Recent Research in Science and Technology 2014, 6(1): 36-38
ISSN: 2076-5061
Available Online: http://recent-science.com/

Artificial neural network for ecg classification

Gaurav Kumar Jaiswal and Ranbir Paul

Dept. of Electronics and Telecommunication Engineering, Chouksey Engineering College, Bilaspur, India

Abstract
This research work is supervised by ANN based algorithm to classify the ECG waveforms. The ECG waveform gives the almost all information about activity of the heart, which is depending on the electrical activity of the heart. In this paper we are focused only five features of ECG signal P, Q, R, S, T. This is achieved by extracting the various features and duration of ECG waveform P-wave, PR segment, PR interval, QRS Complex, ST segment, T-wave, ST- interval, QTc and QRS voltage. ECG signal and heart rate are used the parameter for detection diseases, most of the data comes from PhysioDataNet and MIT-BIH data base. This research is focused on to find out best neural network structure which classifies the abnormalities of heart diseases. This technique also identifies the normal region for classification of abnormalities; because of ECG waveform is varying from person to person at different condition.

Keywords: ECG, ANN, PhysioDataNet, classification.

INTRODUCTION

An Electrocardiograph (ECG) is a Cartesian representation of the electrical potential generated by the heart. Since its invention in 1887, is has been an invaluable diagnostic tool for the clinician [1].The early detection gives the information about heart abnormalities and increase life of human. ECG is used to measure the rate and regularity of heartbeats as well as the size and position of the chambers, the presence of any damage to the heart, and the effects of drugs or devices used to regulate the heart. To acquire the signal, ECG devices with varying number of electrodes (3– 12) can be used [2]. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

This research is based on ECG signal is an application of pattern recognition. The technique used pattern recognition comprises: signal pre-processing, QRS detection, feature extraction and neural network for signal classification. In this research neural network tool box is used in MATLAB environment. We are focused only five wave of ECG signal P, Q, R, S, T. The early detection gives the information about heart abnormalities and increase life of human. ECG is used to measure the rate and regularity of heartbeats as well as the size and position of the chambers, the presence of any damage to the heart, and the effects of drugs or devices used to regulate the heart To acquire the signal, ECG devices with varying number of electrodes (3– 12) can be used [2].Typical ECG waveform shown in figure-1

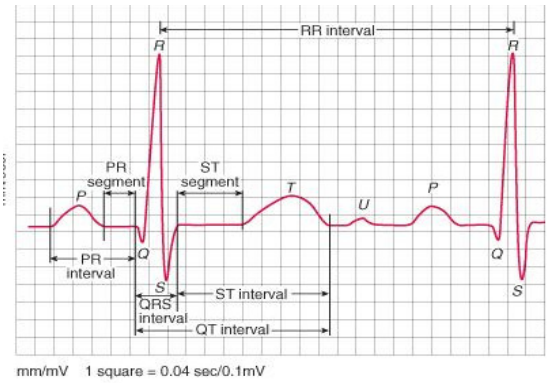

Fig 1. ECG waveform and intervals [1]

The ECG may roughly be divided into the phases of depolarization and repolarisation of the muscle fibers making up the heart. The depolarization phases correspond to the P-wave (atrial depolarization) and QRS-wave (ventricles depolarization). The repolarisation phases correspond to the T-wave and U-wave (ventricular repolarisation) [3]. Arrhythmia or dysrhythmia is a heart disorder representing itself as an irregular heartbeat due to malfunction in the electrical system cells in the heart. It causes the heart to pump blood less effectively and causing disorders in the heart conduction process [4].Early detection of heart dieses is very helpful for living a long life and increase the improvement of our technique detection of arrhythmias. In the ECG waveform found that the general time interval which will occur. ECG signal comprised of P wave, PR segment, PR interval, QRS complex, ST segment, ST interval, RR interval and T wave in the ECG waveform shown in figure-1, for the analysis of amplitude and duration of wave's interval and segment to be used for arrhythmia classification. Typical features (amplitude and time duration) is shown in Table-1

*Corresponding Author
Gaurav Kumar Jaiswal
Dept. of Electronics and Telecommunication Engineering, Chouksey Engineering College, Bilaspur, India

Email: g.gaurav69@gmail.com

Table1. ECG feature and intervals

S.N.	Features	Amplitude(mV)	Duration(ms)
1	P wave	0.1- 0.2	60 -80
2	PR segment		50 -120
3	PR interval		120 -200
4	QRS complex	0.5-1	80 -120
5	ST segment		100 -120
6	T wave	0.1- 0.3	120-160
7	ST interval		320
8	RR interval		(0.4 -1.2)s

LITERATURE REVIEWS

Ramli *et al*. in [7] with the help of (12 lead) ECG and use of signal analysis technique find the important features of ECG signals. The analysis technique depends on the Cross-Correlation, Cross-Correlation identify similar quantity in two ECG waveforms and obtain the value, with the help of this value we can identify the type of arrhythmias.

Tadejko and Rakowski in [8] shows that for detection of abnormal beat in the ECG signals at the time of detection of heart dieses, ECG feature RR interval is focused. Kohonen self-organizing maps (SOM) for finding the ECG wave features in the signal and clustering. In this paper concern for analysis of ECG wave a classifier was developed with SOM and learning vector quantization (LVQ) algorithm using as a data base ANSI/AAMI EC57 standard. In this paper focused only the QRS complex compare the ECG signal with original ECG features of the signal and complete the process arrhythmias detection by using this method improve the arrhythmias detection process.

Ruchita Gautam and Anil Kumar Sharma [9] proposed a method is based on the Dyadic wavelet transform (DyWT) technique this method is applied for finding the QRS complex. In these method focused on the interval of the two consecutive R wave and calculate the heartbeat. This method is applied on the ECG waveforms for detect the dieses Ventricular Late Potentials (VLP's), and separate the wave P R & T which is associated with features of ECG waveforms, In theses method the main consideration is to find out the R waves and threshold is set to 75% of the maximum peak.

Manpreet Kaur, A.S.Arora [10] shows with the help of K clustering technique the output signal is analyzed, the parameter is wave shape, duration and amplitude. With the help of K clustering technique minimize the sum of point to centroid distance, this clustered K summed. In these technique first phase give information about the points are resigned to the closest cluster around the centroid. The second phase gives information on line value where values are self-resigned. The data comes from MIT-BIH for analysis. The success rate of classification for set 2, set 3, set 4, set 5 and set 7 is 100%, for set 1 it is 87.5% and for set 6 it is 75%.

Xu *et al*. in [11] proposed that Slope Vector Waveform (SVM) algorithm helps to find out the RR interval and QRS complex of ECG wave. In this method for determination of better signal to noise ratio, nonlinear amplification and also used differentiator to detect the desired slope vectors for features of ECG wave. In this method with high accuracy and fast response to find the QRS complex and RR interval

F. de Chazal *et.al* [12] shows that we recognize premature ventricular contraction from the normal beats and other heart diseases with the help of denoising module, feature extraction module and classifier module. In the denoising section use the stationary wavelet transform for reducing the effect of noise in heartbeat. In the feature extraction section combination of the morphological-based features and timing interval-based features are proposed. In the classifier module section with the help of multilayer perceptron neural network with different no of hidden layer and algorithm according to radial basis function and probabilistic neural network, 12 files obtained from the MIT–BIH arrhythmia database. Simulation results show that best results are achieved about 97.14% for classification of ECG beats.

S. Mitra *et.al* [13] proposed the three stage technique for detection of heart dieses. In this proposed method consist feature extraction module, a denoising module and a classification module. In the first module with the application of stationary wavelet transform (SWT) for reduction in the noise in electrocardiogram. In the second module features extraction module find out 10 ECG morphological features with the time intervals of ECG wave. In the last section we apply a multilayer neural network with different number of layer and nine algorithms are applied. The data comes from the MIT-BIH arrhythmias database. The best convergent rate can be obtained with the use of Levenberg–Marquardt (LM) algorithm achieved the best overall detection accuracy.

Castro *et al*. in [14] describe the feature extraction with the help of wavelet transform technique and also present an algorithm which will utilize the wavelet transform for extracting the feature of ECG wave. Their proposed method first denoised by use of soft or hard threshold then the feature of ECG wave divided in to coefficient vector by optimal wavelet transformation. In the proposed method choose the mother wavelet transform set of orthogonal and bi-orthogonal wavelet filter bank by means of the best correlation with the ECG signal was developed. After the analysis of ECG signal coefficient are divided QRS complex, T wave, P wave then sum to obtain feature extraction.

Nazmy *et al* [15] presents a novel ECG classification approach. With the help of adaptive neuro-fuzzy inference system (ANFIS) used for classification of ECG wave. In this proposed method feature extraction is done with the help of Independent Component Analysis (ICA) and Power spectrum and input is provided by the RR interval of ECG. In this paper we classify the ECG signal are normal sinus rhythm (NSR), premature ventricular contraction (PVC), atrial premature contraction (APC), Ventricular Tachycardia (VT), Ventricular Fibrillation (VF) and Supraventricular Tachycardia (SVT). In this approach of classification accuracy is obtain an about 97%.

Alan and Nikola in [16] presented that use chaos theory for classification of ECG signal and feature extraction. In this paper also consist of including phase space and attractors, correlation dimension, spatial filling index, central tendency measure and approximate entropy. A new program is developed for ECG classification which is based on the chaos method and also developed semi-automatic program for feature extraction. The program is helpful to classify the ECG wave and extract the features of the signal successfully.

Proposed method

The block diagram in fig. 2 explains the overall methodology for detection and classification of arrhythmias in this work. The overall block diagram consists of signal preprocessing, QRS detection, feature extraction and ANN (Artificial Neural Network) signal

classification.

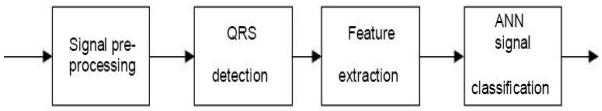

Fig 2. Block diagram of methodology

The first step is the measurement of acquisition period, which requires a wide range of the ECG signal collection including different abnormalities. The data could be collected from real subjects in the future, but it is presently available from the database. The second step is QRS detection which to corresponds to the period of ventricular contraction or depolarisation. The third step is to find the smallest set of features that maximize the classification performance of the next step. ECG feature extraction is mainly used in this step

RESULT

Major abnormalities which can be comparable according to age difference, ST segment change, T waves on their baseline ECG, women had more ischaemic findings, men showed more arrhythmias, bundle branch blocks, and left ventricular hypertrophy. The most predictive ECG findings for CVD death were ST segment depression (risk ratio (RR) 4.7), major ECG findings (RR 3.2), left ventricular hypertrophy (RR 2.79), bundle branch blocks (RR 2.5), T wave flattening (RR 2.47), ischaemic ECG findings (RR 2.46), and arrhythmias (RR 2.16). The prognostic value of major ECG findings for CVD and CHD death was more powerful than well established cardiovascular risk factor

REFERENCES

[1] Mr.Deshmukh Rohan, Dr. A. J. Patil, 2012.Layered Approach for ECG betas Classification utilizing Neural Network functions, International Journal of Engineering Research and Applications (IJREA) ISSN:2248-9622.,2(6):1495-1500.

[2] Jenisha.J.Hannah and Suja Priyadharsini,2012. Patient Adaptive ECG Beat Classifier using Repetition Detection Approach Enhanced by Neural Networks, International Conference on Computing and Research and Control Engineering (ICCCE 2012), 12 & 13 ISBN:978-1-4675- 2248-9.

[3] K .O. Gupta and Dr. P. N. Chatur, 2012. ECG Signal Analysis and Classification using Data Mining and Artificial Neural Networks, International Journal of Emerging Technology Advanced Engineering, ISSN:2250-2459, 2(1) 56-60.

[4] J. T. Catalano, Guide to ECG analysis, Lippincott, 2nd edition

[5] http://en.wikipedia.org/wiki/Electrocardiography.

[6] Y.C. Yeha, and W. J. Wang, 2008. QRS complexes detection for ECG signals The Difference Operation Method (DOM), Computer methods and programs in biomedicine, vol. 9, pp. 245–254.

[7] A. B. Ramli, and P. A. Ahmad, 2003.Correlation analysis for abnormal ECG signal features extraction,‖ 4th National Conference on Telecommunication Technology, 2003. NCTT 2003 Proceedings, pp. 232-237.

[8] P. Tadejko, and W. Rakowski, 2007. Mathematical Morphology Based ECG Feature Extraction for the Purpose of Heartbeat Classification, 6th International Conference on Computer Information Systems and Industrial Management Applications, CISIM '07, pp. 322-327.

[9] Xiaomin Xu, and Ying Liu, 2004. ECG QRS Complex Detection Using Slope Vector Waveform (SVW) Algorithm, Proceedings of the 26th Annual International Conference of the IEEE EMBS, pp. 3597-3600.

[10] F. de Chazal and R. B. Reilly. 2006. A patient adapting heart beat classifier using ECG morphology and heartbeat interval features, IEEE Trans. Biomed. Eng., 53(12): 2535–2543.

[11] S. Mitra, M. Mitra, and B. B. Chaudhuri. 2006. A rough set-based inference engine for ECG classification, IEEE Trans. Instrum. Meas., 55(6): 2198–2206.

[12] B. Castro, D. Kogan, and A. B. Geva, 2000. ECG feature extraction using optimal mother wavelet, The 21st IEEE Convention of the Electrical and Electronic Engineers in Israel, pp. 346-350.

[13] T. M. Nazmy, H. El-Messiry and B. Al-bokhity. 2009. Adaptive Neuro-Fuzzy Inference System for Classification of Ecg Signals, Journal of Theoretical and Applied Information Technology.

[14] Alan Jovic, and Nikola Bogunovic, 2007.Feature Extraction for ECG Time-Series Mining based on Chaos Theory, Proceedings of 29th International Conference on Information Technology Interfaces.