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Deep Learning Based Cardiac Arrhythmia Detection from ECG Dataset

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ABSTRACT: People who are good at finding arrhythmias by hand take a lot of time and need a lot of experience to do it right. This paper uses deep learning to come up with a new 2-D convolutional neural network (CNN) method for accurately classifying different types of arrhythmia. Electrocardiogram (ECG) signals from an arrhythmia benchmark database. An ECG signal was segmented into heartbeats and each of the heartbeats was converted into gray scale images as an input data for CNN structure. We then use our model in an active learning process to perform heartbeat classification tasks on the ECG data set from the Arrhythmia Database.

KEYWORDS: Arrhythmia Detection, Cardiovascular Diseases, Heartbeat, Neural Network, E-healthcare device Electrocardiogram (ECG).

I. INTRODUCTION

Nowadays, arrhythmia-based cardiovascular diseases are main cause of sudden death and heart failure. ECG is a tool that records the electrical activity of myocardium when state of contraction and relaxation[1]. Heartbeat includes the P wave that represented atrial depolarization, QRS wave that represented the ventricular depolarization and T wave that rep-resented the ventricular repolarization in the heart. Arrhythmia is known as abnormal heart rhythm which can be form of irregular heart rhythm or not normal wave morphology. ECG arrhythmia classification means that identification of normal and abnormal (arrhythmic) heartbeats based on heartbeat mor-phology of ECG signal. In ECG diagnosis, normal state and abnormal state classification of heartbeats plays vital role in medicine[5][7]. Analyzing duration and identification of heart-beats depends on the clinician experiences which can block the earlier and accurate detection. As a solution, automatic cardiac rhythm detection algorithms and new approaches can be proposed for efficient performances[9].

A. Motivation

Acute myocardial infarction, commonly referred to as Ar-rhythmia diseases is the most common cause for sudden deaths in city and village areas. It is one the most dangerous disease among men and women and early identification and treatment is the best available option for the people.

B. Objectives

- To do an extensive study by literature survey on arrhyth-mia detection.
- To work on arrhythmia-based cardiovascular diseases.
- To Design of an optimized CNN model for feature learning required to distinguish different cardiac rhythms using a single lead ECG.
- To implement advanced deep learning techniques to im-prove the classification accuracy.

II. REVIEW OF LITERATURE

M. A. Jabbar et.al, [1] proposed another method of applying affiliation management procedures in the medical field to find heart disease predictions. The human service industry collects a large amount of medical service data. Unfortunately, these services have not been tapped to find successful enveloped data. Choose hidden examples and find that hidden examples and relationship softening have not been fully utilized. Information mining strategies can help

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solve this problem. Data mining has discovered various applications in business and science. Affiliation rules, arrangements, and aggregation are important areas of passion for information mining.

Ms.M.C.S.Geetha et.al, [2] analyzed the commonly used classification algorithms in the medical data set that helps predict heart diseases that are the main ones Cause of death throughout the world. Doctors need professionals to predict heart attacks based on experience and knowledge, which is complicated. Today's healthcare field contains secret but meaningful information to make decisions. The experiments carried out reveal this algorithm.As expected J48, SIMPLE CART,and REPTREE Greater predictive precision than other algorithms.

M. Akhiljabbar et.al, [3] pointed out that the nearest neighbor (KNN) is a basic, well-known, proficient and powerful design confirmation method. KNN is a direct classifier, where the arrangement of parts depends on the category of its nearest neighbors. The clinical information
base is substantial in nature. If the informational set contains too high and irrelevant attributes, grouping may produce less accurate results. Coronary heart disease is the best cause of death in India. In Andhra Pradesh, coronary heart disease is the best cause of death, accounting for 32 percent of all deaths, which is as high as Canada (35 percent) and the United States. Subsequently, it is necessary to characterize a choice of emotional support network. This choice will lead the clinician to make great strides. In this work, another strategy is proposed that combines KNN with genetic programs to achieve a strong order. Genetic strategies perform global queries in complex huge and multi-mode scenarios and provide ideal arrangements.

Chaitrali S Dangare [4] examined the expected framework of heart disease using progressive information quality. This work uses clinical terms such as gender, circulatory system strain, cholesterol and 13 credits to predict the likelihood of patients suffering from heart disease.Until recently, 13 traits have been used for expectations. The inspection work also includes two additional functions, such as robustness and smoking The estimation of the data mining arrangement was checked in the coronary illness database, including specific decision trees, naive Bayes and neural networks.

ZeinabArabasadi et.al, [5] proposed a high-precision hybrid method for diagnosing coronary artery disease . As a matter of fact, the proposed method is able to increase the performance of neural network by approximately 10 through enhancing its initial weights using genetic algorithm.

Sahar H. El-Khafifand Mohamed A. El-Brawany [6] introduced that the ECG signal is famous for its non-linear changing behavior and is the key trademark used in this inspection. Under normal and abnormal conditions, the non-linear part of its elements changes more naturally than straight conditions. Due to the high measurement (HOS) required to maintain the phase data, this work utilizes the one-dimensional shear from the terrible areas that are more demanding for typical and ischemic subjects. The feed forward multi-layer neural system (NN) has a Negligent Backlash (BP) learning method and is used as a computerized ECG classifier to discover the chance of discovering ischemic coronary heart disease from common ECG signals.

I. S. Siva Rao, T. Srinivasa Rao [8] predicted that heart disease is the most widespread driving force for humans to kick buckets. Consistently, 7.4 million people are attributed to heart disease (cardiovascular arrhythmia), of which 52 percent die from stroke and 47 percent die from coronary heart disease. Subsequent determination of evidence of various heart diseases at the basic stage is of great significance for the safety of cardiovascular-related diseases. Current conventional ECG examination strategies (such as RR span, wavelet mutation, and group calculation) (for example, support vector machines, K nearest neighbors, and Levenberg Marquardt neural networks) are used to find cardiovascular arrhythmias. Even after extracting a large number of highlights, the problem identification will not be accurate using these programs.

Amma, N.G.B [9] proposed that medical diagnostic systems undertake important work in clinical practice and are used by clinical professionals for analysis and treatment. In this work, the clinical estimation system is portrayed by the normal danger of cardiovascular infection. This structure works by consolidating genetic programs with the general preferences of the sensory system.The multi-layer feed forward neural system has been specially adjusted for complex layout problems. The load of the nervous system can be solved by genetic methods because it can find an acceptable load arrangement in fewer cycles.

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III. PROPOSED METHODOLOGY

Senthilkumar Mohan et.al, [7] proposed a novel method aimed at discovering important features by applying machine learning techniques to improve the accuracy of cardiovascular disease prediction. The prediction model is introduced with different combinations of features and several known classification techniques.
We propose a deep learning based new method for detection of different ECG arrhythmia types. CNN approach tested on ECG signals that were obtained from MITBIH database. ECG signals are transformed to ECG beats with segmentation processing. After segmentation, each beat of ECG signals converted grayscale images as an input data on proposed CNN structure. The architecture of proposed model is mimicking the CNN structure for classification of different arrhythmia types

A. Architecture results.

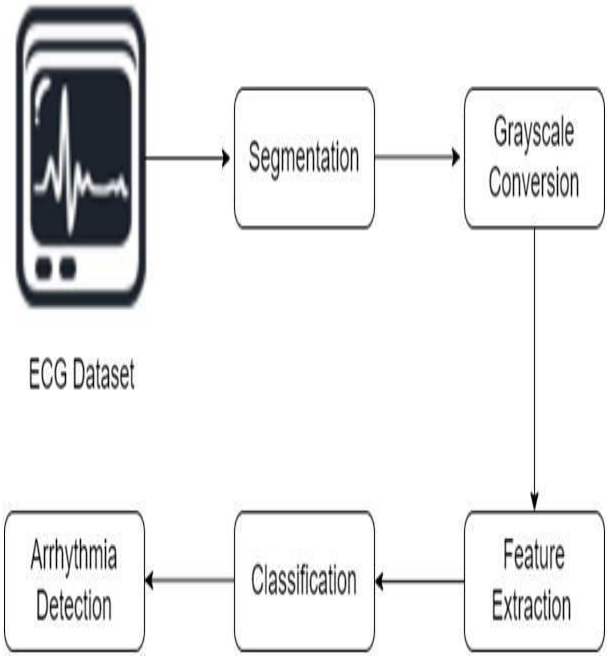

Fig. 1. System Architecture

B. Algorithms

The structure of CNN algorithm includes two layers.First is the extraction layer of features in which each neuron's input is directly connected to its previous layer's local ready fields and local features are extracted. The spatial relationship between it and other features will be shown once those local features are extracted. The other layer is feature map layer; Every feature map in this layer is a plane, the weight of the neurons in one plane are same. The feature plan"s structure make use of the function called sigmoid. This function known as activation function of the CNN, which makes the feature map have shift in difference. In the CNN each convolution layer is come after a computing layer and it's usage is to find the local average as well as the second extract; this extraction of two feature is unique structure which decreases the resolution.

Step 1: Select the dataset.

Step 2: Perform feature selection using information gain and ranking.

Step 3: Apply Classification algorithm CNN.

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Step 4: Calculate each Feature fx value of input layer.

Step 5: Calculate bias class of each feature.

Step 6: The feature map is produced and it goes to forward pass input layer.

Step 7: Calculate the convolution cores in a feature pattern

Step 8: Produce sub sample layer and feature value.

Step 9: Input deviation of the kth neuron in output layer is Back propagated.

Step 10: Finally give the selected feature and classification

IV. RESULT AND DISCUSSION

The Experiments are done by personal computer with configuration: Intel (R) Core (TM) i3-2120 CPU @ 3.30GHz, 4GB memory, Windows 7, MySQL 5.1 backend database and JDK 1.8. The application uses web application tool for design code in Eclipse and execute on Tomcat server.

Positive (P) : Observation is positive.

Negative (N) : Observation is not positive.

True Positive (TP) : Observation is positive, and is predicted to be positive.

False Negative (FN) : Observation is positive, but is predicted negative.

True Negative (TN) : Observation is negative, and is predicted to be negative.

False Positive (FP) : Observation is negative, but is predicted positive.

Accuracy = TP + TN / (TP + FP + TN + FN)

Precision = TP / (TP + FP)

Recall = TP / (TP + FN)

F1-Measure = 2 * Precision * Recall / (Precision + Recall).

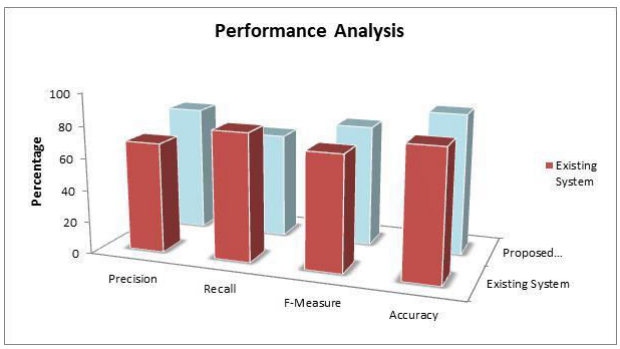

Fig. 2. Classification Results

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	Existing System	Proposed System
Precision	68.45	78.70
Recall	79.44	65.64
F-Measure	72.11	74.31
Accuracy	77.19	88.26

V. CONCLUSION

In this paper, a new way to classify different types of arrhythmias using deep learning has been shown. We have used ECG images instead of ECG signals to train neural networks. There is no need to apply pre-signal processing methods to the data that comes in. Furthermore, the noise in the signal has less of an effect on the signal. In addition, the ECG images that are taken are sent to the networks in a single colour depth, which avoids complicated network struc-tures. The deep learning results show that the proposed CNN architecture is good at classifying these types of arrhythmia.

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