Early Detection of Myocardial Ischemia Using Transient ST-Segment Episode Analysis of ECG

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Abstract

Sudden Cardiac Death (SCD) is an unexpected death caused by loss of heart function when the electrical impulses, fired from the ventricles, become irregular. Most common SCDs are caused by different types of cardiac arrhythmia. Coronary heart disease (CHD) is noticed to be one of the main risk factors (nearly up to 80%) for SCD cases, which is mainly due to Acute Myocardial Infarction (AMI), myocardial ischaemia and cardiac arrhythmia. The focus of this work is to automate the early detection of heart attacks, strokes and heart diseases. Heart diseases and stroke are responsible for nearly 40% of all deaths in the U.S. The enormous health-care costs and long time of observation-based heart symptom detection are the primary motivation behind devising automated early warning systems.

This work is based on the application of signal processing and artificial intelligence to the heart signal known as the ECG (Electrocardiogram). Coronary heart diseases are clinically diagnosed by the study of ST-T complex in the ECG signal. The changes in amplitudes, time intervals and duration on the ST-T segment can indicate an electrical instability due to increased susceptibility to ventricular fibrillation, and may lead to SCD. Our work aims at automating the recognition of ST-segment deviations and transient ST episodes which help in the diagnosis of myocardial ischaemia and also classifying major cardiac arrhythmia. Discrete Wavelet Transforms have been incorporated for feature extraction and back/forward search algorithms for the ST episode detection. We propose an improved morphological feature vector including ST-segment information for heart beat classification by supervised learning using the support vector machine approach. Our system has been tested on the European ST-T Database and yields an accuracy of 93.33% for the ST episode detection. The high accuracy of our ST segment analyzer system makes it highly efficient for early detection of CHDs.