Automatic Classification of Cardiovasular Diseases Using Bi-Orthogonal Wavelet Transform

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Abstract – ECG is a realistic record of electrical activity of the heart. ECG has been widely used for the detection of cardiovascular diseases. ECG feature extraction plays a significant role diagnosing most of the cardiac disease. The accurate detection is mandatory to provide effective treatment to the patients. In this paper we propose our various techniques and methods for the automatic classification of cardiovascular diseases such as first degree AV block, second degree AV block, third degree AV block and sinus arrest . ECG wave consist of PQRST waves which are major feature for the detection of cardiovascular diseases. Various intervals and amplitudes are determined by ECG classification and feature extraction methods. The ECG based automatic classification of cardiovascular diseases is done by heartbeat classification using signal pre processing, the heart beat segmentation techniques, feature extraction methods and learning algorithms. The segmentation technique used here is biorthogonal wavelet transform and for classification fuzzy logic, supervised learning NN techniques has been used.

KEYWORDS: ECG, Amplitude and interval detection, AV blocks, biorthogonal wavelet, fuzzy logic, supervised learning NN.

I. INTRODUCTION

According to the WHO cardiovascular disease is the main cause for the death worldwide. Electrocardiogram is the measurement of electrical activity of the heart which gives realistic record of cardiovascular diseases. An ECG consists of PQRST waves in a cardiac cycle[1]. These waves play significant role in diagnosing the functioning of human heart. The electrical signals in ECG waveform is generated by the depolarisation and repolarisation of the atria and ventricles.

Normally the ECG taken from the patients are obtained in the form of graph. The graph is examined by the cardiologists for hours to determine the correct disease and provide proper treatment for the patient[3].

This paper describes about automatic classification of cardiovascular diseases using biorthogonal wavelet transform. Here first degree AV block, second degree AV block, third degree AV block and sinus arrest. Initially signal is acquired from the patients. Then the signal is pre-processed using lynn's filter. The signal is allowed to divide from continuous time function into wavelets using biorthogonal wavelet transform bior 1.5 and essential features were extracted. Using fuzzy logic and supervised learning NN different AV blocks and sinus arrest were classified and displayed on the monitor.

II. EXISTING SYSTEM

In existing system the ECG signal is acquired from the patients in which the doctors will classify the normal and abnormal heartbeats. From the past few decades many researches has been conducted and algorithms has been proposed theoretically for implementing automatic classification technique, in which it classifies the disease on its own without any human interruption.

III. PROPOSED SYSTEM

In this paper the automatic classification system has been implemented. Various theoretical assumptions and technicians such as biorthogonal wavelet transform, fuzzy logic and supervised learning NN are used. The main advantage of this paper is that automatically disease classification can be done during long term monitoring and also reduce the time consumption for technicians.

IV. METHODOLOGY

- DATA COLLECTION

Initially the ECG signals are acquired from patients using ECG sensors. Then these waveforms are read by the system.

- PRE-PROCESSING

Pre-processing is carried out with help of filters. Thus digital filtering has been commonly used in many areas particularly arear of biomedicine such as cardiology. In this paper zero phase lynn's filter is used. Zero phase lynn's filter with cut-off frequency 0.5 Hz is used to suppress the low frequency base line wandering[4]. Zero phase filtering helps to preserve features in a filtered wave exactly where they occurred before filtering process. QRS complex and other intervals are more important in ECG signal[5]. ECG corrupted with noise is very difficult to diagnose the diseases. So, zero phase filtering reduces noise in the signal and preserves the QRS complex.

- BI-ORTHOGONAL WAVELET TRANSFORM

Bi-orthogonal bior 1.5 case there are two scaling functions are used which may generate different multiresolution analysis, also allows the use of long time intervals where we want more precise low frequency information, and shorter regions where we want high frequency information. Such that the durations and parameters of each intervals can be analysed deeply and

QRS complexes also segmented exactly. This will help to diagnose the cardiovascular disease shortly.

- FEATURE EXTRACTION

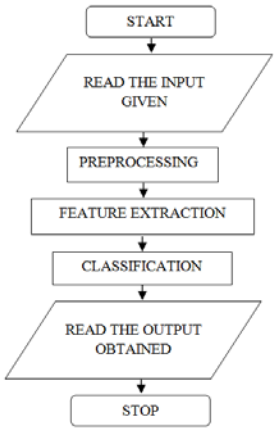
In ECG signal there are three events in which their morphological representation and duration is more significant[8]. Feature extraction technique extract the feature such as PR interval, PR segment, QRS complex, ST segment, RR interval and presence of P wave and T wave. Based on these features different type of AV blocks and sinus arrest were classified. Deep learning is most commonly used technique in feature extraction method.

- CLASSIFICATION

Classification is the process of organising data into categories for its most effective and efficient use. In this paper it will analyze the data obtained from feature extraction and compared with fuzzy set. If the extracted feature and fuzzy set get matched it will display the particular disease otherwise it will begin to compare with another fuzzy set. The main advantage of using fuzzy logic in classification is it is conceptually easy to understand, it can model nonlinear functions of arbitrary complexity and it can be blended with conventional control techniques[10].

In this paper the input vectors are given to the network and it will be trained to produce the output vector. This output vector is compared with desired output vector for correction detection of AV blocks and sinus arrest. If output vector is matched with desired output vector the particular disease will get displayed on the monitor.

V. FLOWCHART



DESCRIPTION:

Initially the ECG signals are acquired from patients and given to the systems. Then it is pre-processed using Lynn's filter. Thus zero phase Lynn's filter with cut-off frequency 0.5 Hz is used to suppress the low frequency baseline wandering. Then it is segmented from continuous time function to wavelets using biorthogonal wavelet transform bior 1.5, which will help to analyze the amplitude and duration of different intervals and QRS complex. Then important feature were extracted for cardiovascular disease classification. Here classification is done using fuzzy logic which will compare the extracted data with fuzzy sets to distinguish the disease and supervised learning neural network is also used for classification. Here input vector is trained to produce the output vector. Then this actual output is compared with desired output for cardiovascular disease classification.

VI. RESULT

Thus the automatic classification system has been implemented. First degree, second degree, third degree AV block and sinus arrest has been classified successfully and displayed on the monitor.

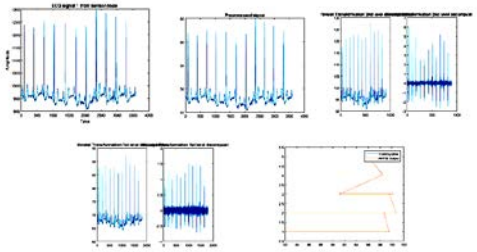


Fig 6.1 First Degree AV Block

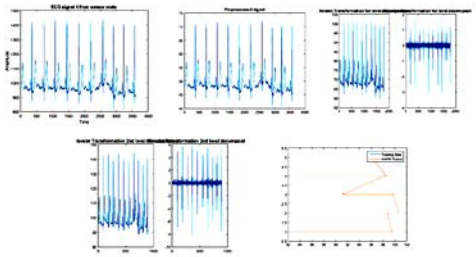


Fig 6.2 Second Degree AV Block

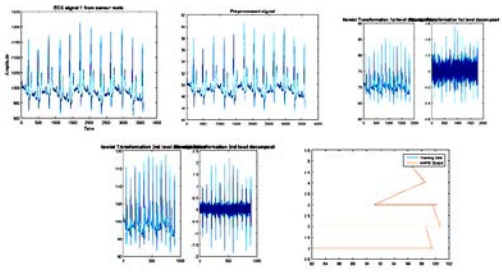


Fig 6.3 Sinus Arrest

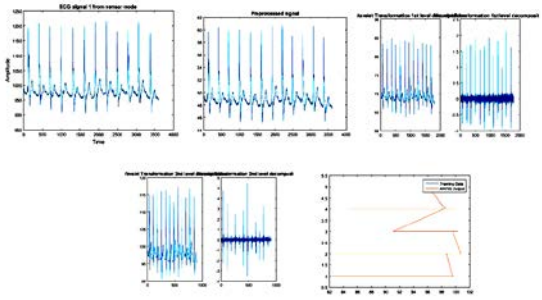


Fig 6.4 Third Degree AV Block

VII. CONCLUSION

Automatic classification system is implemented. The first and foremost function of this system is to classify the first degree AV block, second degree AV block, third degree AV block and sinus arrest automatically. These diseases were displayed on monitor. This system is mainly used when the long term monitoring has to be done and where a large amount of data is recorded. Manual evaluation of long term monitoring is time consuming. So this system help us for automatic classification of disease and reduce the time consumption for doctors and technicians. This system is found to be more efficient and more accurate.

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