A Survey on Wavelet Based Bio-Medical Data Compression Scheme

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Abstract: In most of the today's telemedicine applications, the amount of medical image data consumes more memory space for store systems and more bandwidth is required to transmit, which further degrades medical image data. In order to overcome certain limitations and retain high image quality, image compression is considered as a useful tool. There are various methods employed in image compression and the most advanced method for image compression is Discrete Wavelet Transform (DWT), because there are less blocking artifacts, which in turn leads to energy compaction with high quality of reconstructed data. The purpose for image compression is to reduce the bit-rate of the actual image, while preserving high quality of the image. In this paper, we present the overview of medical image compression system using wavelet transform.

Keywords: Medical Image Processing, Wavelet Transform.

I. INTRODUCTION

Data compression [8] is defined as the process of reducing the amount of data required in order to reduce the actual size of the data. This can be done by removing the redundant and irrelevance information. The data compression

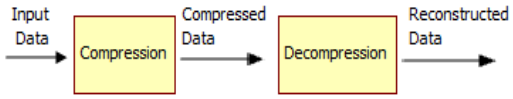

Fig1: The Basic Data Compression System.

system is as shown in fig1. The compression system takes input data and produces a compressed data. The output of compression system is given as the input to the decompression system and produces the output as the reconstructed data. The image can be defined as a two dimensional signal, represented by the mathematical function *f(x, y)* where *x* and *y* represents the horizontal and vertical coordinates respectively. The signal can also be defined as a mathematical function that conveys some information. There are two types of image compression system [14]. They are lossy and lossless image compression. In lossy compression, there is a loss of information but the efficiency of compression ratio is high. In lossless image compression, there is no loss of information but the efficiency of compression ratio is less when compared to lossy compression. The choice of image compression depends on the type of applications. In today's telemedicine applications, biomedical data compression system plays a vital role. In such systems, there should be no loss of information.

The Wavelet Transform [2] [4] can be considered as a useful approach in solving the problem of analyzing the signal/image processing both in time and frequency. Initially the data (i.e., image/signal) is in spatial domain that needs to be transformed into frequency domain in order to extract the features or meaningful information of the data. Thus before compressing any data (image/signal), we need to transform the data from time domain (also known as spatial domain) to frequency domain. For this purpose, the discrete wavelet transform is employed in order to achieve high quality of the data and also the better compression efficiency.

II. BACKGROUND RESEARCH

Earlier much research work took place in the field of medical imaging. Some of those works were focused on feature extraction and image compression. In order to serve this purpose, many methods were used and discrete wavelet transform [1] [4] [6] [9] is the most advanced method that needs to be considered. From the literature survey, we observed that the wavelet transform has been employed in various applications, apart from image compression. Some of them are as follows: signal denoising by wavelets, signal compression, fingerprint compression, image filtering and also in wireless communication systems.

According to the wavelet transform method, the medical image decomposition is done at various levels in order to obtain the coefficients of the image. These coefficients are known as frequency components. Once the coefficients are extracted, now divide the image in smaller blocks. On each block, the encoding is performed using different function. The encoding process is defined in such a way that the most significant pixels will be remained over the image and the low significant pixel will be removed from the image. After this stage, the image information and the compressed one will be obtained effectively from the image. These coefficient blocks are then combined using inverse DWT approach. Once the image is constructed, the compressed form of image is obtained. After this compression stage, the ROI (Region of Interest) extraction is performed based on the significant analysis. Based on this analysis, the segments over the image are defined and the image content mapping to the segments is done based on minimum distance analysis. Once the segments are obtained, the average intensity analysis is performed to identify the integrity of these segments. This cyclic process continued till the effective image information is not obtained from the work.

III. METHODS

Initially the image is in spatial domain which is difficult for image analysis and feature extraction, and need to be transformed into frequency domain in which most of the image information resides. For this purpose, the Discrete Wavelet Transform (DWT) method employed in the image compression system. [16] [17] First, the input image should be transformed from one form to another form in order to enhance the feature extraction of the image or gives the more detailed information of the image. In fig2, the image is first transformed from spatial domain to frequency domain using wavelet transform. The transformation method is also known as mapping.

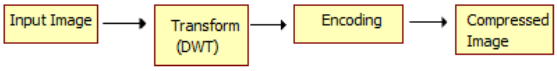

Fig2: The data flow for image compression

After transforming the image from one form to another form, the transformed image is given as input to the encoding process. There are various encoding techniques used in wavelet transform. The selection of these techniques is still a major research challenge work. However, the most efficient encoding technique is chosen with respective applications and then applied on the decomposed image or the transformed image. This produces the compressed image which can be stored in medical database systems for future use. These images in medical systems are useful in many ways like for future medical staff education, for future medical diagnosis and many more.

IV.CONCLUSION

In this article, we discussed about the need to compress a medical image using wavelet transform and also discussed about the various methods used in medial image compression. The most advanced method i.e., discrete wavelet transform is selected for image transformation, which is also used in feature extraction of the image and image segmentation. From a hardware design perspective, complexity reduction can be thought of as a cost reduction when implementing a particular application. There are several open problems and more work to be done

related with the subject. Future work includes: First, to develop parallel versions of the wavelet transform and the image encoders. Second, a study of hardware designs for the algorithms presented, since we have shown that they are suitable for efficient image compression implemented in hardware with low-cost systems.

REFERENCES

[1] Larbi Boubchir, *Member, IEEE,* and Boualem Boashash, *Fellow, IEEE "Wavelet denoising based on the MAP estimation using the BKF prior with application to images and EEG signals*" Journal of latex class files, vol. 11, No. 4, December 2012.

[2] Detlev Marpe, *Member, IEEE*, Gabi Blättermann "*A Two-Layered Wavelet-Based Algorithm for Efficient Lossless and Lossy Image Compression*" 1094 IEEE transactions on circuits and systems for video technology, vol. 10, NO. 7, October 2000.

[3] Chandandeep Kaur, Sumit Budhiraja "*Improvements of SPIHT in Image Compression- Survey*" International Journal of Emerging Technology and Advanced Engineering in Jan 2013.

[4] "*Wavelets and their Applications*" First published in Great Britain and the United States in 2007 by ISTE Ltd.

[5] Ranjeet Kumar A and Kumar G.K. Singh "*Hybrid Method based on Singular Value Decomposition and Embedded Zero Tree Wavelet Technique for ECG Signal Compression*" Computer Methods and Programs in Biomedicine in 2016

[6] M. K. Lakshman and H. Nikookar "*A Review of Wavelets for Digital Wireless Communication*" in 2006 Springer science.

[7] Muhammad Ali Qureshi1 · M. Deriche1 "*A new wavelet based efficient image compression algorithm using compressive sensing*" Springer Science Business Media New York 2015

[8] David Salomon "*Data compression: the complete reference*" Springer-Verlag London Limited 2007

[9] Gulley Tohumoglu, K. Erbil Sezgin "*ECG signal compression by multi-iteration EZW coding for Different wavelets and thresholds*" 2005 Elsevier Ltd.

[10] Regis Fournier and Amine Naït-ali "*Multimodal compression applied to biomedical data*" Article in Journal of biomedical science and engineering · January 2012

[11] Amine Naït-ali, Azza Ouled Zaid and Christian Olivier "*A Novel Scheme for joint Multi-channel ECG ultrasound image compression*" Annual International Conference of the IEEE Engineering in Medicine and Biology Society published in February 2007

[12] M. Abo-Zahhad' *Senior Member ZEEE,* Sabah M. Ahmed2 and A. Al-Shrouf "*Electrocardiogram data compression algorithm based on the linear prediction of the wavelet coefficients.*" in 2000 IEEE publications.

[13] Larbi *Boubchir, Tahar Brahimi, Regis Fournier and Amine Na¨ıt-ali "A novel multimodal compression scheme based on a spiral insertion function in the wavelet domain*" IEEE 2012

[14] Aftab Khan1 & Ashfaq Khan1 & Mushtaq Khan2 & Muhammad Uzair1 "*Lossless image compression: application of Bi-level Burrows Wheeler Compression Algorithm (BBWCA) to 2-D data*" Springer Science Business Media New York 2016

[15] Qiufu Li, Derong Chen, Wei Jiang, Bingtai Liu, and Jiulu Gong "*Generalization of SPIHT: Set Partition Coding System*" IEEE transactions on image processing, vol. 25, No. 2, Feb 2016

[16] Said A, Pearlman WA 1996 " *A new, fast and efficient image codec based on set portioning in hierarchical trees*". IEEE transactions circuits sys video

[17] Shapiro JM 1993 "*Embedded image coding using zerotrees of wavelet coefficients*". IEEE transactions signal process