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Electrocardiogram (ECG) Signal Analysis and Feature Extraction: A Survey

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***Abstract*—** ECG Signal plays an important role in the primary diagnosis, prognosis and survival analysis of heart diseases. ECG feature extraction plays an important role in the cardiac diseases. One cardiac cycle in an ECG signal consist of the P-QRS-T waves. It has amplitude and interval value which determines the functioning of heart of every human. ECG measures the rate and regularity of heartbeat. It displays the electrical activity of the heart in form of wave line on the paper. The ECG Signal is conducted with the data compression and reconstruction. Today so many research and techniques have been developed for analyzing the ECG signal. The information will then analyzed and classified on basis of compression method, fuzzy logic, etc.

***Keywords*—**Electrocardiogram; DWT; WT; Fuzzy Logic Method

INTRODUCTION

The health problem is major issues in today's lifestyle. Mostly health problems lead to heart attack and others serious condition. Wearable ECG device (Electrocardiogram) is very thin in size uses three lead systems more flexible by Comparing with other. ECG is a noninvasive and it is the record of variation of the biopotential signal of patients. Noninvasive means that signal measured without entering the human body [10]. The ECG signal detects the information signal of heart as well as used for diagnosing many cardiac diseases. This is realistic record of the direction and magnitude of the electrical commotion which is created by depolarization and repolarization of atria and ventricles [11]. Clinical importance in cardiology is well developed [7].

In recent year numbers of techniques have been developed for analyzing and classifying the ECG signal.ECG signal is conducted by data compression and reconstruction. This includes Fuzzy Logic method, Self-Organizing Map method, ammeter Direct Compression method, Parameter Extraction method, and Transform method [9].After compression of signal it can be reconstructed by DFT, FFT, DCT and DWT.We can handle both digital ECG recordings as well as scanned paper ECGs Using novel image processing techniques. ECG sample signal format is shown in figure.

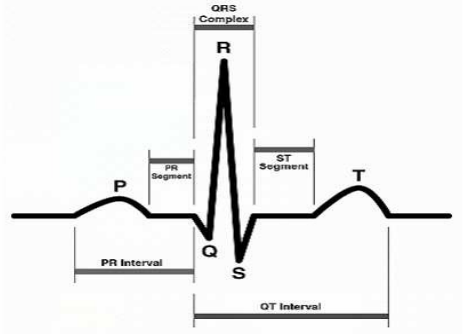

Figure 1: ECG Signal.

A normal ECG waveform has a characteristic shape shown in figure. Normally frequency range of an ECG signal is of 0.05 to 100 HZ. It has five peak named as P, Q, R, S, T. and consists of P wave, QRS complex and T wave. The P wave is the electrical signature of the current due to repolarization of atria. T wave shows the repolarization of the ventricles. QRS wave causes contraction of the left and right ventricles [6]. The width of a wave on the horizontal axis represents a measure of time and height and depth of a wave presents measure of voltage [8]. The performance of ECG signal analyzing is depends on how accurate detects the QRS complex and T wave. In normal condition of heart the P-R interval is of 0.12 to 0.2 seconds. The QRS interval is in the range of 0.04 to 0.12 seconds. And Q-T interval is less than 0.42 seconds. We know that normal rate of heart beat is in range of 60 to 100 beats per minute. QRS detection algorithm has many steps like Filtering, Transformation and peak detection are categorized in three steps as follows are

1) Preprocessing: The first step of signal preprocessing is filtering the ECG signal in that Band Pass filter used because as any other unwanted signals, high frequency signal along with ECG signal. Important thing is that to separate R peak to other artifacts. This Band Pass filter used between 0.05HZ to 100HZ range. ECG mages, scanned at 600 dpi, the waveform trace at a good thickness, usually about 4 pixels. Also noise is suppressed by LMS and RLS algorithms [10].
2) Transformation: QRS complex characteristics emphasis from the ECG signal for that transformation required wavelet, squaring and averaging is used.
3) Peak detection: For Peak detection different types of methods are used. Transformed signal used as input for different signal processing tool[12].

The next section of paper describes different address in detail. In Section II, we discuss related work in ECG analysis and extraction of ECG waveforms. In section III we conclude our paper.

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.ECG SIGNA ANALYSIS AND EXTRACTION

A. *ECG signal Analysis*

The wavelet analysis of ECG signal is performed by using MATLAB simulator software. MATLAB is provided with wavelet tool box. These tools are used for analysis and synthesis of signal and images. The results are in [1]. The signal is processed by wavelet up to 3 levels in that 2 levels are important others are deleted for detection of QRS complex.

Data Compression Technique can be used for ECG signal analysis are follows

1) Direct Data Compression Method
2) Transform Method
3) Parameter Extraction compression Method

For direct analyzes we can use direct data compression method depends on prediction or may be on interpolation algorithm. Transform method converts the time domain signal to frequency domain. It has processing of the input signal and encoding of the output signal. Parameter extraction method extracts the parameter of an ECG signal. This method is irreversible. Neuro Fuzzy logic in [11].We can use various transformation eg.DFT, FFT, DCT and DWT for signal compression and reconstruction techniques [9]. Also new compression technique is analysis by synthesis ECG Compressor [5].

B. *ECG Signal Extraction*

ECG signal extraction is studied by lots of advanced techniques (Wavelet transform, ECG Obfuscation method, Discrete Wavelet Transform etc) feature extraction method by using wavelet transform along with support vector machines. Wavelet transform is used for extract the coefficients of the transform as feature of each ECG signal. Another new concept of feature extraction is based on ECG morphology and R-R interval. A well known Kohonen self – Organizing and learning vector quantization is used. Slop vector waveform algorithm can be used for feature extraction of ECG signal many different techniques are used [2].
Feature extraction of ECG signal in paper [3] proposed the techniques along with the state of the art of Linear Discriminate analysis and Cross Correlation process. Cross Correlation is similar to Convolution determines specific class value. Cross Correlating of ECG signal completed unknown input ECG signal and Coefficients are generated all these signals normalized between range 0 to 1. Finally find the unknown ECG signal.

Linear Discriminate Analysis used as feature extraction technique is classify objects into groups and mathematical Derivation of LDA in [3].The extraction of scanned ECG is done in [4]. Discrete wavelet transform is used to address the problem of non-stationary ECG signal is decomposed into time –frequency domain using discrete wavelet transform advantage is that provides good time resolution. DWT uses two filter named as Low pass filter and High pass filter so referred as decomposition using algorithm [11].

CONCLUSION

This paper provides an overview of various ECG Signal Analysis and feature Extraction techniques. Key idea that gives the disease labels has similarities in their ECGs. Noise removing techniques are present. We can easily measure the ECG signal by using different tool

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