QRS complex classifier for personalized healthcare applications

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Many personalized healthcare devices that monitor cardiovascular health use long term HRV analysis for hypertension and atrial fibrillation diagnosis. HRV is derived by masking the non-sinus node QRS complexes (nsQRS) on a person's electrocardiogram (ECG). Often the presence of nsQRS such as ectopic beats, jeopardize the overall HRV accuracy.

In the current study, we report on a machine learning based algorithm that is designed to correctly identify nsQRS complexes in long-term ECG recordings. The approach assumes that QRS complexes have already been detected using an existing detector. From each detected QRS complex three fiducial points, namely, R peak (R), QRS onset (Q), and QRS endpoint (S) are determined. Subsequent to this 10 features are determined. These include ECG amplitudes at Q, R, and S, time differences between QR, QS, and RS, RR interval between R peaks of consecutive QRS complexes, and the angles between points R, Q, and S (Qθ), Q, R, and S (Rθ), and R, S, and Q (Sθ) respectively. These features are then used to construct a vector that is fed into a k-nearest neighbor (kNN) based binary classifier. We evaluated our algorithm on 103635 pre-annotated QRS complexes from 44 ECG that were taken from the MIT-BIH arrhythmia database. The kNN classifier was built using a training dataset of 50000 QRS complexes. The number of nearest neighbors was set to k = 5. The remaining 53635 complexes were used to test the performance of the algorithm. To quantify the performance of the algorithm, sensitivity (Se) and specificity (Sp) were computed for the developed classifier using the testing dataset.

The algorithm was found to be 99.65% sensitive and 97.05% specific in the identification of nsQRS complexes in testing dataset. In this study we report on a simple technique that allows for basic nsQRS complex detection with reasonable accuracy.