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Review On Denoising And Detection Of QRS Complex Using Mamemi And Derivative Filter

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Abstract: ***Wireless QRS detection in ECG is necessary for the diagnosing various heart diseases. It displays the electrical activity and present state of the human heart. Number of techniques has been used previously for the accurate detection of ECG signal that are accompanied with certain disadvantages like less accuracy, less signal to noise ratio, resource complexity etc. The technique that is used here for the noise removal consists of derivative filter and mamemi filter beside the high pass and low pass filter. This technique is originated to provide better results in respect of accuracy, specificity, sensitivity etc. and efficiently eradicates low and high frequency noise artifacts.***

Keywords: Electrocardiograph (ECG), QRS complex detection, derivative filter, mamemi filter

I. INTRODUCTION

ECG reports the electrical variations that arise in the heart. Any change in the normal ECG signal can cause cardiac problems. ECG signal involves different waves that are P, Q, R, S and T as shown in the fig. 1. These waves collectively constitute cardiac cycle. Doctors use this graph to measure the heart rate of a person and in case of any discrepancy or change in normal pattern, they take the required action. Here, P wave appears due to the atrial polarization with the duration of 0.1 seconds and QRS complex results because of ventricular polarization consisting of long isoelectric period.

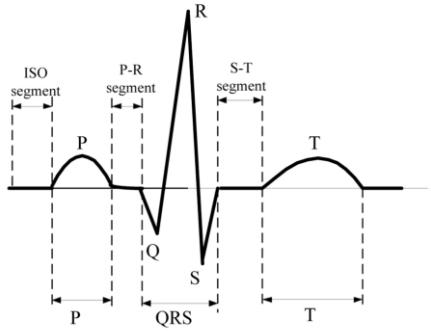

Figure 1.1: Normal ECG signal

QRS complex detection and consecutive R peaks interval is important to detect the heart rate. But there are some monitoring problems that can interfere with the ECG signal. These are listed as

A. ARTIFACTS

This problem occurs due to the excessive movement of the patient. Poor contact of the electrodes can also affect the detection process.

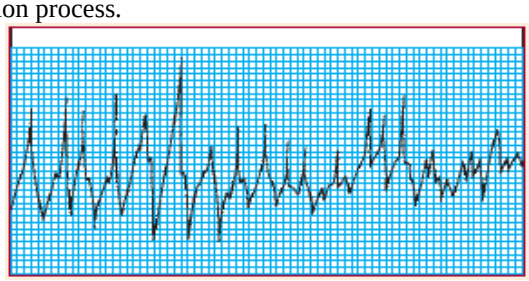

Figure 1.2: Artifacts

B. INTERFERENCE

This occurs due to the power leakage and interference from other room equipment. This appears on the baseline of the ECG signal which is unable to read.

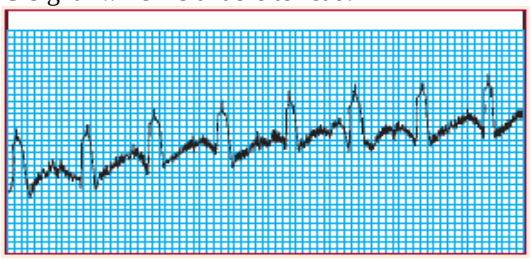

Figure 1.3: Interference

C. WANDERING BASELINE

This problem occurs due to the respiration process, poor electrodes etc. Further this cause the non-stationary baseline which can be issue for the detection procedure.

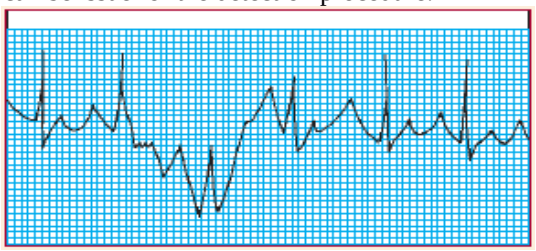

Figure 1.4: Wandering baseline

D. FAULTY EQUIPMENT

Overused equipment and broken cables can badly affect the QRS detection as well as the patient's life.

These interruptions in the normal signal can act as a barrier in diagnosing the actual cardiac disorder from which the person is suffering. Also, when a person suffers from any disease QRS complex takes different patterns. So, there is great need to improve the QRS detection methods for the precise detection of the QRS complex. Number of methods has been used earlier that have certain shortcomings. So, upgraded method has been proposed to overcome the noise issues. This includes the combination of mamemi filter and derivative filter along with the high pass and low pass filter. Mamemi comes from maximum mean minimum and this filter effectively eliminates baseline wander. Further, following this first order derivative filter is used. Various parameters such as accuracy, detection error rate, sensitivity etc. will be used to analyze the results with the help of recordings from MIT/BIH database.

II. RELATED WORK

Many different techniques have been proposed for detection of QRS wave in ECG signal. Indu Saini et. al [1] have used *K*-Nearest Neighbor algorithm (KNN) for QRS detection. Two databases, CSE and MIT/BIH database are used for the evaluation. Filtering of ECG signal is done by band pass filter so as to diminish the false detection. Comparison between two databases is made using different parameters. Monisha et al [2] compare two filtering techniques. These are band pass filtering and Savitzky-Golay filtering. Band pass filtering includes low pass and high pass filter, which has been taken from Pan Tompkins algorithm. In both types of filtering, signal to noise ratio is calculated and compared to find out the best one. Hongjun [3] use Matlab software for the QRS wave detection with MIT/BIH arrhythmia database. In this, noise is removed by butterworth filter and further analysis is done on the basis of wavelet transform. Ranjeet et al [4] propose wavelet filter method which uses Kaiser windows with run length encoding and simple linear optimization to derive the coefficients. The improved thresholding technique is used in this. Performance is compared with three parameters, percent root mean square difference (PRD), compression ratio (CR) and signal to noise ratio (SNR). Raul et al [5] compare three algorithms, Pan Tompkins algorithm, Hamilton and Tompkins algorithm and Phasor algorithm. Furthermore, software is developed as outline for the QRS detection algorithms. A.R. et al [6] present a tunable notch filter for ECG QRS detection. This filter effectively removes muscle contraction noise and power line interference. In this, filter coefficients are computed and noise is removed within the specified frequency range. This helps to improve the signal to noise ratio. David et al [7] propose a Mamemi filter for the efficient elimination of baseline wander. This was suitable method for the portable and wearable devices. Santanu et al [8] enhance the ECG signal by using adaptive thresholding technique along with Hilbert Transform for the accurate detection of the R peaks. MIT/BIH database is used for evaluating the experimental results. Sachin et al [9] present total variation technique (TVD) for locating the R peaks. Forty eight records of MIT/BIH database are used for the calculation and evaluation purposes.

III. LITERATURE SURVEY

Year	Author	Journal/ conference	Title
2012	Indu Saini, Dilbag Singh, Arun Khosla	Journal of Advanced Research	QRS detection using K-Nearest Neighbor algorithm (KNN) and evaluation on standard ECG databases.
2012	Dr. Monisha Chakraborty and Shreya Das	Biomedical Signal Processing and Control	Determination of Signal to Noise Ratio of Electrocardiograms Filtered by Band Pass and Savitzky-Golay Filters
2012	Hongjun Zhang	International Conference on Solid State Devices and Materials Science	An Improved QRS Wave Group Detection Algorithm and Matlab Implementation
2012	K. Ranjeet, A. Kuamr,	International Conference on	ECG Signal Compression using

	Rajesh K. Pandey	Modelling, Optimisation and Computing	optimum wavelet Filter Bank based on Kaiser Window
2013	Raul Alonso Alvarez, Arturo J. Mendez Penin, X. Anton Vila Sobrino	Conference on ENTERprise Information Systems	A comparison of three QRS detection algorithms over a public database
2015	A.R. Verma, Y. Singh	3rd International Conference on Recent Trends in Computing	Adaptive Tunable Notch Filter for ECG Signal Enhancement
2015	David Castells-Rufas, Jordi Carrabina	Biomedical Signal Processing and Control	Simple real-time QRS detector with the MaMeMi filter
2016	Santanu Sahoo, Prativa Biswal, Tejaswini Das, Sukanta Sabut	Global Colloquium in Recent Advancement and Effectual Researches in Engineering, Science and Technology	De-noising of ECG Signal and QRS Detection using Hilbert Transform and Adaptive Thresholding
2016	Sachin Kumar , Neethu Mohana, Prabaharan, K P Soman	6th International conference on Advances in Computing and Communications	Total Variation Denoising based Approach for R-peak Detection in ECG Signals

Table 1

IV. GAPS IN THE LITERATURE

It has been observed from the survey that still ample progress is needed in the QRS detection techniques. Various limitations are observed from the survey. The techniques that are used previously affect the quality of the ECG signal. They have lesser accuracy and high detection error rate. Sensitivity and specificity values were also less. Their energy cost increases due to the high computational complexity and high resource need.

V. CONCLUSION

The proposed method i.e. combination of mamemi filter and derivative filter is capable of eradicating high frequency and low frequency noise from the ECG signal. Improved technique has been suggested for the accurate detection of the QRS complex. Performance evaluation is performed with MIT/BIH database. Different parameters are used for the comparison.

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