An Efficient Approach for Heartbeat Classification

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In this paper an efficient heart beat classification algorithm for mobile devices is presented. A simplified ECG model is used for feature extraction in the time domain. QRS complex is modeled by two straight lines while P and T waves are modeled by parabolas. The T wave asymmetry is achieved using a fourth degree parabola, whereas the P wave is modeled by the second degree parabola. The model parameters are estimated by minimizing the root mean square (RMS) of the model error. Heart beats are classified as one of the following: normal (N), supraventricular (S) and ventricular (V) ectopic beats. Classification of model parameters is done using a feed-forward neural network. The inputs used by the classifier are: QRS slopes and duration, P wave coefficients, adjacent and averaged RR intervals. Patient specific adaptation is achieved using a dominant heart beat as an additional classifier input. A series of tests have been performed to evaluate the classification algorithm. Three model sets were used for that purpose. The first one contains QRS parameters only. The second one contains the dominant QRS model as well and in the third model set the P wave and appropriate dominant P wave model are included. Training and testing is done using the MIT-BIH arrhythmia database ECG signals subset and expressed in sensitivity (Se), specificity (Sp) and accuracy (Acc). It can be concluded that the best results are achieved when applying the classification algorithm on the third model set. The following results were obtained: SeN = 0.9915, SpN = 0.9750, AccN = 0.9865; SeS = 0.9208, SpS = 0.9641, AccS = 0.9448; SeV = 0.9469, SpV = 0.9566; AccV = 0.9531. Additionally, the proposed algorithm has been implemented as a J2ME mobile application. It has been tested on signals recorded by a telemedicine health care system and have achieved average accuracy above 93%