(Form6)

論　文　要　旨
Thesis Abstract

(yyyy/mm/dd)　　2019 年 01 月 10 日

※報告番号	甲 第 245 号	氏　名 (Name)	MOHAMAD SABRI BIN SINAL

主論文題名　(Title)

Quick Identification of Arrhythmia symptoms using Empirical Approach in Long Sequence of Heart Cycles

内容の要旨　(Abstract)

Computational electrocardiogram (ECG) analysis is one of the most crucial topics in cardiovascular research domain especially in identifying the abnormalities of heart conditions through cardiac arrhythmia symptom. Each symptom consists of its own unique characteristic and the complexity to characterize various types of abnormalities is one of the big challenges in this study. Hence, the difficulties in identifying an early stage of heart diseases symptom due to random behaviour and rare appearance in time series has proven a challenge to create the solution towards the detection of the symptom. Previous studies have tried to solve this issue and some of them achieved the discrimination with a high degree of accuracy. However, the accuracies never reach 100%. Hence, the complexity in identifying the disease is huge. In addition, no research has achieved it in a long duration time frame, e.g. 12 hours, of ECG data. Therefore, this dissertation tries to deal with that problem constructively. In this dissertation, an efficient, quick and highly sensitive computational intelligence to accurately detect abnormalities of a heart condition based on Arrhythmia symptom is proposed. The proposed mechanism consists of two primary components, namely an efficient Arrhythmia detection using autocorrelation and statistical approach, and hybrid mechanism to detect Paroxysmal stage of Atrial fibrillation using adaptive threshold-based algorithm with Artificial Neural. There are two main concerns for each study. For the first study, the detection of heart condition abnormalities should be simple and with the capability to detect abnormalities regardless of the symptom's origin. Next, for the second study, the focus is more on the design of a very sensitive mechanism to detect the abnormalities at early stage namely the Paroxysmal stage of the Atrial Fibrillation. How to deal with the complexity of the disease behaviour at an early stage and the visual representation of the outcome to classify the disease are the two of main concerns in this study.

In the first study, an Efficient Arrhythmia Detection Using Autocorrelation and Statistical Approach is proposed. This study proposes an autocorrelation method with K-Nearest Neighbor (KNN) classifier method to accurately and robustly detect 14 types of Arrhythmia symptom regardless of the origin of the symptom in a long hour data. Moreover, variability analysis based on periodic autocorrelation result is proposed and used for the classification procedure. 1 minute and 12 hours duration data are chosen to compare and signify the most suitable time duration to detect the Arrhythmia symptom. As a result of the proposed method performance evaluation, it is revealed that the accuracy of 95.5% in discriminating Arrhythmia from Normal Sinus data is achieved. Furthermore, it is confirmed that by utilizing the autocorrelation result in long hour data can help generalize the abnormalities' characteristic of heart condition like Arrhythmia symptom. It is concluded that the proposed method can be useful to diagnose abnormalities of a heart condition at any stage.

Secondly, the Hybrid Mechanism to Detect Paroxysmal Stage of Atrial Fibrillation using Adaptive Threshold-based Algorithm with Artificial Neural Network is proposed. In this study, a new mechanism called "Door-to-Door" algorithm is introduced to accurately and quickly detect the significant peaks of heart cycle in 12 hours ECG data and to discriminate obvious Preliminary stage of Atrial Fibrillation rhythms from Normal Sinus rhythms. In addition, a quantitative method using Artificial Neural Network (ANN), which discriminates unobvious Paroxysmal stage of Atrial Fibrillation rhythms from Normal Sinus rhythms is investigated. As a result of Door-to-Door algorithm performance evaluation, it is revealed that the Door-to-Door algorithm achieves the accuracy of 100% in detecting the significant peaks of heart cycle in 17 Normal Sinus ECG data. Furthermore, it is verified that the ANN-based method achieves the accuracy of 100% in discriminating the Paroxysmal stage of 15 Atrial Fibrillation data from 17 Normal Sinus data. Therefore, it is confirmed that the computational time to perform the proposed mechanism is less than the half of the previous study.

As concretely presented in this study, the proposed mechanism not only accurately detects the abnormalities of the heart condition based on Arrhythmia symptom but also reduces the complexity in identifying the symptom with small and simple parameter. Consequently, it is concluded that this research can contribute to the medical field as one of the best technologies in diagnosing abnormalities of heart condition as early stage as Paroxysmal stage of Atrial fibrillation.