6.1 Matlab Implementation of ECG Signal Processing

Created by The MathWorks and short for Matrix Laboratory, MATLAB provides a high level numerical computation environment and programming language. A powerful and also popular tool in both the industry and academia, it allows for easy toolbox extension using its native M-code programming language. It is intended to “perform computationally intensive tasks faster than with traditional programming languages such as C, C++, and Fortran.” MATLAB also provides support for a Java Virtual Machine (JVM) so it is possible to use the Java interpreter via MATLAB commands. This study develops a real-time personal computer-based (PC-based) ECG signal measurement and monitoring system to allow PC users to monitor their health status at any time. Electrocardiogram (ECG) represents electrical activity of human heart. ECG is composite from five waves: P, Q, R, S and T. This signal could be measured by electrodes from human body in typical engagement. Heart rate frequency is very important health status information. The frequency measurement is used in many medical applications like stress tests or life treating situation prediction. One of possible ways how to get heart rate frequency is compute it from the ECG signal which have been designed. Software can be developed in MATLAB to process each acquired ECG signal as given in Figure 6.1.0. This processing consists of verifying the heart beat as illustrate Figure 6.1.1, Frequency analysis through Fourier series as illustrated in Figure 6.1.2, R-wave, S-wave, Q-wave Amplitudes as illustrated in Figure 6.1.3. The software can also calculate the RR, P-R, QRS and S-T, time intervals as illustrated in Figure 6.1.4. The normal value of heart beat lies in the range of 60 to 100 beats/minute. A slower rate than this is called bradycardia (Slow heart) and a higher rate is called tachycardia (Fast heart). If the cycles are not evenly spaced, an arrhythmia may be indicated. If the P-R interval is greater than 0.2 seconds, may be suggested blockage of the AV node.

- Heart rate is calculated as=1/RR interval in sec=60 sec.
- Rate=60/ RR interval beats for minutes
Figure 6.1.0 Normal PQRST waveform

Figure 6.1.1 Heart Beat For the Given ECG signal
Figure 6.1.2 Frequency analysis for given ECG Signal
Figure 6.1.3 R-wave, S-wave, Q-wave Amplitudes
6.2 Using Artificial Neural Network Training for the classification of ECG Signals

Multilayer Perceptron (MLP) feedforward neural network model as shown in Figure 6.2.0 is used to classify arrhythmia cases. A neural network is trained using command nntool. Time intervals of P-wave, QRS-wave, ST-wave, T-wave as shown in Figure 6.2.1. Once trained, the network is tested on nine more datasets which have gone through the same procedure as by the training dataset.

Figure 6.2.0 A Trainable Neural Network for ECG Beat classification
Figure 6.2.1 A Trainable Neural Network data manager.

Especially, in a multilayered neural network, the zero (lower), input layer consists of input neurons while the last (upper), output layer is composed of output neurons. The remaining, hidden (intermediate) layers contain hidden neurons. The layers are counted starting from zero that corresponds to the input layer, which is then not included in the number of network layers (e.g. a two-layered neural network consists of input, four hidden, and output layer). In the topology of a multilayered network, 4 layers and 16 neurons create a network as shown in Figure 6.2.2.
Figure 6.2.2 Block diagram of create network and Network properties

Training of the units is accomplished by adjusting the weight and threshold to achieve a classification. The adjustment is handled with a training rule (a learning rule), from which a training algorithm for a specific task can be derived as shown in Figure 6.2.3. Epoch are nine iterations time taken 2 sec And performance is show in Figure 6.2.4. After training neural network weight to input layer as shown in Figure 6.2.5.
Figure 6.2.3 Block diagram of Neural Network Training

Figure 6.2.4 Block Diagram of Neural Network and Its Weight Factor
The study goal was to investigate autonomic activity with heart rate, heart rate variability, weight factor, analysis during different weight factors form neural network stages in males and females as shown in Figure 6.2.6.

Figure 6.2.6 shows as report weight factor and related ECG signal, heart rate and heart rate variability
Identification of the normal p-wave, QRS wave ST wave time intervals. The normal duration of the QRS is 0.08-0.09 s, the P-wave duration of 0.1 s, as shown in Figure 6.2.7 neural network weight and its time intervals.

![Neural networks weight](image)

Figure 6.2.7 neural weight and P wave, QRS wave, ST wave time intervals

### 6.3 Diagnosis And Medical Prescription of Heart Disease Implementation in Fuzzy Logic and PHP

The use of computer technology in the fields of medicine area diagnosis, treatment of illnesses and patient pursuit has highly increased. Despite the fact that these fields, in which the computers are used, have very high complexity and uncertainty and the use of intelligent systems such as Fuzzy logic, algorithms have been developed as shown in Figure 6.3.0 and Figure 6.3.1. In the domain fields of Heart Disease Risk, Neural Weight Factor, Age, Sex, Smoking, Overweight, Hereditary, Bad Cholesterol Level, Blood Sugar Level, P-Wave Related Factor, PR-Wave Related Factor, T-Wave Related Factor, Alchol Intake, High Salt Diet, Blood Pressure, Sedantary Lifestyle Inactivity, Exercise Habit, Heart Rate, High Saturated Fat Diet, Stree, QRS-wave Related factor, RR-wave related factor are main risk factors that affect heart disease risk. Detecting the diseases at early stage can enable a patient to have early treatment which can lead to effective control. Identifying
the treatment accurately depends on the method that is used in diagnosing the diseases. Click with predication with fuzzy logic button it will display the risk level may be normal or high. Click on fast Fourier series button it will detect frequency and heart rate of given ECG signal.

![ECG AND HEART ATTACK PREDICTION USING NEURAL NETWORKS](image)

**Figure: 6.3.0** Based On Fuzzy Logic For Diagnosis Of Normal Human Body
Figure: 6.3.1  Pulse-Based Fuzzy logic Diagnosis setup

6.4 ECG signal prediction Report by using neural networks

ECG signal prediction report by using neural networks as shown in Figure 6.4.1 enter patient name, patient id click report button displays the a summary of the patient's treatment history, like the Related ECG pulse, Risk Level, Precautions. And p-wave time interval, QRS-time-interval, PRI-time interval, ECG related wave form. Click SMS button message will display patient mobile phone. Click print button it will print patient report.
6.5 Preparing Data Form PHP Underlying Artificial Neural Network

The data is collected from daily Report while doctor examining the patients. The symptoms and information about patients details like Previous History(p1), Present History(p2), Personnel History(p3), Physical Examination(p4), Neural weight, name, age, sex, smoking, weight, hereditary, cholesterol, sugar, alcohol, salt, bp, lifestyle, exercise, heart, fat, stress, P-Wave, Q-Wave, R-Wave, S-Wave, T-Wave, RR-Wave. The main point is ECG from which the patient can easily diagnose whether the patient is having heart problem or not. All 300 patients’ data collected stored in database i.e. MySQL regarding heart disease as shown figure 6.5.1.
Figure 6.5.1 Preparing Data form PHP various parameters of ECG Signal and its symptoms