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A computationally efficient electrocardiogram analysis system

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Fast, portable and accurate electrocardiogram (ECG) analysis systems play a major role in the diagnosis of the cardiovascular diseases that causes a vast number of deaths each year. Even though the application of the wavelet transformation based techniques in ECG analysis systems provides very accurate QRS wave complex detection results (associated with the ventricular depolarization), they are often computationally demanding. Further they are generally too complicated to be directly implemented in portable microcontroller based battery powered systems and usually require the power of a modern computer. Thus, in this paper a new and computationally efficient wave transformation technique for discovering the QRS complexes in ECG records by obtaining the wave's first derivative and then transforming the signal using a single impulse response function (IRF) based R peak pulse (in the QRS complex) detection method is proposed and established. By using this technique, a high degree of accuracy is rapidly achieved to locate the R peaks by clearly distinguishing them from large wave distortions in the ECG signal. The analysis of the new technique was implemented using ECG records from the MIT-BIH Arrhythmia database, and then compared with a wavelet transformation based very accurate and recognized detection technique. Based on the computational time consumption comparisons the proposed method is at least faster by 350%. Further the calculated standard QRS detector performance parameters such as the sensitivity (Se) and the true prediction (+P) are comparable with the recognized method. For every ECG instance an identification error rate of less than 1% was attained. We believe that there is room for further improvements and the technique can be used in portable ECG analysis systems with a higher computational performance.

Keywords: Electrocardiogram, Noise Distortion, Impulse Response.

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