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ECG Signal Processing for Feature Extraction with R Peak Detection and DWT Coefficients

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Abstract: ***The World Health Organization (WHO) estimated the reason behind 30% of all global deaths corresponds to heart disease. Heart Disease is one of the main causes of death in India. Many computational techniques were proposed for detection of heart disease. Hence there is a need to design a diagnosis technology which can help in detection of heart disease. For detection of heart diseases, Diabetes, cancer Machine learning techniques are widely used. In this research Feature extraction approach is used to select the important features from the dataset based on the genetic algorithms. For diagnosis of heart disease ECG signals are used. ECG signal is graphical representation hearts activity. And then classification techniques Support Vector Machine have been applied on the features to detect heart disease. These machine learning techniques take less time for the prediction of the disease with accuracy.***
Keywords: ECG Signal, Feature Extraction, DWT, R peak detection, Support Vector Machine.

I. INTRODUCTION

Health monitoring is now becoming part of everyday life. Today's healthcare industry aims to provide better health services to people in an efficient and patient friendly manner. The heart disease is major death factor in the world. So many times it might have happened that you need doctor help immediately, but they are not available due to some reason. Therefore we need to develop the system which can detect disease immediately. The electrocardiogram i.e. ECG or EKG is tool that is used to assess the electrical and muscular functions of the heart. . The electrocardiograms measure the heart rate and rhythm of the beat, as well as provide indirect evidence of blood flow to the heart muscle. System has been developed to record ECG. An electrode lead, or patch, is placed on each arm and leg and others are placed across the chest wall. Waves in ECG signal contain all the disease related information. Those features are rapidly used by the interval of RR[1] so feature extraction is very important task after noise renovation.There are many types of heart disease such as Bundle Branch Block, Cardiomyopathy, Myocardial infarction, Dysrhythmia, Heart failure/ Hypertrophy.

A. Problem Definition

There are varieties of methods available for ECG signal characteristics estimation. The aperiodicity in ECG signal is main cause of complexity in finding out diseases related to heart. There different types of heart diseases that can be detected through ECG signal and there is need of robust method for detecting such diseases by means of classification process. There variety of classifiers such artificial neural network, support vector machine, k-nearest neighbor which can be adopted for classification purpose.

B. Objectives

1) To detect different types of diseases using ECG signal we consider following sub objectives.
2) To preprocess ECG signal to remove noise and get characteristic ECG signal
3) To extract features of ECG signal
4) To train classifier using features with respect to disease classifications
5) To evaluate the performance of classification using accuracy, specificity, sensitivity parameters

II. PROPOSED METHODOLOGY

Block diagram of system is as below which is consist of ECG dataset, preprocessing of ECG signal, Feature extraction, and Support vector machine algorithm. Each block will be explained in this section.

A. Operation Stages

1) *Step 1:* Take input Dat. File from ECG dataset.
2) *Step 2:* Apply filter order of 32 to remove noise.

3) *Step 3:* Find R values/peaks & their locations in the signal.
4) *Step 4:* Find Interval within two consecutive R values.
5) *Step 5:* Find Heart Rate using R interval
6) *Step 6:* Find variation in heart rates among all the samples.
(avgHR,meanRR,rmssd,nn50,pNN50,sd_RR,sd_HR,average_hrv,hrv,se,coeff')
7) *Step 7:* Discrete Wavelet Transform and save extracted features dump into .mat file and generate vector.
8) *Step 8:* Perform all above steps on selected test dataset and get feature vector for testing signal.
9) *Step 9:* Generated feature vector of training dataset are saved as feature vector.
10) Step 10: Load feature vector to train SVM.
11) *Step 11:* Fed feature vector of test signal on trained SVM to identify disease.
12) *Step 11:* Display detected output on Graphical user interface.

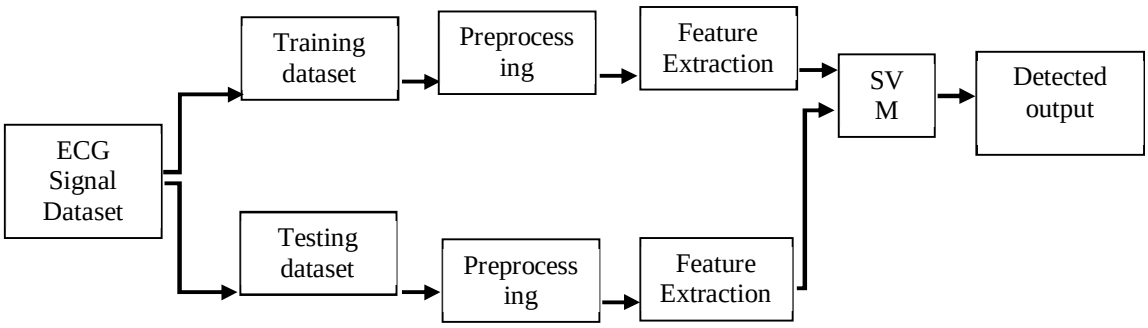
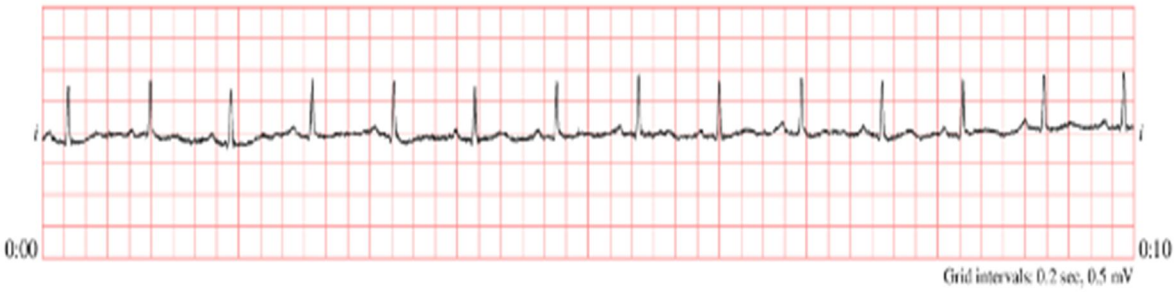


Figure1. Block diagram of system for Heart disease detection

B. ECG Signal Dataset

The ECG dataset containing records of patients of different heart diseases will be used in proposed work. An Ideal ECG looks like this and it keeps repeating itself. All raw ECG signals used in this work are obtained from records of the Physiobank PTB Diagnostic arrhythmia database.



C. Preprocessing

The ECG signal recorded contains noise. Due to which main features of the signal are dominated and hence exact estimation diseases becomes complicated. The filtering approach will be used to remove the noise from the signal and to retain the features in the signal.

D. Feature Extraction

This stage will extract different types of features from ECG signal. Such as Wavelet Features extraction and feature extraction using R peak.

E. Steps for R peaks Detection

1) Heart rate

Rate= 60*sampling rate/(R-R interval)… in beats

2) Average Hear Rate (avg HR)

$$\text{avg HR} = \frac{\sum_{i=1}^{n} HRi}{n}$$

3) Standard Deviation in Heart Rate Variation (sd_HR)

$$\text{Sd\_HR} = \frac{\sqrt{\sum_{i=1}^{n}(HRi+1-HRi)}}{n}$$

4) Mean of RR interval (meanRR)

$$\text{mean\_RR} = \frac{\sum_{i=1}^{n}(di+1-di)}{n}$$

5) Square root value of average distance (rmssd)

$$\text{rmssd} = \sqrt{\frac{\sum_{i=1}^{n} d(i+1)-di}{n}}$$

6) Count of RR intervals with greater than 50ms windows (nn50)

7) Percentage of RR intervals with greater than 50ms windows (Pnn50)

8) Standard Deviation in RR interval (sd_RR)

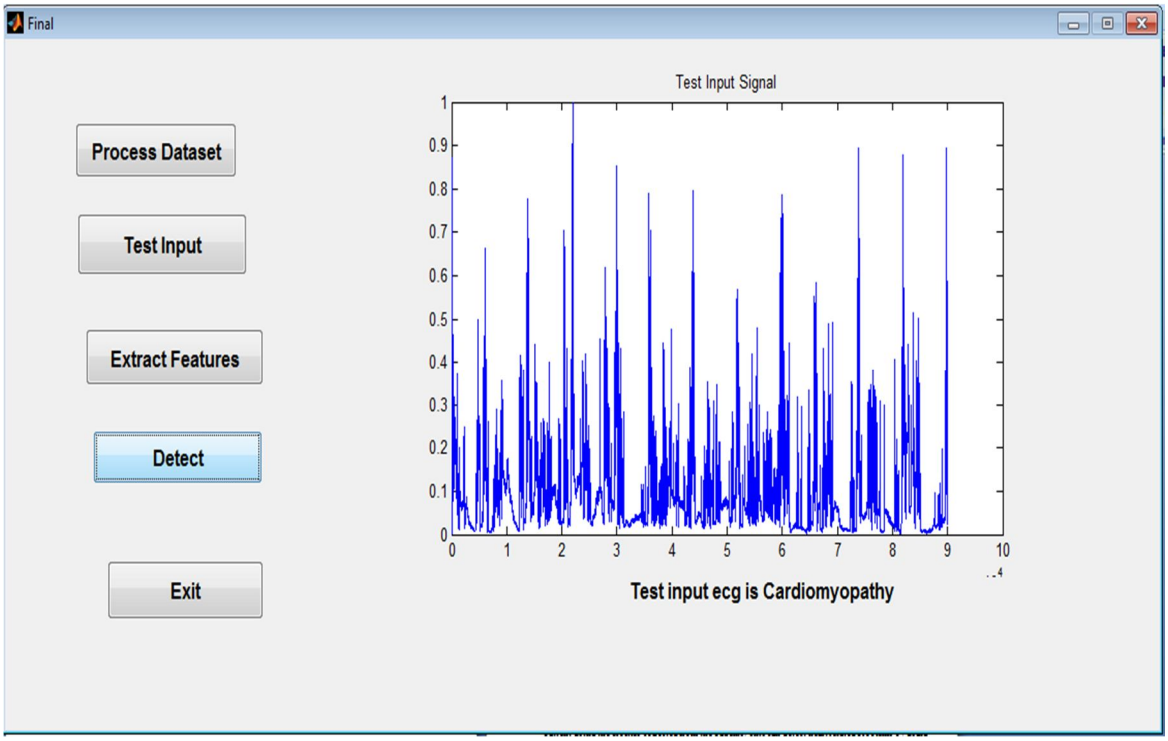
$$\text{Sd\_RR} = \frac{\sum_{i=1}^{n} dv(i+1)-dvi}{n}$$

Discrete Wavelet Coefficient

F. Classification using SVM

SVM is an established machine learning tool.

Output On GUI



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III. CONCLUSION

In this project Braille supported ATM facility is provided to the blind people. Hence, with the help of this system the blind people complete their banking functions independently. This proposed system also provides audible instructions with Braille keypad to access banking services. So this project is helpful for blind people to perform banking activities properly.

IV. ACKNOWLEDGMENT

We take the opportunity to thank a few of our friends from the society who are suffering from blindness i.e. impaired vision status for their contribution in research work. We would also like to thank 3D printer technicians for their support to design Braille keypad.

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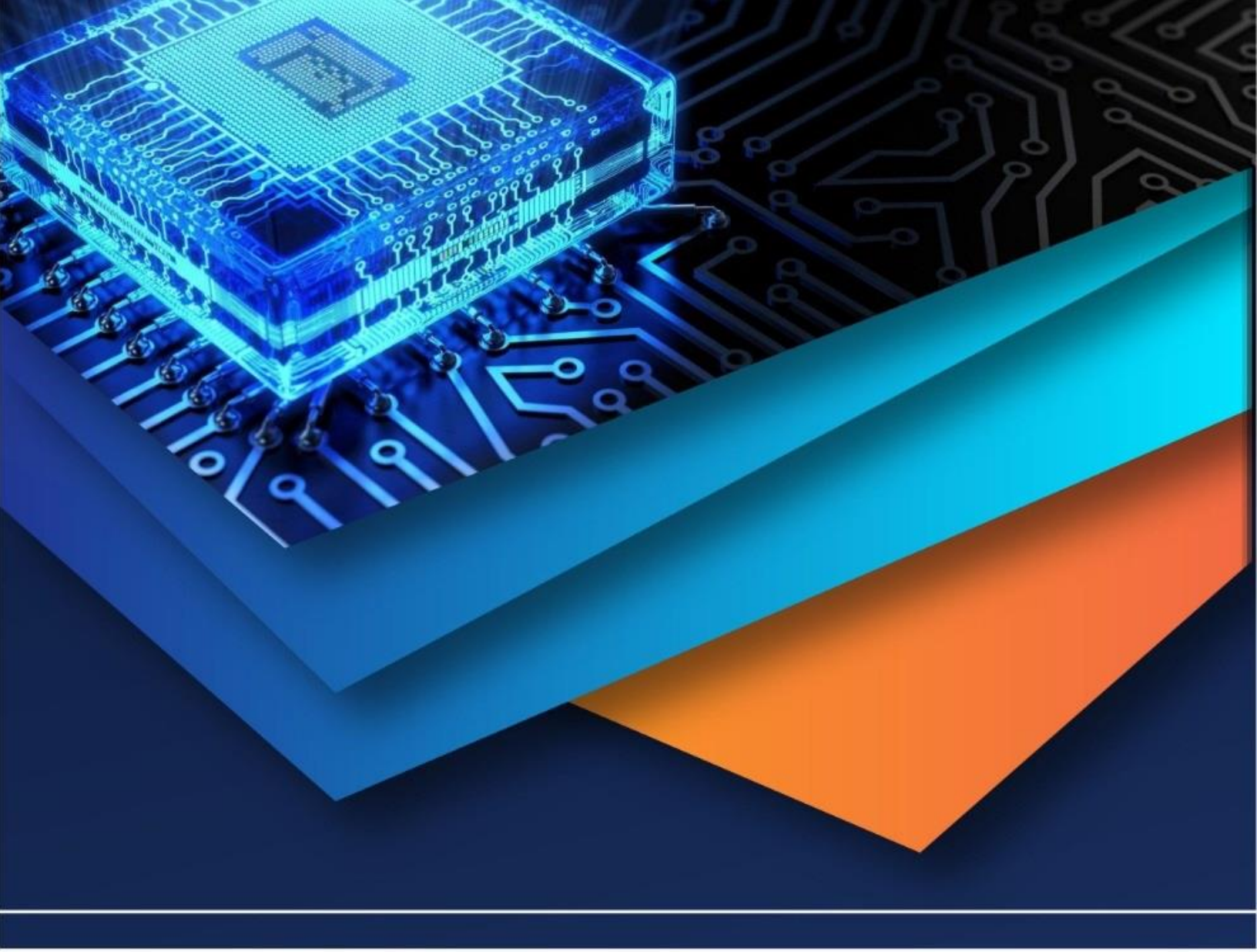

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