A Novel Time Frequency Approach of Content Revival Based Medical Image Compression

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Abstract—Storage space requests in healing centers are continuously expanding the compression of recorded medical images. In Medicine Field Medical imaging has an awesome effect on medication, particularly in the fields of analysis and surgical planning. In most cases doctors may not bear the cost of any deficiency in diagnostically important region of images, called regions of interest(ROI). A methodology that carries a high compression rate with great quality in the ROI. This paper exhibits a methodology for a medicinal image compression algorithm. Embedded zerotree wavelet (EZW) coding, presented by J. M. Shapiro, is an extremely powerful and computationally straightforward procedure for image compression. Set-partitioning in hierarchical trees (SPIHT) is a broadly utilized compression algorithm for wavelet-transformed images which gives better execution. These two strategies are used to compress ROI region. In this paper we compress images utilizing EZW and SPIHT algorithms. The point is to build the compression ratio and to get great quality in region of interest. Experimental result demonstrates that SPIHT method has better performance.

Keywords- *Compression,ROI,EZW,SPIHT, CR, PSNR, MSE.*

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I. INTRODUCTION

Compression techniques in medical domain work with dual objectives of diminishing the file size and in the meantime keep up important indicative data. Diminished record size has an immediate effect on transmission speed, which assumes an indispensable part in fields like telemedicine [1]. However, much of the time doctors may not bear the cost of any inadequacy in analytically imperative regions of images; called egions of interest (ROIs). A methodology that carries a high compression rate with great quality in the ROI is consequently essential. The usefulness of ROI is essential in medical applications where certain parts of the image are of higher indicative significance than others. In such a case, these regions should be encoded at higher quality than the background [3] Several compression algorithms were created. J.M. Shapiro added to the implanted embedded zero tree wavelet algorithm in [7] which yields a completely embedded code and consistent compression. With embedded coding, it is possible to recover the lossy version with distortion corresponding to the rate of the received image at the point of decoding process.. EZW is a progressive image compression algorithm[6].One of the most proficient algorithms in the zone of image compression is the Set Partitioning in Hierarchical Trees (SPIHT). The SPIHT coder is a highly refined version of the EZW algorithm and is an effective image compression algorithm After wavelet transform SPIHT algorithm is utilized to encode the coefficients of wavelet. In SPIHT sorting is finished by looking at two components at once and results in yes/no states.[2]. In this paper we can execute both EZW and SPIHT technique for image compression.The compression for the SPIHT system is better than EZW methods.

II. COMPRESSION TECHNIQUES

A. Basic concepts of ROI

The usefulness of ROI is important in medical applications where certain parts of the image are of higher symptomatic significance than others. In such a case, these areas should be encoded at higher quality than the background. During image transmission for telemedicine purposes, these regions are required to be transmitted first or at a higher need. In transformation-based ROI coding methods, the coefficients connected with the ROI are transferred in front of those connected with the background. Consequently, when a image is coded with an emphasis on ROI, it is important to distinguish the coefficients needed for the recreation of the ROI. Thus, an ROI mask is introduced to indicate which coefficients have to be transmitted exactly in order for the receiver to reconstruct the ROI. Usually, the wavelet transform is applied to the image at the encoder side and the resulting coefficients not associated with the ROI are scaled down (shifted down) so that the ROI-associated bits are placed in higher bit planes. The mask in the wavelet domain is a map pointing out all the related coefficients for the reconstruction of the ROI. The relating areas of the coefficients in the following scale are calculated from the present scale. [3]

B. EZW Algorithm

This algorithm established the framework of advanced wavelet coders and gives superb execution to the compression of still images when contrasted with block based DCT algorithm. Presented by Shapiro in 1993 [2], this algorithm utilizes the multi-resolution properties of wavelet transform.

ISSN: 2321-8169
3716 - 3718

The EZW algorithm first uses DWT for the decomposition of an image where at every level i, the lowest spatial frequency subband is split into 4 more subbands for next higher level i+1,i.e., LLi+1, LHi+1, HLi+1 and HHi+1 and then decimated. The algorithm utilizes the thought of significance guide as a sign of whether a specific coefficient is zero or nonzero (i.e.significant) in respect to a given quantization level. This implies that if a wavelet coefficient at a coarse scale or largest amount is irrelevant (quantized to zero) regarding a given threshold T, then all wavelet coefficients of the same orientation at the same spatial area at next better scales (i.e., lower level) are prone to be zero with respect to T. The coefficient at coarse scale is called parent while the coefficients at the next fine scales in the same spatial orientation are called children (Figure 1).[1]

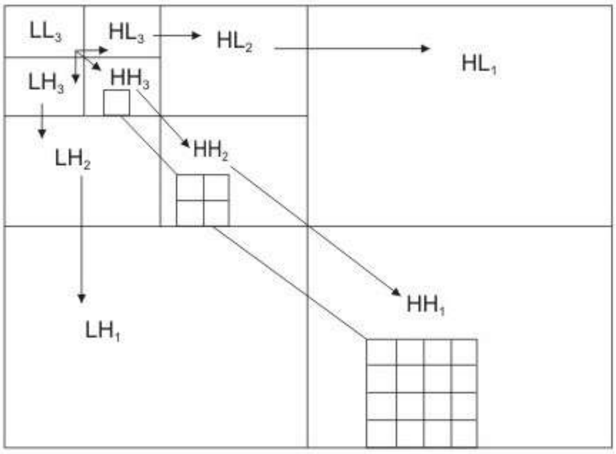

Figure 1. Parent-child dependencies of subbands in EZW

One can utilize this principle and code such a parent as a zero-tree root (ztr), accordingly avoiding from coding every last bit of its children. This gives extensive compression when contrasted with block based coding algorithms such as DCT. EZW scans wavelet coefficients subband by subband in a zigzag manner. Parents are scanned before any of their children by first scanning all neighboring parents. Each coefficient is compared against the current threshold T. A coefficient is significant if its amplitude is greater than T; such a coefficient is then encoded using one of the symbols negative significant (ns) or positive significant (ps). The zero-tree root (ztr) symbol is utilized to signify a coefficient below T, with every one of its children in the zero-tree information structure likewise below T. The isolated zero (iz) image implies a coefficient below T, however with one of its child not below T. For significant coefficients, EZW further encodes coefficient values using successive approximation quantization (SAQ plan. Coding is done bit-plane by bit-plane. The successive approximation approach to quantization of the wavelet coefficients prompts the embedded nature of EZW coded bit-stream. At long last the coefficients in the bit-stream are coded losslessly utilizing adaptive arithmetic coding.

C. SPIHT algorithm

SPIHT stands for Set Partitioning in Hierarchical Trees. The SPIHT coder is a very refined version of the EZW algorithm and is a powerful image compression algorithm that produces an embedded bit stream from which the best recreated images. The SPIHT algorithm, presented by Said and Pearlman [7],is a efficient technique for both lossy and loss-less natural image coding. The SPIHT algorithm adopts a hierarchical quad-tree data structure on a wavelet-transformed image. The energy of a wavelet-transformed image is centered on the low-frequency coefficients and the coefficients are ordered in hierarchies and have a parent-child relationship through subbands. By utilizing this relationship, the SPIHT algorithm saves many bits from representing insignificant coefficients. The coding procedure of the SPIHT algorithm is briefly described as follows. The SPIHT algorithm can be defined recursively using a sequence of thresholds[8].

1) Intitialization: Set the list of significant points(LSP) as empty.Set the roots of similarity trees in the list of insignificants points(LIP) and the list of the insignificant sets(LIS).Set the threshold $T_0=2^n$ with

$n = \lfloor \log_2 (\max |c(i,j)|) \rfloor$, where $c(i,j)$ denotes the

coefficient at position (i,j) .

2) Sorting pass in LIP: Each coefficient in the LIP is checked and the significant coefficients are moved to the LSP. The sign bits of the significant coefficients are encoded.

3) Sorting pass in LIS: If an entry in the LIS is significant, a one is sent and then its two offspring are checked like an entry in the LIP. If an entry in the LIS is insignificant, a zero is sent.
4) Refinement pass: Each old entry of LSP is checked.If it is significant under current threshold, a one is sent and its magnitude reduced by the current threshold. If it is insignificant, a zero is sent.

D. Comparison Parameters

The image that has been regenerated after being compressed can be compared using MSE,PSNR and compression ratio.
Compression Ratio CR = n1/n2
Mean Square Error (MSE) σ2,

$$\sigma^2 = \frac{1}{N}\sum_{n=1}^{N}(x_n - y_n)^2$$

where xn, yn, and N are the input data sequence, reconstructed data sequence, and length of the data sequence respectively.

PSNR

$$PSNR = 10\log_{10}\frac{x_{peak}^2}{\sigma_d^2}$$

III. EXPERIMENTAL RESULTS

The EZW and SPIHT methods was vigorously tested with test images to analyze its performance on compressing medical images. The methods is evaluated using the performance parameters, like MSE, Compression Ratio, Peak Signal to Noise Ratio (PSNR).

A. MSE

The average MSE values obtained are shown in Figure.

IMAGE	ezw	spiht
Image-1	84.52	66.24
Image-2	352.43	129.09
Image-3	92.17	75.77
Image-4	189.67	122.87

Figure 2: The average MSE values

B. PSNR

The average PSNR values obtained are shown in Figure.

IMAGE	ezw	spiht
Image-1	28.9	29.95
Image-2	22.69	27.06
Image-3	28.52	29.37
Image-4	25.38	27.27

Figure 3: The average PSNR values

C. Compression Ratio

The average compression ratio obtained during experimentation for the test images is shown in figure.

IMAGE	ezw	spiht
Image-1	72	78
Image-2	91	94
Image-3	92	94
Image-4	79	84

Figure 4: The average CR values in %

IV. CONCLUSION

The EZW and SPIHT algorithms for medical images was analyzed and compared in this paper. The compression process began with identifying the ROI and background information of the medical image.Various experiments conducted showed that SPIHT method produce better results and shows significant improvement in terms of MSE,PSNR,and compression ratio.There are many possible directions for future investigation. In order to obtain better compression rates, the ROI algorithm can be improved.

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