor signal quality.

In this study, we developed three xResNet-based ECG signal quality assessment models, trained on the Brno University of Technology ECG Quality Database (BUT QDB). The first model is designed for quality assessment in arrhythmia screening tasks, and it can distinguish between ECG data in which the PQRST waves or only QRS complexes are visible from data in which these cannot be used for further analysis with a sensitivity (Se) of 98.87% and specificity (Sp) of 99.83%. The second model is used for quality assessment in arrhythmia diagnosis tasks, and it detects ECGs with visible PQRST waves with a Se of 97.15% and Sp of 95.95%. The third model classifies ECGs into data with PQRST visible, with only QRS visible, or unsuitable for analysis and achieves an accuracy (Acc) of 96.62%, 93.66%, and 98.97%, respectively.

The results indicate that the proposed models can accurately evaluate the ECG signal quality during wearable monitoring, meeting the analysis requirements for arrhythmia.