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REVIEW OF ANALYSIS OF ECG IMAGE

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***Abstract*— The present paper mainly shows the review literature of ECG image analysis. Electrocardiograph (ECG) waveform is used for detecting abnormality present with the reference of P, Q, R and S peaks. The normal and abnormal ECG signals are based on the features extracted. The software uses algorithms and techniques for detection of abnormalities present in the ECG signal. Proper utilization of MATLlab functions (both built-in and uses defined) may lead us to work with ECG signals for processing and analysis in real applications. The simulation can help in improving accuracy and hardware can be built conveniently. The paper aims at extensive experimental study of implementation of various techniques.**

Keywords— **ECG signal analysis, MATLAB, ECG signals processing, heart disorders.**

I. INTRODUCTION

Medical imaging began with radiography after the discovery of x- ray in 1895. Radiography method is the technique and method of creating visual demonstration of the interior of a body of scientific analysis and medical intervention, as well as visual representation of the function of some organs or tissues. ELECTROCARDIOGRAM (ECG or EKG) is a diagnostic tool that calculates and records the electrical activity of the heart in delicate detail. Explanation of these details allows finding of wide range of life aggressive heart conditions. An electrocardiogram (ECG) is a bioelectrical signal which records the heart's electrical activity versus time. The early detection of arrhythmia is very important for the cardiac patients. ECG is a test that measures the electrical activity of the heart. The signals that make the heart's muscle fibers contract come from the senatorial node, which is the natural pacemaker of the heart. The work is implemented in the most familiar multi-use tool, MATLAB. The present scenario is to study and analyze electrocardiograph (ECG) waveform to identify abnormalities present with reference to P, Q, R and S peaks. The first phase includes the getting hold of real time ECG data. In the next phase, generation of signals followed by pre-processing. Thirdly, the procured ECG signal is subjected to feature extraction. The extracted features detect abnormal peaks present in the waveform Thus the normal and abnormal ECG signal could be differentiated based on the features extracted.

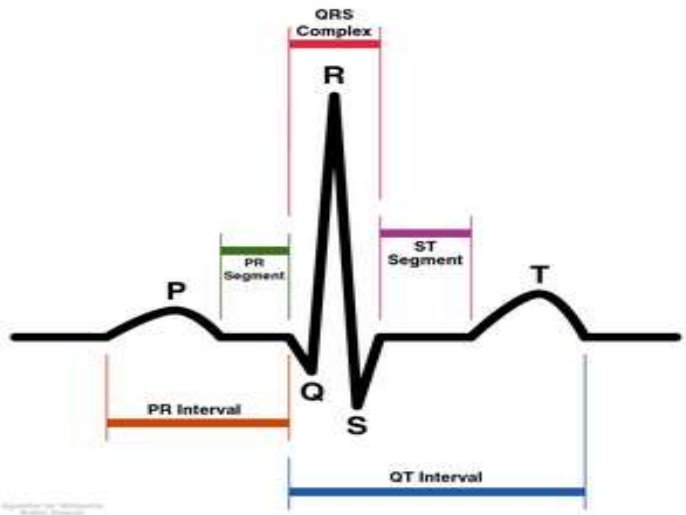

Fig 1: Schematic representation of normal ECG

The detection requires denoising techniques, to be efficient and to elaborate good arrhythmias classification systems . The Fig 1 representation of normal ECG All the methods used were applied on ECG signal. The study of temporal signals is long and sometimes the interpretation of the signals is difficult and requires a deep knowledge, especially in disease case. Here, authors have propose a new ECG image representation based on synchronous R_R intervals of the complex QRS. This well illustrates the ECG waves grouped within a particular colored image. Two electrical circuits were studied in the present work, using common electronic parts and application specific parts. Signals were acquired using a USB acquisition platform. LABVIEW is a software application from National Instruments that is specially designed for easy and powerful data acquisition purpose. Thus, LABVIEW software was used for data copy and image, due to its known capabilities. Since ECG signals are very noisy, usually 50Hz noise, MATLAB is used to test and adjust a digital filter , in order to obtain a good QRS complex, which represents the ventricular depolarization in the ECG, i.e., it shows the electrical impulse of heart as it passes through the ventricles. Finally, LABVIEW were used again to apply real time

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filtering of the signal, with the MATLAB filter studied in the initial step, and it is implemented a small application for real-time visualization of an ECG. In view of characteristics of the ECG signal is very weak and strong background noise, and treated with hardware before enter the extension step to avoid noise signal amplification with the useful signal at the same time ECG is complex form of 5 waves - P, Q, R, S and T.
The paper contains four sections. 1st section gives introduction the topic whereas 2nd section gives review of literature, section 3 presents conclusion and last section lists the references.

II. REVIEW OF LITERATURE SURVEY

To study and analyze more about the ECG techniques, the following literature survey has been done. In this review paper some of the important algorithm of ECG feature extraction presented in the past has been discussed. In [1], authors have worked on acquisition, filtering and analysis of ecg using matlab This method deals with the study and analysis of ECG signal by using MATLAB. Study of ECG signal includes acquisition of real time ECG signal, filtering and processing of ECG signal, feature extraction and analysis of ECG signal. The acquisition of ECG signal is done by the 8-channel system hardware. It is digitized using ADC MAX1112. The aim of this project is to design an ECG system which could help the doctors to perform diagnosis and analysis of the heart. The system presented here is a combination of hardware and software. Hardware is used for the data acquisition and signal conditioning. Software is used for further processing of the signals. Since ECG signals are very noisy, usually 50Hz noise, MATLAB is used to test and adjust a digital filter, in order to obtain a good QRS complex. The ECG data is process analyzed by multipurpose software MATLAB. Both hardware and software have effect on signal processing. Real time ECG data is acquired and a clean ECG waveform is obtained for analysis. MATLAB is a very effective tool for ECG data analysis and abnormality detection. The whole system is very useful for monitoring the ECG signal and self finding of the heart. This system is cost efficient along with the advantages of digital system.
In [2], authors have worked on ECG feature extraction analysis system for arrythmia detection-a review of electrocardiogram is an important tool in diagnosing the condition of the heart. Extracting the information from the electrocardiograph is an important task in determining the variations of the electrical activity of the heart. ECG feature extraction plays a major significant role in diagnosing the most of the cardiac diseases. One among the major cardiac diseases is arrhythmia which is abrupt and abnormal heart beat. In case of arrhythmia heart doesn't pump sufficient blood required for the human body and sudden cardiac death may happen and this can even damage vital organs such as brain, heart, etc. of the body positions. So it is very much needed to determine conditions of arrhythmia and should take necessary measure before the patient reaches some serious condition. Hence in order to find out arrhythmia ECG signal should be analyzed. The database contains 48 records, each containing two-channel ECG signals for 30 min duration selected from 24-hr recordings of 47 different individuals. In binary data signal file, the signal is stored in 212 format which means each sample requires number of leads times 12 bits to be stored and the binary annotation file consists of beat annotations. It is very much needed to determine conditions of arrhythmia and should take necessary measure before the patient reaches some serious condition.
In [3], authors have presented MATLAB based GUI for arrhythmia detection using wavelet transform Cardiac arrhythmia indicates abnormal electrical activity of heart can be threat to human, so it has to be automatically identified for clinical diagnosis and treatment. This method presents efficient and flexible software tool based on Matlab GUI to analyze ECG, extract features using discrete wavelet transform and by comparing them with normal ECG classify arrhythmia type. Proposed software tool is tested for multiple databases like MIT-BIH and Creighton University arrhythmia databases. Performance of software is tested and also the software tool along with detecting arrhythmia, helps in analyzing ECG by provides different parameters. Matlab-based GUI-driven tool is developed for effective detection and classification of arrhythmia using ECG signals. GUI for this software is divided into number of subgroups according to their functionality. Our software module not only detects arrhythmia but also helpful in analysing ECG signal. implemented traditional approach for extracting QRS complex in ECG which has differential filter followed by squaring filter. The proposed algorithm achieved sensitivity of 94.12%, positive predictively of 88.9% and disease detection accuracy of 86.1% but accuracy dropped to 77.3% for highly muscle artifact signals.
In [4] , authors presented analysis of digitization of ECG paper records using MATLAB. It is the most important and widely used method to study the heart related diseases. The detailed study of ECG graph by the medical practitioner helps him to understand and identify the condition of the heart. Based on the information retrieved from the ECG graph, the patient can be given proper treatment. This process requires large storage space and extensive manual effort. Therefore, an automatic system which involves digital signal integration and analysis is required. In this study a MATLAB-based tool is being designed to convert electrocardiography (ECG) information from paper charts into digital ECG signals. Here authors have develop a method that involves processing of ECG paper records by an efficient and iterative set of digital image processing techniques for the conversion of ECG paper image data to time series digitized signal form, resulting in convenient storage and retrieval of ECG information. In addition, this tool can be used to potentially integrate digitized ECG information with digital ECG analysis programs and with the patient's electronic medical record**.** An capable method for extraction and digitization of ECG signal from

various sources such as thermal ECG printouts, scanned ECG and captured ECG images from devices is proposed. The methodology produced a reasonably accurate waveform that is free from printed character and as tested through heart rate, QRS width and stability calculations.

In [5], authors have presented analysis of electrocardiograph (ECG) signal for the detection of abnormalities using MATLAB. In this method authors have presented a study and analyze Electrocardiograph (ECG) waveform to detect abnormalities present with reference to P, Q, R and S peaks. It include three phases. The first phase contains the acquisition of real time ECG data. In the next phase, generation of signals followed by pre-processing. Thirdly, the procured ECG signal is subjected to feature extraction. Thus the normal and abnormal ECG signal could be differentiated based on the features extracted. The work is implemented in the most familiar multipurpose tool using MATLAB. This software efficiently helps for detection of any abnormalities present in the ECG signal. Proper utilization of MATLAB functions (both built-in and user defined) can lead us to work with ECG signals for processing and analysis in real time applications. The objective is to produce the typical ECG waveforms of different leads and as many arrhythmias as possible. This technique has many advantages in the simulation of ECG waveforms. Firstly saving time, secondly removing noise and thirdly Q, R, S detection in an easy manner The significant features of waveform are the P, Q, R, S waves, the duration of each wave and time.

In [6], authors have worked on MATLAB based ECG signal classification. The Bioelectrical signal records the heart's electrical activity versus time. It is an main diagnostic tool for assessing heart functions and also detection of arrhythmia is very important for the cardiac patients. ECG arrhythmia can be defined as electrical activity of the heart is irregular and can cause heartbeat to be slow or fast. The ECG signal is downloaded from MIT-BIH Arrhythmia database, since this signal contains some noise and artifacts hence pre-processing of ECG signal are performed and ECG signal is given as input to the feature extraction algorithm where in the features related to time such as the occurrence and duration of P, Q, R, S and T waves are determined. The extracted parameters are compared with the standard morphological values of ECG signal based on which decision taking algorithms are developed and abnormality is classified. The different types of arrhythmia classes including normal beat, Tachycardia, Bradycardia and Myocardial Infract (MI) are classified. The detection of arrhythmia is very important for the cardiac patients. It is found that the efficiency of detection is nearly around 98% as the data is compared with MIT-BIH database. In an algorithm based on Wavelet Transform is presented for the detection of QRS complex of ECG signal. Smaller scales correspond to high frequency components and higher scales correspond to low frequency components of the signals. Finally the abnormality that ECG signal is facing is identified using basic morphological classification technique.

In [7]. author have presented ECG image representation of normal sinus rhythm. The method consists in decomposing the ECG signal in beats. The ECG segmentation is based on the time location of the peak R of the QRS complex. A matrix parameterized by QRS rank comprises the signal tranches around this time reference. This representation is very useful for diagnosis in both normal and heart diseases cases and the different ECG records are given from the arrhythmias database. In this effort, authors have focus on the normal sinus rhythm to show the performances of this demonstration. The shape and duration of each characteristic of the ECG signal are significant diagnostic parameters. The ECG signals belong to the class of pseudo-periodic signals. That's why they are studied by different signal processing tools. The major problematic are the QRS complex detection. The period of an ECG signal is an important parameter for ECG diagnosis but the waveform is also a principal parameter. The plot on a graph paper of the ECG signal requires a sequential study of waves and intervals, a systematic search for correlations and a constant evaluation of periods. First, authors have apply wavelet transform as preprocessing technique to reduce signal base line. Second we consider the multiscale product algorithm to proceed to the R- peaks detection. High degree accuracy, superb image resolution. Easy to perform detect more easily the ECG records problem. Any abnormality on the ECG signal reflects problems of myocardial electrical conduction or rhythm changes.

In [8], authors worked on detection of various diseases using ECG signal in MALAB Electrocardiogram (ECG) represent electrical activity in the heart, and is the most important physiological parameter that gives the correct assessment regarding the functioning of the heart. ECG is the graphical recording of the electrical activity of the heart used for clinical diagnosis. The project has been devised to find a method for ECG signal analysis which is simple has good accuracy and takes less computation time. Electrocardiogram (ECG) is generally used for diagnosis of cardiovascular abnormalities and disorders.

PAN TOMPKINS ALGORITHM:

The works of Pan Tompkins greatly authority the QRS detection. A survey of literatures signifies this approach as one of important algorithm in detecting QRS peak Wherever The accuracy of any ECG waveform extraction plays a vital role in helping a better diagnosis on any heart related illnesses. It can be used to determine the speed of heart beat. Any abnormality in the rhythm of heart beat such as steadiness, disturbances or irregularities can be detected. The strength and timing of electrical signals can be detected as they pass through each part of the heart. Matlab software for the Pan and Tompkins QRS detection algorithm for detection of diseases related to heart, implementation of every stage processes the entire sample and then can the next stage begin. However, the samples that have already been processed by a stage may be processed by the next without waiting all the samples to be processed by the first.

In [9] authors have worked on morphologic features of the ECG for finding of stress-induced ischemia. In this work authors have evaluated the progress in the finding of strain induced ischemia achieved by ECG features not usually measured by cardiologists. Authors have evaluated 927 patients recorded during treadmill exercise SPECT following the Bruce protocol. The patients were labeled in three groups by two experts according to their SPECT images as: no ischemia (Ischemic Miocardium (IM)< 5%), mild ischemia (5% _IM< 10%) and moderate/severe ischemia (IM_ 10%). "Exercise testing and perfusion imaging" spread by and before described in detail . The database includes 927 patients referred for work out MPI single photon emission computed tomography (SPECT). for the period of the test, 12-lead ECG is recorded until the improvement phase and ampling rate of 1000 Hz, 0.15 _V of declaration and an analog bandwidth from 0.05 to 125 Hz. For the finding task, we used logistic failure, while the performance is evaluated and in this work authors have presented a model of features for ischemia discovery in EST, based on three groups those are: pretest, exercise and a set of proposed capacity calculated in ECG recordings of predictable analog bandwidth. The proposed group of features is the main procedural contribution with respect. These features are intended in mainly of the cardiac cycle in classify to measure the cause of stress-induced ischemia.

In [10]. authors have worked on automatic detection of electrocardiogram ST segment. The application in ischemic disease diagnosis. The ECG signals information is derived from analysis of the information indirectly reflected on the surface ECG. The ECG signal is able to make of basic information for heart disease, indisposed of the autonomic nervous system and stress. The world Health Organization estimates that 17.5 million people died of cardiovascular disease. It is representing 30% of all global deaths. Out of these, 7.6 million are due to coronary artery disease (CAD). During the last few years, a lot of research has provided the solution of analysis and diagnosis in ECG by adopting new technologies and algorithms. The European ST-T database is intended to be used for evaluation of algorithm for analysis of ST and T wave changes. It consists of following three files: 1) Header file has the patient's information, lead, medication, clinical findings and recording equipment information. 2) Data file has an ECG data recording format that is of double-channel 2-hour length, resolution of 12bits and 250Hz sampling frequency, and data format of MIT-212 format. 3) Finally, annotation file contains data information (data beat, ST and T change start-peak-end, noise, rhythm). The European database is used for evaluation of automatic detection of the ST segment. This system is intelligent computer applications that provide decision support through acquisition and processing of human experts knowledgehe performance and the limitations of this method are discussed. The method and the various limits and the detection parameters used were test on just one patient's data.

In [11], author have jointly developed a method called identification of cardiac ischemia using bispectral analysis of ECG. The Cardiac Ischemia (CI) is the most common type of cardiac arrhythmia. CI is caused by narrowing of arteries which makes a reduced amount of oxygenated blood to reach the heart muscle. This state may lead to heart attack with no prior notice. The present method distinguishes the ECG of a normal healthy person from that of CI patient. Bispectral analysis - Bispectrum, Bicoherence and Quadratic Phase Coupling techniques are used to identify and distinguish phase coupled harmonics in ECG. Normal Sinus Rhythm Data is obtained from MIT-BIH Database. CI data is obtained from European ST-T Database. The algorithm is tested on MIT-BIH database and European ST-T Database. The electrical impulse is initiate by Sinoatrial (SA) node. This causes the atria to convention and is clear on the ECG as P-wave. The idea of the method is to examine and compare normal person ECG with a patient ECG who prone to cardiac ischemia. The special parameters such as kurtosis, skewness and variance that the signal represented are calculated. The bispectrum and bicoherence of the signal data was performed. The bispectral analysis was capable to supply a clear view of the phase coupling in the data To detect more easily the ECG records difficulty. The bispectral study could nearby a original approach to identify the occurrence of disease in ECG signal. Bicoherence magnitude indicates the strength of phase connection which is low in NSR person, more in CI person. This result proves that high degree in diseased person ECG signal than NSR person.

In[12] , authors have jointly developed a method called study and analysis of ECG signal using MATLAB & LABVIEW as effective tools. This method deals with the study and analysis of ECG signal processing by means of MATLAB tool effectively. Study of ECG signal includes generation & simulation of ECG signal, acquisition of real time ECG data, ECG signal filtering & processing, feature extraction, comparison between different ECG signal analysis algorithms & techniques , detection of any abnormalities in ECG, calculating beat rate and so on using the most familiar and The ECG data is acquired by Simulink. Detection of any abnormalities in ECG, calculating beat rate and so on using the most familiar and multipurpose MATLAB software along with LABVIEW & saves a lot of time. Another advantage is removing the difficulties of taking real ECG signals with invasive and noninvasive methods. Both MATLAB and Lab VIEW have immense effect on ECG signal processing. They are so useful and handy that even one can monitor his/her heart condition simply utilizing the power of MATLAB and/or Lab VIEW without having an ECG machine and also self diagnosis is possible. All these examples and techniques that are discussed here can be really useful for experimental/lab purpose even we don't have any ECG data we still can simulate and analyze it.

In [13], authors have jointly developed a mehod called comparison of different ECG signals on MATLAB. Authors

have discuss about biomedical engineering and then a brief description of ECG signal. Authors have generated a new method to compare different arrhythmic heart signals with normal sinus signals at MATLAB. Result obtained shows that Comparison of Normal (Sinus) and Abnormal (arrhythmia) ECG signal**.** The primary function of the heart is to circulate and supply blood and nutrients to the body. The proper beating or contraction of the heart moves and transfers the blood throughout the body. Each heart beat is controlled by electrical impulses travelling through the heart. These electrical impulses occur in regular intervals (time period) in the normal heart. ECG is used to measure the rate and regularity of heartbeats, as well as the position and size of the chambers, the existence of any damage to the heart, and the effects of devices or drugs used to regulate the heart. This method presents an original work related to comparison of ECG Signals in a reliable manner. Simulation of dynamic system is one of the challenging computational task because of its numerical complexity and simulation time.

In [14], authors have presented ECG analysis and detection of arrhythmia using matlab This method has been inspired by the need to find an efficient method for ECG Signal Analysis which is simple and has good accuracy and less computation time. For analysis the ECG signals from MIT database is used. The initial task for efficient analysis is the removal of noise and detection of QRS peaks. It actually involves the extraction of the QRS component by rejecting the background noise. This task is done using Pen Tompkins algorithm. The second task involve calculation of heart rate, detection of tachycardia ,bradycardia , asystole and second degree AV block from detected QRS peaks using MATLAB. The results show that from detected QRS peaks, arrhythmias which are based on increase or decrease in the number of QRS peak, absence of QRS peak can be diagnosed. It's the algorithm for detection of QRS complex of ECG signals. It reliably recognizes QRS complexes based upon digital analyses of slope, amplitude and width. Special digital band pass filter reduces false detection caused by various types of noises such as muscle noise, artifacts due to electrodes motion, power line interference, base line wander, T wave with high frequency characteristic similar to QRS complex. This algorithm is implemented for detection of QRS complex on normal database. The results obtained using MATLAB for ECG analysis and detection of arrhythmia is very fast and useful, as the ECG can be easily read , saved in a file. It is a efficient method for ECG Signal Analysis which is simple and has good accuracy and less computation time. The filtering, derivation, squaring, thresholding , applying the moving window integration, peak detection can be done accurately .The peak detection is very important in diagnosis arrhythmia which is proved as tachycardia, bradycardia, asystole, second degree AV block is detected.

In [15], author have worked on an enhanced EMD algorithm for ECG signal processing The Empirical Mode Decomposition (EMD) is becoming increasingly popular for the multi-scale analysis of signals. However, the data-driven and adaptive nature of the EMD raises concerns regarding the uniqueness of the decomposition as well as the extend to which oscillatory modes can be mixed across different IMFs. This method proposes a solution to this problem for the analysis of ECG signals. The bivariate extension of the decomposition (BEMD) is used as the basis of an analysis in which a synthetic ECG signal of idealized waveform guides the decomposition of an input ECG segment. The purpose of pattern recognition is to extract information that is originally hidden in the data. Multi-scale analysis is one way to address this problem. For one dimensional physiological signals such as the electrocardiogram (ECG), phonocardiogram (PPG), blood volume pressure (BVP), photoplethysmogram (PPG) and other that are widely studied in diagnostics, typical approaches include the Fourier transform, the spectogram, the cosine transform, the Wigner-Ville distribution and wavelet analysis. This section provides an overview of the EMD algorithm, proposed by Huang *et al.* in order to then extend it to the bivariate case, and present the proposed solution. EMD decomposes a signal adaptively into a number of IMFs. Each IMF describes a disctint oscillation. Despite the advantages of the data-driven nature of the decomposition, the EMD is considerably vulnerable to noise. This practically leads to uniqueness and mode mixing issues.

In[16], author have worked on ECG waveform data extraction from paper ecg recordings by k-means method. An ECG engine with digital-out has been applied for years, paper recordings are still chosen by medical organizations especially in China. But the recording paper is easily broken. A method based on K-means is proposed to extract ECG data from paper recordings. The ECG waveform and the background grid were separated well.105 patients' ECG paper recordings were adopted in the experiment. And the recordings are in different damage level, the paper are in different background color and made by different manufacturers. In order to extract the waveform fast and precisely, improved k-means based on Sobel is proposed in the paper. K-means is used in the paper as the core of the ECG waveform extraction method. First, making the clustering number initialized and the iteration convergence expression for measurement function is given. Then, k initial clustering center is randomly selected. These ECG data were necessarily to be extracted and keep the valuable ECG information as digital type for clinical information sharing, online diagnosing and ECG database. establishing. The heart rate and RR interval after digitization have small differences from the original paper ECG. The experiment shows the accuracy rate of waveform amplitude 99%, and heart rate of that 99%.

In [17], authors have presented on electrocardiogram signal processing method for exact heart rate detection in physical activity monitoring system Physical Activity Monitoring is a device that can measure the human activity quantitatively through Heart Rate detection in real time. R-Spike detection of ECG is required for this Heart Rate detection. This method to

convolute wavelet function and scaling function as the optimum signal disposition method for optimum R-Spike detection. To verify performance of signal disposition method suggested , the ECG of noise stress test database (NSTDB) and MIT-Database are tested in combination. it is used as important parameter of living body during exercise. Heart rate is measured by using Arterial blood pressure (ABP) and Photoplethysmograph (PPG) or mostly Electrocardiogram (ECG). It is mainly measured by RSpike detection of ECG in the physical activity monitoring system. (RR interval, namely, the interval between R-Spike and next R-spike is calculated.) Thus, the failure of R-Spike detection makes exact HR detection difficult. The wavelet is newly formed through convolution of scale function and wavelet function and the newly formed wavelet is obtained by formula. The wavelet function formed by convolution of scaling function and wavelet function presented in this paper showed performance better than that of quadratic spline wavelet in R-Spike detection of noisy ECG signal rate.

In [18], authors have worked on research on electrocardiogram signal noise reduction based on wavelet multi-resolution analysis In this method Electrocardiogram (ECG) signal's noise reduction is critical for ECG automatic diagnosis and analysis, and the de-noising result directly affects the accuracy of ECG parameter extraction diagnosis and analysis. ECG signals are often seriously distorted by noises with the characteristics of low signal-noise ratio and non-stationary stochastic property, especially for P wave and T wave because they have lower amplitude and are sensitive to noise. This method presents an ECG signal noise reduction method utilizing coif3 wavelet and notch filter. Experiment results show that this algorithm effectively solved the serious ECG signal distortion problem caused by baseline drift, power line interference and EMG interference, greatly inhibits the noise in P wave and T wave, and improves the accuracy of ECG parameter extraction. ECG signal de-noising methods mainly include: digital filtering, mathematics morphology filtering, adaptive filtering and so on. Some methods are affected by ECG waveform variety, some methods result in long time delay because of numerous calculation and some methods are difficult to realize, so it is necessary to study new ECG signal noise reduction method. This research presents a new ECG signal noise reduction approach utilizing coif3 wavelet combined with notch filtering. The ECG signal noise reduction algorithm based on wavelet transform combined with notch filter is programmed in MATLAB 7.1 and run under Windows XP Time-frequency window can be adapted automatically to meet actual need for both low frequency and high frequency local signal. ECG signal noise reduction method utilizing coif3 wavelet and notch filter**.** The ECG signal's serious distortion problem caused by noise is solved, the ECG signal's characteristics are outstanding, and a new method for ECG signal parameter extraction and processing is provided.

In [19], authors worked on ecg beat classification method for ecg printout with principle components analysis and support vector machines ECG is an electric signal which is generated from human heart. It is used for investigate some of abnormal heart function. For this method the shape of ECG is used to classify ECG beat in four types such as normal beat (N), left bundle branch block beat (L), right bundle branch block beat (R) ventricular premature beat (V). After that PCA(Principle Components Analysis) and SVM (Support Vector Machines) are adapted to create model of classifier for using with method based ECG printout. The ECG image from ECG is processed by some image processing techniques such as red grid removing, noise rejection, image thinning and time-series ECG extraction to obtain the time-series ECG signal before classification. Based on MIT-BIH arrhythmia database The ECG classification method for three basic components. The first component is time series ECG beat detection from ECG printout. The second is data preprocessing such as discrete wavelet transform and PCA. The last component is ECG beat classification with SVM. This method proposes a classify ECG signal from ECG printout. It composes with ECG beat detection from ECG printout, training ECG beat classification model with SVM and implementation base on LIBSVM with Python and its libraries. MIT-BIH arrhythmia database is used for SVM training and validation with single lead basis (MLII). The process starts by scanning vertically to find out the black pixel. If the black pixel is found and all adjacent pixels around it are white background color, then this black pixel will be considered and treated as a noise which will be replaced with white background color. It is used for investigate some of abnormal heart function. Support vector machine with discrete wavelet transform and principle component analysis is a good performance ECG beat classifier.

In [20], Authors have presented on MATLAB in intracardial ECG analysis. The efficient intracardial ECG analysis algorithm. The main focus was design an optimal detection method for intracardial signals based on essential intracardial measuring methods and basic principles of gathering and processing data from invasive catheters. Detailed signal description generated in heart, together with heart function knowledge can provide us with an useful information about heart's condition or it's diseases. Designed detection method is able to mark significant points in intracardial records, compute it's elemental parameters and important time intervals. Incurred algorithm is designed and tested. Data is stored in a file with the extension *. txt, and can therefore be viewed as a classic notepad in Windows. After the opening we see that this is a table of numbers, where each column represents a seduction. The measured signals were recorded with a sampling frequency of 977Hz. It follows that for such a long signal for 30 seconds for each lead-recorded 29310 samples. The benefits file with the *. txt is the fact that it is very easy to load into MATLAB as a multidimensional variable. The benefit of this work is a new approach to detect

points in the ECG signals nonstandard shapes. It introduced an efficient method to recognize, label and border impulses, which are directly from the heart wall observed invasive catheters.

In [21], authors have worked on detection of sleep disordered breathing by automated ECG analysis. Sleep related breathing disorders are a highly prevalent disease associated with increased risk of cardiovascular complications like chronic arterial hypertension, myocardial infarction or stroke. Gold standard diagnostics (polysomnography) are complex and expensive; the need for simplified diagnostics is therefore obvious. As the ECG can be easily conducted during the night, the detection of sleep related breathing disorders by ECG analysis provides an easy and cheap approach. Authors believe that with further improvements in ECG analysis this algorithm can be used for screening diagnostics of obstructive sleep apnea. The underlying procedures have been selected from different existing algorithms. In a first step the developed algorithm performs a beat-to-beat analysis of the heart rate for the whole recording. The detection of QRS complexes of the ECG is done using correlation analyses between the recorded ECG signal and an ideal QRS complex created using normative values for ECG. If the squared correlation coefficient r^2 is >0..3 the presence of a QRS complex is assumed. As the ECG can be easily conducted during the night, the detection of sleep related breathing disorders by ECG analysis provides an easy and cheap approach. We believe that further sophistication of the presented algorithm e.g. by using further correlation analyses may increase the diagnostic accuracy as well as sensitivity and especially specificity.

In[22], authors have presented on ECG and echocardiography processing for decision support in heart failure This method presents an effective way to achieve a high level integration of signal and image processing methods in the general management of heart failure, by means of a Clinical Decision Support System (CDSS). In particular, significant and suitably designed image and signal processing algorithms are introduced to objectively and reliably evaluate important features that can facilitate decisional problems in collaboration with the CDSS. Architectural details of the components of the CDSS needed for the seamless integration of image and signal analysis In this area, the development of computer-aided diagnosis schemes is still attracting a lot of interests and efforts. Actually, clinical interpretation of diagnostic data largely depends on the reader's subjective point of view, knowledge and experience. ECG signals and echocardiography images was early realized

• discovery of novel pertinent knowledge. An effective way to achieve a high level integration of signal and image processing methods in the general management of heart failure, by means of a Clinical Decision Support System (CDSS). In this paper we have presented a suite of diagnostic signal and image processing algorithms and we have described their integration into the wide-ranging services provided by a CDSS for the management of heart failure.

In [23], authors have presented computer analysis of th electrocardiograms from ECG paper recordings. It will be very helpful ECG could be converted to digital form. In general, the background of ECG charts can be divided into three types: uniform background, background with colored grid and background with black grid. In this study, we developed a morphological method to retrieve ECG data on paper charts using optical scanner and computer. The results show that our method can erase the background noise and acquire the digital ECG signal from ECG paper charts correctly. Conversion of ECG by optical scanner is of practical use when attempting ECG data exchange between healthcare providers. The electrocardiogram (ECG) represents a graph of variations in electrical potential generated by the heart and recorded at the body surface The volume of electrocardiograms (ECG's) recorded in hospital is increasing and shows no sign of leveling off. Recently, exchanging patients' clinical information between healthcare facilities has become very important. In this method Two parallel systems were in operation. In the first, the ECG's were recorded on a 3 - channel electrocardiograph, which records a group of 12 leads, each 2.5 sec, and 10 sec of rhythm lead (lead **11)** on a black grid ECG paper. In the second system, ECG's were recorded on analogue magnetic tape and a computer-assisted interpretation system was provided. These signals were sampled at a rate of 500 samples/sec. This method can also be used to recover the data from the other paper-recording charts, such as EEG and EMG. The experimental results suggest that digitization of electrocardiogram by optical scanner is of practical use when attempting ECG data exchange between healthcare providers. Old paper records, which could not be used as digitized signal before, are also accessible now.

In [24], authors worked on detection of QRS complex in ecg signal based on classification approach Electrocardiogram (ECG) signals are used to analyze the cardiovascular activity in the human body and have a primary role in the diagnosis of several heart diseases. The QRS complex is the most important and distinguishable component in the. The aim of the present work is to detect the QRS wave from electrocardiogram (ECG) signals. Initially the baseline drift has been removed from the signal followed by the decomposition using continuous wavelet transform. Modulus maxima approach proposed by Mallat has been used to compute the Lipschitz exponent of the components. By using the property of R peak, having highest and prominent amplitude and Lipschitz exponents, we have applied the K means clustering technique to classify QRS complex. In order to evaluate the algorithm, the analysis has been done on MIT-BIH Arrhythmia database. In terms of disease classification, the QRS complex is of pathological importance and its detection serves as an entry point of almost all of the automated ECG analysis algorithms. Several different approaches based on neural networks, some heuristic methods

based on non linear transform and wavelet transform has been proposed in the past. The detail overview of these approached analysis has been done on MIT-BIH Arrhythmia database. Many methods have been developed in the past for the detection of QRS complex. However, most of these methods suffer mainly from of problems like, QRS waveform varies from patient to patient, noise and noise removal technique results in modification of original signal which ultimately results in false detection. Therefore in order to overcome these problems, authors are proposing to decompose the signal and by computing the Lipschitz exponent from modulus maximas,. In [25], authors have worked on SPIHT compression of ECG signals using an image processing concept In this method a new electrocardiogram (ECG) data compression algorithm is presented. This algorithm converts the I-D ECG signal into a 2-D matrix and then pre-processing is performed in order to compress the 2-D matrix with the Set Partitioning In Hierarchical Trees (SPIHT) algorithm. The periods of ECG signals are found by the detection of the QRS complex,. The effect of Additive White Gaussian Noise (AWGN) on the quality of the compressed ECG signals is studied. Efficient compression of ECG signals has become necessary for data transfer in telemedicine. ECG compression algorithms can be classified into direct algorithms, which attempt to remove redundancy by acting directly on the temporal consecutive samples of an ECG record, and transform-based algorithms which perform the compression in a suitable transform domain. To compress the 2-D ECG matrix, the Karhunen-Loeve Transform (KLT) is the optimum unitary transform, which gives the minimum geometric mean, i.e., maximizes the coding gain. However, the KLT depends on the input signal; it requires the knowledge of the eigenvectors of the covariance matrix of the input signal. So, alternative transforms such as the Discrete Cosine Transform (DCT) are more practical. Because of the intra- and inter-beat correlation of ECG signals, 2-D ECG signal compression algorithms have better performance. To map a I-D ECG signal to 2-D matrix, the peaks of the QRS complex should be detected to identify each heart-beat period, namely the R-R interval. By this method we have a matrix, in which each row is a heartbeat of the ECG.

III. CONCLUSION

The paper presents an existing algorithms available for the analysis of ECG signal. Authors have implemented the different algorithms on echocardiography disorders using MATLab. Authors have introduced new dynamic model which is capable for many of the important features of the human ECG. We can hope that this model can provide a valuable tool for testing biomedical signal which can process algorithm applied to ECG signal for different sample frequency and levels of noise or movement. This paper shows research issues in ECG analysis.

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