INTERNATIONAL JOURNAL OF MERGING TECHNOLOGY AND ADVANCED RESEARCH IN COMPUTING

ISSN: 2320-1363

A New Algorithm For Ecg Signal Compression And Decompression

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Abstract

The biomedical waveforms, such as electrocardiogram (ECG) and arterial plus, always possess a lot of important clinical information in medicine and are usually recorded in a long period of time in the application of telemedicine. Due to the huge amount of data to compress the biomedical waveform data is vital. By recognition the strong similarity and correlation between successive beat patterns in biomedical waveform sequences an efficient data compression scheme mainly based on pattern matching is introduced in this paper. This project presents a new hybrid algorithm for ECG signal. Following beat delineation the periods of the beats are normalized by multirate processing. The main aim of this project is to eliminate the noise introduced in the data acquisition system and in the signal processing methodologies. This project also concentrates in the data compression using discrete wavelet transform. The de compressed wave form is analyzed for its reconstruction error. In this paper we are taking a sinusoidal signal as the ECG signal and we are applying the algorithm to that signal.

1. Introduction

It is very important to record physical condition of human being. Heart beat is one of those physical conditions. It is important to record the patients ECG for a long period of time for clinical diagnosis. This produces a large volume of ECG data everyday for storage and transmission. An efficient and accurate data compression technique is important for ECG signal. ECG signal compression has been one of the major biomedical research topics during the last decades. Triggered by the availability of new theoretical tools technological advances and e-health initiatives a plethora of original solutions have been reported and comparative tests on publicly available databases were conducted. Many algorithms have been proposed to the development of ECG data compression. Wavelet based linear prediction algorithm and high performance compression algorithm using pattern matching for ECG compression have been proposed. One common aspect shared by many of the top per formant compression method refers to the use of the Discrete Wavelet Transform (DWT). It has been widely used in ECG signal analysis since this type of signals favors processing tools with variable time frequency resolution. Reported result indicate that DWT not only enable reliable identification of specific points and segments characterizing the ECG waveforms but may also yield high compression ratios since most of the signal energy is concentrated in a limited number of

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significant coefficients. In this paper a new algorithm is proposed for ECG data compression. The algorithm consists of two main parts one is encoder and another one is decode. In the encoder the ECG signal or the normal signal defined into beats and then amplitude normalization is performed. Afterwards discrete wavelet transforms (DWT) is performed for each beat and we get DWT coefficients for representing the normalized beats. Certain significant coefficients are selected for transmission. In the decoder the normalized beats are reconstructed by inverse discrete wavelet transform (IDWT) and the original signal is reconstructed beat by beat.

Recent studies revealed that a cardiologist would spend most of the time inspecting specific regions along the ECG waveform hence in order to preserve critical diagnose information we shall construct the mask by combining the contributions of several distinct foveal points placed on the R peak and the middle of the P and T waves respectively. The discussion of the paper is as follows encoding part is discussed in the next session and decoding part is done is discussed in the third session. Experimental results are discussed in the next session followed by conclusion.

2. Related Work

2.1 Pattern matching of ECG signal

In this project matching scheme for electrocardiogram ECG signal is purely based on wavelet transform. The flowcharts of encoding part are shown in figure 1 and 2 respectively. The procedures in the encoder will be discussed step by step in the following sections.

Normalization of beat signal

We define a cycle as the signals form one R-peak to the next peak. The wavelet transform is introduced as a method for analyzing electromagnetic transient's associated with power system faults and switching. These processes like the Fourier transform provides information related to the frequency composition of a waveform but it is more appropriated than the familiar Fourier methods for the non periodic wide band signals associated with electromagnetic transients. This one is use the technique reported for QRS detection. Beat normalizing the period of each isolated beat. Sampling rate changing by different fractional factors for different cycles is involved and the beat of different periods are converted into beats of a constant period thus eliminating the effect of heart rate variability. Fixed length of the cycles is selected based on the maximum possible period of any cardiac cycle and sampling frequency. And if you further choose the best wavelets adapted to your data or truncate the coefficients below a threshold your data is sparsely represented. This sparse coding makes wavelets an excellent tool in the field of data compression. Other applied field that are making use of wavelets include astronomy, acoustics, nuclear engineering, sub band coding signal and image processing, human vision, and pure mathematics applications such as solving partial differential equations. The modified sampling rate must still satisfy the Nyquist criterion. Then have to select a length such that the new sampling rate is always higher than the original one ensuring that there will be no distortion of the signal. The standard period is estimated from some initial cycles of the data being coded and this value is initial cycles of the data being coded and this value is initially sent to the decoder.

The normalized amplitude brings about further similarity between the beat patterns. Each sample of a beat is divided into the magnitude of the largest sample of the beat. It makes magnitude of the largest sample of each beat equal to unity. The variations between the magnitudes of different cycles are minimized. Each cycle being coded the amplitude scale factor is transmitted to the decoder.

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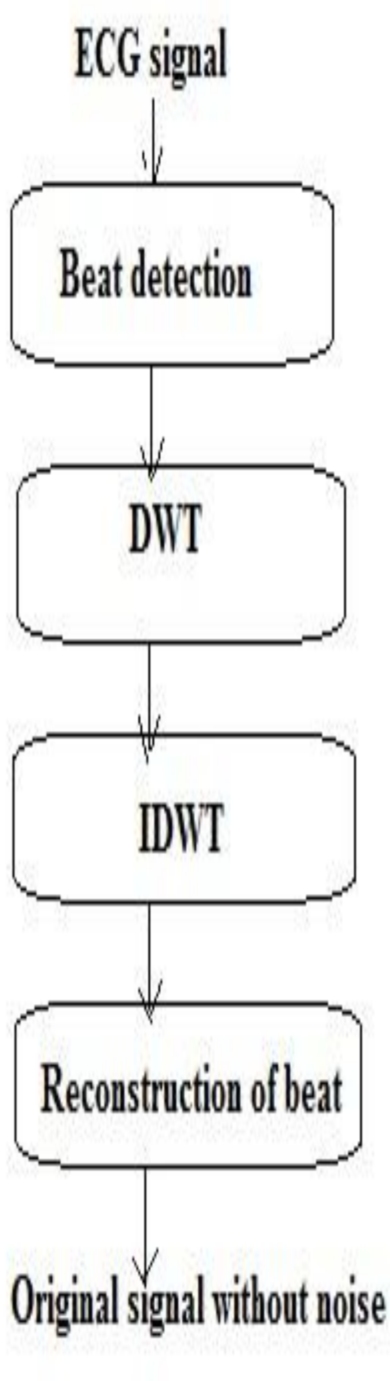

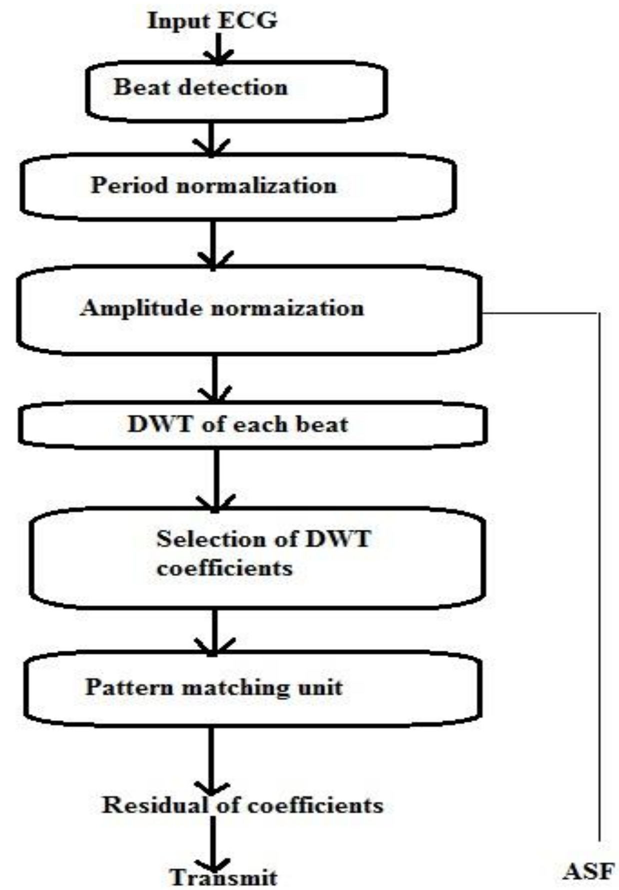

Block diagram of encoder

3. Methodology

3.1 Wavelet transform of normalized beats

Dilation and translation of the mother function or analyzing wavelet φ(x) define an orthogonal basis our wavelet basis. In wavelet analysis a mother function φ(x)

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and linear combination of its dilated and shift versions are used represent a given signal

$$f(x) = \sum_{j\in Z}\sum_{k\in Z} wj,k\varphi j,k(x) \quad (1)$$

where f(x) is signal to be analyzed $\varphi_{j,k}(x)$ is the dilated and shifted version of mother wavelet φ(x), j and k determine the dilation and shift factor respectively $W_{j,k}$ are wavelet coefficients and $\varphi_{j,k} = \varphi(2^j - k)$. of many available orthogonal basis functions.

Wavelets are functions that satisfy certain mathematical requirements and are used in representing data or other functions. The idea is not new. Have to used Daubechies-4 (D4) functions for representing each normalized beat. Because high suitability of time localized basis functions for representing the locally no stationary ECG cycle not all the wavelet coefficients are significant in the reconstruction of any beat.

One of the most useful features of wavelet is the ease with which a scientist can choose the defining coefficients for a given wavelet system to be adapted for a given problem. In daubechies original she developed specific families of wavelet system that were very good for representing polynomial behavior. The Haar wavelet is even simpler and it is often used for educational purposes. By choosing a fixed set of significant coefficients to be transmitted from each beat important rhythm and morphological information can be still be retained. Observed that only the highest of the coefficients are necessary for reconstruction without loss of any significant rhythm or morphological information.

Pattern matching

Correlation between the corresponding wavelet coefficients of different normalized beats the current one can be approximated by certain past coefficients and only the residual need to be transmitted. We perform pattern matching of wavelet coefficients across beats. The variance of residuals obtained is less than that of the original coefficients. Thus we are able to allocate fewer bits to each residual than the number of bits required for each wavelet coefficient set.

The coefficient set template pattern is a pattern appropriately selected from the wavelet coefficients of the data file to be coded and needs to be transmitted to the decoder initially so that the coefficients set template pattern library in the decoder has the same coefficient set as in the encoder. A template replenishing scheme for synchronously updating the libraries in the encoder and decoder is adopted. The residual coefficients set is obtained for each beat which is the difference between the input coefficient set and the coefficient set in the library. When the wavelet coefficient set of input beat varies drastically and become very dissimilar from the one in the library during the encoding session the library must be updated by replacing it with the input coefficient set. The template pattern must also be transmitted to the decoder to synchronize the library.

Decoder

The output of the encoder is given to the decoder as an input. The waveform compressed from the encoder will be decompressing in the decoder section. The ending part of the decoder section consists of reconstructed signal. The coefficients are reconstructed form the residual and the coefficient set template. The normalized beats are then multiplied by the corresponding amplitude scale factors. The original period beat is then recovered by resampling of the normalized beat from which follows the reconstructed ECG signal.

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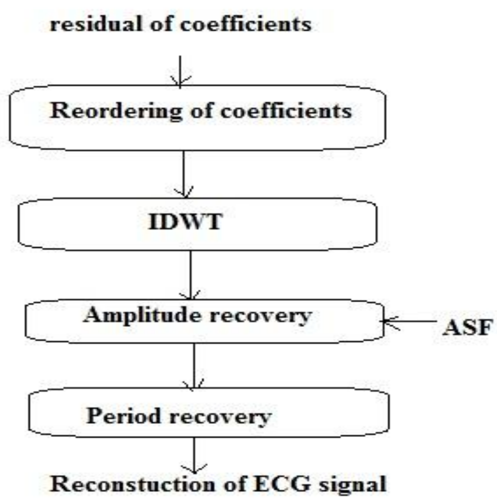
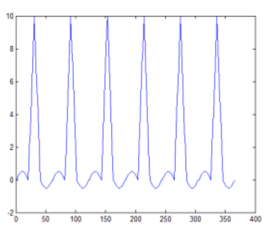
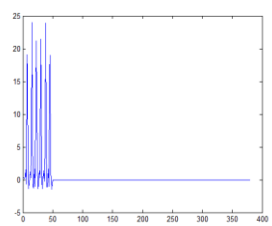
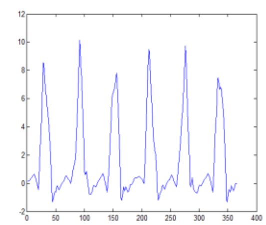


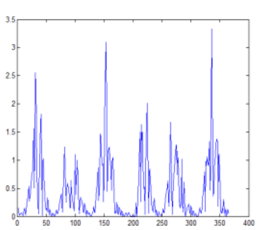
Block diagram of decoder

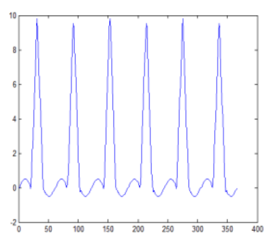
Results with Analogy

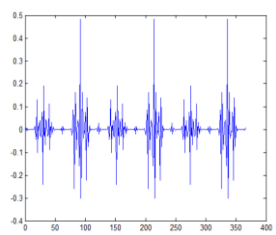
a) 

b) 

c) 

d) 

e) 

f) 

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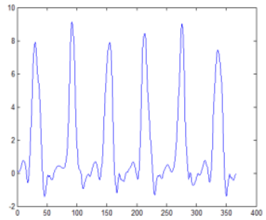
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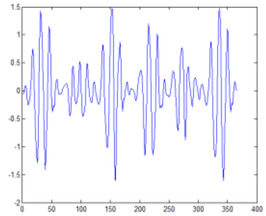
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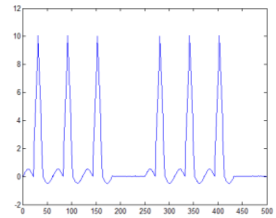
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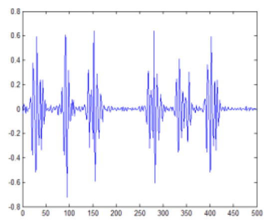
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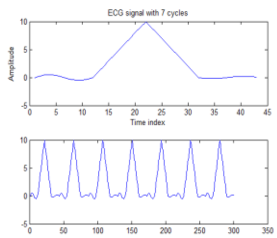

k)

Fig. a). Input ECG signal. b). Encoder output or compressed signal. c). Decoder output or decompressed signal. d). Eliminated noise. e). Input ECG signal. f). Amplitude modulation of input signal. g). output signal after algorithm. h). output signal amplitude modulation. i). missing pulse input. J). missing pulse after detection using amplitude modulation. k). comparison between actual ECG seven cycle signal with single cycle signal.

4. Conclusion

A new hybrid algorithm for ECG signal smoothing has been proposed. The wavelet transform is then performed on the normalized beats and the wavelet coefficients of consecutive beats show high correlation. The designed pattern matching unit for efficient compression. The original signal is reconstructed beat by beat. The proposed algorithm was tested on ECG signal in off line processing techniques. And also we can use this algorithm in online processing technique. In that the error is not uniformly distributed along the whole signal this is caused by the eliminating of some wavelet coefficients.

5. References

[1]. W. S. Chen, L. Hsieh and S. Y. Yuan, "High performance data compression method with pattern matching for biomedical ECG and arterial pulse waveforms," Computer Methods and Programs in Biomedicine.

[2]. A. Ramakrishnan and S. Saha, "ECG coding by waveletbased linear prediction," IEEE Trans. Biomed.

[3]. R. Istepanian, L. Hadjileontiadis and S. Panas, "ECG data compression using wavelets and higher order statistics methods,"IEEE Transactions on Information Technology in Biomedicine. [4]. Zhitao Lu, Dong Youn Kim and W. A. Pearlman, "Wavelet compression of ECG signals by the set partitioning in hierarchical trees algorithm," IEEE Trans. Biomed.

[5]. Y. Zigel, A. Cohen, A. Abu-Ful, A. Wagshal and A. Katz, "Analysis by Synthesis ECG signal Compression," Computers in Cardiology.

ISSN: 2320-1363

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