ECG ARRHYTHMIA CLASSIFICATION USING ARTIFICIAL DEEP LEARNING NEURAL NETWORK

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Abstract : Electrocardiogram (ECG) is alluded as change in heart rate which can be high or low sometimes as compared to normal heart rate. This change leads to various heart disease. So this has significance in human beings. different researchers introduced different classifiers to classify the ECG datasets. In this paper we have proposed an algorithm deep learning artificial neural network. ECG datasets contains the pattern data because of it, neural networks work better but based on deep learning artificial neural network algorithm has been enhanced with the use of back propagation. This enhanced algorithm has been compared with other classifiers and with the use of best algorithm other parameters such as accuracy, true positive, false negative, false positive, specificity, ROC curve and many more parameters has been computed. The output results in better efficiency of deep learning artificial neural network(DLANN).

***Keywords*- Electrocardiogram,Classification, Arrhythmia,HRV, Heart Rate,Deep Learning, Neural Network.**

I. INTRODUCTION

In this era, the progressive change towards e-healthcare and the vision of giving customized social insurance is a move towards human health services where there would be no dividers, where social insurance conveyance stage will be capably upheld by utilization of information got from patient and examination of the information through effective tools[1]. Hence, it empowering the patient and doctor networks all in all. Numerous individuals pass on because of heart assaults. Early analysis of heart glitch can avoid a great deal of hazardous circumstances[2]. But various compact gadget, for an example, holter ECG[3] are utilized to screen the conduct of the cardiovascular framework. In this era, a programmed framework which can distinguish and caution such a breakdown is of need. Because in today's life even young persons are getting heart problems. The research admit that the heart related medical problems leads to death even[4]. ECG is one of the main tool to detect the heart rate. The figure 1 shows the normal heart wave of a human beings where QRS area represents as QRS complex. The distance between the R point of one wave to another wave is known as R-R interval. The parameter HRV (Heart Rate Variability) has vital role for heart pulses. As the high rate of HRV considers good health and vice versa.

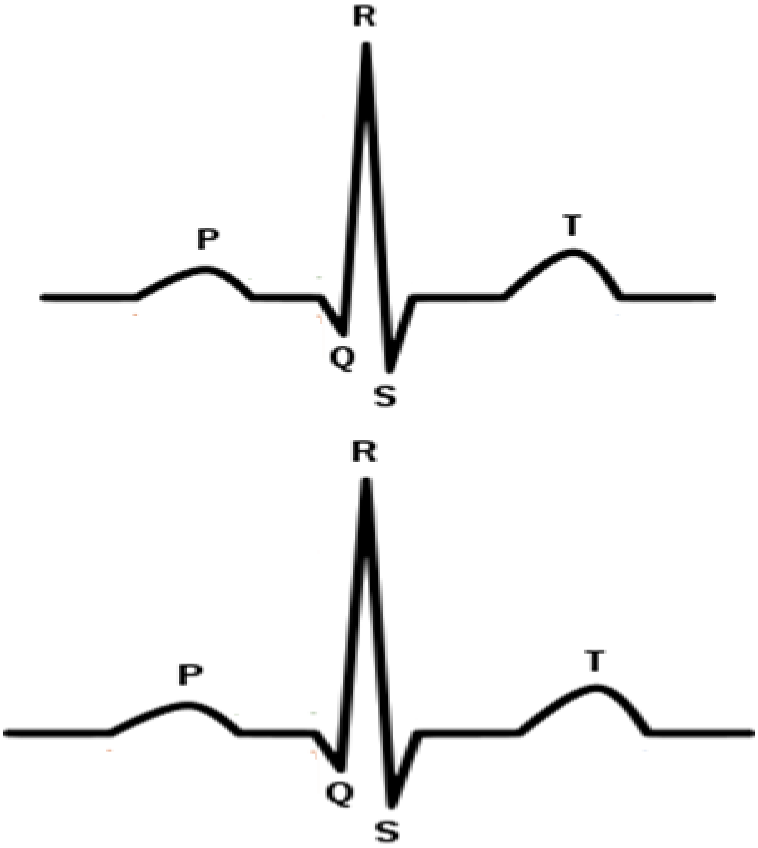


FIGURE 1 HEART PULSE OF HEALTHY HUMAN BEING

In this paper, the classification of ECG dataset has been performed to see the arrhythmia where high value of arrhythmia leads to less amount of blood pump, tiredness and unconsciousness. we have used the various models to classify the ECG dataset collected from different repository. This paper based on best model Deep Learning Artificial Neural Network Model and gives the comparative analysis to other classifiers. This paper grouped as following: Section 2 discusses the previous work done in analysis of ECG Waves. Section 3 describes the methodology followed. Section 4 discusses the dataset description and Experimental Setup. Section 5 discusses the metrics used section 6 describes the results evaluated last section describes the conclusion and future scope.

II. LITERATURE REVIEW

In this sections, different views of various researchers have been discussed.

[5] This paper has used the dataset of MIT-BIH which contains record of 480 patients. For clustering K-means algorithm is used and new bacterial Optimization Algorithm is proposed. The algorithm for preprocessing data is not appropriate based on accuracy achieved. [6] used the Principal Component Analysis to analyze the MIT-BIH dataset. It has used various parameters like normal beats, ventricular contraction, left branch block and many more. The authors have not used the artificial neural network.[7] performed the artificial neural network for classification and wavelet transform for extracting the feature but accuracy achieved is only 70%. [8] utilized the two new methods based on unlabeled data and administrative learning. [9]used the support vector machine algorithm that are used based on fuzzy subsets and svm followed different methods such as one to all and one to one. [10] gives the different mathematical models to analyze the datasets related to electrocardiogram arrhythmia.

III. METHODOLOGY

In this section, the methodology has been discussed. The same method has been performed on both the datasets. The preprocessing steps of dataset is performed, in this step all the missing values has been removed in next step QRS complex has been detected and the various classifiers performed based on 7:3 ratio training and testing data. Then different parameters has been detected. The best model deep learning artificial neural network is performed based on layers. In this investigation is performed on input layer that contain different hidden layers and output layers. Deep learning enhanced the back propagation in neural network. The figure 2 describes the methodology.

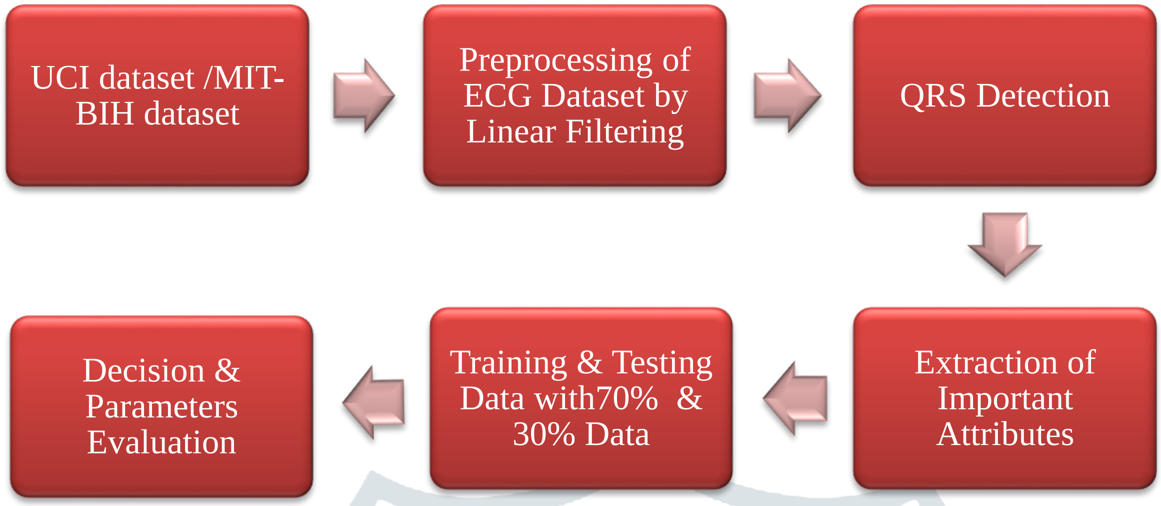


FIGURE 2 METHODOLOGY TO ANALYZE DATASET

IV. DATASET DESCRIPTION AND EXPERIMENTAL SETUP

3.1 Dataset Description

For this paper, dataset has been considered from UCI repository and Kaggle. UCI dataset contains 279 attributes and 400+ elements. Kaggle considered MIT-BIH database, this arrhythmia dataset contains 109400+ samples. To classify the data and extract useful information, the above methodology has been applied with the use of Jupyter tool in Anaconda. Datasets contains critival attributes the heart rate , QRS intervals, duration of waves and many more.

3.2 Experimental Setup

For this experiment, various libraries like numpy, scikit-learn has been used in Jupyter. In which .csv file formats are given as input and further different classification algorithms like naive bayes, decision tree and random forest are applied. The new method proposed is considered and used for classification then further some parameters such as accuracy, confusion matrix, precision, recall and many more are considered to check the efficiency of classifier that results DLANN is better as compared to other.

V. METRICS EVALUATED

The measurement performances i.e sensitivity , specificity and classification accuracy are described by using confusion matrix as follows:-

1.TRUE POSITIVE(TP):It occurs when both classifier and the physician detect the present of arrhythmia
2.TRUE NEAGATIVE(TN):It occurs when both the classifier and the physician detect the not present of arrhythmia
3. FALSE POSITIVE(FP): It occurs when the classifier observe an arrhythmia case but physician does not observe it.
4. FALSE NEAGATIVE(FN): It occurs when the classifier does not observe an arrhythmia case but physician observes it.

The four performance measurements are

1. Classification Accuracy: It is ratio of total number of correctly classified instances divided by total number of instances.

$$Accuracy = (TP+TN) / (TP+TN+FP+FN) \quad (1)$$

2. Sensitivity: It is the ratio of correctly classified True Positive(TP) upon sum of True Positive(TP) and False Negative (FN). It is also same as Recall.
3. Specificity: It is the ratio of correctly classified True Negative(TN) upon sum of True Neagative (TN) and False Positive (FP). It is also same as Precision.
4.F-measure: It is the combination of precision and recall. It computes harmonic mean of both the terms.

$$F\text{-measure} = (2*precision* recall) / (precision + recall). \quad (2)$$

VI. RESULTS AND COMPARISON

Following tables and graphs are collected as a result..

Table 1 defines the precision, recall and F-measure computed for UCI dataset.

Parameters of UCI dataset

Algorithms	Parameters		
	Precision	**Recall**	**F-measure**
Naive Bayes	60.12	59.50	64.27
Decision Tree	64.75	63.08	66.32
Neural Network	73.21	75.25	72.8
Support Vector Machine	58.24	56.64	59.3
Random Forest	59.11	61.19	60.01
Deep Learning Artificial Neural Network	89.27	86.34	85.03

Table 2 Parameters of MIT-BIH database

Algorithms	Parameters		
	Precision	**Recall**	**F-measure**
Naive Bayes	63.23	64.11	61.18
Decision Tree	67.21	65.25	62.18
Neural Network	76.21	78.13	79.25
Support Vector Machine	59.24	60.12	60.11
Random Forest	58.34	57.12	52.14
Deep Learning Artificial Neural Network	90.10	90.30	89.12

Table 3Classification accuracy by using different classifiers for UCI

Models	Accuracy(%)
Naive Bayes	62.24
Decision Tree	68.03
Neural Network	78.28
Support Vector Machine	65.10
Random Forest	64.16
Deep Learning Artificial Neural Network	89.19

Table 4 Classification accuracy by using different classifiers for MIT-BIH dataset

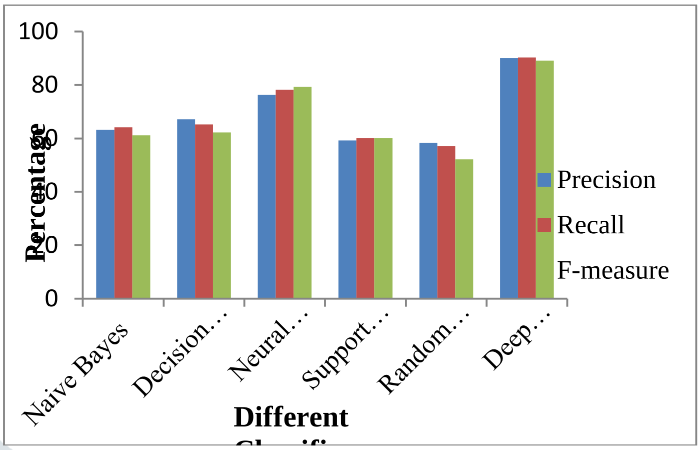
Models	Accuracy(%)
Naive Bayes	63.01
Decision Tree	71.34
Neural Network	74.19
Support Vector Machine	74.8
Random Forest	64.16
Deep Learning Artificial Neural Network	86.27

Table 5 Confusion Matrix values for MIT_BIH

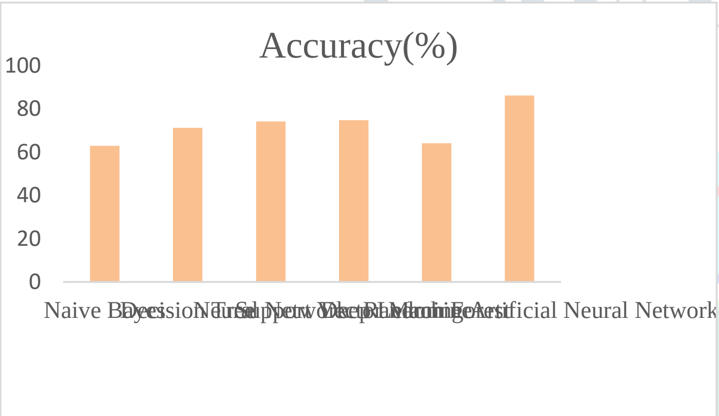
Algorithms	Parameters			
	True Positive	True Negative	False Positive	False Negative
Naive Bayes	0.805	0.811	0.195	0.189
Decision Tree	0.827	0.804	0.173	0.196
Neural Network	0.902	0.916	0.098	0.084
Support Vector Machine	0.813	0.811	0.187	0.189
Random Forest	0.8	0.860	0.2	0.14
Deep Learning Artificial Neural Network	0.983	0.991	0.017	0.009

Graph 1 Comparative analysis of different parameters MIT-BIH for UCI dataset

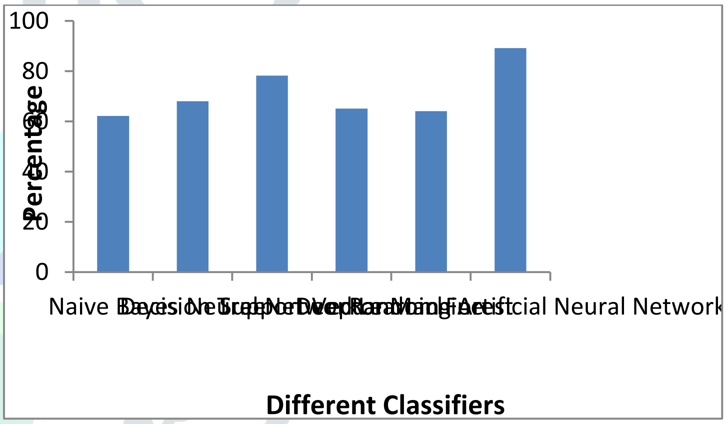
Graph 2 Comparative analysis of different parameters for dataset



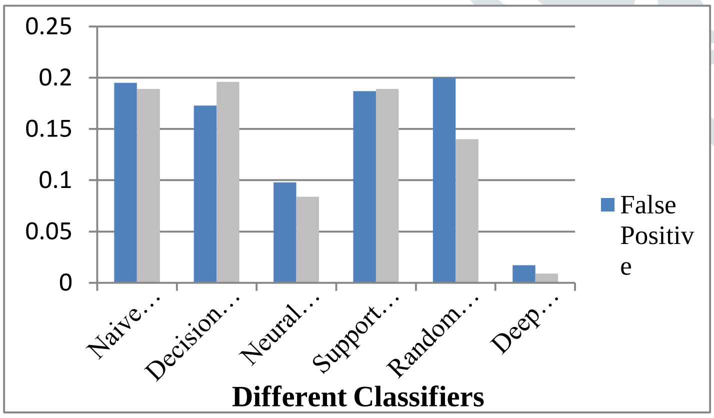
Graph 3Accuracy parameter for UCI dataset



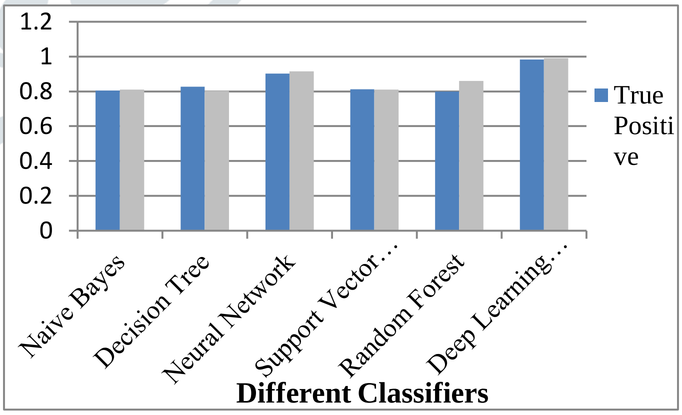
Graph 4 Accuracy Percentage for MIT-BIH database



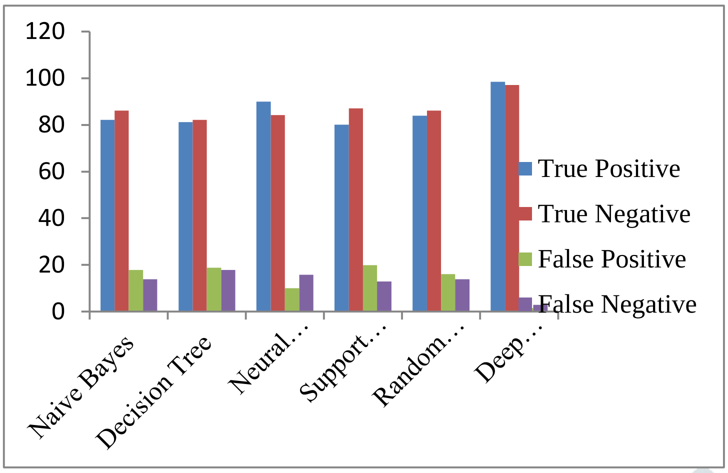
Graph 5True positive and true negative for MIT-BIH



Graph 6 False Positive and False negative for MIT-BIH



Graph 7 Confusion Matrix parameters for UCI dataset



VII. CONCLUSION AND FUTURE SCOPE

While considering health first, heart is the one of the important organ of the body. Heart rate involves morerisk for survival. The analysis of Heart rate is effective and significant task. This paper gives a model toanalyze ECG datasets collected from UCI and Kaggle repository. Here,different linear models for classification have been applied for comparison. Based on that analysis

Deep Learning Artificial Neural Network(DLANN) introduces as strongest model to diagnose Heart related Problems. This paper showsaccuracy and efficiency of DLANN is better for diagnose purposes than other classifiers likenaive bayes, random forest, decision tree and many more. In this method, the classification accuracy achieved is 87.2%. Otherparameters such as Precision, Recall and F-measure is 85.2%, 83.2% and 81.6% respectively. Thisanalysis gives better comparative result to other models using the same dataset. In future, this datasetwill be analyzed based on modern advanced classifiers such as Transfer Learning andvarious multiclass classification strategies.

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