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Naïve bayes classifier for predicting ventricular arrhythmia disease

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Abstract

This paper proposes a classification algorithm for the classification of ventricular Arrhythmia disease associated with heart attack. Classification of this disease and its type is important in the prediction process so that the life of the people can be saved. Recently, numerous research and techniques have been developed for the analyzing the biomedical signal and helps in classification of dysrthymia. The proposed scheme were mainly based on naïve Bayes algorithm which is efficient compared with others. The proposed paper is implemented and simulated using ModelSim software and produce output of accuracy 90%.

Keywords—classification, featureextraction, ventricular arrhythmia

I. INTRODUCTION

Nowadays sudden cardiac arrest is found to be commonly occurring all over world which finally leads to a death and is called as cardiac arrhythmia disease. It is mainly occur in the lower chamber of the heart and suddenly the blood cessation occurs and heart fails to work. In order to prevent this prediction of this disease is more important, for this classification is done to distinguish the normal and abnormal signal which causes Cardiac Arrhythmia. ECG analysis can be used to detect Cardiac Arrhythmias, which often arise as a consequence of a cardiac disease and may be life threatening. If the disease occur in the ventricular region then it is said to be ventricular arrhythmia. In this paper, Naïve Byes algorithm is applied to classify the arrhythmia using the ECG biomedical signal feature. ECG features plays an important role in classification process and by continuous monitoring of the ECG is required to analyze the disease and its features. A typical ECG signal consists of the P-wave, QRS complex, and T-waves. The P wave is the result of slow moving depolarization of the atria. QRS complex which is made of Q, R and S waves shows ventricular depolarization. The T wave represents depolarization of the ventricles, and is longer in duration than depolarization. Ventricular arrhythmia mainly is caused mainly because of hyper tension, myocardiopathy .This disease not only affects the older people but also it affects the children. The figure shows the some risk factors which are responsible for the cardiac ventricular arrhythmia

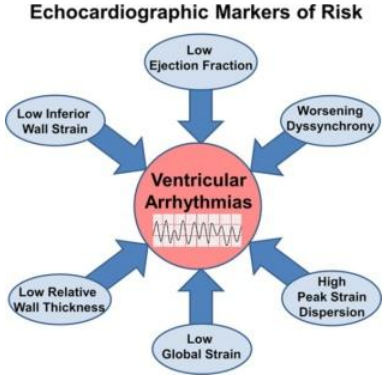

Fig 1. Cardiac Ventricular Arrhythmia

II . EXISTING METHOD

In all the existing methodology, they use several classifiers in detecting the various diseases in medical applications but they mainly implement the classifier using matlab tools and they mainly used to detect the disease only and not worked out in prediction of

disease before its onset period .The various classifiers used in the detecting the ventricular arrhythmia diseases are SVM, neural network, random forest etc. but all these classifiers work well in matlab and in detecting process only and the major drawback behind these algorithms are its complex architecture, consumes more power and area. This is not suitable for predicting process.

This paper attempts to design an classifier algorithm which is best among all ie naïve bayes classifier algorithm helps in the prediction process and it is designed and implemented using vlsi tool , Modelsim software .this classifier found to consume less area and produces better accuracy in prediction of ventricular arrhythmia disease.

III SYSTEM OVERVIEW

The architecture of naïve Bayes classifier is designed in such a way it efficiently classify the normal ECG signal with the abnormal ECG signal which indicates the presence of VA or not and classify its types as VT or VF based on the fast and slow heart beat. This algorithm receives the data only after the feature extraction stage and it contains the information of T and P wave which is essential for the classification of disease. The below figure shows the overall system architecture which is used to classify the arrhythmia disease.

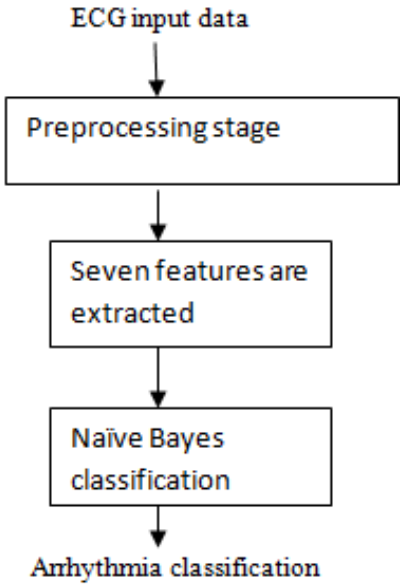

Fig 2. Overall Block Diagram

In the following section first we present the preprocessing stage in section IV and in section V the feature extraction stage is described and in final stage naïve Bayes classification is applied in section VI and in Section VII the performance result is analyzed and in section VIII conclusion is described.

IV ECG PREPROCESSING STAGE

The first step is to preprocess the data in order to filter the unwanted noise added to it which affects the original data. Preprocessing is carried out using LPF and HPF.

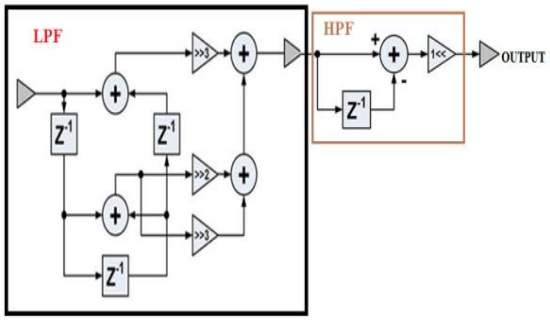

Fig:3 Filtering stage

And then from the preprocessed data the QRS detection is carried out based on Pan and Tompkins (PAT) algorithm [3]. In PAT algorithm R wave is taken as reference and T wave and P wave are detected. Finally T and P waves are delineated and its features are extracted. In each heartbeat, the QRS complex is used as a reference for the detection of T and P wave s[2] .

IV . FEATURE EXTRACTION STAGE

The ECG data after preprocessing stage, it is applied to feature extraction process where there are many techniques for feature extraction like ceptrum , neural methods, but these methods found to be complex and does not produce better accuracy.

Therefore the extracted ECG features should show a significant relevance in the classification of arrhythmia and maintaining a high accuracy and it is done by using statistical method. Main parameters like complexity and accuracy are satisfied by using statistical analysis techniques which is famous in decision making in biomedical research to choose the ECG features [1].

VI. NAÏVE BAYES CLASSIFICATION

The features extracted include RR, PQ, QP, RT, TR, PS and SP and these are extracted from, two consecutive heart beats and is shown in Fig. 4.

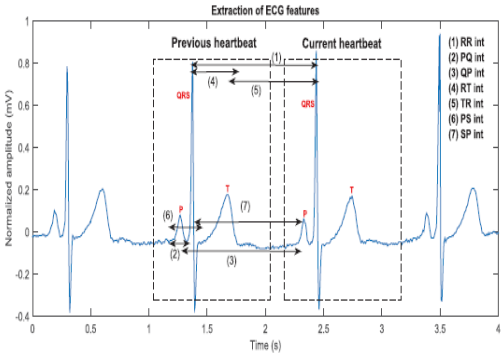

Fig 4 . Feature Extraction

There are many techniques for classification of the ECG signal but they are found to be less accurate in classification of VA and they occupy large area. But in case of naïve Bayes classification it is simple approach and provides good accuracy, sensitivity in case of analyzing and classification of ECG features for VA and its types. The figure 5 shows the architecture of naïve bayes classifier algorithm which include training and testing model.

First the training model is designed from the database obtained from the physionet. The ECG data is taken and for this feature the mean and variance value for the ECG is computed.

Then finally the log probability value is calculated for the computed values. The calculated training set value is stored for further analysis and for comparison. The training model produces the output which contains the details of classification of VA. Next is to test the input data obtained from the people who is suffering from the disease.

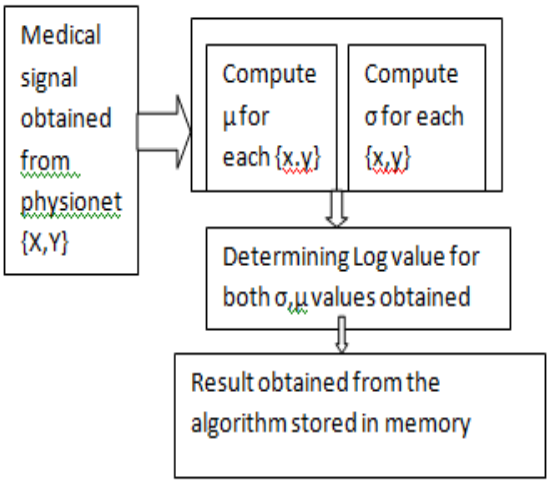

Fig 5a. Training Model

In testing the data the values are calculated and is compared with the training data set and it produces the classification output i.e. presence or absence of ventricular arrhythmia. The naïve Bayes algorithm produce accurate result in classification process. The mean and variance is calculated in this algorithm and is summed to get the original values which helps in prediction of disease. The below diagram shows the architecture model of naïve bayes testing model.

The data files from arrhythmia database were sampled at 360 samples/second and the Malignant ventricular arrhythmia database were sampled at 250 samples/second are taken from physionet [5]. The sampling rates of these signals were increased to 360 samples/second by zero padding.

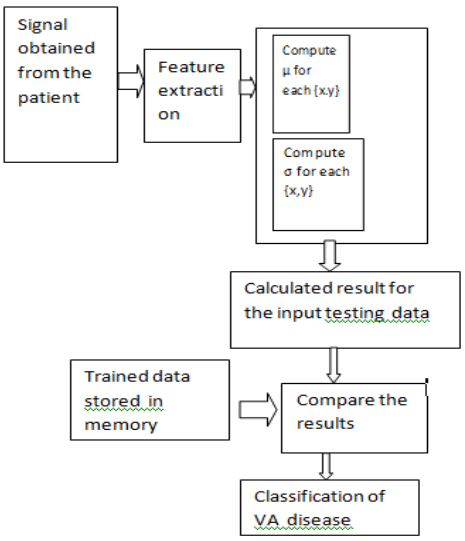

Fig 5b. Testing Data Model

VII . PERFORMANCE ANALYSIS

To verify the output of the proposed paper simulation is carried out using Modelsim tool and in order to check the hardware design synopsis tool can be used . The below figure shows the performance analysis obtained with the classification of VA using Naïve Bayes classifier.

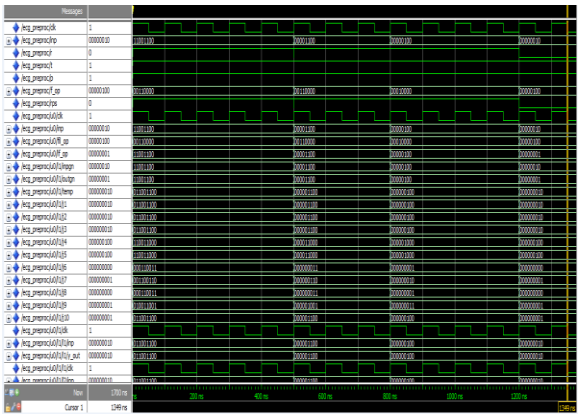

Fig 6. Output Of ECG Preprocessing

The above result is obtained after the preprocessing of ECG data obtained from the heart of the patient. It is obtained after the data processed over filtering , QRS detection and T and P wave delineation .After that the ECG is extracted in order to get seven features which are essential in the classification process. The seven features are extracted between consecutive heart beats continuously. The features extracted are PQ,QR,RS,ST..

The below result shows the output after applying naïve Bayes classifier algorithm.

The above simulation output shows three different waveform. the first two waveforms are database obtained from the physionet i.e. the normal heart beat and the malignant ventricular arrhythmia database. The third wave form is the signal taken from the patient's heart beat and preprocessed, feature extracted and finally classified as presence of ventricular arrhythmia disease by comparing with the trained data set. The classification accuracy is found to be high compared to other techniques.

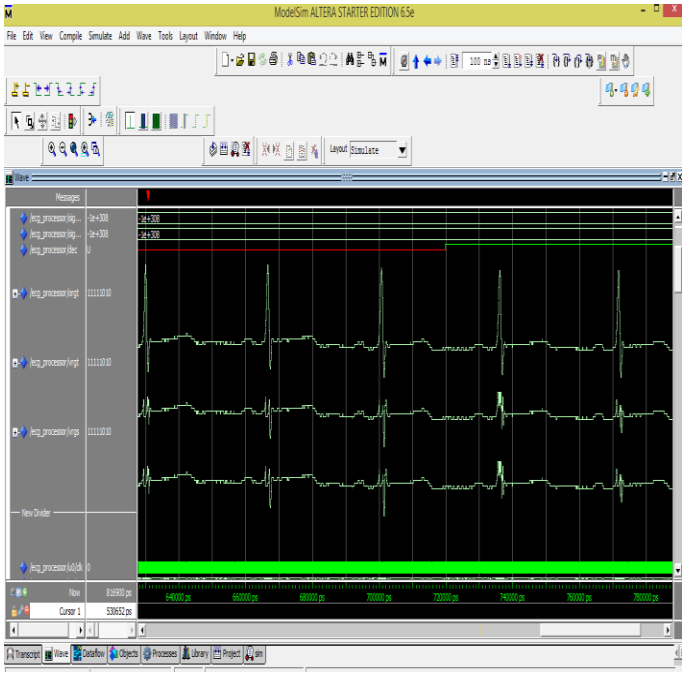

Fig 7. Classification Output.

The classification of various types in ventricular arrhythmia can be done based on the fast and slow heart beat on occurrence of VA and is called as ventricular fibrillation and ventricular trachyardia.

The classification results, were obtained after simulating the ECG data in ModelSim. The classification accuracy is computed theoretically using this formula[4].

$$ACC = \frac{TP + TN}{TP + TN + FP + FN}$$

VIII. CONCLUSION

In this paper the Naïve Bayes classification algorithm is designed and is used for the classification and prediction of ventricular arrhythmia disease which is very essential to save the life of the people. Accurate classification only helps to diagnose and give proper treatment to the patient. It produces the accuracy of 90% in classification process and it is found to be simple and occupies less area and power and the output is analyzed theoretically and simulated

using ModelSim software.

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