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Recognition of ecg arrhythmias using back propagation Neural network

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Abstract: In this paper, the back propagation neural network method used for Electrocardiogram (ECG) Arrhythmia recognition. Different types of ECG patterns were chosen from the real database to be recognized, including normal sinus rhythm, premature ventricular contraction, atrial premature beat and left bundle branch block beat. ECG wave and different interval features were performed as the characteristic representation of the original ECG signals to be fed into the neural network models. Back propagation neural networks will be separately trained and tested for ECG Arrhythmias recognition. The objective is to find different arrhythmias of different patients by analyzing the different ECGS with their parameters using back propagation network.[1,2] In this paper we are using MATLAB for implementation of training and testing of neural networks.

Keywords: Neural Networks, BPN, ECG, Recognition

I. INTRODUCTION

ECG is a Tran thoracic interpretation of the electrical activity of the heart over time captured and externally recorded by skin electrodes. It is a noninvasive recording produced by an electrocardiography device. The etymology of the word is derived from the Greek electro, because it is related to electrical activity, cardio, Greek for heart, and graph, a Greek root meaning "to write". The ECG works mostly by detecting and amplifying the tiny electrical changes on the skin that are caused when the heart muscle "depolarizes" during each heart beat.

At rest, each heart muscle cell has a charge across its outer wall, or cell membrane. Reducing this charge towards zero is called de-polarization, which activates the mechanisms in the cell that cause it to contract. During each heartbeat a healthy heart will have an orderly progression of a wave of depolarization that is triggered by the cells in the senatorial node, spreads out through the atrium, passes through "intrinsic conduction pathways" and then spreads all over the ventricles. This is detected as tiny rises and falls in the voltage between two electrodes placed either side of the heart which is displayed as a wavy line either on a screen or on paper.

This display indicates the overall rhythm of the heart and weaknesses in different parts of the heart muscle. Usually more than 2 electrodes are used and they can be combined into a number of pairs. The output from each pair is known as a lead. Each lead is said to look at the heart from a different angle. Different types of ECGs can be referred to by the number of leads that are recorded, for example 3-lead, 5-lead or 12-lead ECGs

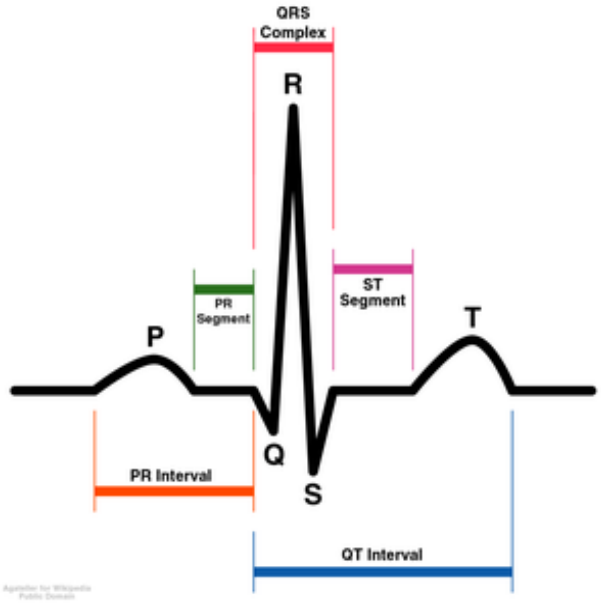

Figure. 1. A typical ECG Waveform

A 12-lead ECG is one in which 12 different electrical signals are recorded at approximately the same time and will often be used as a one-off recording of an ECG, typically printed out as a paper copy. 3- and 5-lead ECGs tend to be monitored continuously and viewed only on the screen of an appropriate monitoring device.

II. BACK PROPAGATION NEURAL NETWORKS

An Artificial Neural Network (ANN) is used to handle changing network conditions. It is used to update the network parameters with time. An Artificial Neural Network

(ANN) is an information processing paradigm that is inspired from the biological nervous systems, such as the brain, pass information. The main element of this paradigm is the structure of the information processing system. It is composed of a large number of highly interconnected processing neurons working in union to solve exact problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems contains adjustments to the synaptic connections between the neurons.

III. BACK-PROPAGATION ALGORITHM

To train a neural network to perform some task, we must adjust the weights of each unit in such a way that the error between the desired output and the actual output is condensed. This process requires that the neural network compute the error derivative of the weights [5], [8]. It must calculate how the error changes when each weight is increased or decreased slightly. The back propagation algorithm is the most generally used method for determining the Error.

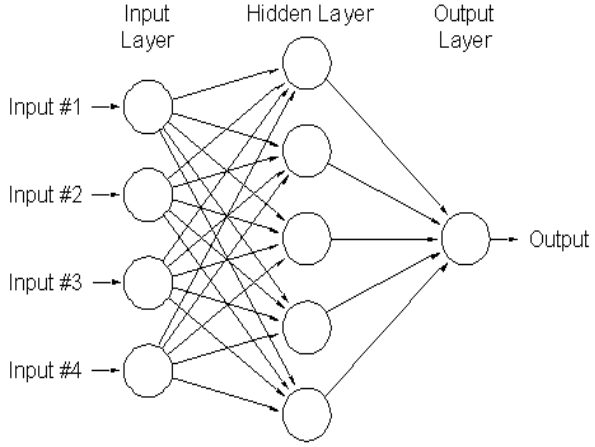

Figure 2. Back Proportion Neural Networks

A. Training Algorithm

Initialize the weights in the network (often randomly)
Do
For each example e in the training set
O = neural-net-output (network, e); forward pass
T = teacher output for e
Calculate error (T - O) at the output units
Compute delta_wh for all weights from hidden layer to output layer ; backward pass Compute delta_wi for all weights from input layer to hidden layer ; backward pass continued Update the weights in the network Until all examples classified correctly or stopping criterion satisfied
Return the network.

IV. PARAMETER RECOGNITION

A. R Waves

It is measured by the interval between the first two R waves, and then each successive RR Interval is noted. Any variation in the rhythm – more than 0.12 seconds denotes the rhythm is irregular.

B. Heart Rate

a. For Irregular Rhythms**:** It is calculated by the counting the number of QRS complexes on a 6-second strip and then multiplied by 10

b. For Regular Rhythms**:** It is calculated by the counting the number of small squares between two consecutive R waves and then divide 1500 by that number

C. P Waves

P waves are upright, rounded, and regular .P waves should be the same. Inverted P waves indicate an impulse generated in the AV node. Waves of different shapes in a rhythm strip indicate arrhythmias.

D. PR Interval

It is measured by the gap between the beginning of the P wave and the first deflection of the QRS complex. The interval should be between 0.12 and 0.20 seconds. A PRI longer than 0.20 seconds indicates arrhythmias.

E. QRS Complex

It is measured by the interval between the first deflection of the QRS complex and the Return to the isoelectric line. . The duration should be less than 0.12 seconds. A QRS duration of longer than 0.12 seconds indicates abnormality.

V. METHODOLOGY

A. Data Collection

It contains real data of different patients. That is used for the reorganization of arrhythmias.

B. Parameter Extraction

Arrhythmias can be studied with the help of different parameters so from the different data reports parameters were selected to recognize arrhythmia.

C. Training Back Propagation Neural Network

After parameter extraction network is trained as for input to recognize arrhythmias with the help of MATLAB.

VI. CONCLUSION

In this work, we focused on patterns of ECG signals. Our aim is to design a method using artificial neural network to help the physicians in the recognition of ECG patterns. ECG wave and different interval features were performed as the characteristic representation of the original ECG signals to be fed into the neural network models. Back propagation neural networks will be separately trained and tested for ECG Arrhythmias recognition.[10],[15] It is observed the ECG parameter recognition is easy and fast to be extracted by mature ECG analysis technology. Different arrhythmias are detected with this method. For this process training and testing of back propagation neural network have been done. This proposed experiment used MATLAB for implementation.

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