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Hybrid Medical Image Compression Method Using SPIHT Algorithm and Haar Wavelet Transform

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Abstract— CT or MRI Medical imaging produces digital form of human body pictures. There exists a need for compression of these images for storage and communication purposes. Current compression schemes provide a very high compression rate with a considerable loss of quality. In medicine, it is necessary to have high image quality in region of interest, i.e. diagnostically important regions. So, ROI part can be compressed with the help of the Lossless compression whereas Non Region of interest part can be compressed with help of Lossy compression as it is of lesser importance for diagnosis. In this paper Region of interest part is extracted with the help of thresholding method of segmentation and compressed with the help of SPIHT Algorithm thus producing a good quality image. And NROI part is compressed with the help of Haar wavelet transform.Our algorithm provides better PSNR values for medical images.

Keywords— SPIHT(Set Partitioning In Hierarchical Tree),Haar wavelet transform, Binary Thresholding, median filter, PSNR(Peak signal to noise ratio), ROI, NROI

INTRODUCTION

Image compression based on region of interest has been one of the hot issues in the field of image compression and coding. However, there is not a fixed model for region of interest automatic detected. In order to reduce storage spaces and transmission times of infrared target image data, a coding way is proposed for ROI automatic detected of image based on the region growing segmentation algorithm. In order to improve efficiency for transferring image data in real time, a coding-crossed algorithm for ROI automatic detected of infrared target image is studied as same time as it is realized on the frame of SPIHT Algorithm. An experimental study is also conducted that is proved the method of detecting automatically and compression algorithm based on region of interest automatic detected is reliable and effective, significant in applications. Non region of interest part is of lesser importance as it is the background part which is not much helpful in diagnosis of the disease. So, using the lossy method of compression for compressing the background part will make the compression more easier and will also not effect the issue of diagnosing the disease.

Currently, many applications want a representation of the image with minimal storage. Most images contain duplicate data. There are two duplicated parts of data in the image. The first is the existence of a pixel that has the same intensity as its neighboring pixels. These duplicated pixels waste more storage space. The second is that the image contains many repeated sections (regions). These identical sections do not need to be encoded many times to avoid redundancies and, therefore, we need an image compression to minimize the memory requirement in representing a digital image. The general principle used in the process of image compression is to reduce duplication of data within the image so that the memory needed to represent the image is smaller than the original image.

The block diagram of the proposed methodology is shown below in figure 1.

The methodology consist of following parts:-

1. Filtering
2. Segmentation of ROI and NROI
3. ROI compression using SPIHT Algorithm
4. NROI compression using Haar wavelet transform

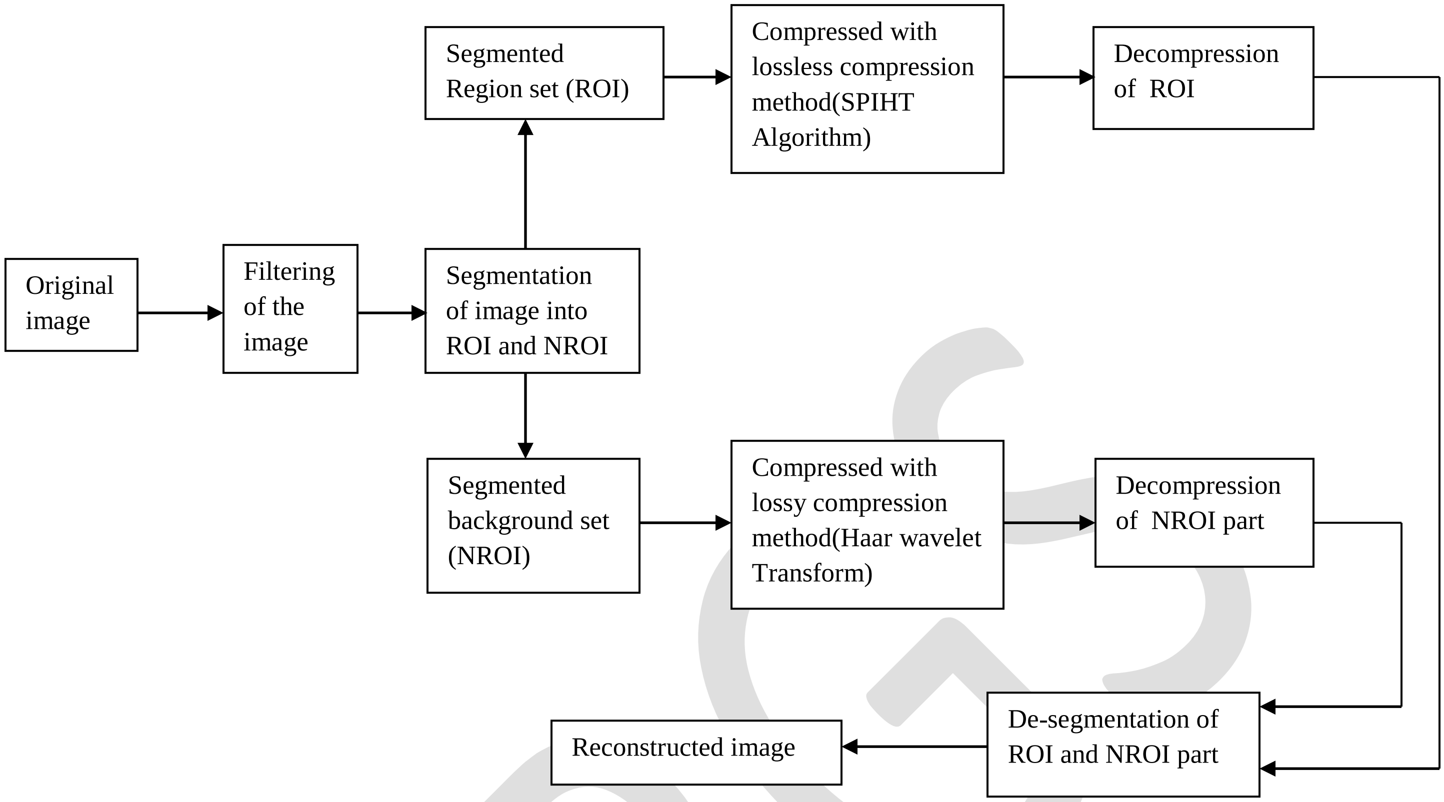


FIGURE 1: BLOCK DIAGRAM OF METHODOLOGY

METHODOLOGY

1.FILTERING

In image processing, it is often desirable to be able to perform some kind of noise reduction on an image so that image could be clearly visible. In this methodology median filter is used.

The median filter is a non linear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise

The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal .For 2D (or higher-dimensional) signals such as images , more complex window patterns are possible (such as "box" or "cross" patterns). In this methodology a *brain tumor* image is considered as shown below:-

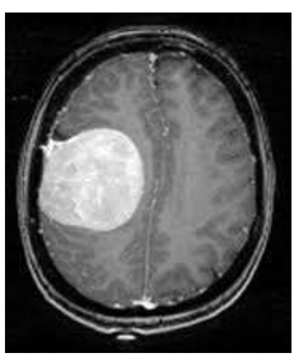
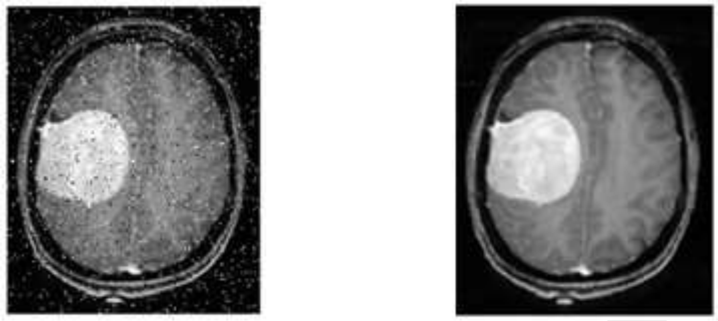


Figure 2: Brain Image with Tumor

Noise in the form of salt & pepper noise is added. It is filtered with the help of median filter and output is shown below:-



(a) (b)

Figure 3: (a) Brain image with salt and pepper noise (b) Filtered image(PSNR-37.8858 dB)

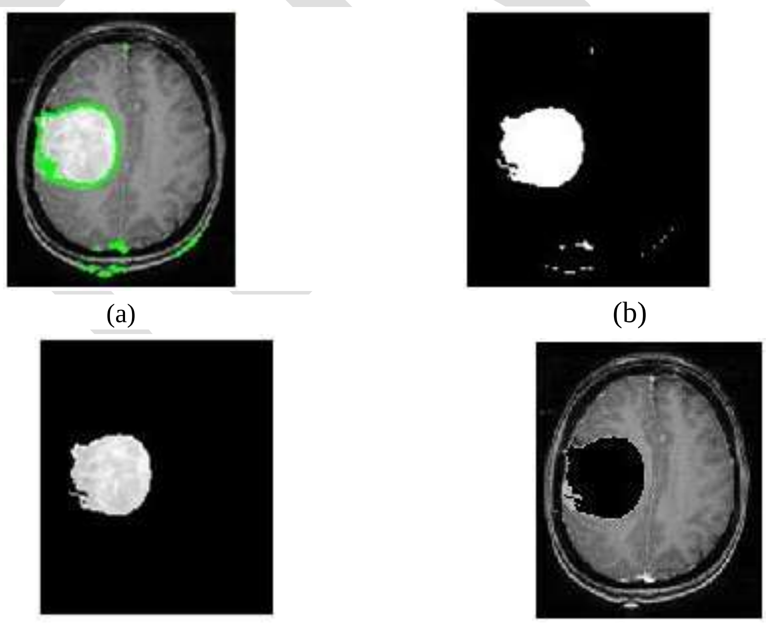
2. SEGMENTATION OF ROI AND NROI

In the proposed methodology Binary thresholding method is used for segmenting the image into ROI and NROI part.

Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. Image thresholding [6] is most effective in images with high levels of contrast. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T (that is), or a white pixel if the image intensity is greater than that constant.

In this method the ROI part is the tumor part in the brain having the intensity greater than the background part so tumor part is separated from the original brain image and further compressed for transmission.

The segmentation of ROI and NROI part is shown below:



(a) (b)

(c) (d)

Figure 4: (a) Outlined tumor part in the Brain image (b) Binary image obtained after thresholding, threshold value(T=190) (c) Tumor part (ROI) (d) Background part after removal of the tumor(NROI)

3. SPIHT ALGORITHM

SPIHT (Set Partition in Hierarchical Trees) [5] is one of the most advanced schemes, even outperforming the state-of-the art JPEG 2000 in some situations. The basic principle is the same; a progressive coding is applied, processing the image respectively to a lowering threshold. The difference is in the concept of zero trees (spatial orientation trees in SPIHT). There is a coefficient at the highest level of the transform in a particular sub band which considered insignificant against a particular threshold; it is very probable that its descendants in lower levels will be insignificant too. Therefore we can code quite a large group of coefficients with one symbol. A spatial orientation tree is defined in a pyramid constructed with recursive four sub bands splitting.

Normally most of an images energy is concentrated in the low frequency components Consequently the variance decreases as we move from the highest to the lowest levels of the sub band pyramid Furthermore it has been observed that there is a spatial self similarity between sub bands and the coefficients are expected to be better magnitude ordered if we move downward in the pyramid following the same spatial orientation [1].

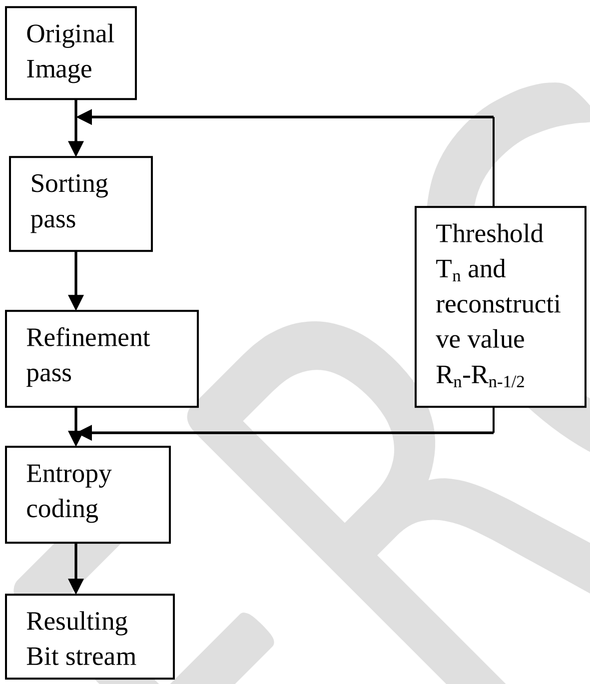


Figure 5: Flowchart of SPIHT

In the proposed methodology the Brain tumor image is then separated into ROI and NROI part. The ROI part is compressed with help of SPIHT Algorithm and then reconstructed at receiver end. The PSNR of reconstructed image is calculated and shown below:-

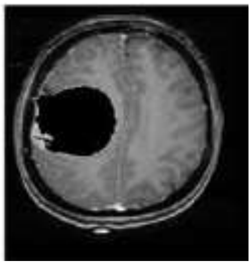
(a) (b)

Figure 7:(a) ROI uncompressed part before applying SPIHT Algorithm (b) Reconstructed image of the tumor of the brain with PSNR=69.7988 dB for bpp=1.00

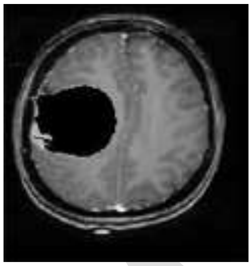
4. HAAR WAVELET TRANSFORM

Haar wavelet compression is an efficient way to perform both lossless and lossy image compression. It relies on averaging and differencing values in an image matrix to produce a matrix which is sparse or nearly sparse. A sparse matrix is a matrix in which a large portion of its entries are 0. A sparse matrix can be stored in an efficient manner, leading to smaller file sizes. In these notes we will concentrate on grayscale images; however, rgb images can be handled by compressing each of the color layers separately. The basic method is to start with an image A, which can be regarded as an m × n matrix with values 0 to 255. In Matlab, this would be a matrix with unsigned 8-bit integer values. We then subdivide this image into 8 × 8 blocks, padding as necessary. It is these 8 × 8 blocks that we work with.

In the proposed methodology the separated NROI part is compressed with the help of the Haar wavelet transform and then reconstructed at the receiver end. The PSNR of reconstructed image is calculated and shown below:-



(a)



(b)

Figure 8:NROI uncompressed part before applying Haar Wavelet Transform (b) Reconstructed image of the background of the brain with PSNR=44.74 dB for bpp=1.00

CONCLUSION

At the final stage of the algorithm we have combined the background part and region of interest part and calculated the PSNR value. Table-1 illustrates compressed image quality with different bit rate values (number of bits per pixel).We have varied the bits per pixel from 0.25-2.00 Bpp and PSNR is calculated. We have compared our algorithm with SPIHT method of compression and we have found that our algorithm is better. From Table-1 it is evident that for higher bit rate higher PSNR is obtained and our algorithm shows better PSNR output than SPIHT. Hence we have obtained a satisfactory result and in future we would try to compress colored image.

Table 1: PSNR Calculation

S.No.	BPP(Bits per Pixel)	SPIHT(ROI) and HAAR (NROI)	SPIHT
1	0.25	37.4182	19.9700
2	0.50	39.9725	25.2000
3	0.75	41.4570	30.3384
4	1.00	41.8750	34.8400
5	1.25	41.9874	36.2500
6	1.50	42.0072	38.8800
7	1.75	42.0109	40.0100
8	2.00	42.0153	41.1850

REFERENCES:

[1] Md. Ahasan Kabir, M. A. Masud Khan, Md. Tajul Islam, Md. Liton Hossain, Abu Farzan Mitul Image Compression Using Lifting Based Wavelet Transform Coupled With SPIHT Algorithm Informatics, Electronics & Vision (ICIEV), 2013 International Conference on 17-18 May 2013 at Dhaka

[2] Jia ZhiGang Guo XiaoDong Li LinSheng, A Fast Image Compression Algorithm Based on SPIHT, Industrial Electronics and Applications, 2009. ICIEA 2009. 4th IEEE Conference on 25-27 May at Xi'an.

[3] T.P. Fowdur D. Indoonundon K.M.S. Soyjaudah ,An Unequal Error Protection Scheme for SPIHT Image Transmission with Prioritised Retransmissions and De-noising, AFRICON, 2013, 9-12 Sept. 2013 at Pointe-Aux-Piments.

[4] Sure. Srikanth, Sukadev Meher, Compression Efficiency for Combining Different Embedded Image Compression Techniques with Huffman Encoding International conference on Communication and Signal Processing, April 3-5, 2013, India,IEEE

[5] Amir Said, William A Pearlman, A New Fast and Efficient Image Codec Based on Set Partitioning in Hierarchical Trees IEEE Transactions on Circuits and Systems for Video Technology Vol6 June 1996

[6] Rajesh C. Patil, Dr. A. S. Bhalchandra, Brain Tumour Extraction from MRI Images Using MATLAB International Journal of Electronics, Communication & Soft Computing Science and Engineering,ISSN: 2277-9477, Volume 2, Issue 1

[7] P. Vasanthi Kumari, Dr.K.Thanushkodi ,A Secure Fast 2D - Discrete Fractional Fourier Transform Based Medical Image Compression Using Hybrid Encoding Technique**,** International Conference on Current Trends in Engineering and Technology, ICCTET'13 1© *IEEE 2013*

[8] LiBin meng qingang ,An Improved SPIHT Wavelet Transform in the Underwater Acoustic Image Compression, 2013 2nd International Conference on Measurement, Information and Control,978-1-4799-1392-3/13 IEEE

[9] C. Rengarajaswamy, S.Imaculate Rosaline ,SPIHT Compression on Encrypted Images Proceedings of 2013 IEEE Conference on Information and Communication Technologies (ICT 2013).

[10] Salija.P , Manimekalai.M.A.P, N.A Vasanthi, PhD. ROI and Seam-SPIHT based Efficient Image Compression for Mobile Multimedia and Medical Applications, International Journal of Computer Applications (0975 – 8887) Volume 64– No.12, February 2013.

[11] Papitha, G. Merlin Nancy and D. Nedumaran, *Member, IEEE*, Compression Techniques on MR Image – A Comparative Study, International conference on Communication and Signal Processing, April 3-5, 2013, India.

[12] U.S.Ragupathy,D.Baskar,A.Tamilarasi New Method of Image Compression Using Multiwavelets and Set Partitioning Algorithm, 2008 IEEE Region 10 Colloquium and the Third International Conference on Industrial and Information Systems, Kharagpur, INDIA December 8 -10, 2008