International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

USING BACK PROPAGATION NEURAL NETWORK FOR ANALYZING ECG SIGNALS

[1] Mr.Repakula Naresh,[2]Mr.A.Vinay Kumar

[1,2] Assistant Professor,Dept. of CSE,
Malla Reddy Engineering College (Autonomous), Secunderabad, Telangana State

ABSTRACT: A computer-aided application model for the classification of ECG signals was developed. The model is based on some existing algorithms from literature, which were adapted. The developed system model involves the extraction of some morphological features of an ECG signal and simulating it with a trained BPNN object. The accuracy of detection of signal components and features extraction, show that the developed computer-aided application model maybe employed for the detection of heart diseases in patients.

1. INTRODUCTION

Biomedical signals are observations of physiological activities of organisms, ranging from protein sequences, tissue and organ images, to neural and cardiac rhythms. Biomedical signals are obtained by electrodes that record the variations in electrical potential generated by physiological processes. Each physiological process is associated with certain types of signals that reflect their nature and activities. Observing these signals and comparing them to their known norms, diseases or disorders can often be detected. When such measurements are observed over a period of time, a one dimensional time-series is obtained which is called a physiological signal. An electrocardiogram is a graphic recording of the electrical activity produced by the heart. Electrical activity radiates from the heart in all directions. The ECG signal is recorded by properly pasting a certain number of electrodes on the body [1]. A typical ECG signal of one heart beat is shown in Figure 1.

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

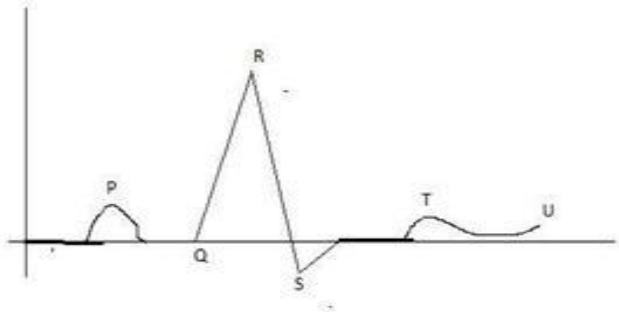

Figure 1: ECE signal

The heart provides the driving force for the circulation of blood. It contains four-chambered pump with two atria for collection of blood and two ventricles for pumping out of blood. The resting or filling phase of a cardiac chamber is called *diastole;* the contracting or pumping phase is called *systole.* A normal ECG pattern consists of P wave, QRS complex, and T wave. The QRS complex, in turn, includes three separate waves: Q, R and S. All these are generated when the cardiac impulse goes through the ventricles.

By interpreting the details in the ECG waveform, a wide range of heart conditions can be diagnosed. Therefore, the quality of the signal is extremely important. Signal processing is performed in the vast majority of systems for ECG analysis and interpretation. It is used to extract some characteristic parameters [2], [3]. Now a days, biomedical signal processing has been towards quantitative or the objective analysis of physiological systems and phenomena via signal analysis [4], [5].

Many researchers have worked towards reduction of noise in ECG signal [6], [7]. In recent times, a number of techniques have been developed to detect ECG features such as amplitude and time intervals as well as frequency domain representations [8], [9], [10]. Also, several researchers have developed various methodologies and algorithms for analyzing and classifying ECG signal

These methods include Digital Signal Processing, Knowledge-based System, Rule- based system, Fuzzy Logic System, Artificial Neural Network, and Hybrid System .. Other methods include Genetic Algorithm, Support Vector Machines, Self Organizing Map, Wavelet- Domain Hidden Markov Models, Bayesian and other methods with each method having its own advantages and disadvantages .,

As reported by Upasani and Kharadkar,, Silipo and Marchesi showed that ANN's approach is capable of dealing with the ambiguous nature of the ECG signal when tested and compared with the most traditional ECG analysis on appropriate databases

., .. Castro *et al*, (2000) put forth a novel approach for ECG feature extraction with an algorithm, based on an optimal mother wavelet .. Saxena *et al*. (2002) used a modified combined wavelet transforms technique. It involves Quadratic Spline Wavelet (QSWT) for QRS detection, and the Daubechies Six Coefficient (DU6) wavelet for P and T detection.

Owis *et al*., used blind source separation techniques which are Principal Component Analysis (PCA) and Independent Component Analysis (ICA) for classification of ECG signals. The features were classified by using Minimum Distance classifier, Nearest Neighbor classifier, and Bayes Minimum Error classifier. Highest accuracy of 84.4% was achieved with the nearest neighbor classifier .. Povinelli *et al*., (2002) used phase space based method with ANN to identify life threatening arrhythmias. Average accuracy of 93.75% over all classes capable of detecting and classifying was reported .. Alexakis *et al*., (2003) used time interval and morphological features to classify ECG into normal and arrhythmic.

Zhao and Zhan used wavelet transform and support vector machines with Gaussian kernel for classification of different ECG heart rhythm. The results of computer simulations to determine the performance of the proposed approach reached the overall accuracy of 98% .. Mahmoodabadi *et al* used Daubechies Wavelets Transform for ECG feature extraction. They achieved sensitivity of 99.18% and positive predictivity of 98% .. Tayel and El-Bouridy (2006, 2008) used a technique for ECG intensity image classification by extracting their feature using wavelet transformation and feed forward back propagation neural network. The ANN uses adaptive learning rate with momentum term algorithm as a supervised classifier. Classification accuracy of 92% was achieved for the wavelet decomposition, and 95% for edge detection ., .. Hadhoud *et al*., (2006) used FFT, Autoregressive Modeling (AR) and Principal Component Analysis (PCA) for feature extraction, and Feed Forward Multilayer Neural Network (FFMNN) as classifier. Highest accuracy of 92.7% was achieved with the PCA .. De Chazal and Reilly (2006) used morphology and heart beat interval with Linear Discriminate (LD) as classifier. Average accuracy of 85.9% was achieved ..

Tadejko and Rakowski presented the classification performance of an automatic classifier of ECG for the detection of abnormal beats with feature sets based on ECG morphology and RR-intervals. Configuration adopted a Kohonen self-organizing maps (SOM) for analysis of signal features and clustering. Also, it was used with learning vector quantization (LVQ) algorithms using the data from the records recommended by ANSI/AAMI EC57 standard .. Alan and Nikola (2007) applied Chaos Theory to ECG feature extraction .. Sufi *et al* (2008) formulated a new ECG obfuscation method for feature extraction and corruption detection .. Chouhan and Mehta (2008) used adaptive quantized threshold for detection of QRS complexes. Detection rate of 98% and positive predictivity of 99.18% were achieved .. Jen and Hwang (2008) formulated an approach using Cepstrum Coefficient method for feature extraction from long term ECG signals, and artificial neural network (ANN) for classification. MIT-BIH database was used, and accuracy of diagnosis was 97.5% .. Ubeyli (2009) used Lyapunov exponents and wavelet coefficients with ANN as classifier. Average accuracy of 93.9% was achieved Fatemian and Hatzinakos (2009) used new wavelet based framework for ECG feature extraction. Identification rate of 99.61% was achieved .. Pedro *et al*. (2010) used Wavelet Transform (WT) with state of the art Continuous Density Hidden Markov Models (CDHMMs) for ECG classification. They used MIT-BIH database for experimental results ..

Jadhav *et al.*, (2011) used Modular Neural Network (MNN) model to classify arrhythmia into normal and abnormal classes. They performed experiments on University of California, Irvine (UCI) Arrhythmia data set, and the experimental results presented in their paper showed more than 82.22% classification accuracy .. Kohli *et al*. (2012) used Hilbert Transform based adaptive technique to detect ECG R- peak. The developed R peak detection algorithm provides 100 % efficiency in the absence of noise, and notably high computational speed compared to other contemporary methods .. Das and Ari (2014) presented a system for classification of ECG signals into the five classes of beats recommended by AAMI standard, by using mixture

The aim of this work is to develop a cost-effective computer – aided application to analyze ECG signals with a view to detecting cardiac arrhythmia. In this paper, the specific objective is to develop a model consisting of method of pre- processing and apply analytical methods (DSP with knowledge-based) for feature extraction taking into account QRS estimation, amplitude and time variability of ECG signals; and use back-propagation neural network for classification and diagnosis of cardiac arrhythmia. Back- propagation neural network (BPNN) is a nonlinear multilayer network used for training a set of inputs with their corresponding targets.

MATERIALS AND METHODS

The development of the model for the application can be divided into the following stages: ECG Signal Pre-processing, Feature Detection, Feature Extraction, and Feature Classification using BPNN. For the signal pre-processing and feature detection, we made use of Pan-Tompkins and

CONCLUSION

Electrocardiogram (ECG) is a graphic recording of the electrical activity produced by the heart. The accuracy of any electrocardiogram waveform extraction plays a vital role in helping a better diagnosis of any heart related illnesses. We present a computer-aided application model for detection of cardiac arrhythmia in ECG signal, which consists of signal pre-processing and detection of the ECG signal components adapting Pan-Tompkins and Hamilton-Tompkins algorithms; feature extraction from the detected QRS complexes, and classification of the beats extracted from QRS complexes using Back Propagation Neural Network (BPNN). The application model was developed for ECG signal classification under 'Normal' or 'Abnormal' heartbeats to detect cardiac arrhythmia in the ECG signal.

REFERENCES

[1] Clark J.W. 1998, The Origin of Biopotentials, Medical Instrumentation: Application and Design, 3rd Edition, Edited by J.G. Webster, John Wiley and Sons, Inc., New York, NY Chap. 4, pp. 123-124.

[2] Ince T., Kiranyaz S., and Gabbouj M. 2009, A Generic and Robust System for Automated Patient-Specific Classification of ECG Signals, IEEE Transactions on Biomedical Engineering,

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

Vol. 56, pp. 1415-1426.

[3] Kohler B.U., Henning C., and Orglmeister R. 2002, The Principles of Software QRS Detection, IEEE Engineering in Medicine and Biology Magazine, Vol. 21, Issue 1, pp. 42–57.

[4] Correia S., Miranda J., Silva L. and Barreto A. 2009, LabVIEW and MATLAB for ECG Acquisition, Filtering and Processing, In Proceedings of 3rd International Conference on Integrity, Reliability and Failure (IFR2009), Porto/Portugal, 20-24 July 2009, paper ref: S0228_A0402.,