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"PREDICTION OF CARDIAC ARRHYTHMIAS USING NEURAL NETWORKS"

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ABSTRACT

Develop of wearable cardiac monitors is becoming an important field of research because Cardiovascular disease is the leading cause of morbidity and mortality in the world. Real time arrhythmias detection algorithms are necessary to improve this kind of devices. This article presents a premature ventricular contraction detection method based on Discrete Wavelet Transform for pre-processing, segmentation and feature extraction. Discrete Wavelet Transform (DWT) is used to perform baseline wander and power line noise reduction algorithm. Three different feature spaces based on wavelet coefficients are tested. Cardiac arrhythmias are classified by abnormal activities in the heart. These abnormalities can be analyzed by an electrocardiogram (ECG).Heart rate variability (HRV) reflects all symptoms associated with autonomic nervous system (ANS) as well as heart disease. Thus, HRV has frequently been used in various studies.

Computer assisted recognition and classification of ECG into different pathophysiological disease categories is critical for diagnosis of cardiac abnormalities. Evaluation and prediction of life threatening ventricular arrhythmias greatly depend on Premature Ventricular Contraction (PVC) beats. Many studies have revealed that PVC when associated with myocardial infarction can be linked to mortality.

KEYWORDS : *ECG, Wavelet Coefficients, PVC, DWT, HRV.*

I. INTRODUCTION

Evaluation and prediction of life threatening ventricular arrhythmias greatly depend on Premature Ventricular Contraction (PVC) beats. Many studies have revealed that PVCs when associated with myocardial infarction can be linked to mortality. [1]

The recognition and classification of the electrocardiogram (ECG) beat is important for diagnosing different cardiac diseases. Electrocardiography is a method that registers electrical activity of heart against time. Instead of manually annotating the ECG signals by experts such as doctors and cardiologists which could take enormous time and efforts, computer assisted automatic detection of the types of ECG

signal can be employed. ECG signals are one of the most important sources of diagnostic information and hence their proper acquisition and processing provide an indispensable tool to support medical diagnosis. Acquired signals are affected by noise and call for advanced filtering techniques. It is expected that any computerized interpretation of ECG signals has to be user-friendly, meaning that the results of classification/ interpretation could be easily comprehended by a human user. Among the different arrhythmias, PVC also known as Ventricular Premature Beat (VPB) or extra systole is a form of irregular heartbeat in which the ventricle contracts prematurely [2].

An electrocardiogram (ECG) contains a large amount of information that can be used for determining many different attributes of the electrical activities of the heart. Typically, an ECG varies from person to person due to the difference in the position, size, anatomy of the heart, age, body weight, chest configuration, and various other factors. An ECG is a representative signal of cardiac physiology, which can be very useful in diagnosing cardiac disorders [3, 4]. The ECG was originally observed by Waller in 1899. In 1903, Einthoven introduced the electrophysiological concepts still used today, which includes the labels of the waves [5]. To this day, an ECG is the main way of gathering information from the body in order to better analyze the heart's activities [6].

II. FREQUENCY DOMAIN MEASUREMENT OF HRV

Various spectral methods for the analysis of the heart rate variability (HRV) have been applied since the late 1960s. Power spectral density (PSD) analysis provides the basic information of how power (i.e. variance) distributes as a function of frequency.

Short-term recordings: Three main spectral components are distinguished in a spectrum calculated from short term recordings of 2 to 5 min [7], very low frequency (VLF), low frequency (LF), and high frequency (HF) components.
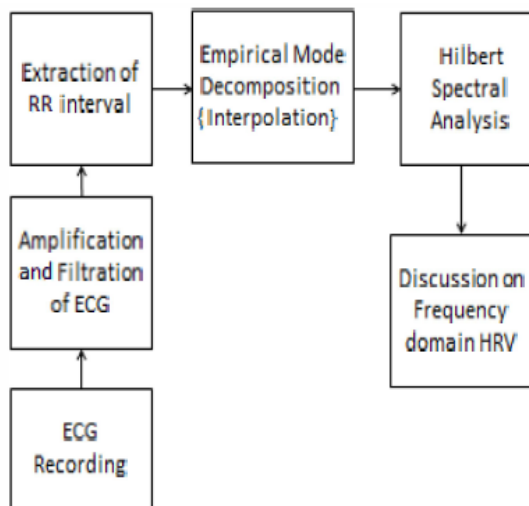

Figure l. Flow graph of proposed work for HRV analysis

III. METHODOLOGY

The fundamental aim of this work is to demarcate between normal ECG signals and abnormal ECG signals. This is a complex task because there is appreciable variation of

waveforms in both normal and abnormal ECG. It is this phenomenon which makes it difficult to analyse ECG signals. The performance of ECG pattern classification strongly depends on the characterization power of the features extracted from the ECG data and the design of the classifier (classification model or network structure and parameters). In the current work, the proposed feature extraction technique employs a suitable wavelet transform in order to effectively extract the morphological and statistical information from ECG data and these extracted features are given to classifier. The overview of the proposed system is shown in Figure.2
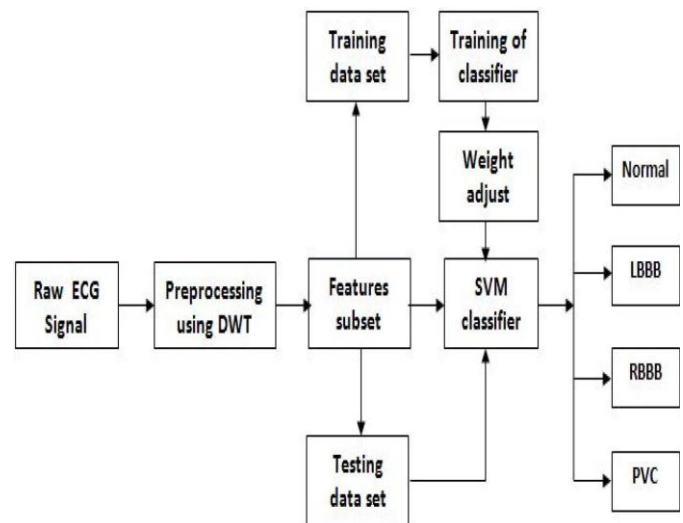

Figure. 2: Block Diagram of the System

It can be seen that the whole methodology is divided into three basic parts: pre-processing, feature extraction and classification. From the figure, it can be seen that the raw ECG signal is initially pre-processed.

IV. DISCUSSION

The work discussed in this paper illustrates that empirical mode decomposition does not require a priori knowledge of the signal to be analyzed, as compared to other transforms like Fourier and wavelet transforms which requires basis functions to be described. EMD can be used for non-stationary signals. Therefore, the algorithm can be used to identify the low-frequency and high-frequency bands of HRV more sharply and effectively through Hilbert spectrum than using the Fourier spectrum, which may help physicians make decisions on individual therapy or intervention on time.

V. CONCLUSION

Diagnosing arrhythmia is a difficult task requiring observation of the patient, patient's ECG and gathering of additional clinical information. Here an automatic detection and classification system was designed and executed. An expert model was developed for PVC arrhythmia on the background of ECG by using discrete wavelet transforms and support vector machine. The performance of the system is found to be better for combined feature set than the individual feature sets. The performance of the system may be improved by increasing the training and testing dataset for each type of heartbeat.

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