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Intelligent Recognition and Classification of Three Cardiac Conditions Using ECG Signals

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An electrocardiogram (ECG) is a bioelectrical signal which records the heart's electrical activity versus time. It is an important diagnostic tool for assessing heart functions. In this study, pattern recognition techniques are used for the interpretation of an ECG signal. The techniques used in this pattern recognition application are, signal pre-processing, QRS detection, feature extraction and artificial neural network for signal and cardiac condition (healthy or a certain disease) classification. In this study, the signal processing and neural network toolbox are used in Matlab environment. The processed signal source came from the Massachusetts Institute of Technology Beth Israel Hospital (MIT-BIH) arrhythmia database which was developed for research in cardiac electrophysiology.

Three conditions of ECG waveform were selected from MIT-BIH database for this study. The ECG samples were pre-processed, then features representing the each sample were extracted to produce a set of features that can be used in a neural network to make the classification of samples and the recognition rates were recorded. The study is focused on finding a simple but reliable feature extraction method and best neural network structure to correctly classify the selected three different cardiac conditions.

It was found that different structures of the neural network were able to obtain perfect training and testing recognition rates (based on our feature extraction method) as high as 100% for three different cardiac conditions. But network structure with 200 inputs, 7 hidden and 3 output neurons showed highest accuracy around 90% (0.8976)while obtaining recognition rate of %100.Also with this structure network showed its fastest training and testing times (around 7 and 0.9secs respectively). Training rates were always around 100% with each run of the program (training and testing) but testing differs between %86-%100 with accuracy values changing from 60%-%90 respectively. Based on these results, the method of using 200 sample values of the ECG between R-R intervals as feature values feeding the network can dramatically decrease the complexity of the neural network structure, which can increase the training and testing speed and the accuracy rate of the network classification.

Biography

Ali Işın is a Senior Biomedical Engineer at Ministry of Health in Nicosia, Turkish Republic of Northern Cyprus (Northern Turkish part of Cyprus). He is also a Lecturer at Near East University, Biomedical Engineering Department, North Cyprus. He gained his Bsc Degree as first in class at University of Başkent, Ankara, Turkey on Biomedical Engineering. He started his Msc Degree studies at University of Essex, Colchester, United Kingdom on Computer Science-Brain Computer Interfaces and gained the degree at Near East University on Biomedical Engineering. He is currently working on his PHD degree on Biomedical Engineering at Near East University, North Cyprus.

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