A Study on: ECG Feature Extraction Technique

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Abstract— The cardiogram is nothing however the recording of the heart's electrical activity. ECG Feature Extraction plays a significant role in diagnosis most of the internal organ diseases. One cycle in associate cardiogram signal consists of the P-QRS-T waves. This feature extraction theme determines the amplitudes and intervals within the cardiogram signal for future analysis. The amplitudes and intervals price of P-QRS-T segment determines the functioning of heart of each human. Recently, various analysis and techniques are developed for analyzing the cardiogram signal. The planned schemes were largely supported symbolic logic Methods, Artificial Neural Networks (ANN), Genetic formula (GA), Support Vector Machines (SVM), and alternative Signal Analysis techniques. Of these techniques and algorithms have their blessings and limitations. This paper discusses various techniques and transformations planned earlier in literature for extracting feature from associate cardiogram signal. Additionally this paper conjointly provides a comparative study of varied ways proposed by researchers in extracting the feature from cardiogram signal.

Key words: ECG, ANN, Support Vector Machine (SVM), Venticular Fibrillation (VF)

I. INTRODUCTION

In the past decade, the electrocardiogram (ECG) biometric has established itself as a substantial body of knowledge which primarily focuses on improving the recognition performance. Adhering to the concept of pattern recognition, improvising and enhancing previous and existing methods have solved ambiguities in the process of subject recognition. Electrocardiogram (ECG) is the measure of electrical activity of heart which shows the series of waves and deflections. They are quasi periodic signals; finite periodicity and non-stationary. It is difficult the physician to visually analyze an ECG signal and arrive at conclusions. This calls for automation in the analysis of ECG signals, automated methods for feature extraction and automated methods for classification.

Electrocardiogram is one of the necessary tools used by the cardiologists to analyze the graphical record wave forms in diagnosing of varied diseases and monitoring the conditions related to the center. It's obtained by inserting electrodes on the skin of the patient. It provides info of an individual's heart like disturbances in cardiac rhythm, abnormalities within the electrical impulses etc. Signal corruption takes place as a result of noise and artifacts throughout the transmission of graphical record. The characteristics of graphical record signal vary as a result of differing kinds of noises like cable Interference, baseline drifts, motion Artifacts and instrumentation noise etc. Such a loud signal analysis bound to offer incorrect results. So it's necessary to enhance the graphical record signal. Variety of ways are enforced for the sweetening of graphical record signal.

Cardiac Arrhythmia is any of a bunch of conditions within which the electrical activity of the guts is irregular or is quicker or slower than traditional [1]. They cause the guts to pump blood less effectively. Throughout an arrhythmia, the heart might not be ready to pump enough blood to the body. Lack of blood flow can injury the brain, heart, and alternative organs. Though several arrhythmias are not grievous, bodily cavity arrhythmias will cause asystole. Arrhythmias will occur within the higher chambers of the guts (atria), or in the lower chambers of the guts (ventricles). Arrhythmias might occur at any age. Some area unit temporary and benign, whereas others may be additional dramatic and can even result in abrupt cardiac death.

Ventricular cardiac arrhythmia could be a in no time rhythm that begins within the ventricles. The ventricles square measure the 2 lower chambers of the guts. They fill with blood from the atria, or prime chambers of the guts, and send it to the rest of the body. Chamber cardiac arrhythmia could be a pulse of quite a hundred beats per minute with a minimum of 3 irregular heartbeats during a row. It's caused by a malfunction within the hearts electrical system. Your pulse is controlled by electrical impulses that trigger every contraction and confirm the rhythm of the heart. Once this method is discontinuous and therefore the electrical signals square measure sent too quickly, chamber cardiac arrhythmia will occur. The speedy heartbeat does not give the ventricles enough to time to fill with blood before the guts contracts. As a result, the guts might not be ready to pump enough blood to the remainder of the body.

Ventricular arrhythmia could solely last for some seconds or for abundant longer. It does not continuously cause symptoms, however once symptoms do occur, they may embrace lightsomeness, dizziness, and fainting. The condition most commonly affects folks that have heart disorders, like arteria disease and heart condition. Ventricular arrhythmia could eventually result in ventricular fibrillation, that is characterised by a speedy, inadequate heart rhythm. During this condition, the heartbeat is thus quick and irregular that it causes the heart to prevent operating. To forestall this complication from occurring, its important to urge immediate treatment for cavity arrhythmia.

A normal ECG is illustrated in fig.1.a. Note that the guts is thrashing in a regular sinus rhythm between 60-100 beats per minute (specifically 82 bpm).In ventricular arrhythmias ventricular activation doesn't originate from the AV node and/or doesn't proceed within the ventricles in an exceedingly traditional means. If the activation takings to the ventricles on the conductivity system, the inner walls of the ventricles are activated virtually at the same time and also the activation front takings primarily radially toward the outer walls. As a result, the QRS-complex is of

comparatively short period. If the ventricular conduction system is broken or the ventricular activation starts off from the AV node, it takes a longer time for the activation front to proceed throughout the ventricular mass. The criterion for normal ventricular activation could be a QRS- interval shorter than 0.1 s. Ventricular arrhythmias are presented in Figure 1.b.

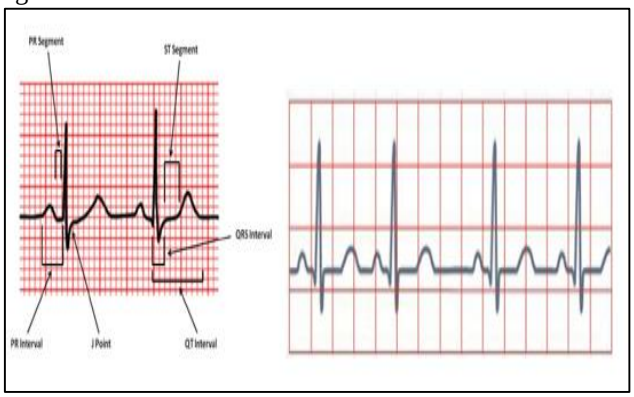

Fig. 1: a) ECG waveform b) Ventricular Arrhythmia

The implantable cardioverter debrillator has been thought-about because the best protection against sudden death from ventricular arrhythmias in high risk individuals. However, most sudden deaths occur in individuals who do not have high-risk profiles. Long term cardiogram observation is that the criterion customary for the diagnosing of ventricular arrhythmia. The 12-lead ECGs are obtained and analyzed to observe any changes within the characteristics of the cardiogram signal. By extracting data concerning intervals, amplitudes, and waveforms morphologies of the different P-QRS-T waves, the onset of the ventricular arrhythmia may be detected. Different methodes were developed to detect ventricular arrhythmia based on morphological [4], [5], spectral [6], or mathematical [7] features extracted from the cardiogram signal. Machine learning techniques, like neural networks [8] and support vector machine (SVM) [9] also suggested as a great tool to enhance the detection efficiency. Though these ways have exhibited benefits within the detection of ventricular arrhythmia, they have some shortcomings, such as, some are difficult to implement or compute, some have low specificity in discriminating between normal and abnormal conditions, and every one maintain late detection interval, that is sometimes not enough to require associate degree action.

II. LITERATURE SURVEY

ECG feature extraction has been studied from early time and plenty of advanced techniques yet as transformations are planned for correct and quick cardiogram feature extraction. This section of the paper discusses varied techniques and transformations planned earlier in literature for extracting feature from cardiogram.

Zhao et al. [6] planned a feature extraction methodology using wavelet transform and support vector machines. The paper given a brand new approach to the feature extraction for reliable regular recurrence recognition. The ripple transform is employed to extract the coefficients of the remodel because the options of each graph phase. At the same time, autoregressive modeling (AR) is additionally applied to urge hold of the temporal structures of graph waveforms. Then at last the support vector machine (SVM) with Gaussian kernel is employed to classify different graph regular recurrence. The results of pc simulations provided to work out the performance of the planned approach reached the overall accuracy of 99.68%. Their planned paper gift associate rule, based on the ripple remodel, for feature extraction from associate cardiograph (ECG) signal and recognition of abnormal heartbeats. Since ripple transforms are often localized each within the frequency and time domains. They developed a way for selecting associate best mother ripple from a collection of orthogonal and bi-orthogonal ripple filter bank by means that of the most effective correlation with the graph signal. The foremost step of their approach is to denoise (remove noise) the ECG signal by a soft or onerous threshold with limitation of 99.99% reconstructs ability so every PQRST cycle is rotten into a coefficients vector by the optimum moving ridge operate. The coefficients, approximations of the last scale level and also the details of the all levels, are used for the ECG analyzed. They divided the coefficients of every cycle into 3 segments that are associated with P-wave, QRS complicated, and T-wave. The summation of the values from these segments provided the feature vectors of single cycles.

Mahmoodabadi et al. in [1] represented associate approach for electrocardiogram feature extraction that utilizes Daubechies Wavelets remodel. That they had developed and evaluated associate cardiogram (ECG) feature extraction system based mostly on the multi-resolution riffle remodel. The electrocardiogram signals from Modified Lead II (MLII) were chosen for process. Work is to guage the classification performance of associate automatic classier of the cardiogram (ECG) for the detection abnormal beats with new idea of feature extraction stage. A classier was developed with Kyrgyzstani monetary unit and learning vector quantization (LVQ) algorithms victimization the information from the records suggested by ANSI/AAMI EC57 customary. Additionally their work compares 2 methods for classification of annotated QRS complexes: supported original electrocardiogram morphology options and planned new approach - supported preprocessed electrocardiogram morphology options. The mathematical morphology filtering is employed for the preprocessing of electrocardiogram signal.

Su et al. in [5] developed a replacement ECG obfuscation methodology for feature extraction and corruption detection. They gift a replacement ECG obfuscation method, that uses cross correlation based mostly templet matching approach to distinguish all ECG options followed by corruption of these options with added noises. It's extraordinarily difficult to reconstruct the obfuscated options without the information of the templates used for feature matching and therefore the noise. Therefore, they thought of 3 templates and 3 noises for P wave, QRS advanced and T wave comprise the key, that is barely zero.4%-0.9% of the initial ECG file size. The key distribution among the licensed doctors is efficient and quick due to its little size. however it suffer from high noise effects.

Xu et al. in [8] delineated an algorithmic rule victimization Slope Vector undulation (SVW) for electrocardiogram QRS complicated detection and RR interval analysis. In their planned technique variable stage

differentiation is employed to attain the desired slope vectors for feature extraction, and therefore the non-linear amplification is used to urge higher of the signal-to-noise. the tactic permits for a quick and correct search of the R location, QRS complicated period, and RR interval and yields glorious electrocardiogram feature extraction results. so as to urge QRS durations, the feature extraction rules area unit required.

A method for automatic extraction of each measure and morphological features, from the graph (ECG) to classify ECGs into traditional and arrhythmic was delineated by Alexakis et al. in [4]. the tactic utilized the combination of articial neural networks (ANN) and Linear Discriminant Analysis (LDA) techniques for feature extraction. 5 EKG options specifically RR, RTc, T wave amplitude, T wave skew land, and T wave kurtosis were used in their technique. These options area unit obtained with the help of automatic algorithms. The onset and finish of the T wave were detected victimization the tangent technique. The 3 feature mixtures used had terribly analogous performance once considering the typical performance metrics.

A Mathematical morphology for electrocardiogram feature extraction was projected by Tadejko and Rakowski in [10]. The first focus of their work is to evaluate the classification performance of AN automatic classifier of the electrocardiogram (ECG) for the detection abnormal beats with new conception of feature extraction stage. The obtained feature sets were supported electrocardiogram morphology and RR-intervals. Configuration adopted a standard Kohonen self-organizing maps (SOM) for examination of signal options and clustering. A classifier was developed with Kyrgyzstani monetary unit and learning vector quantisation (LVQ) algorithms exploitation the information from the records. Additionally their work compares 2 methods for classification of annotated QRS complexes: based mostly on original electrocardiogram morphology options and projected new approach - based mostly on preprocessed electrocardiogram morphology options. The mathematical morphology filtering is employed for the preprocessing of electrocardiogram signal.

III. Conclusion

The examination of the cardiogram has been comprehensively used for diagnosis several heart diseases. Various techniques and transformations are projected earlier in literature for extracting feature from cardiogram. This paper provides an over view of varied cardiogram feature extraction techniques and algorithms. The feature extraction technique or algorithms developed for cardiogram should be extremely correct and may guarantee quick extraction of features from the cardiogram signal. The future work concentrates on developing a more efficient algorithm for correct and quick feature extraction. Improving the accuracy of diagnosing the cardiac disease at the earliest is necessary in the case of patient monitoring system.so our future work aims on improvement in diagnosis the cardiac diseases. However, the wavelet approach is additional convenient than the traditional filtering techniques, that highlights the main points of the cardiogram signal with optimum time-frequency resolution.

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