ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

Image Compression Using SPIHT

Veera Basavanthaswami[1], T.Somasekhar[2]

M.Tech Scholar, Dept. of CSE, BIT Institute of Technology, Hindupur, Affiliated to JNTUA, Andhra Pradesh, India [1]

Associate Professor & HOD, Dept. of CSE, BIT Institute of Technology, Hindupur, Affiliated to JNTUA, Andhra Pradesh, India[2]

ABSTRACT: In recent years there has been an astronomical increase in the usage of computers for a variety of tasks. With the advent of digital cameras, one of the most common uses has been the storage, manipulation, and transfer of digital images. The files that comprise these images, however, can be quite large and can quickly take up precious memory space on the computer's hard drive. In multimedia application, most of the images are in color and color images contain lot of data redundancy and require a large amount of storage space. Set partitioning in hierarchical trees (SPIHT) is wavelet based computationally very fast and among the best image compression based transmission algorithm that offers good compression ratios, fast execution time and good image quality. We will obtain a bit stream with increasing accuracy from EZW algorithm because of basing on progressive encoding to compress an image. All the numerical results were done by using matlab coding and the numerical analysis of this algorithm is carried out by sizing Peak Signal to Noise Ratio (PSNR) and Compression Ratio (CR) for standard Lena Image

KEYWORDS: Wavelet, SPIHT, Encoding, Decoding. EZW.

I. INTRODUCTION

Digital image compression is now essential. Internet teleconferencing, High Definition Television (HDTV), satellite communications and digital storage of images will not be feasible without a high degree of compression. Wavelets became popular in past few years in mathematics and digital signal processing area because of their ability to effectively represent and analyze data. Typical application of wavelets in digital signal processing is image compression. Image compression algorithms based on Discrete Wavelet Transform (DWT),such as Embedded Zero Wavelet (EZW)[3] which produces excellent compression performance, both in terms of statistical peak signal to noise ratio (PSNR) and subjective human perception of the reconstructed image. Said and Pearlman further enhanced the performance of EZW by presenting a more efficient and faster implementation called set partitioning in hierarchical trees. SPIHT is one of the best algorithms in terms of the peak signal-to-noise ratio (PSNR) and execution time. Set partitioning in hierarchical trees provide excellent rate distortion performance with low encoding complexity.

It is clear that traditional image compression techniques like JPEG and MPEG produce annoying visual degradation when operating at low bit rates because they introduce errors in visually important parts of the image structure and also introduces the 'blocking artifacts' in the reproduced images. Since compressed images are to be transmitted over the data communication network or a wireless network, where the bandwidth of the link cannot be guaranteed. Therefore the rate scalable image compression methods are appealing for low bit rate applications, as the application of battery based devices is increasing rapidly in image capturing, storing and transmission over web based networks. There is a need of efficient image compression method that must be suitable for the data communication networks. On the same hand, compression method should be suitable for the devices having limited battery life and on board memory. The main objective of this paper is to propose an image compression and transmission algorithm which is suitable for low bit rate applications over Internet or any other wireless network.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

It needs to maintain a perfect balance between available bandwidth and perceived quality of received image, with minimum transmission delays .Important factors to be considered are compression time, algorithm complexity, cost and computational resources. Considering such factors, one requires a compression method which should be simple and fast. It should reproduce a good quality image after compression at low bit rates.

II. RELATED WORK

Different Wavelet Techniques

For image compression, a really effective technique is wavelet coding which is considerably proved as a better algorithm than other algorithms because its efficiency is much better than other computed efficiency of image compression techniques. Now, compression systems use biorthogonal wavelet. Instead of orthogonal wavelets like: Haar, Daubechies etc. Bior is wavelet family it uses biorthogonal wavelet which is bior wavelet family. It is a real fact that it is not energy preserving but this thing can't effect its use because it is not a huge drawback. Now we are going to differentiate between orthogonal wavelet and biorthogonal wavelet. The main difference is that in orthogonal wavelet associated wavelet transform is orthogonal but in biorthogonal wavelet, the associated wavelet transform is invertible however not essentially orthogonal but there are some coefficients of linear phase biorthogonal filter which are so much close to biorthogonal. Biorthogonal wavelet have symmetric filters and it also permits the employment of a way broader category of filters. Linear phase filters are used in biorthogonal wavelet transform so this is so much advantageous in this sense because with the help of symmetric inputs we can obtain symmetric outputs which are given once. With the help of this transform we can solve many issues like coefficient expansion (Usevitch, 2001) and broader discontinuities.

Wavelet Difference Reduction (WDR)

WDR technique combines run-length coding of the significance map with a well-organized illustration of the run-length symbols to produce relates embedded image coder. SPIHT and WDR both have techniques, the zero tree data structure is precluded, but the embedding principles of lossless bit plane coding and set partitioning are sealed. Rather than using the zero trees, each coefficient during a off wavelet pyramid is appointed a linear position index in the WDR algorithm. Output of the WDR encoding can be arithmetically compressed.

III. PROPOSED SYSTEM

Embedded Zero tree Wavelet (EZW)

EZW coding algorithm is one of the most powerful progressive method for image compression. In this algorithm, firstly we combine stepwise thresholding and progressive quantization. Our focus is to encode image coefficients more efficiently so that we can get minimum CR. For a given threshold T at every location, a zero tree have insignificant values of wavelet transform. In wavelet transform, Zero tree is a tree of locations with its main root which is [j, k]and then it has its descendants which can be located at [2j,2k], [2j, 2k+1], [2j+1,2k] and [2j+1, 2k+1] (we can say it its children)and with all their other groups so on and we can say these their youngsters. We can mark the root location in EZW by encoding method through symbols. Here, R or I is used for output In EZW, the zero tree offers slender descriptions for the purpose to describe locations for insignificant values.

SPIHT ALGORITHM

A. DESCRIPTION OF THE SPIHT ALGORITHM

The SPIHT algorithm is a more efficient implementation of EZW (Embedded Zero Wavelet) [6] [8] algorithm which was presented by Shapiro. After applying wavelet transform to an image, the SPIHT algorithm partitions the decomposed wavelet into significant and insignificant partitions based on the following function:

$$S_n(T) = \begin{cases} 1 & \max\limits_{(i,j)\in T_M} \{|c_{i,j}|\} \geq 2^n \\ 0 & otherwise \end{cases}$$

Here $S_n(T)$ is the significance of a set of coordinates T, and $c_{i,j}$ is the coefficient value at coordinate (i, j). There are two passes in the algorithm, the sorting pass and the refinement pass. The SPIHT encoding process utilizes

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

three lists LIP (List of Insignificant Pixels), it contains individual coefficients that have magnitudes smaller than the thresholds LIS (List of Insignificant Sets)- It contains set of wavelet coefficients that are defined by tree structures and are found to have magnitudes smaller than the threshold.
LSP (List of Significant Pixels)- It is a list of pixels found to have magnitudes larger than the threshold (significant).
The sorting pass is performed on the above three lists. The maximum number of bits required to represent the largest coefficient in the spatial orientation tree is obtained and represented by n_{max}, which is

$$n_{max} = [\log_2(\max_{i,j}\{|c_{i,j}|\}]^{(2)}$$

During the sorting pass, those coordinates of the pixels which remain in the LIP are tested for significance by using equation 2. The result is sent to the output and out of it the significant will be transferred to the LSP as well as having their sign bit output. Sets in the LIS will get their significance tested too and if found significant, will be removed and partitioned into subsets. Subsets with only one coefficient and found to be significant, will be eliminated and divided into subsets. Subsets having only one coefficient and found to be significant will be inserted to the LSP; otherwise they will be inserted to the LIP. In the refinement pass, the nth MSB of the coefficients in the LSP is the final output. The value of n is decremented and the sorting and refinement passes are applied again. These passes will keep on continuing until either the desired rate is reached or n =0, and all nodes in the LSP have all their bits output. The latter case will give an almost exact reconstruction since all the coefficients have been processed completely. The bit rate can be controlled exactly in the SPIHT algorithm as the output produced is in single bits and the algorithm can be finished at any time. The decoding process follows the encoding exactly and is almost symmetrical in terms of processing time.

B. MERITS OF SPIHT

SPIHT provides higher PSNR than EZW because of a special symbol that indicates significance of child nodes of a significant parent, and separation of child nodes from second generation descendants. The SPIHT algorithm depends on Spatial Orientation Trees (SOT) defined on dyadic sub band structure, so some problems will arise because of its adaptation to WP decomposition. One of them is the so-called parental conflict that occurs when in the wavelet packet tree one or more of the child nodes are at the lower resolution than the parent node. It must be resolved in order that SOT structure with well-defined parent–child relationships for arbitrary wavelet decomposition can be created.

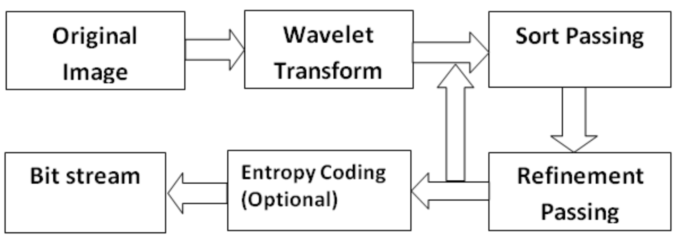

Fig 1: Flow Diagram of SPIHT

The flow diagram of SPIHT is offered is proven under Fig 1. In the 1st step the whole picture might be divided into sub bands. In the later or next step the numbers of iterations had to be executed are calculated. Then the DWT is carried out to discover all the coefficients that are considerable after which the ones additives are coded based on their signal. The preceding step is referred to as type passing wherein the enormous coefficients are calculated. Then the outputs of sorting skip block are passed to refinement bypass block which adds two bits to make the near values nearer to authentic values which will increase visible quality. The last steps are repetitive and after every repetition two values get reduced they are threshold and reconstructive cost. And next block within the waft is entropy coding had been entropy coding of calculated values will be performed and then the values are bit streamed.
Even though wavelet coding will increase the visible great of compressed photograph and compression fee, due to its complexity is a problem. SPIHT is one many of the vital of this approach.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

VII. SIMULATION RESULTS

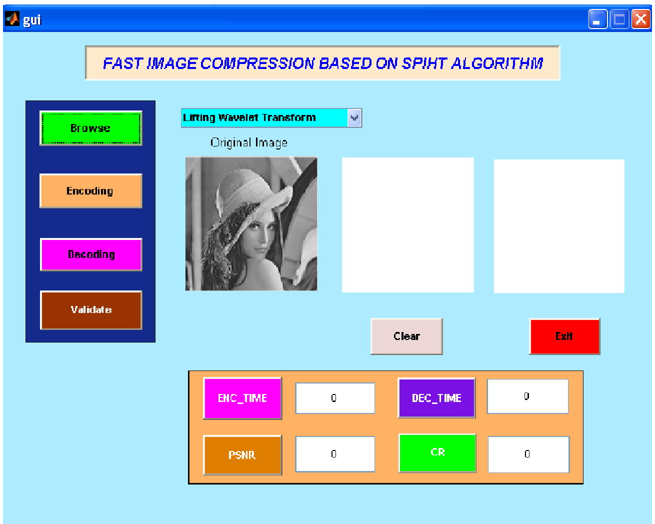

Fig 2: Original Image

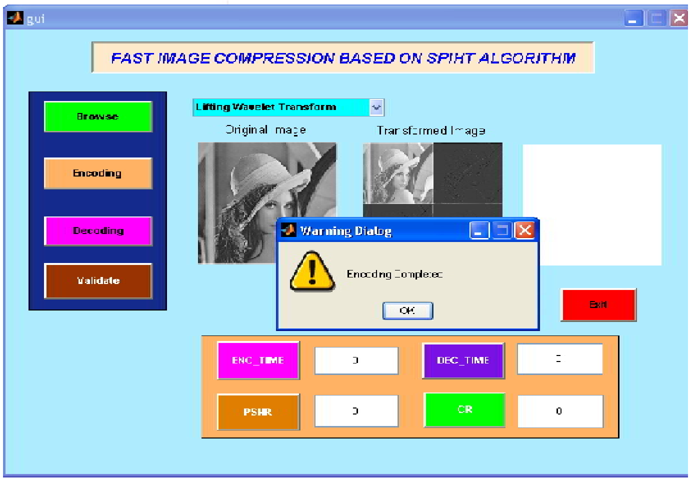

Fig 3 Encoding process

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

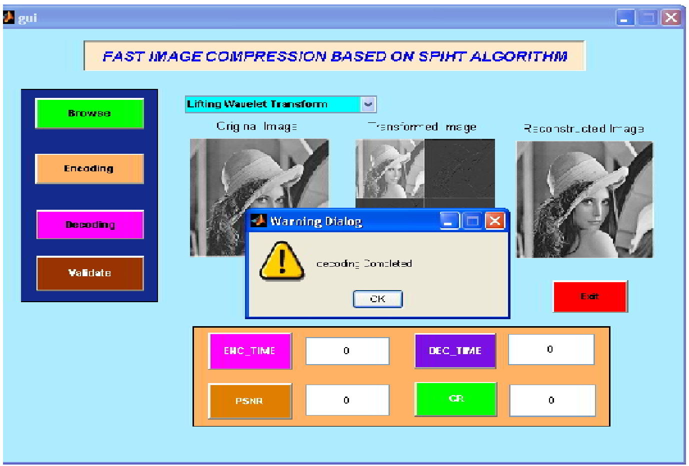

Fig 4 Decoding process

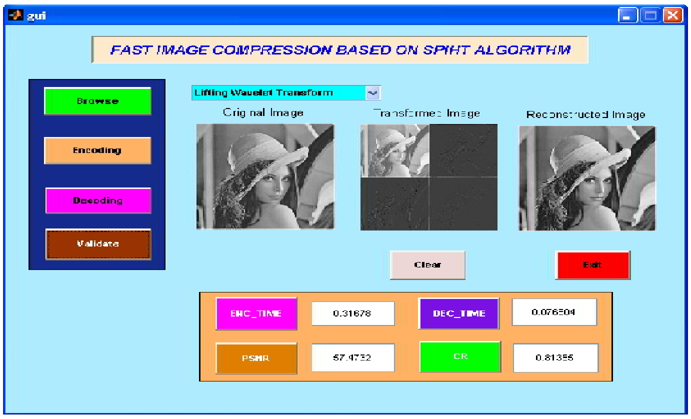

Fig 5 Complete view of parameter of an image

Table 1 Simulation Results obtained

Transform	Lifting scheme		DWT	
Image 256x256	PSNR dB	CR %	PSNR dB	CR %
Lena	57.4732	81.355	52.1220	80.510
Gold hill	57.2015	85.607	52.0476	84.841
Rice	58.1407	74.974	53.3020	73.816
Moon	61.3040	63.922	56.5574	63.758
Brain MRI	57.2074	78.810	52.6020	78.251

VIII. CONCLUSION

SPIHT algorithm is used and at a given bit-rate, the subjective visual first-rate is advanced to a certain volume. At the identical time, because of the ignoring of unimportant information scanning, simplest 25% data changed into handled. The reminiscence has been saved and the coding efficiency is been improved. In conclusion, the set of rules may be broadly used within the memory-restricted and real time situations. In addition, DWT and Lifting Wavelet rework are in comparison via the usage of SPIHT algorithm for Compression Ratio (CR), Peak Signal-to-Noise Ratio (PSNR) and

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

encoding and decoding time. Higher PSNR is performed in Lifting scheme in comparison to DWT. This SPIHT algorithm performs fast compression and decompression, saves lot of bandwidth, enables rapid transmission and requires less storage memory. The SPIHT algorithm can be carried out to warm research fields such as scientific discipline, communication area and so on. In which speedy transmission of photograph file from one vicinity to any other can be achieved through preserving fine of photograph identical.

Scope for Future Work

- The present project work has been carried out for the compression of grayscale images. The same algorithm can be used to compress the colour images by making suitable changes.
- By making modifications in the SPIHT algorithm and by taking Human Visual System into account, the memory can be saved and the coding efficiency can be improved

REFERENCES

[1] Jia Zhi Gang, Guo Xiao Dong, Li Lin Sheng, *A Fast Image Compression Algorithm Based on SPIHT*,IEEE Conference on Industrial Electronics and Applications 2009, pp. 3779-3781
[2] A.Said, and W.A.Pearlman, A New, *Fast and Efficient Image Codec Based on Set Partitioning in Hierarchical Trees*, IEEE Trans on Circ and Syst for Video Tech, vol.6, no.3, June 1996, pp.243-250
[3] A. R. Calderbank, I. Daubechies, W. Sweldens, and B.L.Yeo, *Lossless Iimage Compression Using Integer to Integer Wavelet Transforms*, in Proc. IEEE Int. Conf. Image Processing, vol. 1, Santa Barbara, CA, Oct. 1997, pp. 596–599.
[4] Safranek and Johnston, *A perceptually tuned sub-band image coder with dependent quantization and post-quantization data compression*, in proc.ICASSP 1989:1945-1948
[5] Meng Wang, and Qi-rui Han, *An Improved Algorithm of SPIHT based on the Human Visual Characteristics*, World Academy of Science, Engineering and Technology, Vol. 17, 2006, pp. 119-122.
[6] Mannos and Sakrison, The Effects of a Visual Fidelity Criterion on the Encoding of Images, IEEE Trans. On Information Theory, vol. IT-20, no.4, pp. 525-36, July 1974
[7] A.P.Beegan, L.R.Iyer, A. E. Bell, V.R.Maher, M.A .Ross, *Design and Evaluation of Perceptual Masks for Wavelet Image Compression*, available at http://www.ecpe.vt.edu/fac_support/DSPCL/docs/DSP02_HVS.pdf
[8] Zhou Wang and Alan Bovik, *A Universal Image Quality Index*, IEEE Signal Processing Letters, Vol.xx, No.9, March 2002
[9] J. Clerk Maxwell, *A Treatise on Electricity and Magnetism*, 3rd ed., Vol. 2. Oxford: Clarendon, 1892, pp.68–73