ARRHYTHMIA CLASSIFICATION USING DEEP LEARNING

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ABSTRACT— *The importance of ECG classification is on the rise with its many current medical applications of the same. Currently, there are many machine learning approaches contributed towards analysing and* ***classifying*** *ECG data. The main setbacks of these ML results are use of hand-crafted or inadequate feature learning architectures which often relies on the probability of finding the appropriate features. One of the proposing solutions is to use deep learning architectures where first layer uses LSTM which behave as feature extractors and summarized with some fully-connected (FCN) layers are used for predicting the final conclusion about classes in ECG*

Keywords-- *arrhythmia classification using deep learning*

I. INTRODUCTION

Cardiovascular disorders are a significant burden worldwide, inflicting thirtieth of the deaths within the world per the world Health Organization. Therefore, early detection the patients in danger, and a much better understanding of the unwellness mechanisms are crucial to boost designation and treatment. Electrocardiogram (ECG) recordings catch the propagation of the electrical signals within the heart from the body surface.

Many electrophysiological abnormalities have a mark on the ECG and on identifying them, we can detect cardiac disorders. Holter ECGs record the electrical activity of the centre over longer periods of your time (several hours), whereas customary twelve-lead ECGs give data on cardiac activity from 12 completely different views (leads) over many heartbeats regulated by electrical signals created by 2 nodes at intervals the centre and conducted through a series of specialised cardiac cells. throughout healthy, traditional operation, this happens at regular intervals and also the electrical signal, that causes the centre muscles to contract, propagates via the cardiac conductivity system on the proper path through the atria and ventricles. Cardiopathy happens once the heartbeat is simply too quick (tachycardia), too slow (bradycardia), or altogether abnormal. although several arrhythmias are symptomless, people who don't seem to be will cause symptoms as gentle as occasional palpitations or as severe as stroke and abrupt internal organ death. As arrhythmias are caused by disorders of the conductivity system, they're mirrored in ECG readings as abnormal waveforms

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II. PRESET SYSTEM

The present system involves machine learning techniques which prove to be redundant due to the shallow feature learning architecture. This current electrocardiogram classification task is often represented as task to determine to which class patient's ECG can be allotted. The given information is non-balanced.

It is crucial to analyze into ECG information which may be obtained from patients and choose what reasonable pre-processing and machine learning algorithmic rule we should to use. Firstly, most ECG information is time series information with length regarding 30 or 60 s with sampling time approximately 0.003s. This feature extraction must free the developers from use of expert information and hand-crafted features.

III. PROPOSED SYSTEM

Our proposed model is based on RNN precisely LSTM which outputs a limited set of input-output pairs. The effectiveness of our model is evaluated on totally different records of electrocardiogram information. As a detection measure of our model, we tend to reason the 3usually identified performance measures i.e. sensitivity (se), specificity (sp) and accuracy (ac). The advantage of the algorithm's ability to extract options is extremely helpful in the cases when there is no any medical or connected subject specialists for feature engineering because of some reasons it is fascinating to check a recurrent neural internet (RNN, LSTM etc.) in electrocardiogram classification task due to its implicit ability to work with historical data like time series.

LSTM

Long short-term memory [LSTM] networks extends the memory of Recurrent neural network [RNN]. It is very well applicable for incidents that have a long

time gap in between.

They allow the RNN's to remember their inputs for over a long period of time. LSTM contain their data in a memory

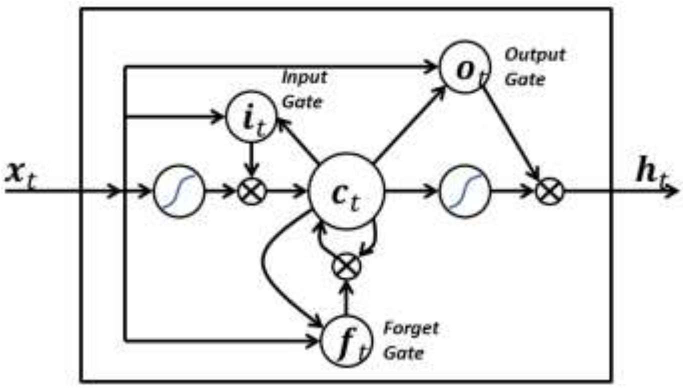

Figure 1. LSTM unit with input, output and forget gate

and they can also read, write and delete information from their memory stored. The gradient is kept steep in LSTM and the issue of problematic gradient is solved here.

IV. LITERATURE SURVEY

We surveyed some literature which included machine learning techniques to detect arrythmia and classify them accordingly.

Paper [1] uses algorithms to diagnose cardiac arrhythmia. They are Naïve Bayes, OneR, and J48. Greedy technique algorithm is used to utilize decision trees for the purpose of classification. A decision-tree model is constructed out of training data and the created model is used to classify unseen data.

This paper suggests that the usage of machine learning diagnosis cardiac arrythmia but J48 does not classify them accurately. It also used the software WEKA.

Paper [2] covers majorly the use of support vector machine (SVM), Artificial neural networks to generate models and classify and defects in the heartrate. This paper proved that features extraction has more accuracy than decision trees in signal matching which is the opposite of naïve Bayes.

It also proved that compared to decision trees, ANN has more accuracy when ECG signal has a lot of noise.

Paper [3] provides classification technique using LogitBoot for boosting any classifier. It also uses SVM and concludes that it needs assistance from user to review and adjust the parameters of optimal model.

The disadvantage of this method is that the images are obtained as input and is the digital conversion from paper, which is less accurate. The result is time consuming and is mismatched. To overcome this issue machine learning techniques based on feature extraction on real time using embedded devices are carried out by patients to analyze their heartrate for over a long period of time.

Paper [4] tries to diagnose irregular heartbeats using KNN (K-Nearest Neighbor) algorithm by collecting five iteration by varying the value of k. This feature selection technique gives good accuracy when the value of k is 7.the distance of nearest neighbor is determined by using Euclidean distance. Although this method is found to give lesser accuracy than by using SVM.

This paper also uses ROC [Receiver Operating Characteristic] curve to plot the true positive and false positive rates of the classification algorithm. This classification problem is used for classifying arrhythmia in 16 classes and the average of the output classes is used to obtain the ROC curve.

Paper [5] tries to predict the result of the signals of ECG using various machine learning techniques. It uses a total of 20 features for predicting the results. This paper tries comparing the accuracy of prediction in 6 algorithms them being Naïve Bayes, LogitBoot, K-Nearest Neighbors algorithm, Random forest, Artificial neural networks.

Artificial Neural Network performed the best with an accuracy of 68%. The Artificial Neural Network employed a total of 5 hidden layers. LogitBoot algorithm performed second best after the artificial neural network and the Naïve Bayes Algorithm performed the worse among all the algorithms.

In conclusion, the overall accuracy obtained in this paper using Artificial Neural Network is 68%

Paper [6] This paper showed an overall accuracy of 79%.

They employed the methods of ANN, SVM. Using an open accessible database ECG records were obtained. A feature set was produced by extracting the statistical features of over 80 normal and 442 irregular ECG recordings obtained from the database. The 10-fold cross-validation technique was employed in order to gain more generalized results.

The best performance was derived by using SVM with an accuracy result of 78.7% out of which 89 was sensitivity.

Paper [7] This paper uses wavelet for feature extraction technique. However, using wavelet also increases the complexity of feature extraction as the decomposition level increases and in order to remove noise from feature extraction higher level of measures must be implemented.

Pan-Tompkins algorithm which uses 5 steps namely squaring, band-pass filtering, moving window, differentiation, and integration. ECG signal is reduced by using band-pass filtering. Squaring method is point by point squaring of the signals of ECG.

Paper [8] uses the technique of convoluted neural networks [CNN] that combines feature classification and classification. By using common and patient specific training data a CNN will be trained for every patient individually. This method can be used for real-time ECG monitoring and also used to detect any irregularities in any wearable device.

This system achieves a performance which is superior to other techniques such as SVM, naïve Bayes.
This method has been proven to be robust and patient specific system with high accuracy.

V. TRADE OFFS BETWEEN PROPOSED SYSTEM AND EXISTING SYSTEM

The proposed system is more efficient than the existing system because the current system uses heuristic hand-crafted or shallow feature learning techniques which often depends on the probability of identifying the correct feature.

Since the proposed system uses LSTM the results obtained are more accurate and the memory space extends from RNN.

It uses architecture of deep learning where the first layer uses LSTM which is helpful in feature extraction and in the end Fully connected layers [FCN] are used for accurate classification of ECG.

VI. COMPARISON OF RESULTS

Below are the findings of the various research papers surveyed

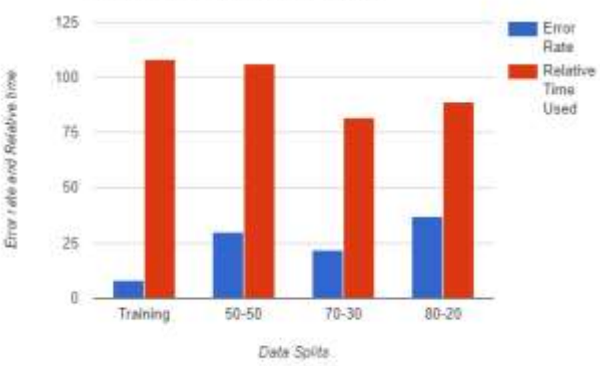

Table 1: Accuracy of ECG classification using J48

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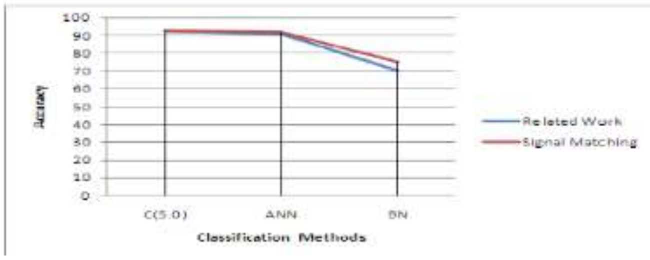


Table 2: Signal matching using SVM

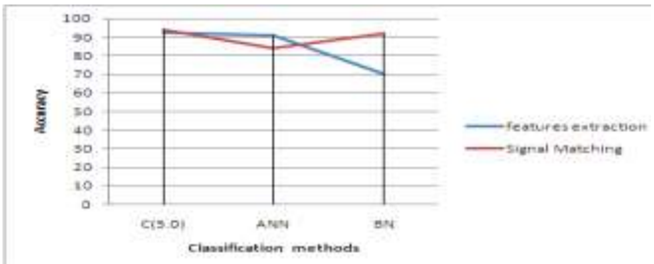
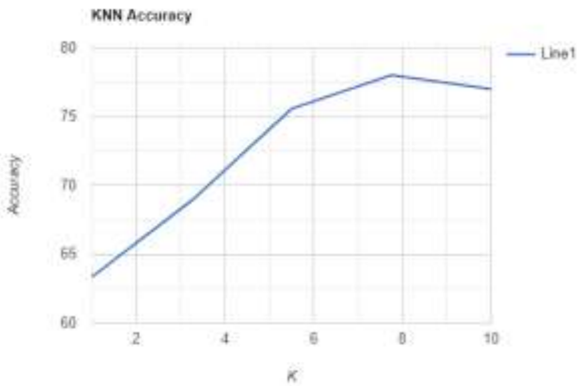


Table 3: Accuracy comparison between extractioin of features and signal matching shapes



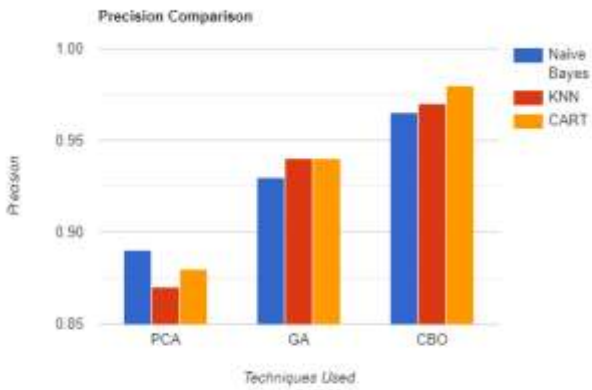


Table 5: Obtained result using naïve Bayes and KNN

VII. FUTURE ACTION

After reviewing several research papers, we've gained a fair amount of idea of the various classification algorithms that exist for classifying the abnormalities present in ECG. We wish to use this knowledge and improve the accuracy in the classifying process and help to build the scope in this project.

REFERENCES

1. Classification of Arrhythmia Using Machine Learning Techniques THARA SOMAN PATRICK O. BOBBIE School of Computing and Software Engineering Southern Polytechnic State University (SPSU) 1100 S. Marietta Parkway, Marietta, GA 30060
2. Classification of Cardiac Arrhythmias using Machine learning techniques based on ECG Signal Matching Makki Akasha Babikier, Mohammed Izzeldin, Ibrahim Musa Ishag, Dong Gyu Lee, Keun Ho Ryu
3. Classification of Cardiac Arrhythmias using Machine learning techniques based on ECG Signal Matching Makki Akasha Babikier, Mohammed Izzeldin, Ibrahim Musa Ishag, Dong Gyu Lee, Keun Ho Ryu
4. KNN Based ECG Pattern Analysis and Classification Namita Thomas and Deepthy Mathew
5. R. C. Holt, Very Simple classification rules perform well on most commonly used datasets, Machine Learning, Vol 11, 1993, pp. 69-90.
6. Xiao Tang, Mo Zhiwen "Electrocardiogram Classification Method Based on SVM", ISKE-2007,ISBN.978-90-7867704-8.
7. D.L. Donoho, I.M. Johnstone, Adapting to unknown smoothness via wavelet shrinkage. J. Am. Stat. Assoc. **90**(432), 1200–1224 (1995)
8. Neural Networks for Patient-Specific ECG Classification Serkan Kiranyaz, Turker Ince, Ridha Hamila and Moncef Gabbouj

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