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Performance Evaluation of HRV Parameter based Deep Neural Network

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Abstract: Electrocardiogram Signal have an important information in monitoring and detecting various Cardiovascular Dieseas (CVDs).This paper aims to develop an algorithm that can accurately extracts the features of Electrocardiogram Signal and classify the abnormal Electrocardiogram Signal using Convolutional Neural Network.

Keywords:- Electrocardiogram Signal (ECG), Convolutional Neural Network(CNN), MIT-BIT Cardiovascular Dieseas (CVDs).

I. INTRODUCTION

In this Modern Era Heart Diseases is one of the prominent reason of death. Indian Council of Medical Research has done several study and found that maximum death occurs due to Cardiovascular Diseases (CVD) is mainly in age group of 25-70 years. And most them lies in low income group and have less resources available for diagnosis. Arrhythmias is one of the diseases when ECG signal deviates from its normal pattern and it can be detected by various algorithms.

The ECG signal is the record of electrical activity of the heart when heart beats and is recorded from the various significant part of the human body. It is an periodic Voltage signal which have crucial points in it like P,Q,R,S and T. Several other data is collected from this point like Heart beat ,HRV,RR Interval and QRS complex.

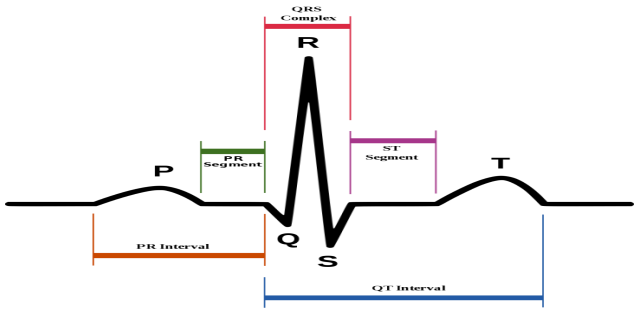

Fig. 1: ECG Signal

Artificial intelligence (AI), machine learning which is the part of AI, is one of the most Commonly used tools in predicting and diagnosing different types of fatal diseases, especially heart disease. Numerous method have been used to classify ECG signal in various study like e-knearest neighbors (KNN) With 89% Accuracy, neural networks (NN) with 96.70% Accuracy ,support vector machines (SVM) with 89.72% Accuracy, decision trees, linear discriminant analysis (LDA). CNN is proved to be the best feature extraction tecnquie in various Study and used as classifier to classify the abnormality.

II. LITERATURE SURVEY

In writing survey it is observed that the identification and grouping of ECG arrhythmia has done however precision of recognition of ECG arrhythmia is around 90 to 98%. From by utilizing wavelet change strategy we are attempting ECG arrhythmias can be dissected for 100% exactness, that gives the identification and arrangement results better to further develop the heart sicknesses of person.

J.I.Willams et.al. [1] did a free assessment measure by a group of cardiologists and AHA. Examination of a bunch of suggestions pointed toward estimating value on a multicent ECG is introduced. These AHA suggestions have prompted worldwide acknowledgment. BekirKarhket et al. [2] made a neural organization of ECG signal dissects examined in the time region along these lines the relating not set in stone utilizing ANN, around 95% of the outcome is accomplished in diagnosing arrhythmia. Chuang-chienet et.al. [3] fostered a successful arrhythmia calculation utilizing the relationship coefficient on the ECG sign of the QRS complex was distinguished, a coefficient of connection with the RR span was utilized to ascertain arrhythmic closeness. S. C. Saxena et.al. [4] fostered the incorporated Wavelet change innovation Quadratic spline wavelet utilized for QRS recognition and Daubechies six-coefficient wavelet utilized for P and T discovery and coronary illness analysis. Stefan Gradl et.al. [5] performed calculation investigation of the A) Pan-Tompkins QRSdetection (B) model plan and commonality; (C) include expulsion; (D) order.

The calculation was varified utilizing the MIT-BIH Arrhythmia information base. Over 98% of all QRS structures are accurately recognized by calculation. Generally speaking affectability for the location of unusual beat was 89.5% and explicitness was 80.6% .J. Lee, K. et.al. [6] cause input highlight For wavelet to change and direct separation investigation. The proposed calculation got the precision of arrhythmia discovery that for NSR, SVR, PVC and VF were 98.52, 98.43,98.59 and 98.88% separately. Pedro R.Gomes, et.al [7] caused changes to the ripple effects and models of the secret markov. The experimental outcomes got from the real information from the MITBIH arrhythmia information data set show that it surpasses the ordinary line division. V.Rathikaraniet.et. al.

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III. PROPOSED METHOD

The Raw ECG signal has noise and attenuation in it. First, the noise is removed from the signal by using various filtering techniques and using digital Finite Response filters. which makes the signal ready for further features extraction and after that various features of ECG signal are detected like R wave, QRS Complex is detected. then this The FFT of the signal is taken and from there, this data is given as input to the CNN layer. First The Network is trained by using the predetermined signals and once the network is trained the input is given to the first layer and the trained network produced.

The extracted features of ECG signal R-Peaks is used to determine the HRV and Heart Beats of the person. RR Interval is also calculated using the Detected R waves .From Beginning of the signal heart rate is calculated and And the abnormality is classified by the discrete signal and CNN input is given as the discrete ECG signal and The Classification is done on the basis of these features .Futher the performance of the system is determined and accuracy is also verified and CNN sensitivity is considered

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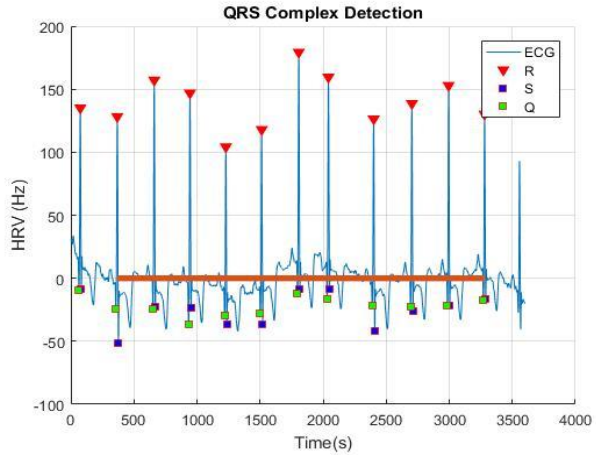

Fig. 2: QRS Complex Detection

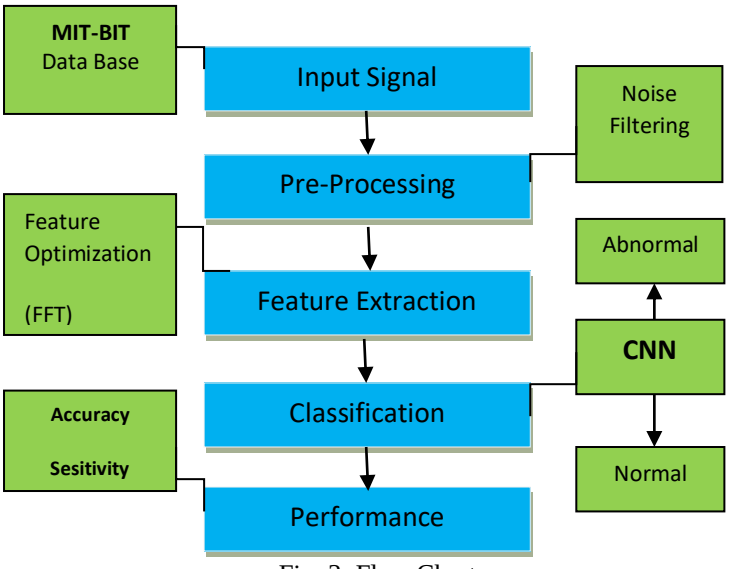

Fig. 3: Flow Chart

In this module classification is done using the CNN and is made from 2-D array of segment which is connected to each other to form neural network.The working of the each segment depends upon the input and output signal . the architecture of the network depends upon the transmitted signal through the each block segment of the Network .

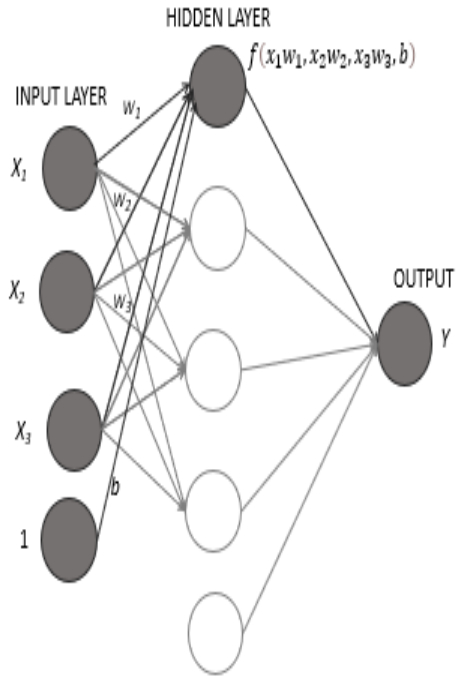

Fig. 4: CNN Layers

The weights of the network structure is optimized by training the network and using the Particle Swarm Optimization algorithm. The extracted features of ECG signal like RR interval, HRV and QRS complex is served as input to the Network structure in vector form this input is classify by the trained weight of the network structure and the signal is classified by the CNN as normal or abnormal Signal.

IV. COMPARISION TABLE

S.no	Reference	Methods	Accuracy
1	**[5]**	NN	96.70%
2	**[7]**	SVM	89.72%
3	**[6]**	PNN	92.80%
4	**[8]**	SVM,GA	97.30%
5	**[9]**	NN,SVM	93.00%
6	**[12]**	SVM	86.40%
7	Proposed Method	CNN	99.00%

Table 1: Comparision Table

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V. RESULT AND ANALYSIS

The proposed CNN classifier is implemented in one of the most important machine learning languages The System diagnose and classify the given ECG signal with 99% CNN Accuracy.The normal ECG signal is given to the proposed algorithm and the result is shown in fig.

The accuracy of the proposed method is 99.05% and have the high CNN sensitivity.

For training of the Convolution Neural Network the data set is taken from MIT-BIT dataset and training needs huge computational power and training takes lot of time so the Graphical processing Unit was used to reduce the time complexity and computational complexity.By applying the above structural method the learning time was reduced and faster result was obtained.

$$A = \frac{Tp+TN}{Tp+Tn+Fp+Fn}$$

Where Tp stands for right classified cases and FP stands for worng classified cases Tn stands for case detected as correct but not needed and Fn stands for false detected case as not required.

$$\mu = \frac{\sum_{i=1}^{n} x_i}{n}$$

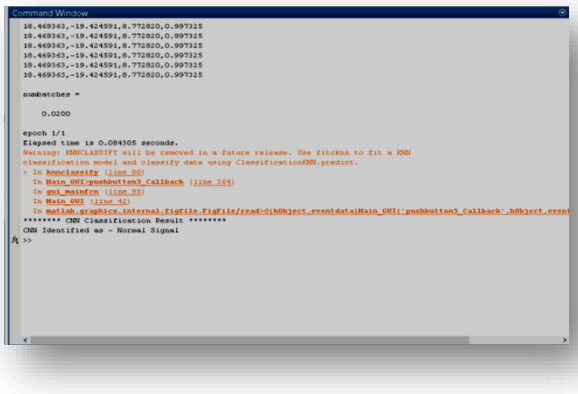

Fig. 5: Output Window

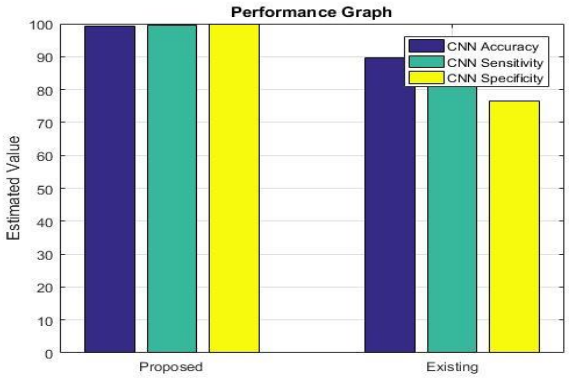

Fig. 6: Performance Graph

VI. CONCLUSION AND FUTURE WORK

In this work we studied the performance of CNN to classify various ECG signal MIT-BIT Data base which is first collected from the source and then it is preprocessed to remove the noise and unwanted elements and then the features of this signal is extracted using various tools and techniques .The detection of R waves was done first and then RR interval was calculated then QRS complex was detected and We then convert the signal into FFT and then its Mean value and Standard Deviation was calculated and all this data was given to CNN classifier to dectect the normal and abnormal signal.

In future the the implementation of CNN can be done in any machine learning languages and readily available and open sources library can be used for its implementation Tensor Flow can be a best method for implementing this algorithm

By using this algorithm the heart dieseas can be detected in early stage and can be also be detected my smart wearable and the information is may be fetched by medical team and life of many may be saved.

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