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Life Threatening Arrhythmias Classification using Nuclear Quadrupole Resonance Spectroscopy Signals

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Abstract— In this paper, Nuclear Quadrupole Resonance Spectroscopy signals of human recorded using called HTEC is analysed and compressed to classify Arrhythmias .The device is able to record medical quality which leads ECG signal from the patient's hearth by using dry electrodes and without any skin preparation or medical knowledge. Nuclear quadrupole resonance spectroscopy is a method of measuring the pattern activities of heart. Every portion of spectroscopy is very essential for the diagnosis of different cardiac problems. But the amplitude and duration of spectroscopy signal is usually corrupted by different noises. In this paper a broader study for denoising every types of noise involved with real spectroscopy signal and the type of adaptive filters are considered to reduce the spectroscopy signal Base Line Interference. Hence adaptive filters, now days, are used for artifact removal from spectroscopy signals and the adaptive filters update their coefficients according to the requirement. Spectroscopy is an essential clinical analytic apparatus for recognition of cardiovascular arrhythmias and also, RR interim data is processed to give dynamic elements. These two different types of features are concatenated and a support vector machine classifier is utilized for the classification of heartbeats into different classes. The procedure is independently applied to the data from two Spectroscopy leads and the two decisions are fused for the final classification decision.

Keywords— Adaptive Wiener Filter, Wavelet Transform, Nuclear quadrupole resonance spectroscopy, Support vector machine

1. Introduction

Transform based methodology is presented for compression of spectroscopy electrocardiogram (ECG) signal. The methodology employs different transforms such as Discrete Wavelet Transform (DWT), Fast Fourier Transform (FFT) and Discrete Cosine Transform (DCT)[5][6]. A similar investigation of execution of various changes for ECG flag is made regarding Compression proportion (CR), Percent root mean square distinction (PRD), Mean square blunder (MSE), Maximum mistake (ME) and Signal-to-commotion proportion (SNR).The simulation results included illustrate the effectiveness of these transforms in biomedical signal processing.The focal objective of spectroscopy information pressure procedures is to protect the most helpful indicative data while compacting a flag to a worthy size. Lossless pressure is the best decision the length of the pressure proportion is adequate, however it can't typically offer a tasteful pressure proportion (CR). When compared, Discrete Cosine Transform and Fast Fourier Transform give better pressure proportion, while Discrete Wavelet Transform with ICA yields great constancy parameters with tantamount pressure proportion[4].

To get huge flag pressure, lossy pressure is desirable over a lossless pressure.Lossless pressure is only correct reproduction of the first flag and depends on breaking a record into a "littler" shape for transmission or capacity and after that assembling it back on the flip side so it can be utilized once more. Whereas lossy compression simply eliminate "unnecessary" bits of information, that's why for compressing an spectroscopy signal lossy is preferred. In this case,pressure is expert by applying an invertible orthogonal change to the flag, and one tries to lessen the repetition show in the new portrayal. Due to its de-correlation and energy compaction properties and to the existence of efficient algorithms to compute it, discrete cosine transform have been widely investigated for spectroscopy signal compression and DWT has been proven to be very efficient for spectroscopy signal coding.

In this paper, a hybrid two-stage spectroscopy ECG signal compression method based on continuous wavelet transform and DWT with ICA is proposed. Their blend evacuates the phantom repetition by compacting the subordinate parts more than the predominant segments. The resulting transformed coefficients that represent the transformational signal are then threshold and compressed using a new coding technique for storage space saving. A number of the researchers have utilized digital Infinite Impulse Response (IIR) filter to evacuate the impacts of power line interface and baseline wander from ECG signals.Since, the arrangement of IIR channel is basic, on other hand; higher request IIR channels are performing admirably to expel the clamor from the signs[11]. Then again, it has the hindrance of extended filtering time, memory and not able to channel the exceedingly non-straight flags in the entire ECG range[7]. Recent years, adaptive filtering techniques are utilized for removing the power line interference and other noises from ECG signals[2] .This system is all the more well-known because of its faster filtering response and smaller residual errors. In any case, this framework requires reference flag either flag or clamor angles information for compelling separating process[3]. There are different central purposes of the proposed method, for instance, the figure botch is spread non-reliably along the analyzed waveform, showing lower values around fragments of basic clinical significance, since it is basically a wavelet-oriented approach it may benefit of existing highly performance compression techniques such as DWT ICA. In this context, an additional advantage is given by the possibility of progressive-quality transmission may be highly desirable in critical, alarm-triggering situations, and the operator may be realized by using lookup tables, and further simplified by considering binary approximations, thus greatly smoothing the progress of the implementation step.Herethe statistical information of the compressed ECG signal is calculated and NeuroSupport Vector Machine is applied in order to classify whether given ECG signal is normal or abnormal.

2. Related Works

Lately, versatile sifting has turned out to be one of the successful and prevalent methodologies for the preparing and examination of the biomedical signs.Versatile channels allow to recognize time fluctuating possibilities and to track the dynamic varieties of the signs. Besides, they modify their behavior according to the input signal. Therefore, they can detect shape variations in the ensemble and thus they can obtain a better signal estimation. Many existing compression algorithm have shown some success in ECG compression, however calculation that produces better pressure proportions and less loss of information in the recuperated information is required. The techniques used for compression of ECG image are basically DWT. This technique uses transformed based method which helps to convert time domain to frequency domain. By compressing the ECG Image more information can be stored & processed for future evaluation. Orthogonal changes give interchange flag portrayals that can be helpful for electrocardiogram (ECG) information pressure.The objective of orthogonal changes is to choose as little a subset of the change coefficients as conceivable which contain the most data about the flag, without presenting questionable blunder after remaking. Wavelet Transform (WT) is an intense time-recurrence flag examination apparatus and it is utilized as a part of a wide assortment of utilizations including sign and picture coding. Discrete Wavelet transform has an orthogonal basis function and exhibits zero redundancy. It expresses the waveform in the form of a dyadic grid arrangement. P, Q, R, S, T and U are specific wave forms identified in the time domain of an ECG signal. The QRS mind boggling, shaped by Q, R and S waves, speaks to an important wave frame in light of the fact that the heart rate can be distinguished finding two progressive QRS complex.Flag preparing procedures for the data in the recurrence area incorporate Fourier changes and wavelet changes. The last beats the essential restriction of Fourier changes, which is instability of the data in time after the change. The wavelet transform has been applied to the ECG for a wide range of purposes: feature extraction, feature detection, noise reduction and data compression. The joined strategy of wavelet deterioration and highlight extraction was already connected to an ECG flag to separate ordinary beats and strange beats.

3. Proposed Work

In the proposed work, spectroscopy electrocardiogram (ECG) signal is processed to remove the artifacts of ECG signal like base line wandering, power-line interference and then processed signals are classified to detect the arrhythmias. Basic block diagram of the methodology is shown in the figure3.1.

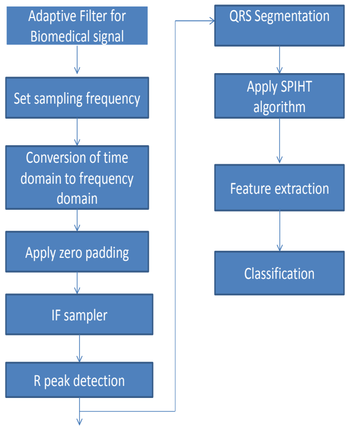

Fig.1: Overall Architecture Diagram

3.1 Adaptive Wiener Filter for Denoising Spectroscopy ECG Signal

The dyadic stationary wavelet transform (SWT) is used in the Wiener filter as well as in estimating the noise-free signal. The objective was to locate an appropriate channel bank and to pick different parameters of the Wiener channel as for the flag to-commotion proportion (SNR) acquired. Testing was performed on artificially noised signals from the standard CSE database sampled at 500 Hz. While making a manufactured obstruction, we began from the produced white Gaussian commotion, whose power range was changed by a model of the power range of an EMG flag.To enhance the sifting execution, we utilized versatile setting parameters of separating as per the level of obstruction in the information flag.. We were able to increase the average SNR of the whole test database by about 10.6dB. The proposed algorithm provides better results than the classic wavelet Wiener filter. The Wavelet Wiener Filtering method has many parameters, which have to be set manually. The most imperative ones are the decay level of the wavelet change, the thresholding strategy in the wavelet area, the limit multiplier, and the wavelet channel banks utilized as a part of the SWT1 and SWT2 changes. The fitting setting of the information parameters affects the sifting comes about. Unfortunately, it is not clear which parameters should be used for ECG signal de-noising. Moreover, it is obvious that for different noise levels present in the input signal different settings of the input parameters are suitable. In this way, a powerful separating calculation ought to change its parameters relying upon the genuine measure of commotion.The adaptive filtering has become one of the effective and popular approaches for the processing and analysis of the biomedical signals.

3.2 Spectroscopy ECG Signal Compression

Information pressure diminishes the quantity of bits of data required to store or transmit the biomedical signs. Pressure calculation of bio-restorative signs is executed utilizing Discrete Wavelet Transform. High limit esteem (λ) gives high information diminishment and poor flag constancy and low edge esteem (λ) gives low information decrease and high flag loyalty. Threshold value selection should be such that the quality of the Spectroscopy ECG signal is not distorted on reconstruction and a good amount of data reduction is also achieved. The database has been collected from arrhythmias database of the lead II signal. The Spectroscopy ECG signal to be compressed is decomposed to the Level 5 using the biorthogonal 4.4 wavelet family. Wavelets permit both time and recurrence investigation of signs all the while on account of the way that vitality of wavelet is packed in time and still has the wave likes qualities. Following are some important steps of the proposed algorithm.

- Transform the ECG signal using DCT and DWT.
- To achieve an adaptive threshold compute the maximum value of the transformed coefficients.
- Apply the edge of a settle rate in light of total greatest estimations of the change coefficients.
- After threshold operation to reconstruct the signal apply inverse transform. For wavelet based pressure the flag is decayed up to fifth level utilizing Bior4.4 wavelet.

Therefore DWT and ICA algorithm is suitable for the compression of time-varying non-stationary signals such as Spectroscopy ECG signals.

3.3 Feature Extraction from the Compressed Signal

Highlight Extraction assumes a critical part in diagnosing a large portion of the heart ailments. One heart cycle in an ECG flag comprises of the P-QRS-T waves. This component extraction plot decides the amplitudes and interims in the ECG motion for resulting investigation. The amplitudes and intervals value of P-QRS-T segment determines the functioning of heart of every human.
R peak and QRS segmentation is applied to different Spectroscopy ECG signal obtained from MIT-BIH database. The proposed method of detecting various peaks in signal, finds P, Q, R, S and T peaks from Spectroscopy ECG signal. It is evident that the proposed method is able to detect various peaks of ECG signal i.e. P, Q, R, S and T efficiently and correctly.

3.4 Classification of Arrhythmias.

Life threatening arrhythmias classification is done using Neuro Support Vector Machine (SVM) method. A SVM is known to have the advantage of offering solid performance of classification with even smaller learning data. The purpose of Support Vector classification is to devise a computationally efficient way of learning good separating hyper planes in a high dimensional feature space. Support Vector Machines are an attractive approach to data modeling. They combine generalization control with a technique to address the curse of dimensionality. The detailing brings about a worldwide quadratic enhancement issue with box imperatives, which is promptly explained by inside point techniques. The kernel mapping provides a unifying framework for most of the commonly employed model architectures, enabling comparisons to be performed.

4. Experimental results

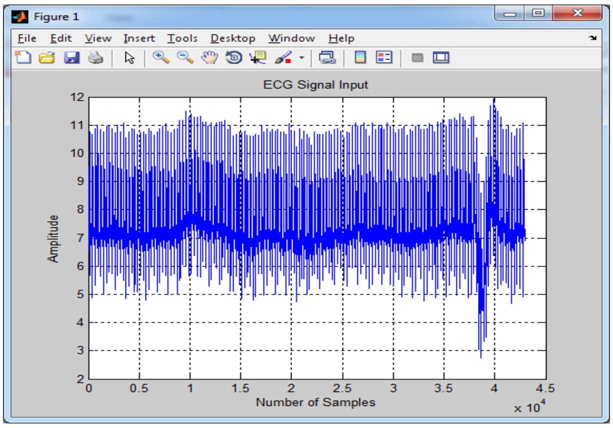

Fig.2: ECG Input Signal

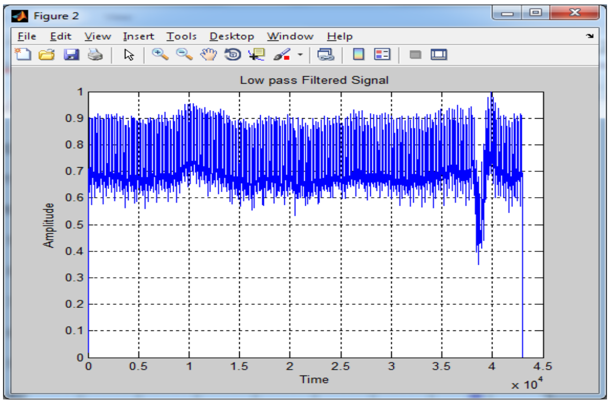

Fig.3: Low Pass Filtered Signal for the given input ECG Signal

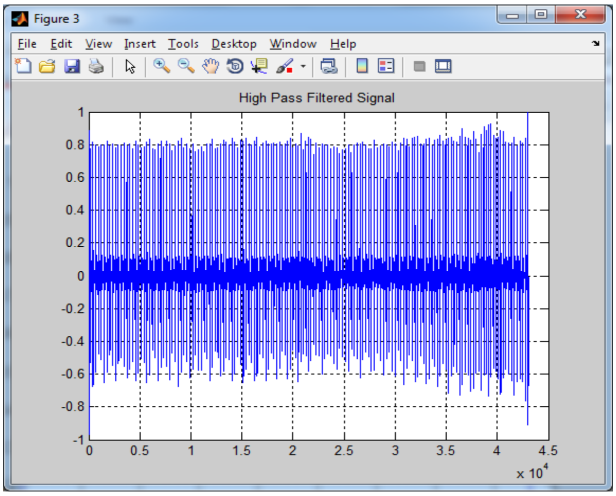

Fig.4: High Pass Filtered Signal only with the signals above cutoff frequency

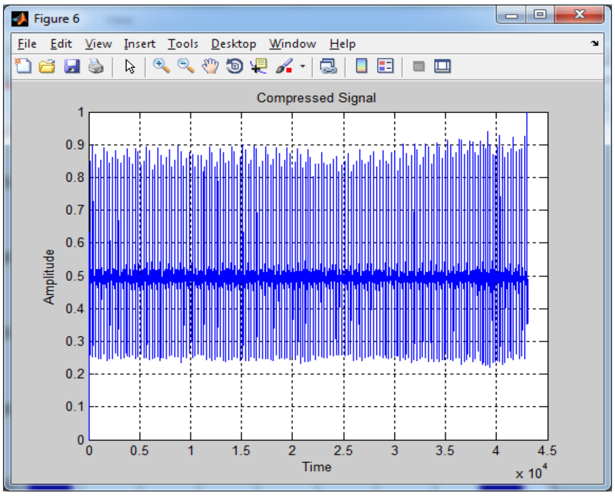

Fig.7: Compressed Signal which reduces bits by identifying and eliminating statistical redundancy

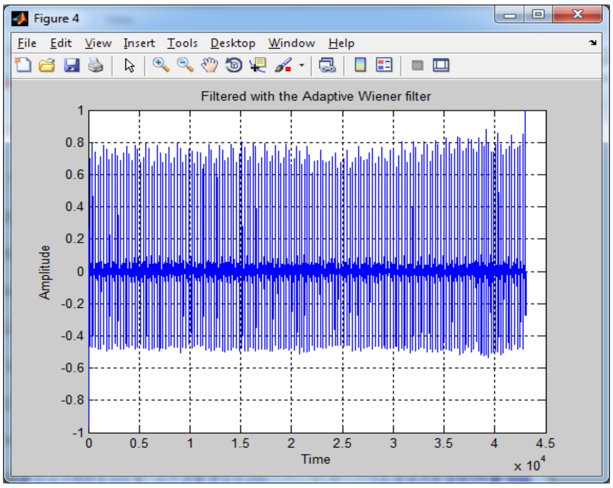

Fig.5: Filtered the observed noisy signal using Adaptive Wiener filter

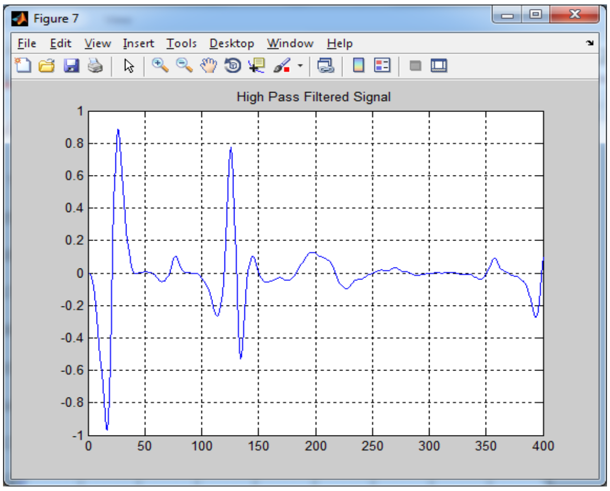

Fig.8: High-pass Filtered Signal for only few samples

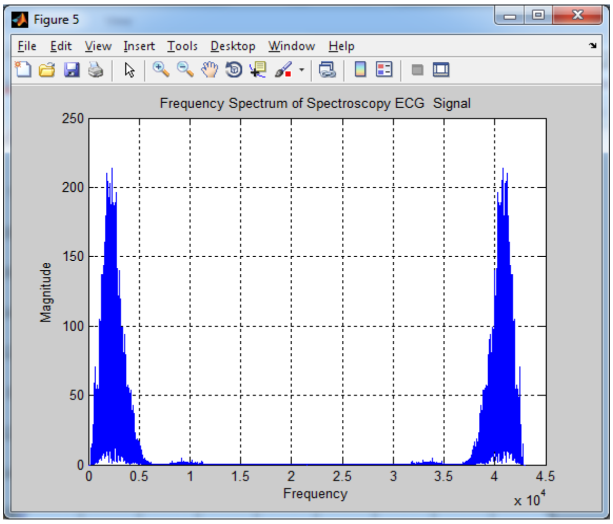

Fig6: Frequency Spectrum of Spectroscopy ECG Signal to calculate magnitude of the given signal

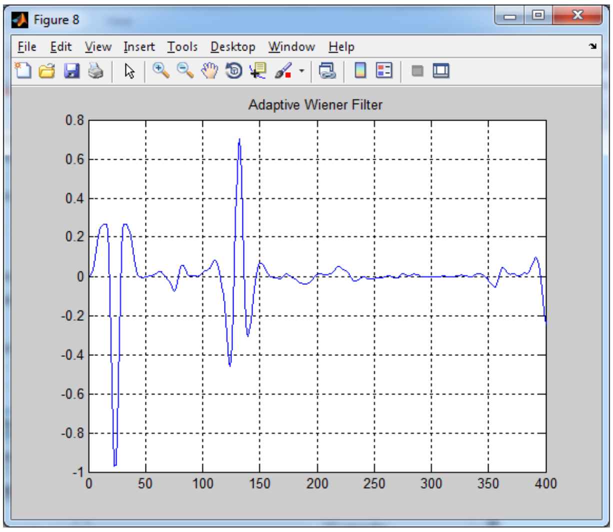

Fig.9: Adaptive Wiener Filtered Signal by eliminating more fluctuations for few samples

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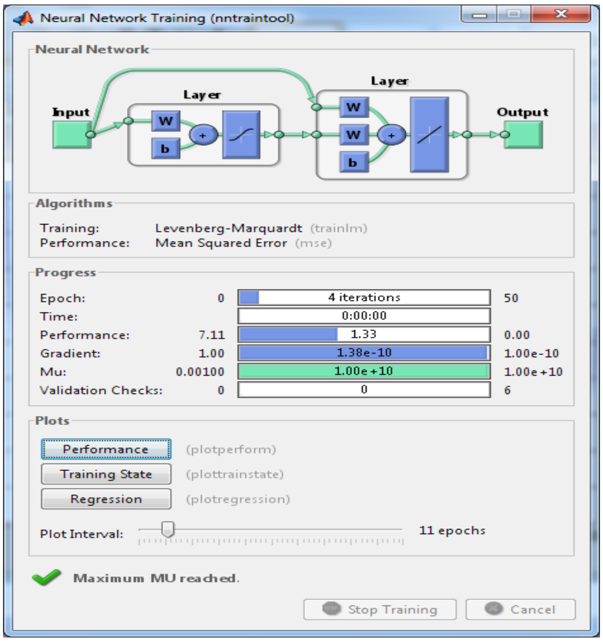

Fig.10: During Neural Network Training, the progress is constantly updated in the training windows

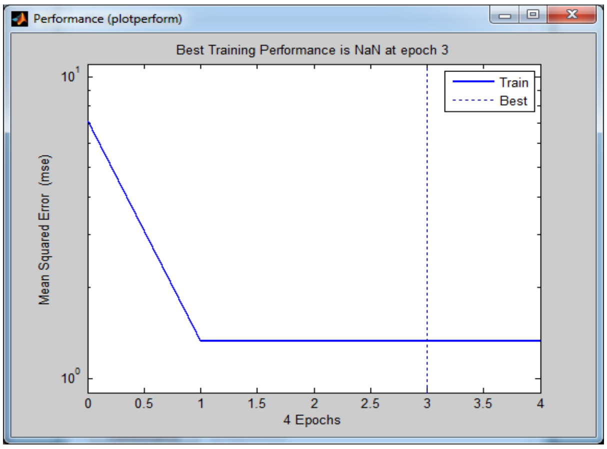

Fig.11: Best Training Performance in NaN at epoch 3

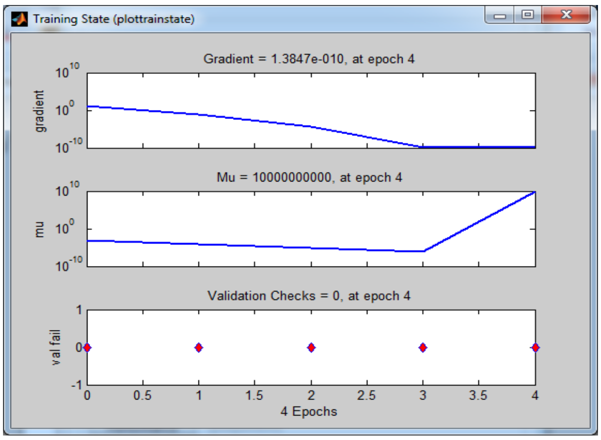

Fig.12: Training State shown with the graph plotting gradient, Mu and validation at epoch 4

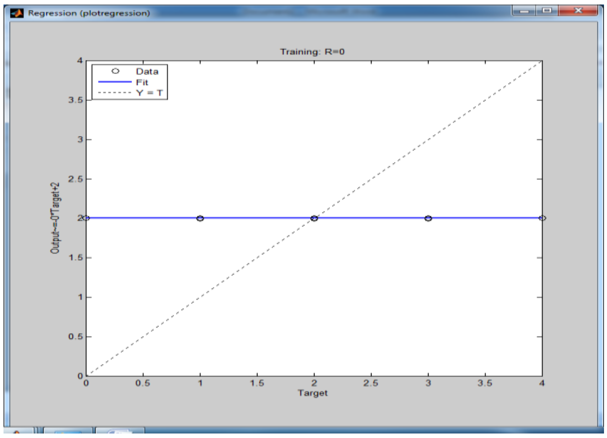

Fig.13: Regression state shown with the graph plotting with Target verses Output

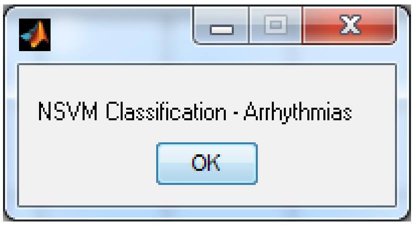

Fig.14: Final output results showing that the given Spectroscopy ECG Signal has Arrhythmias using NVSM Classification

5. Conclusion

Spectroscopy ECG signal carries very important information about the abnormalities in heart and other organ of human body. It is in this way exceptionally important to investigate the flag effectively which helps the specialists to take the choice instantly. Consequently there is have to devise some calculation which can break down the ECG flag effectively. One novel feature representation of arrhythmias classification using spectroscopy signals of human is done, based on adaptive filter, feature extraction and support vector machine.

References

[1] Y. Der Lin and Y. Hen Hu, "Power-line interference detection and suppression in ECG signal Processing," IEEE Trans. Biomed. Eng.,vol.55, pp. 354-357,Jan.2008.

[2] Mr. Ateet Joshi, Dr.Aravind.H.S, "Analysof Adaptive Wavelet Wiener Filtering for ECG Signals": Review,International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 3, Issue 4, April 2014.

[3] ChinmayChandrakar, M.K. Kowar, "Denoising ECG Signals Using Adaptive Filter Algorithm," International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2331-2307, Volume-2, Issue-1, March 2012

[4] K. D. Wesson, R. M. Ochshornb, and B. R. Land, "Low-cost, high-fidelity, adaptive cancellation of periodic 60 Hz noise," Journal of Neuroscience methods, vol. 185, pp. 50-55, 2009.

[5] Akansu, Ali N.; Haddad, Richard A. (1992), Multiresolution signal decomposition: transforms, subbands, and wavelets, Boston, MA: Academic Press, ISBN 978-0-12-047141-6.