Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 86 (2016) 188 – 191

Procedia Computer Science

2016 International Electrical Engineering Congress, iEECON2016, 2-4 March 2016, Chiang Mai, Thailand

The Development of ST-Episode Detection in Holter Monitoring for Myocardial Ischemia

Nopadol Uchaipichat[a]* , Chusak Thanawattano[b], and Adisai Buakhamsri[c]

[a]*Department of Electrical and Computer Engineering,Faculty of Engineering, Thammasat University, Pathumthani, Thailand*
[b]*National Electronics and Computer Technology Center, Pathumthani, Thailand*
[c]*Division of Cardiovascular diseases, Faculty of Medicine, Thammasat University, Pathumthani, Thailand*

Abstract

Currently, cardiac arrhythmia is a major cause of life threatening. Electrocardiogram (ECG) is the most useful physiological signal that is used in clinical diagnosis. Some abnormalities of heart functions can be investigated from ECG morphology. Many research works present that the changing of ST-T complex is a crucial parameter related to myocardial ischemia. Therefore, this paper reports our progress in ST-episode detection using time domain analysis. The database used in this study is European ST-T database from Physionet. As the results, the performance of our proposed technique can correctly detect ST-episode with 91.37% of sensitivity.

Peer-review under responsibility of the Organizing Committee of iEECON2016

Keywords: ST-Episode; Electrocardiogram; Myocardial Ischemia

1. Introduction

Nowadays heart disease is an important issue in several countries. Electrocardiogram (ECG) is a physical signal that is very helpful in the diagnosis of heart disorders. The ECG morphology is very helpful information in clinic. The abnormality of ECG morphology is related to the functional disorder of heart. Several literatures present that the changing of ST-T complex is a crucial parameter related to myocardial ischemia. The transient ST segment and T wave are important components in diagnosis of ischemia. Therefore; modern ECG monitoring has embedded function for detection of transient ST segment and T wave. In 1995, Taddie A. and colleague proposed 2-lead ECG analysis in time series to measure the episode of ST segment vector [1]. Several research groups applied Karhunen–Loe`ve

Peer-review under responsibility of the Organizing Committee of iEECON2016
doi:10.1016/j.procs.2016.05.059

transform-based algorithm for detection of transient ST segment episodes [2-4]. In 2006 Milosavljevic N. and colleague proposed wavelet transform-based technique to extract some characteristic features of ECG to detect ST segment [5]. This study proposes technique for measuring the ST deviation with time domain analysis.

2. Methodology

2.1. Data Study

The European ST-T Database available in Physionet was used in this study to develop algorithm in measurement of ST deviation and ST-Episode detection [6]. There are 90 annotated excerpts of ambulatory ECG recordings from 79 subjects. Forty six records from database were used in our study. Each record consists of two ECG traces sampled at 250 Hz with 12-bit resolution. Two cardiologists independently evaluated to annotate changes in ST segment and T-wave morphology. Fig. 1 shows the morphology of ECG signal. The definitions of important annotations are:

- *ST segment deviations* are measured from 80 ms after the J point (if heart rate does not exceed 120 bpm) or 60 ms after the J point otherwise.
- *ST Episodes* can be evaluated if ST deviation is higher than 0.1 mV continuously more than 30 seconds.

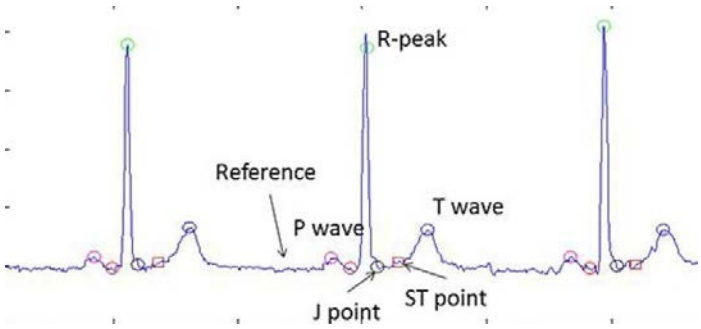

Fig. 1. The morphology of ECG

2.2. The measurement of ST Segment Deviation

The ST segment deviation can be calculated from the absolute value of the difference between values of the ST segment on the reference as presented in Eq. 1

$$ST_{dev} = |ECG_{ST} - ECG_{ref}| \quad (1)$$

where ECG_{ST} is the amplitude of the ST segment after J point. The ST segment is measured 60 ms after the J point if R-R interval is less than 0.5 s and 80 ms after the J point if R-R interval is more than 0.5 s. ECG_{ref} is the reference that is the amplitude of ECG prior to P wave as shown in Fig. 1. The procedure in calculation of ST_{dev} position of J point and P wave are required for calculation of ST_{dev}. The methods to detect J point and P wave are described as follow:

2.2.1. J point and ST point detection

In this stage the ECG was transformed into time-frequency domain using short time Fourier transform (STFT) as shown in Fig 2. The temporal information in selected frequency band (7 to 30 Hz) was considered in J point localization as shown in Fig. 3. It can be noticed that the J point can be detected from the first minima point after R wave. Our technique for R wave detection has been reported in previous work [7]. The location of ST point is then marked depending on heart rate at 80 ms or 60 ms after J point.