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Comparative Study On ECG Data Compression Methods

Abhinandini U.

Student, Department of Telecommunication, KSIT, India

Arpitha V.

Student, Department of Telecommunication, KSIT, India

Madhuri C. R.

Student, Department of Telecommunication, KSIT, India

Vijay V.

Assistant professor, Department of Telecommunication, KSIT, India

Abstract

Efficient and reliable electrocardiogram (ECG) compression system can increase the processing speed of real time ECG transmission as well as reduce the amount of data storage in long-term ECG recording. In this paper, different methods of ECG data compression are compared. This paper has done a survey of various kinds of ECG data compression techniques. The proposed method of ECG Data Compression is intended to attain a lossless compressed data with relatively high compression ratio (CR) and low PRD (Percent Root Mean Square Difference). Different transformation may be used for data compression. This requires very less space for decompression. It also provides low noise and has excellent restoration quality. It reduces redundancy that occurs in an ECG signal.

Key words: ECG, Transforms, P.R.D, C.R.

1.Introduction

The electrocardiogram (ECG) is a representative signal containing information about the condition of the heart. The shape and size of the P-QRS-T wave and the time intervals between various peaks contains useful information about the nature of disease affecting the heart. The presences of cardiac abnormalities are generally reflected in the shape of ECG waveform and heart rate. The ECG is a graphic display of the electrical activity of the heart. Due to low cost and non-invasion, ECG signal has been extended for heart disease diagnosis and ambulatory monitoring. For storage and transmission of large signal data, it is necessary to compress the ECG signal data transformational approaches such as Fourier transform (FT), Discrete Cosine Transformation (DCT), and Wavelet Transform (WT). ECG signal is non-stationary signal, Which includes different frequency components at different times and locations. Among the transformation methods, wavelet transform may localize the signal analysis in the both time and frequency domains simultaneously. The most important stage in data compression is the reconstruction of the original signal from the compressed data.[6] Many methods are used for signal reconstruction for compression Techniques.

2.Performance Evaluation

To verify reconstruction signal quality, the performance parameters such as Compression Ratio (CR), Percentage Ratio Difference (PRD) and Signal to Noise Ratio (SNR) are used in this study.

3.Existing Methods

3.1.R-Peak Detection And ASCII Character Encoding

A paper titled "An ECG data compression method via R-peak detection and ASCII character R-peak detection method, single bit generation, grouping, character encoding and the amplification methods. During the survey, CR was found to be 23.10 and the PRD was 7.55%. [1]

3.2.Standard Deviation And The ASCII Character Encoding

A paper titled "An ECG data compression method via standard deviation and the ASCII character encoding" was submitted in the year 2011 using standard deviation, grouping, Amplification, creating difference array and replacement of critical numbers. During the survey, CR was found to be 23.62 and PRD 7.43%. [2]

3.3.Transform Based Method

A paper titled “A Compression of different Transform based methods for ECG Data Compression” was submitted in the year 2011 using Discrete cosine to transform the method with CR is in the range 110-86.108 and PRD is being in the range 110-0.34%, ECG data compression with CR being in the range 111-86.991 and PRD is being in the range 111-0.31%, Wavelet transforms with CR is in the range 117-86.133 and being in the range 117-0.39% .

Using wavelet transform is one of the best methods because the samples of the wave at different time intervals is considered. If there is any discontinuity in the wave noticed , it is considered as zero. Hence the original signal can be reconstructed. [3]

3.4.Correlation Prediction

A paper titled”Optional quality control of ECG data compression algorithm” was submitted using Electro Cardio signal, correlation prediction, JPEG 2000, compression encoding, Zero tree detecting techniques. The CR was found to be 2.6 and the PRD is 5.7930%. [4]

3.5.DCT-LZWAlgorithm

A paper titled “ECG Monitoring over Bluetooth Data compression and transmission“ was submitted in the year 2010 using DCT-LZW algorithm. [5]

3.6 .Wavelet Neural Method

A paper titled “ECG data compression Research based on Wavelet Neural Network” using an ECG compression algorithm and wavelet neural method. During the survey, CR was found to be 7.6 and the PRD is 2.74%. [6]

3.7. Wavelet Neural Method

A paper titled “Wavelet based ECG Data Compression System with Linear Quality Control Scheme “was submitted in the year 2010 using wavelet neural method. [7]

3.8 .Wavelet Decomposition Method

A paper titled “Multichannel Data Compression based on Multiscale Principal component Analysis “was submitted in the year 2011 using wavelet decomposition method. During the survey , CR was found to be 5.9 8:1 and PRD of 2.09%. [8]

3.9 .PDLZW Method

The proposed method illustrates a mixture system supported on the arrangement of the Parallel Dictionary Lempel-Ziv-Welch (PDLZW) method and the wavelet transform that gives an effectual cardiogram volume reduction . Primarily load data for the signal, then the ECG signal is wavelet transform. The different families of wavelets like Haar wavelet, Symlets, Daubechies wavelets, orthogonal wavelets; Coiflets are used and compared [9].

3.10.Bp Artificial Neural Networks

ECG compression is an important feature in bio-signal processing. The BP Artificial neural network is used for ECG data compression because the compression precision and compression ratio are high but the compression speed is low. The rate of compression is improved by combining BP with TP algorithm by establishing a weight template library. [10]

Method	CR	PRD (%)
R-Peak Detection	23.10	7.55
Standard deviation	23.62	7.43
Correlation prediction	2.6	5.79
Wavelet neural method	7.6	2.74

Table 1

4.Proposed Method

In this method, combination of scalar and vector quantization is used. This proposed method is mainly focused on reducing Percent Root-mean-square Difference (PRD) to an extremely low value by maintaining sufficiently large Compression Ratio (CR).

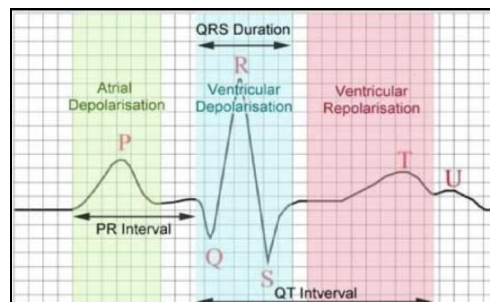


Figure 1

5. Conclusion

In this method, vector quantization is used for Q-R-S curve, which is lossless quantization and scalar quantization is used for P-T-U curve that is lossy quantization.

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