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Classification of Myocardial Infarction using Discrete Wavelet Transform and Support Vector Machine

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Abstract - *This paper addressed the classification of Inferior Myocardial Infarction using Discrete Wavelet Transform(DWT) and Support Vector Machines (SVM). This system is contained of three components including data preprocessing, feature extraction and classification of ECG signals. The Wavelet Transform method is used to extract the feature vector of ECG segment. Then the support vector machine(SVM) with Gaussian kernel is used to categorize diverse ECG heart rhythm. Overall accuracy of SVM classifier is 97.02 percent. The data was collected from MIT/BIH PTB database.*

Key Words: **ECG, DWT, SVM, Myocardial Infarction, MIT/BIH PTB DB.**

1.INTRODUCTION

Electrocardiogram (ECG) is one of the most important tools for the diagnosis of cardiac disease. The waveforms are ready due to the polarization and depolarization of the tissues introduce in the heart and the leads introduce in the hardware are set at various spots on the chest to detect the electrical movement. Since it is an electrical movement, we can apply the procedures of Signal preparing to extricate new data.

Heart attacks also known as Myocardial Infarction. Inferior MI sometimes happens when the blood flow to the part of the heart is blocked causing some cells of that portion to die[7]. ECG is a well-organized signal that can be classified into five parts, namely P, Q, R, S and T wave and sometimes U wave[1]. These waves alongside the morphologies are of clinical importance in light of the fact that the vast majority of the data in the ECG is found in the intervals and amplitudes.

Generally an ECG signal is effected by noise due to electrical cable obstruction, breath, movement antiques, muscle constriction and clamor created by electro-surgical types of gear. The proposed method uses Wavelet Transform to denoise of ECG signal . A multiresolution approach alongside thresholding is utilized for the location of R - Peaks in each cardiovascular beats.

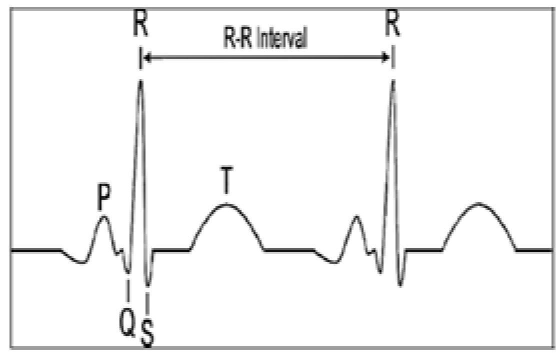

Fig - 1: Typical ECG wave

Different examinations have been accomplished for characterization of different cardiovascular arrhythmias. In this paper, we propose the DWT as feature extraction technique, and then SVM is used for classification of normal and abnormal ECG signal. The proposed approach data collected from MIT-BIH Arrhythmia Database and get high accuracy.

2. PRE PROCESSING

2.1 Data

For this paper data is collected from MIT BIH PTB database. MIT PIH database consists of many records of many patients having abnormalities or heart troubles. The ECG waveforms from MIT-BIH database describes a text header file, a binary file and a binary annotation file[5]. The header files consists of the detailed information such as number of samples, sampling frequency, format of ECG signal, type of ECG leads and number of ECG leads, patients history and the detailed clinical information.

The block diagram of proposed method shown in fig 2.From the fig 2 the original ECG signal is applied to Preprocessing. The Preprocessing stage is classified as denoising and Baseline wander removal of ECG signal [8].

The next step is feature extraction. Extracted signal subjected to classifier to classify the normal and abnormal class.

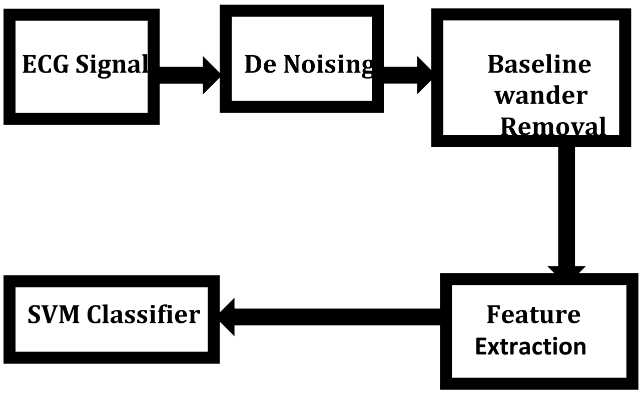

Fig - 2: Block diagram of proposed method

2.2 De-noising

The noise removal is carried out in two steps:

i. High frequency noise removal
ii. Baseline wander removal

Wavelet transform method for de noising of ECG signal, Selection of appropriate wavelet and number of decomposition level is very important in analysis of signals [4]. The wavelet used in this Daubechies families.

2.3 Baseline Wander removal

Baseline wander removal is needed in ECG signal to reduce the inconsistencies in beat morphology. Baseline wander removal obtained by first loading the signal then smooth it using a moving average filter and finally subtracted smoothed signal from loaded input signal. Then signal is free from Baseline drift.

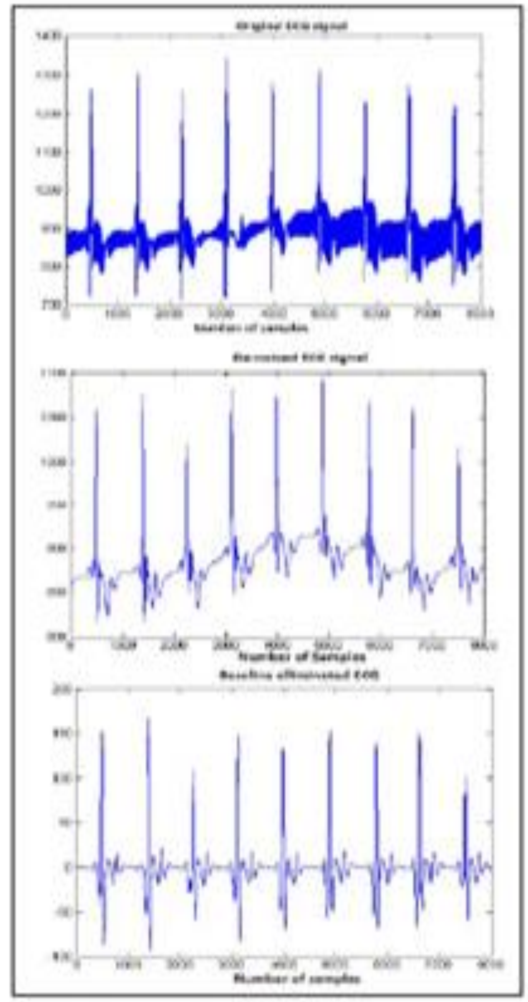

Fig - 3: Original ECG signal, Denoised ECG signal using wavelet transform and Baseline wander eliminated ECG signal

3.FEATURE EXTRACTION

Wavelet Transform is appropriate to analyze non stationary signals. By the multiresolution representation the signal structure is represented by only few coefficients in wavelet domain. The computed wavelet coefficients that illustrates the energy distribution of the signal in time and frequency[3]. The DWT evaluates the signal at diverse resolution (hence, multiresolution) through the breakdown of the signal into several successive frequency bands.

Coordinate utilizing of wavelet coefficient as contributions to the neural system may increment the neuron numbers in concealed layer which in turn has a unsafe effect on arrange operation. To limit the dimensionality of the separated element vectors, the insights of the wavelet coefficients were used [6].

The DWT utilizes two set of functions ¢(t) and $^{\varphi}$ (t) , each associated with the low pass and the high pass filters respectively . These functions have a property that they can be obtained as the weighted sum of the scaled (dilated) and shifted version of the scaling function itself:

¢(t)= ∑h[n] ¢(2t-n) ------------ (1)

$^{\varphi}$ (t) = ∑g[n] ¢(2t -n) ----------- (2)

Here, h[n] and g[n] is the half band low pass filter and high pass filter respectively.

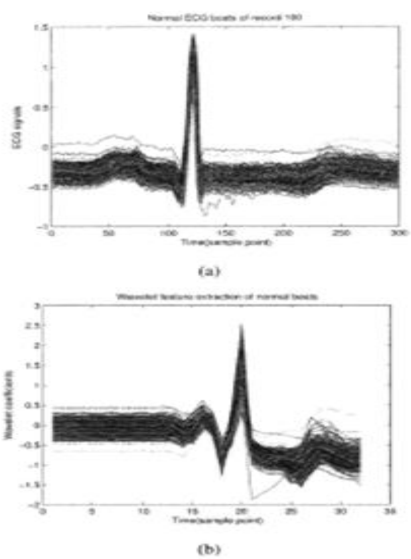

Fig – 4 : Original normal heartbeats, Wavelet coefficients of normal heartbeats

4. CLASSIFICATION

4.1 Support Vector Machines

Data classification eases to a two class problem forming a partition between normal and abnormal class. Threshold based classification was avoided due to poor accuracy. A Support Vector Machine (SVM) is a supervised machine learning method was used for classification. It is an illustration for binary linear classifier, established from Statistical theory of learning. It shows high accuracy and has competence to handle with high dimensional data sequences. The SVM makes use of pattern recognition between two point classes by the Support Vectors. Kernel translates nonlinear data in to linear data by altering data in to a higher dimensional feature space. Kernel functions can used in SVM as ECG data is of nonlinear type.

5. RESULTS

In this work, the Inferior Myocardial infarction was detected by DWT using SVM classifier. Performance of SVM classifier is compared with SAT and ANN classifiers and the classification results shows that SVM Classifier gives better accuracy of 97.02 percent as compared to other classifiers as shown in Table I.

Table - 1: Classification Results

classifier	sensitivity	specificity	Accuracy
SVM	94.8	95.7	97.02
SAT	93.22	94.28	93.61
ANN	85.71	80.00	83.33

For Calculating accuracy two parameters sensitivity and specificity are calculated using the equations 3 and 4

$$Specificity = \frac{Number\ of\ correctly\ classified\ normal\ beats}{Total\ number\ of\ normal\ beats} \quad ----(3)$$

$$Sensitivity = \frac{Number\ of\ correctly\ classified\ abnormal\ beats}{Total\ number\ of\ abnormal\ beats} \quad ----(4)$$

$$Accuracy = \frac{Total\ number\ of\ correctly\ classified\ beats}{Total\ number\ of\ beats} \quad ---(5)$$

6. CONCLUSION

The experiments of recognition of abnormal and normal beat were carried out on MIT- BIH Arrhythmia database. The SVM used for the ECG beat was trained, cross validated and tested with the feature vector extracted from discrete wavelet transform ECG signals. The proposed method gives an accuracy of 97.02 using SVM based classification.

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