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ECG Signal Classification Based On Deep Learning Classifier

R. Kavitha[1*], T. Christopher[2]

[1]Department of Computer Science, Government Arts College, Udumalpet, India
[2]Department of Computer Science, Government Arts College, Coimbatore, India

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Abstract- ECG (Electrocardiogram), non-stationary biomedical signal measures the electrical activity of the human heart. This ECG signal helps the professional as a diagnostic tool to predict the cardiac disorder and the function of the human heart. According to the report of WHO (World Health Organization), most of the humans suffer from the cardiac disorder and passed due to the cardiac illness.ECG signal analysis is an important factor in this prediction and this work proposes an automatic classification of the signal which identifies the normal and abnormal signal. The ECG signals are taken from the MIT BIH database. The ECG signal is identified as normal and abnormal with the deep learning classifier CNN. The CNN is a convolution neural network which requires minimal pre-processing compared with traditional machine learning classifier. This work focus on the prediction of the cardiac disorder with automatic classification.

Keywords: ECG, Arrhythmia, MIT-BIH, CNN**.**

I. INTRODUCTION

ECG is an Electrocardiogram gives the representation of the electrical condition of the human heart. This report helps the professionals to identify many diseases. For the past few decades, many researchers have been done with this ECG and classified by using traditional machine learning techniques. In the previous work, the signals are classified with three important steps available in the ML techniques. Three steps are pre-processing which helps in removing the noise from the signal. Next, we have feature extraction where the most relevant features are identified and labeled with some algorithms like PSO, BFO, and BAT with embedded techniques like Chaotic based PSO, BFO is modified in weight calculation and binary value is included in BAT algorithm for ranking the extracted features. These features are fed into a classifier like SVM, ELM classifier and the classified result shows the accuracy for all the phases. Even though accuracy is obtained from the traditional ML classifier it suffers from certain drawbacks like only one hidden layer is used in the neural network for classification. In SVM over-fitting problem occurs and ELM algorithm is faster in training the dataset but it cannot go in deep classification. In the classical machine learning technique, we need to extract the features for classification of the signal either as normal or abnormal. In the proposed technique the deep learning concept is used to classify the signal. This proposed technique extracts the features automatically and classifies the signal as normal and abnormal with the help of CNN classifier. The CNN is a convolution neural network developed by Fukushima during the year 1980. This CNN comes with the concept of the deep neural network which has more than one layer to classify the output result. Recently CNN classifier plays a major role in the medical field for the prediction of disease diagnosis automatically. One important advantage of the CNN network is that it does not need any pre-processing, feature extraction steps to classify the data. It automatically takes its own best feature and detects the automatic arrhythmia as normal or abnormal.

II. REVIEW OF LITERATURE

In [1] the author the signals are classified as normal or abnormal based on the spatial time and they identified the biometric recognization in [2]. The z.Deng et.al., [3] done the group activity with the deep classifier. Multitasking learning models were developed under deep classifier in [4]. Pattern recognization is done in ECG signal based on the signal [5]. In paper [6] M. Abo-Zahhad et.al found the prediction in PCG and ECG signals authentications. The preceding section describes the review of literature in II, methodology in section III. Section IV gives the previous work and in section V proposed work architecture for CNN classifier. In section VI result and experiments are discussed following with conclusion in section VII

III. METHODOLOGY

The proposed workflow of this article goes with keras. Keras is used as a front end to classify the ECG signal. This keras plays an important role in deep learning here the keras is used as a python library for evaluating the deep learning models. It trains the network model easily with

less computational time comparing to the traditional learning techniques. Keras has 3 styles from that sequential model is used in this work. This sequential model is a linear stack of layers. Moreover, this model needs only the first input value to be specified to identify the input data and the remaining layers will automatically find the shape inference. After giving the input data the compilation is done with needed arguments and the model is trained with the necessary function.ECG signals are obtained from the public database MIT BIH arrhythmia. This database has both male and female data recorded for 30 minutes and the dataset has been taken for testing and training the model and classified with the CNN classifier. The proposed methodology is shown in figure1.

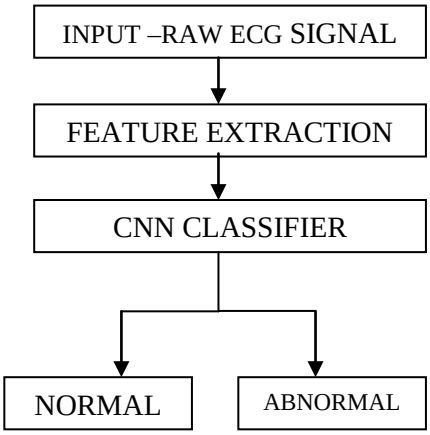

Figure1: Structure of the Proposed Technique.

The block diagram shows the overall structure of the signal classification using keras and tensor flow which is used as front-end and backend to load the data as a binary value and classified the data using the CNN network.CNN has data dimensionality and it can give the accurate data classification for the given ECG data as a normal signal or abnormal signal. Tensor flow gives the graphical structure as data flow and mainly it focuses on deep learning neural network. This is used for fast computing data and it trains the network for the exact classification of the signal. All the required input data is given and it is trained to predict the signal is normal or abnormal which helps the medical professionals to make a decision. This proposed technique has the following steps where the raw ECG signal downloaded from the database is loaded and then the two libraries are used to load the data as input and then the feature extraction is the first step where the best features are extracted automatically by the network with the help of the tensor flow and keras library the data are imported as max-pooling, flatten and dense then the classifier sequential is taken to classify the data. Here, the keras and tensor flow library package is used during the training phase and then the trained data is fed into the classifier for the signal classification. The CNN classifier is used in this proposed work to classify the data. The CNN network has a number of hidden layers where the first layer is taken as a feature extraction which extracts the feature and then the remaining layer finds the data as a normal and abnormal signal.

IV. PREVIOUS WORK

In the previous work, modified techniques are implemented for the classification of the ECG signal where the traditional machine learning solutions are used to analyze and extract the features from the given input data signal. One of the important drawbacks of this solution is heuristically hand-crafted where their automatic classification is not done and even though we get high accuracy but it has difficulties in finding the appropriate features for the classification process. In the previous work the following algorithms are used for identifying the best and relevant features, Particle Swarm Optimization [PSO] is combined with Chaotic with two mapping techniques called logistic and tent map to extract the feature and in next phase, Bacterial Foraging Optimization technique is implemented with modification in the weight calculation part. In the third phase, the Bat algorithm is modified by adding Binary with the algorithm as the sigmoid function is used to identify the feature in the dimensional space. In paper [7] the previous work described with various modified techniques and the average result obtained. All these algorithms are utilized to find the best feature and then it is fed into the classifier to predict the accuracy and where we can get the high level of accuracy but still, it suffers from the drawback of the classical algorithm does not give an automatic classification. In this work 5 classes such as NSR (Normal Sinus Rhythm), PVC (Premature Ventricular Contraction), AF (Atrial Fibrillation), VF (Ventricular Fibrillation) and Heart Block where taken to extract the relevant features and to classify the signals. The classifiers such as SVM and ELM are modified by incorporating rough set and differential evolution in the classifier to classify the data. Since we have the major drawback of heuristic handcrafted of the data and to make the classification as automatic we are moving to the deep learning CNN classifier to classify the data automatically and it helps to predict the normal and abnormal signal.

V. CNN ARCHITECTURE FOR THE PROPOSED WORKFLOW

CNN is a convolution neural network used as a classifier because it needs only minimal data pre-processing and gives better classification result for the given input signal. This helps in the detection of the abnormalities in the signal and classifies accurately the normal and abnormal arrhythmia present in the signal. Here the ECG signals are taken from the MIT-BIH public database and given as input to the network next it pools the data for feature

extraction and classifies the signal. In this CNN network, it has conv layers it inserts a pooling layer in successive conv layers. This pooling layer reduces the parameter and computational time in the network and it also has control over overfitting. With the help of MAX operation, the pooling layer resizes and reduce the size of the data set. The ReLu (Rectified Linear Unit) a rectifier and an activation function f(x) = max (0, X) is employed in neurons where this function is used by the neurons in the hidden layer to detect the large amount of the patterns which accurately predicts the feature and classify the signal. Tensor flow is used as a package library in CNN to load and analyze the data. Here it reshapes and rescales the data between 0 and 1 if needed. Next, the drop out layers are included in the network to train the data and find the dropouts in the hidden layer and this helps to extract the feature relevantly in the first step and it classifies the data as either normal or abnormal.

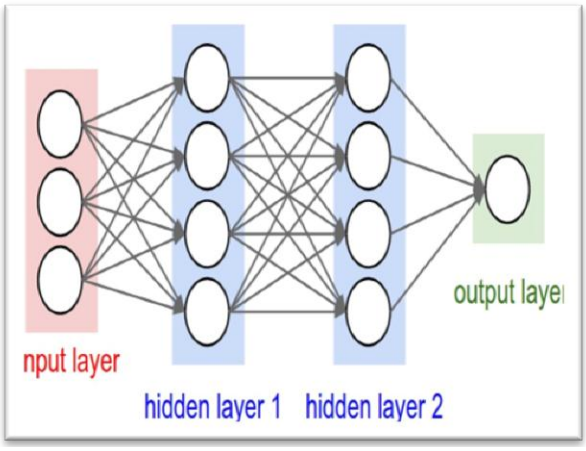

Figure 2: CNN Architecture

VI. EXPERIMENT RESULT AND DISCUSSION

In this classification of ECG signal max pooling done with a pool size of (2, 2) and the data trained and tested with the image data generator function. In this paper, the drop out technique is used which avoids the overfitting problem.CNN comes under deep classifier since the deep classifier has its own feature extraction i.e., it automatically predicts its own accuracy and hence it makes its own decision to classify the result. The neurons are dropped randomly during the training of the network and it predicts the missing neurons and this drop out can be used only during the training phase of the dataset and this helps in reducing the overfitting problem. Table 1 shows the parameters and the values calculated for the sample signals. In this work 5,10,20 and 40 sample signals are taken and processed with 2classes as 0 for abnormal and 1 for the normal signal. The iteration is carried with epochs with 5, 10, 20 and 40 steps per epochs and shows the loss of data. In the first sample, 5 signals are taken randomly from the database and identified 2 signals are in normal and 3 in an abnormal condition. In the next iteration, 10 sample signals were taken and we identified 8 normal signals with loss data of 0.9899. In 20 and 40 sample signals we got 13 and 31 as a normal signal with loss data of 1.1089 and 1.0780. The sample signals are taken from the MIT BIH database and the table gives the number of epoch's iterations and the loss obtained in the tested data given in the table1.

TABLE1: Identification of Loss in the Sample data

Parameters	Result			
Sample Signals	5	10	20	40
Number of classes	2	2	2	2
Starting Epochs	1	1	1	1
Ending Epochs	25	25	25	25
Steps per epoch	5	10	20	40
Loss	1.0899	0.9899	1.1089	1.0780

VII. CONCLUSION

This paper shows the signal classification based on deep classifier with keras and tensor flow library package in the training phase and this package are used for the evaluation of the deep learning model where it predicts the normal and abnormal signal. The result shows the loss in epoch's iteration is very less and when compared with the classical learning model it has a large amount number of missing data to predict the feature and this deep classifier uses package more efficiently to predict the best and more relevant feature with less amount of loss in the data which makes the classifier more reliable to predict the disorder in the input signal.

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