Arrhythmia Optimization and Prediction Analysis on a Sturdy Machine Learning Model using ECG-Based Heartbeat Classification and Pattern Recognition

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ABSTRACT
This research work to describe a quick and entirely automatic ECG arrhythmia classifier based on Echo State Networks, a straightforward brain-inspired machine learning technique. Our classifier simply needs one ECG lead and has a low-demanding feature processing system. Its validation and training follow a patient-to-patient process. Our method works well with an online classification that complements recent developments in wearables and wireless health monitoring equipment. We can take advantage of parallelism to train the classifier at incredibly fast rates by combining ensembles. The MIT-BIH AR and the AHA ECG datasets are used to assess the heartbeat classifier. Our classification method in the MIT-BIH AR database has a sensitivity of 92.7% and a positive predictive value of 86.1% for ventricular ectopic beats when using lead II alone, and a sensitivity of 95.7% and a positive predictive value of 75.1% when using lead V1' alone. These outcomes even outperform other completely automatic ECG classifiers now in use and are on par with the state-of-the-art in this field.
Keywords: Feature extraction, pattern identification, ECG signal

I. INTRODUCTION

Cardiologists use the electrocardiogram (ECG) as a biosignal for diagnostic purposes. Important details regarding the electrical activity of the heart are revealed by the ECG signal. Electrocardiography, sometimes known as ECG, is used to collect the heart signals. that electrodes in our arms, legs, and chest are used to collect heart signals. This signal can be used to detect cardiac disease. Determine the cardiac health based on the ECG waveform's shape. Signal processing is used to read ECG signals and analyse them.
ECG signal analysis and interpretation now heavily rely on signal processing. When compared to manual measurements, improving measurement accuracy and reproducibility is one of the many goals of ECG signal processing. Another goal is to extract information from the signal that is not immediately visible through visual analysis. The five waves that make up an ECG are P, Q, R, S, and T.

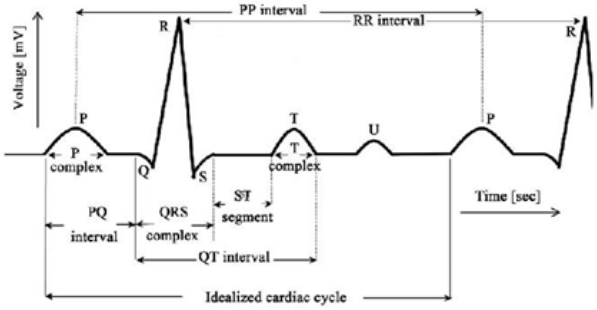

Fig 1: ECG Signal with Idealized Cardiac Cycle Process

Electrodes taken from the human body in a typical engagement could assess this signal [2]. Regardless matter whether a challenge is simple or difficult, optimal and intelligent problem solving techniques are necessary in today's environment. Researchers and programmers are working to improve the effectiveness, intelligence, and accuracy of machines and software. In order to provide effective and ideal solutions, artificial intelligence is

used in this situation. In the process of learning new patterns, data mining techniques are used to explore, analyse, and extract data using sophisticated algorithms. Accuracy in prediction is the key problem since predictions are made using knowledge that is already known or prior values.

Because it is based on biological neurons, the artificial neural network (ANN) is a self-adaptive trainable process that can learn to solve complex problems based on available knowledge. It can be used for pattern recognition, classification, and prediction. One of the most common and highly developed heuristic search techniques in artificial intelligence is the genetic algorithm.

II. LITERATURE REVIEW

Qian Zheng, Chao Chen, Zhinan Li (2020). A Novel Multi-Resolution SVM (MR-SVM) Algorithm to detectECG signals anomaly in WE-CARE project – Center for wireless communication and signal processing.

Cardiovascular disease (CVD) has become the leading cause of human deaths today. In order to combat this disease, many professionals are using mobile electrocardiogram (ECG) remote monitoring system. While using mobile ECG systems, most of the cardiac anomalies can be observed, especially when serious myocardial ischemia, heart failure, and malignant arrhythmia occur. Thus, ECG anomaly detection and analysis have attracted more and more attention in the clinical and research communities. Currently, the existing solutions of ECG automatic detection and analysis technologies are challenged by an accuracy requirement. Based on this motivation, we propose a novel MultiResolution Support Vector Machine (MRSVM) algorithm to detect ECG waveform anomaly. This proposal is tested in our WECARE (a Wearable Efficient project.

Sarikal, P. and Wahidabanu, R. (2020). Robust R peak QRS detection in electrocardiogram using wavelet transform (IJACSA) International Journal of Advanced Computer Science Applications, 1(6), 48-53.

In this paper a robust R Peak and Q,RS detection using Wavelet Transform has been developed. Wavelet Transform provides efficient localization in both time and frequency. Discrete Wavelet Transform (DWT) has been used to extract relevant information from the ECG signal in order to perform classification. Electrocardiogram (ECG) signal feature parameters are the basis for signal Analysis, Diagnosis, Authentication and Identification performance. These parameters can be extracted from the intervals and amplitudes of the signal. The first step in extracting ECG features starts from the exact detection of R Peak in the QRS Complex. The accuracy of the determined temporal locations of R Peak and QRS complex is essential for the performance of other ECG processing stages. Individuals can be identified once ECG signature is formulated. This is an initial work towards establishing that the ECG signal is a signature like fingerprint, retinal signature for any individual Identification. Analysis is carried out using MATLAB Software.

Qibin Zhao and LiqingZhan. (2021). ECG Feature Extraction and Classification Using NN Transform andSupport Vector Machines, International Conference on Neural Networks and Brain, ICNN&B, vol. 2,pp. 1089-1092.

This paper presents a new approach to the feature extraction for reliable heart rhythm recognition. This system of classification is comprised of three components including data preprocessing, feature extraction and classification of ECG signals. Two different feature extraction methods are applied together to obtain the feature vector of ECG data. The wavelet transform is used to extract the coefficients of the transform as the features of each ECG segment. Simultaneously, autoregressive modeling (AR) is also applied to obtain the temporal structures of ECG waveforms. Then the support vector machine (SVM) with Gaussian kernel is used to classify different ECG heart rhythm. Computer simulations are provided to verify the performance of the proposed method. From computer simulations, the overall accuracy of class The electrocardiogram (ECG) is routinely used in clinical practice, which describes the electrical activity of the heart. In physical checkups at hospitals, physicians record the ECG after the patient has exercised to check his/her cardiac condition. The Holter ECG device is used most frequently for recording the ECG. Physicians apply the device to a patient when they need to monitor his/her ECG to find the few abnormal cycles in the ECG throughout the day. Physicians then interpret

the shapes of those waves and complexes. They calculate parameters to determine whether the ECG shows signs of cardiac disease or not. The parameters are the height and the interval of each wave, such as RR interval, PP interval, QT interval, and ST segment. Recognition of the fiducial points and calculations of the parameters is a tedious routine for the physician. Therefore, there is an urgent need for an automatic ECG recognition system to reduce the burden of interpreting the ECG. Various studies have been done for classification of various cardiac arrhythmias [1][2][3][4]. In this paper, we propose the combination of wavelet transform and AR model as the feature extraction method, then use the SVM to classify the ECG heartbeat. The proposed approach is validated in the MIT-BIH Arrhythmia Database[5] and get high accuracy of classification. All ECG data were obtained from MIT-BIH arrhythmia database that contains records of many patients with heart troubles or abnormalities. The frequency of the ECG data was 360HZ. Each record has its respective annotation file that indicates the class of the heartbeat. A single channel ECG is collected and used to algorithm evaluation. Since there are few categories of abnormal QRS complexes in one record, we select different abnormal QRS complexes from several records. Six types of QRS complexes appeared frequently in the database. Therefore, we mainly deal with six types heartbeats which include normal beat(NORMAL), left bundle branch block beat(LBBB), right bundle branch block beat(RBBB), paced beat(PACE), premature ventricular contraction(PVC) and Atrial premature contraction(APC). In the data preprocessing process, continuous ECG signals must be separated into many segments which contain one heartbeat. The extracted data of ECG complexes is centered on R peak. Considered that some PVC duration is great and sometimes R peak detection may be not the center of the complex, we have selected segment of 250ms before the fiducially point and 400ms after that with the R peak point is the 90th point. The R peak is detected using the Pan and Tompkins algorithm [6].

III. PROPOSED MODEL

From the above literature survey we have concluded that heart activity is very important in health care monitoring system. And it is done through the ECG signals. Different machine learning algorithms were used for predicting the heart diseases as well as heart attack. The all research is done using MATLAB tool.

Proposed System Architecture:

Raw Data ECG normal and abnormal signal dataset for male and female taken from MIT-BIH arrhythmia dataset that is raw ECG data take it for further process.

Data Selection This includes operations involved the selecting of either normal or abnormal ECG signal data for further process.

Data Preprocessing This includes operations applied to the data to prepare it for further analysis. Typical pre-processing operations include data cleaning to filter out noisy data elements, data interpolation to cope with missing values, data normalization to cope with heterogeneous sources, temporal alignment, and data formatting.

Feature Extraction This includes operations for representing the data appropriately and selecting specific features from this representation.

Optimized Neural Network Model This stage, also called mining applies knowledge discovery algorithms to identify patterns in the data. Modeling problems can be classified into six broad categories: anomaly detection to identify statistically deviant data, association rules to find dependencies and correlations in the data, clustering models to group data elements according to various notions of similarity, classification models to group data elements into predefined classes, regression models to fit mathematical functions to data and summarization models to summarize or compress data into interesting pieces of information. Here, we are applying Optimized neural network using GA for classification and prediction of heart Attack.

Pattern Identification In this stage system identify the pattern of normal ECG dataset as well as abnormal ECG dataset for the analysis and prediction purpose.

Analysis and Prediction This stage includes operations for analysis and prediction of the results of the pattern Identification process.

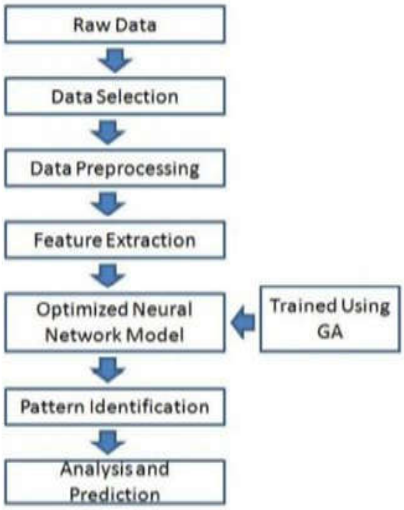

Fig 2: Proposed System Architecture

IV. SIMULATION RESULTS

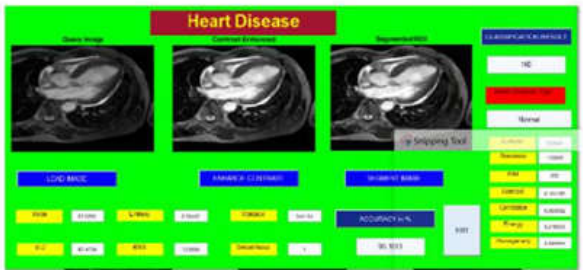

Fig 3: Predicting Heart Disease

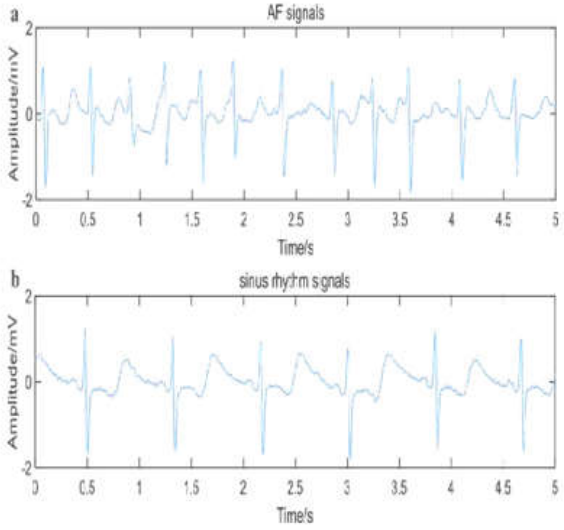

Fig 4: ECG Signal Analysis with rhythm signal classification process

CONCLUSION

Heart disease diagnosis is the primary purpose of the ECG. The initialization of neural network weights is optimised by the use of the genetic algorithm. By enhancing performance and utilising optimised neural network architecture, genetic neural network-based heart disease prediction for patients determines if the patient has heart disease or not. Additionally, research the likelihood of a heart attack depending on heart activity. Long training times, delayed convergence, and local minima are drawbacks of back propagation.

This challenge is solved using a genetic algorithm, which yields the best outcomes and increases the predictability of heart attacks. Due to the dynamic nature of the healthcare industry, this problem presents a difficulty for data mining. Additionally, it serves as a compulsive motivation for healthcare data mining applications. More data mining applications will be used to find new patterns and relationships as a result of this dynamic, opening up new frontiers. according to the participants in this study who were looked at.

FUTURE SCOPE

Future data mining studies seem to take place, not limited but in considerable weight, in distributed data mining applications and text mining algorithms. With the help of data mining algorithms, classification performance increases. This can be further enhanced and expanded with more prediction algorithm for major life threatening diseases. The further enhancement observes on utilizing different method that provides higher accuracy in feature extraction and classification.

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