DETECTING HEART ARRHYTHMIAS WITH DEEP LEARNING USING CNN

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***Abstract*—A modern electrocardiogram (ECG) based methodology for classifying cardiac abnormalities is proposed here. The ECG can aid in generating apparent abnormal heart pattern, known as arrhythmia. For machine learning purposes, the patient database and AAMI specifications will be used in view of the patient-oriented scheme. To train and evaluate the classifier (6 layers convolution neural network (CNN)), this data set of images mixing ECG signals and heartbeat time intervals will be used. The training set will be expanded to achieve best results in order to eliminate the imbalance between different heartbeat classes. Cardiac abnormalities occur as subtle visual artifacts of the ECG, and by signal processing methods can lead to automatic cardiac diagnosis. Classifiers can only be applied to classify the actual ECG signal after reaching an acceptable level of performance after preparation to learn how to recognize its classes.**

Keywords —CNN, arrhythmia, ECG, MIT-BIH ,heartbeat

I. INTRODUCTION

Arrhythmia is a case in which electric system of heart don't function in correct order which affects heart rate and rhythm. Arrhythmias allow the heart to pound too quickly, too slowly, or in an disorganized, erratic manner.

A. Cause of Arrhythmia:

- When natural pacemaker of heart forms an unusual rhythm or rate.
- When pathway of normal conduction is disturbed.
- when pacemaker is replaced with another part of heart.

B. Different classes of Arrhythmia:

- Atrial Fibrillation : irregularity occurs in upper heart chamber.
- Bradycardia : heart rate is slow than usual.
- Conduction Disorders :in this arrhythmia heart beats abnormally
- Premature contraction : heart beats early than normal.
- Tachycardia : in this type heart shows rapid rate
- Ventricular Fibrillation : irregularity occurs in lower heart chamber.

Arrhythmia can cause stroke or heart failure if it persist for long time.

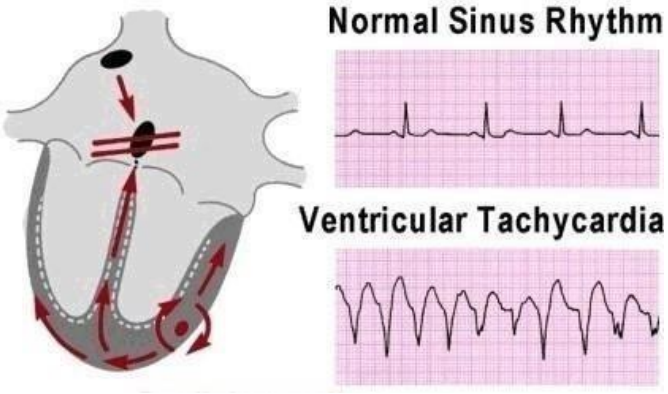

FIG 1: Ventricular Fibrillation

The research of heart electric phenomena since 19th century in order to recognize the heart beat pattern. Electrocardiogram is the test that detects cardiac abnormalities by estimating the heart rhythms which is generated by heart as it gets smaller, it is an important apparatus to assess heart pattern . Because of it is fast identifying nature of arrhythmia and diagnosis. The recognition of the different heart function by the analysis of signal discreteness by comparing with standard signature. ECG visualizes cardiac abnormalities, the procedure can perform by the signal processing technique for diagnosis of automated heart. By the significant application of machine learning methods, ECG categorization can add to diagnosis heart.

The survey report of AAMI(Association for the Advancement of Medical Instrumentation) hints that few databases(Internet-based) of ECG signals with the division of five cardiac heart abnormalities should be used: regular beats (N), fusion beats (F)

Standardization of this, In recent studies, This technique has been widely adopted because it satisfies comparison between result and methodology . For grouping the labeled sample patient-oriented and beat-oriented methods has been used . Beat-oriented is a famous process in which the data categorization set considers into account collection cardiac beats. The patient-oriented method focuses on different pulse. Subjects for information set and testing. This strategy has been proposed and, compared to the past method, presents the advantage of loyally speaking to the situation.

Usually, automatic heartbeat assembling is accomplished by performing extraction, classification and evaluation of characteristics. Several function extraction techniques have been used, but the key one among them is heartbeat intervals to differentiate between forms of heartbeat. The method used for function extraction is Wavelet transforms (WT) that simultaneously conducts current data from the frequency and temporal domains. Various methods of classification, for example SVM, ANN, LD(linear discriminant), CNN, decision trees, have been used, among others. The databases suggested by the AAMI are also used to test methods of arrhythmia classification, e.g. AHADB (for Ventricular Arrhythmia Detectors testing) and MIT-BIH Arrhythmia Database.

New approach to classifying heartbeats is presented here. The method accepted to train the classifier is patient- oriented division. For classifying the images a fresh method is discussed here named lightweight CNN. Characteristics of time are obtained from the heartbeat intervals, whereas WT scales reflect structural characteristics. Further these features are merged into images to be used in the classification stage. 2- D image of of heartbeats will be generated by Wavelet transforms that focuses on time and frequency information related to patient ECG. Finally this images will be processed by CNN scrutiny to provide output.

II. CHALLENGES IN ARRHYTHMIA

Those cases of Arrhythmia which are not recognized or has not been treated can affect brain and heart which can eventually lead to death.

- Analytical disability: Individuals having arrhythmia are at very high risk of getting affected with vascular dementia and Alzheimer's infection .The reason behind it may be low blood flow to cerebrum after few time.

- Cardiovascular breakdown: Capacity of lower heart chamber to pump blood can be affected very badly if a person is having the case of Repeated arrhythmia. Arrhythmia can aggravate the existing heart disease which can cause cardiovascular breakdown.
- Stroke: Certain patients affected by atrial fibrillation can be victim of this. Due to arrhythmia atria can have blood pool which can cause blood clots.Explosion of blood clot can affect mind which can become reason for stroke.
- Immediate cardiac arrest: Due to Ventricular fibrillation the heart unexpectedly stop pulsating which can lead to cardiac arrest .
- Deteriorating arrhythmia: Some arrhythmia target different kind of arrhythmia or worsen on long haul.

III. CNN

"convolutional neural network" is defined as the network's usage of convolutional mathematical operation. CNNs are a type of neural network in which at least one layer uses convolution in place of general matrix multiplication.

CNN or ConvNet in deep learning is a class of deep neural networks, generally used for analyzing graphic imagination. CNN can also be called as shift or space invariant artificial neural networks (SIANN), convolution kernels move upon input features and give similar responses depending on the weight-sharing structure. Surprisingly, many CNNs are only “birational" to translation, rather than constant.

CNN can be used in NLP(Natural Language Processing), video and Image recognition, image segmentation, BCI(brain- computer interfaces), medical image interpretation, image detection, financial time series and recommender systems.

IV.LITERATURE SURVEY

For arrhythmia classification, many strategies have been suggested.

- Khorrami[5] suggested the use of continuous transform wavelets in ECG [5] arrhythmia classification. The two suggested

the use of continuous were MLP that were trained using SVM and back propagation(BP). four district ECG strike, in addition to the usual ECG beat, the forms of arrhythmia be taken from the database of MIT arrhythmia. The findings indicate which MLP output is higher via which of SVM using a single lead.

- An arrhythmia grouping model with ECG signals was developed by the authors of [6] utilize ECG signals Neural modular networks. To divide arrhythmia towards ordinary, these proposed model is used abnormal groups and the experimental findings suggest that model has a accuracy of 82.22%.

- A fresh approach towards the assembling of arrhythmia exist established on type 2 fuzzy C-means in[7]. Algorithms represents the initial learning which executes a heartbeat classification using wavy scanning to transfigure one-Dimensional signals in two-Dimensional images as input to a CNN structure.

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- Neural network and clustering. 10 ECG arrhythmia styles acquired from MIT they used a database. The findings indicate that 99% accuracy was reached by the proposed method[8] .

- A fuzzy k-nearest neighbor method for arrhythmia beat classification was proposed in[4]. they obtained an accuracy of 97% in classification about matual et.Al[9] took advantage of a supervised generalized measure of learning vectors for the description of heart beats. The categorization was utilizing 12 forms on arrhythmia along with the regular beat utilizing arrhythmia of MIT table . In this analysis , the precision secured was 92 percent.

- Another study[10] suggested a quantization of the neuro-fuzzy or generalized learning vector it is based on the quantization of generalized learning vectors and fuzzy- logic. The average precision for generalized learning vector quantization and quantification , the values obtained were 93.36 percent and 95.52 percent.

- The method suggested in[11] is the first research which uses random forests for ECG signals. Classifying ECG beats obtained from the MIT database with five heartbeat groups were used the 99.8% of the over all precision of the suggested solution.

V. METHODOLOGY USED

Title & Year	Authors	Algorithms used	Limitations
Prediction of Cardiac Arrhythmia type using CRA(2017) [1]	Anjana Suresh, Gopika Suresh	Clustering and Regression	The accuracy is only 80%
Classification of Arrhythmia Using ML Techniques (2015)[2]	Thara Soman and Patrick O Bobbie	Naive Bayes and J48 OneR	Applicable for Naive Bayes
A Novel Approach of ECG Classification for Diagnosis of Heart Diseases (2015)[3]	Mr.Jitendra Kumar and Ektha , Gajendra	SVM	The paper does not Help in Classifying cardiac Arrythmia
Prediction and Classification of Cardiac Arrhythmia (2015)[4]	Vasu gupta,Sharan Srinivasan,Sneha S Kudli	Naive Bayes Classifier SVM Random Forests	The accuracy is only 77.4%

TABLE 1: A TABLE SHOWING BRIEF DESCIPTION OF EARLIER METHODOLOGY USED

VI.CONCLUSIONS

The previous study used naive bayes and random forest method by which the abnormal beat calculations were done manually which was very time consuming. So in future a CNN-based two-dimensional(2-D) classifier will be used whose aim is to classify electrocardiogram(ECG) signals based on the patient oriented scheme to build a system that can detect the cardiac arrhythmia of patients from the Electrocardiogram (ECG) signals and classify the ECG trace different arrhythmia classes. The system will be built in order to prevent the possibilities of human error during ECG records Analysis. Once you have the details of the patient we can predict the future health and hence the patient can take necessary prior precautions.

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