

**A combined approach WNN for ECG feature based disease classification**

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Abstract—ECG observes the movements in the heart by sensing the electrical variations in the human skin by using small sensors which are implanted on the chest of the patients. In traditional work many algorithms have been developed for detecting heart disease from which it is concluded that most of the work in biomedical ECG analysis for the prediction or detection was done only up-to the feature extraction, no further decision system development field was highlighted. So, in the proposed work, after getting the information from the ECG, dataset standalone system has developed in this paper. Considering this fact, a novel approach has identified termed as Artificial neural network where the dataset is trained and then classified in order to detect the type of disease a person is suffering from. Specifically, proposed system works on two types of diseases such as Bradycardia and Tachycardia. Apart from this, it also classified either the person is normal or not and if not then which type of disease he or she has. The proposed system is compared with the traditional approach using MATLAB software tool and performance analysis are carried out in the end of the paper. The evaluation of simulation analysis confirmed that proposed system is more efficient and accurate in comparison with the traditional wavelet based approach in terms of overall success rate and error rate of the system.

Keywords—ECG signal, Wavelet Based Approach, Artificial Neural Network

I. INTRODUCTION

Electrocardiography may be described as the technique in which the electrical activity of heart for fixed duration of time with the help of electrodes implanted on the skin. With the help of these electrodes small amount of variations in the skin occur due to re-polarization and de-polarization of heart muscles during each heart beats. Electrocardiogram is usually performed test to check the performance of heart. To identify the problems of heart, the deviations in amplitude of ECG signal or variation in its duration are compared with the standard ECG signal [1]. To determine the variations in ECG signal manually is not an easy task therefore the computer based system is designed to find out the deviations in the recorded ECG signal. To extract the features of ECG signal, non linear techniques need to be implemented due to non linear and dynamic nature of Electrocardiogram signal. To efficiently classify the pattern of recorded ECG signal, it is required to select the optimum set of features in the ECG signal. To obtain the high level of precision, it is required to select the efficient technique for classification of pattern. It is mandatory that the features which are selected in the ECG signal can precisely separate different classes of signal. Features selected in the ECG signal must be analyzed. Different techniques can be implemented to obtain various characteristics from the raw information. It is also necessary to integrate the pattern classifier and feature extractor. In past few years, various methods are presented for feature extraction from the ECG signal, to diagnose cardiac problems, and ischemia detection. Some of the techniques propose for this purpose: discrete wavelet transform, cosine transform, and the discrete Fourier transform. Along with this, the Neural Network, and neuro-fuzzy models are also used to classify the Electrocardiogram signal.

In [2], the poly-spectrum slices along with the poly-spectrum indices of usual and ischemic ECG signals are utilized the characteristics that can be fed at the input of Neural Network classifier. The phase related information is stored in the HOS; it was considered that the non linear features of ECG signal were represented by these selected slices. These slices contain the necessary information that can identify the differences among normal and ischemic Electrocardiogram signal.

The adaptive NN integrated with back propagation technique was implemented for automatic classification of ECG signal so that it can classify the normal as well as ischemic subjects.

As the ANN (artificial neural network technique) is generally used for pattern matching on the basis of mapping of non linear input and output. This can implemented for identifying the morphological variations in Electrocardiogram signals. Tendency of NN to determine the patterns and obtain the data from complex pattern makes it efficient to classify the ECG signal. The input required by neural networks (NN) must have dimension similar to the dimensions of samples. On the other hand the output dimensions must be equal to the number of classes. For classification of ECG signal with the help of NN, the design process is comprised of following steps:

- Selection of input as well as outputs of the NN.
- Selection of type of ANN.
- Evaluation of different hidden layers in the network.
- Identifying number of neurons in all the network layers.
- Choose the function for layers activation function
- Choose network learning technique.
- Choose the technique to analyze the network performance

II. BACKGROUND

ECG is a process which is done for the purpose of monitoring the functionality of electrical motions of heart over the variations of time. It helps in detecting the coronary heart disease, speed rate of the heartbeat, heart failure, cardiomyopathy and congenital heart defects. Several algorithms have been proposed till now in order to detect heart diseases. But in the traditional techniques no artificial intelligent system has used in order to detect disease due to which these techniques are not able to generate highly efficient results. Secondly, existing techniques have been used wavelet transformation which includes manual evaluation for detection. Furthermore threshold values have been changing and decision making was difficult on the basis of threshold value because of variations. Another problem in the existing techniques is that they are not able to analyze more than one person at a time. Due to all these facts, a new technique has proposed.

III. PROPOSED WORK

Owing to various issues in the traditional techniques an automatic system has designed which is able to detect disease on the basis of extracted features. Thus the basic requirement of the proposed system is features. Extracted features have given to the system and then it will generate the result with whether the user has been suffering from a disease or not. For this purpose firstly feature has extracted from the signals and then artificial neural network technique has applied on the extracted features. Consequently, results have obtained from the system either disease detected or not.

IV. METHODOLOGY

The Methodology of proposed work has done in terms of step by step procedure as:

1. Initially, the simulation process initiates where the GUI interface of the proposed model will be shown to the user for the detection of the disease of a particular ECG signal.
2. Now the signal is selected from the window and their features such as P, Q, R, S and T are extracted.

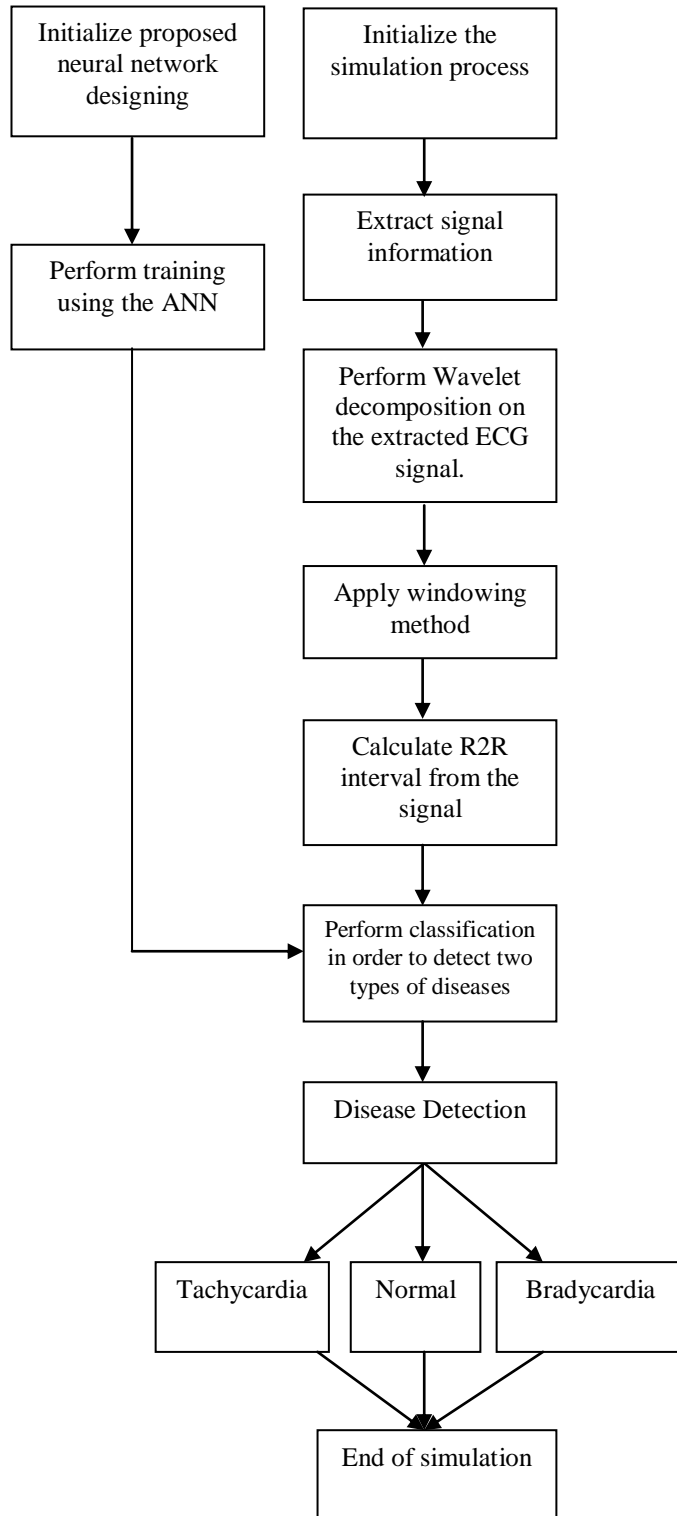


Figure 1 Block Diagram of the proposed technique

3. Apply Wavelet based decomposition on the extracted ECG signal. For the proposed work, four level of decomposition is used on the signal. With the increasing level of decomposition, the possibility of understanding of wavelet increases.
4. Now apply windowing method on the signal to get the time interval between two R's of the signal.
5. Once the R2R detection interval is evaluated, now based on these intervals, type of disease will be detected. The proposed method works on two different types of diseases such as Bradycardia and Tachycardia.

6. Concurrently, proposed neural network follows the similar steps in identifying the disease in the person. For such purpose, the proposed system is designed, its training is performed using the Artificial neural network and then trained dataset is forwarded for the classification.
7. At last performance parameters such as success rate and error rate of individual technique is calculate to understand the performance efficiency of these techniques.

V. RESULTS AND DISCUSSION

This section of work shows the results acquired from the traditional and proposed technique. In the traditional technique, a manual approach is considered where the features are detected through Wavelet transform and Peaks are detected manually. On the counter part, the proposed technique use artificial neural network i.e. artificial intelligence for the extraction of features and the detection of peaks in the signal automatically. After the evaluation of an individual technique, the comparison of between them is performed.

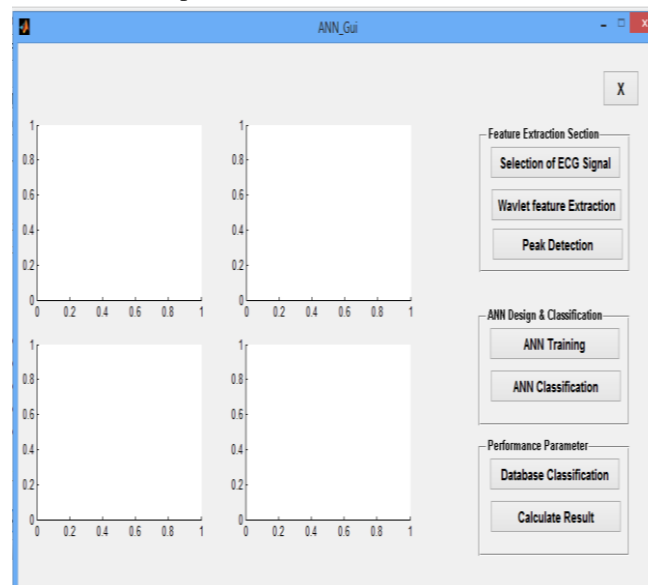


Figure 2 GUI of the proposed technique

Figure 2 shows the GUI interface of the proposed technique for detection of disease among patients. For the proposed work Artificial intelligence approach i.e. ANN has used. Initially, the ECG signal has selected from the database. The figure depicts the evaluation of the disease by clicking on the individual options available in the panel such as selection of an ECG signal, Wavelet feature extraction, Peak detection, ANN designing and classification, Database classification and lastly calculates results.

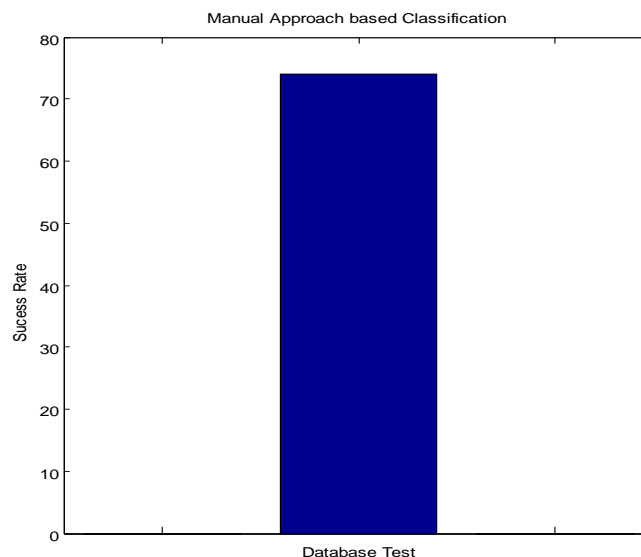


Figure 3 Manual approach based classification

In order to know the efficiency of the proposed and traditional technique, performance parameters are evaluated such as success rate and error rate of individual. The figure below shows the manual approach based classification in terms of success rate. The manual approach is considered as the traditional method and using this method classification is done. The success rate of this approach is reached at 75%. This percentage belongs to the whole database which means that the evaluation of database concludes the efficiency of this approach.

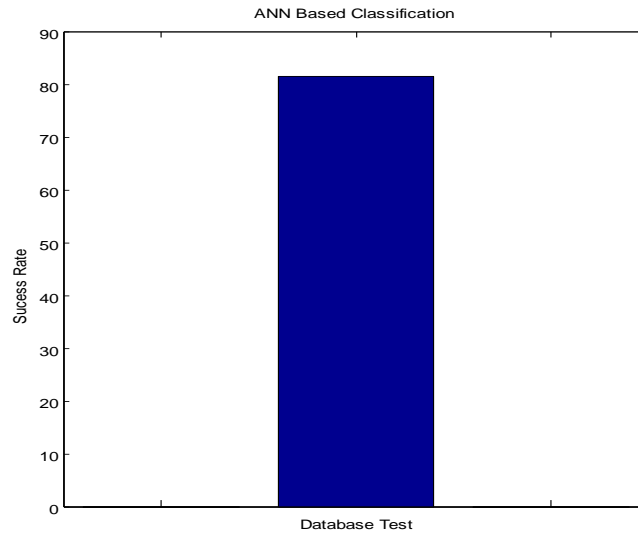


Figure 4 ANN based classification

Figure 4 depicts the success rate of the proposed approach. The classification is done using the proposed technique that implies ANN for training as well as classification. The whole database is calculated using the proposed approach and resultant value has shown below in terms of graph. The overall success rate of the proposed technique is 80% which means that this technique is proven to be competent technique.

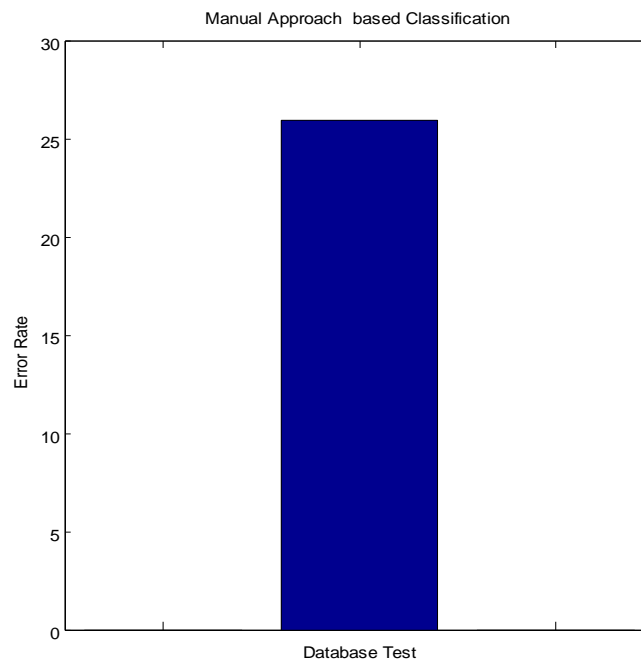


Figure 5 Manual approach Based classification in terms of Error rate

The error rate of the traditional technique has shown in the figure 5. The classification of the database is done through the traditional manual approach and its result has shown in the below figure. As in the figure 5.7 success rate of the technique is calculated likewise the error rate is evaluated for the same. The overall error rate of the traditional approach is 25%.

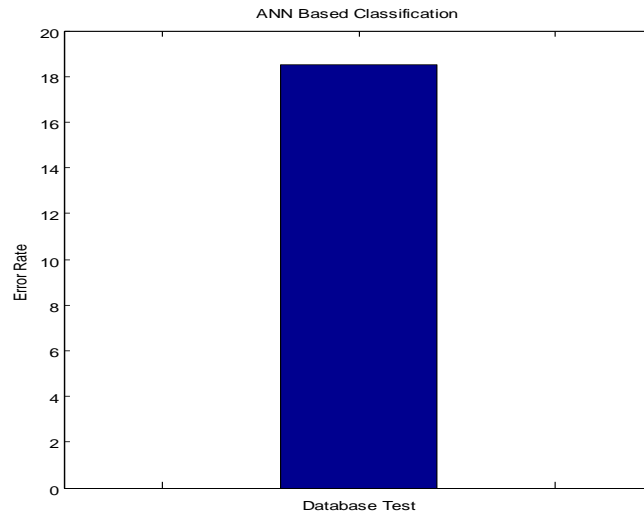


Figure 6 ANN based classification in terms of Error rate

Figure 6 shows the ANN based classification. The error rate shows the chances of having errors in the system while identifying the health of the person such as healthy, non-healthy or Normal. The error rate of the proposed technique obtained at 18% which is quite less. Any system cannot be 100% accurate so is the proposed work. The proposed technique is more efficient and producing less errors while determining.

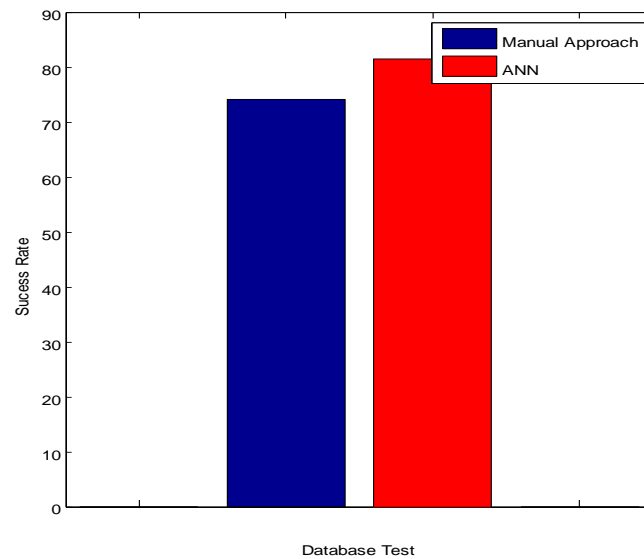


Figure 7 comparison between traditional and proposed technique in terms of success rate

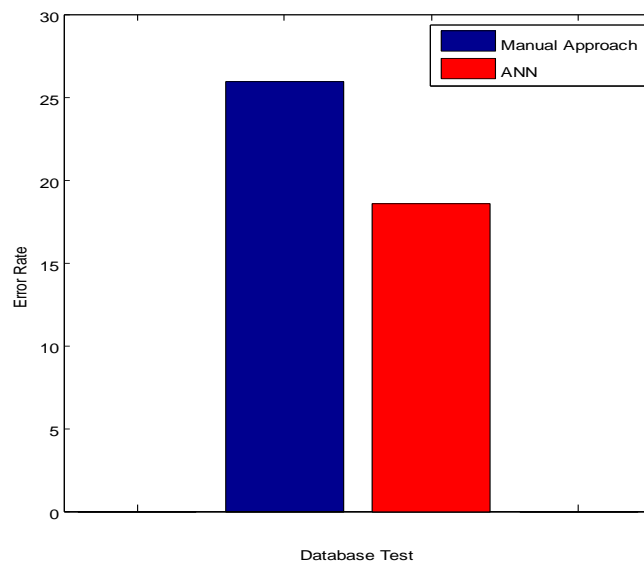


Figure 8 comparison between traditional and proposed technique in terms of Error rate

Figure 7 and 8 illustrates the performance of the proposed and traditional technique in terms of success rate and error rate. Consider the success rate of both the techniques in figure 7, it clearly demonstrates that proposed technique outperforms the traditional technique where the success rate of ANN is 80% approx and traditional manual approach is at 75%. As a result, proposed technique provides 5% more accuracy than the traditional approach. Owing to this hike, proposed technique is more proficient than traditional. Similarly, consider the error rate of the proposed and traditional technique in the figure 8 where both the techniques have shown. The error rate of the proposed technique is lesser than the traditional technique which is 19% approx. On the counter part, the error rate of the traditional approach is high i.e. 25%. Thus, overall 6 to 7 % decrement in the errors while detecting the disease. Consequently, the proposed technique surpasses the traditional approach.

VI. CONCLUSION AND FUTURE SCOPE

The determination of time interval between the occurrences of R to R peak in the signal is used to evaluate the health condition of the person i.e. healthy, non-healthy or normal. Considering this fact, a novel approach has defined in this work. For the detection of Peak and their classification, a neural network based technique is presented. In this proposed method, the training of the database is done and then based on this training; the extracted features' classification is performed. Consecutively, both traditional and proposed technique is applied to evaluate individual performances. For their comparison, success rate and error rate is considered which clearly depicts the efficiency of each technique. The simulation analysis are performed using MATLAB and acquired results concludes that proposed technique surpasses the traditional technique in terms of success rate which means that accuracy of the former is higher than the Later technique. The success rate of proposed and traditional technique is 80% and 75% respectively. So 5% improvement is there in the proposed technique which confirms that proposed technique is more efficient than the traditional technique. Alternatively, the error rate of the proposed technique reduced from 25 to 19% that declares the effectiveness of the ANN approach. Considering this fact, it has concluded that proposed technique outperforms the traditional technique and chances of getting trapped into error are least in case of proposed ANN approach.

The proposed technique is work only two types of diseases such as Bradycardia and Tachycardia. So in future, it can be worked upon detecting different types of diseases with advancement in the procedure of detecting such as advanced optimization techniques.

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