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Colour Image Compression and Performance Analysis Using EZW, SPIHT, and EBCOT

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Abstract*: With advancement of technology and large-scale use of computers in almost every field it becomes necessary to compress images for storing large amount of data in less space. Image compression is a data compression technique used for minimizing the size of image in bytes and maintains the quality of image too. The purpose is to reduce the redundancy of image and to obtain high compression ratios which helps in saving memory and disk space. Wavelet compression is a compression technique helps in reducing the size of image without degrading the quality of image. This research work is providing the overview of the Lossy compression techniques that can be used for compressing images with high compression ratios.

***Keywords*: EZW, SPIHT, EBCOT, MSE, PSNR**

I. INTRODUCTION

Image compression deals in minimizing the size of the images by applying various techniques. The development of multimedia requires high quality of data so it needs large disk space for storage, and takes long transmission time to overcome these factors image compression is required to compress images [13]. It reduces the transmission time and the amount of space required to represent a digital image. Wavelets are used to compress images to a greater extent. Wavelet based compression can be either lossy or lossless.

In Lossless image compression the uncompressed output file contains every single bit of data that is originally present in the input file. Information is completely restored. E.g. – Text or spreadsheet files and GIF provides lossless compression [5]. And lossy compression reduces the size of graphic file in bytes by removing redundant information from the image. Files can be compressed in a JPEG, GIF, PNG, fractals and wavelets. There are different lossy compression algorithms like EZW, SPIHT, EBCOT, transform encoding, wavelet based encoding, etc [6]. The performance of the systems is increased with the various data compression techniques.

The transmission of data becomes fast and requires less space for storage hence it resolves memory issues in digital systems [4]. This work uses EZW, SPHIT, and EBCOT image compression techniques. The bit stream generated by the Embedded zero tree wavelet is in the order of their importance. The transform should be in the way that it reduces the size of dataset when compared to the source data [4].

SPIHT is advanced version of EZW and depends upon ordered bit plane progressive transmission, spatial orientation tree and set partitioning sorting algorithm [13]. The EBCOT work is co-related to the previous techniques on scalable image compression for generating subbands which needs to be quantized[14].

II. LITERATURE REVIEW

Nikolay Ponomarenko et al [1] uses Discrete cosine transform (DCT) based image compression and blocks of size 32*32 is considered. It is shown that the explained method provides better quality of images for JPEG2000 up to1.9 dB. The original size and the compressed size of the image are not shown in the paper. And there is no graphical representation of results.

Ken cabeen et al [2] explains mathematical equations and how these equations are used in image compression. DCT separate images into different frequencies during quantization step and the less frequency components are discarded from the image.

Anil kumar Katharotiya et al [3] uses two techniques DCT and DWT and concentrate on reducing the size of image without degrading quality. The results are expressed using Quality parameters. The author finds that DWT is better than DCT in terms of Quality.

Manjit Sandhu et al [4] use MATLAB software for the implementation of code. The user selects the image as an input and gets compressed image as an output. WCOMPRESS command is used which can perform eithercompression or decompression of true color images or grayscale images. Lossy image compression techniques like WDR, EZW, ASWDR, and SPIHT are used for different types of images including PNG, JPEG etc and corresponding output is analyzed. The author does not provide parameter

like MSE, SNR, and PSNR.

A.M.Raid et al [5] Image compression method like Wavelet transform is used for compressing image and for maintaining the quality of the image with high compression rates. Embedded Zerotree Wavelet (EZW) Algorithm is
used for the Wavelet based Image compression. Because of progressive encoding the generated bit stream gives good accuracy. The numerical results of the EZW Algorithm are carried out by using parameter Compression Ratio (CR) and Peak Signal to Noise Ratio (PSNR) for standard Lena Image. The quality of the compressed is not good and the size of the image is not mentioned.

T. Karthikeya1 et al [6] gives theoretical representation of EZW, SPIHT and EBCOT. The paper discusses pros and cons of various Wavelet based image compression algorithms such as EZW, SPIHT, and EBCOT. But the author does not provide practical implementation of any technique.

R. Janaki et al [7] shows results of compression of still image by using embedded zero-tree encoder and finds the best threshold by analysing the values of Compression Ratio (CR) and Peak-Signal-To-Noise (PSNR) for different thresholds having values between 6 to 60 for level 8 decomposition. The results obtained are satisfactory and the techniques are used for colored image compression.

S. Nirmal Raj [8] uses Wavelet based image compression for compressing and decompressing images. The Performance evaluation of different types of images is carried out by SPIHT technique in order to obtain high compression ratio and good quality of compressed image. The results are then compared with the compression techniques such as VD, DCT, DWT and performance analysis is performed by using PSNR, MSE, CR. The author takes colored image but the compressed image is greyscale image.

Abhishek Thakur et al [9] proposed technique in which the senders message is encrypted using algorithm chaotic encryption method. The key is used for encrypting and decrypting the image transmitted between sender and receiver. It is the new method of cryptography proposed by the author. The development in the field of image security is briefly explained in the paper. The author doses not provide latest techniques like SPIHT and EBCOT for compression of image. The compression is time consuming as shown in results.

Tarun kumar et al [10] uses six different Wavelet based techniques Spatial orientation Tree Wavelet, Wavelet Difference Reduction, Adaptively Scanned Wavelet Difference Reduction , Embedded Zero tree Wavelet, Set Partitioning In Hierarchical Trees, and Spiht_3d are used in the research work. The performance is analysed based on six parameters i.e. Average Difference, Normalized Absolute Error, Normalized Cross Correlation, Mean Square Error, Peak Signal to Noise Ratio, Structural Content, and calculated which technique is better for image compression. The Spiht is improved version of EZW but the MSE in case of SPIHT is much greater then MSE obtained in EZW. The picture quality is too much degraded and the images are completely blurred.

T. K Karthikeyan et al [11] the author proposes SPIHT and modified SPIHT Algorithms for the identification of ultrasound images. It maintains the diagnostic data while reducing the record sizes. The translation function is used for storing the quality of images. Bit rate scope is less for image coding but image quality is good in terms of MSE and PSNR. The method can also be utilized for other medical images that require compression.

Ms. Swati Pawar et al [12] uses EZW and SPIHT for the coloured image compression. EZW is effective and simple technique for image compression and SPIHT Algorithm is improved form of EZW it also exploits redundancy which is formed among different neighbourhoods. The PSNR can be better than it is calculated in paper for SPIHT and the EBCOT technique can also be applied in future work for getting better results.

Pooja Rawat et al [13] the author reduces the time of execution and gives reconstructed image with high PSNR using EZW, SPIHT and EBCOT techniques and compares the results on the basis of MSE and PSNR. High energy components are coded first and then coded bits are transmitted progressively to improve the quality of image and to give finer details.

David Taubman [14] proposed a new algorithm called Embedded Block Coding with Optimized Truncation (EBCOT). The algorithm is best suited for applications that require browsing of large images the generated bit stream has SNR scalability including resolution. All the features are collaborated in a single bit stream to produce better results. The research work is restricted only to the grayscale images but it has been observed that EBCOT is giving better results so the research can also be performed in colored images.

III.MEHODOLOGY

The Methodology used in carrying this research work is exploratory which involves the following steps:-

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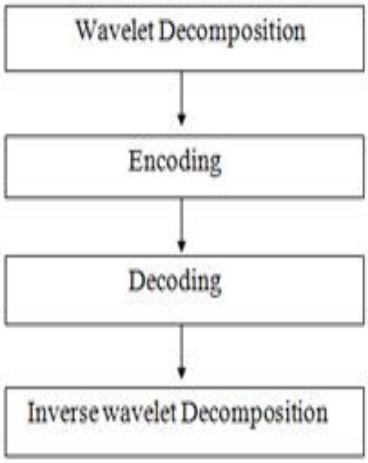

Fig. 1 Block diagram of image compression

A. Wavelet Decomposition

Wavelet decomposition is done by using DWT (Discrete wavelet transform) function. At higher compression ratio Wavelet transform provides good quality of image. The Discrete Wavelet Transform of an M components, form an M x M matrix. Wavelet analysis is performed using the concept of filters. If a image is passed through two filters: High-pass filter, used to keep high frequency information and Low pass filter, used to keep low frequency information. Signal is decomposed into two parts, an approximation part (low frequency) and detailed part (high frequency). Two dimensional collections of coefficients contains four bands, each labelled as

LL (Low subband for rows and columns filtering)

HL (High subband and low subband for rows and columns filtering)

LH (Low subband and high subband for rows and columns filtering)

HH (High subband for rows and columns filtering)

The dwt command performs a single level one-dimensional wavelet decomposition with respect to a particular wavelet decomposition filters (Lo_D and Hi_D) that you specify.

Hi_D - Decomposition high-pass filter.

Lo_D - Decomposition low-pass filter.

[cA , cD] = dwt (X, Lo_D, Hi_D) - Computes wavelet decomposition using high pass and low pass filters.

B. Encoding and Decoding

The encoder converts the image file into a series of binary data, which is called the bit-stream. Decoder decodes the encoded bit-stream to form the decoded image.

C. Inverse wavelet decomposition

It is simply the reformation of the DWT function explained by using the filter bank theory. The up sampling is done by placing zeros in between every coefficient. These are then convolved with the reconstruction scaling filter for approximation coefficients and the reconstruction wavelet filter for the detail coefficients. The results are then added together to get the original image.

IV. OBSERVATION

It has been observed from the literature review that in the image compression using wavelets the quality of the image is preserved at high compression ratios. The EZW technique gives good quality and efficiency of image as compared to DCT but DCT is better in measures of performance and time wise. But overall it has been found DWT is better and can be improved in performance wise by using advanced techniques SPIHT and EBCOT. The observation is performed by using various performance parameters compression ratio, mean square error, peak signal to noise ratio.

V. CONCLUSION

There is a need of image compression algorithm that provides good quality of image at high compression ratios, gives good performance,

& takes less time in execution. The EZW technique provides progressive encoding and uses predefined scanning order but do not exploits redundancy which is formed among different neighbourhoods so SPIHT is used to overcome this limitation and EBCOT technique is used for further improving the results. EBCOT gives good performance, better PSNR and less MSE as compared to EZW and SPIHT. Encoder can produce any number of layers depending on the combinations of code block in EBCOT based compression. It has been observed from the review that these three lossy compression techniques are giving better results in the compression of grey scale images. So the techniques can also be used for colored image compression for the further thesis work and results will be compared using performance measures CR, PSNR, MSE.

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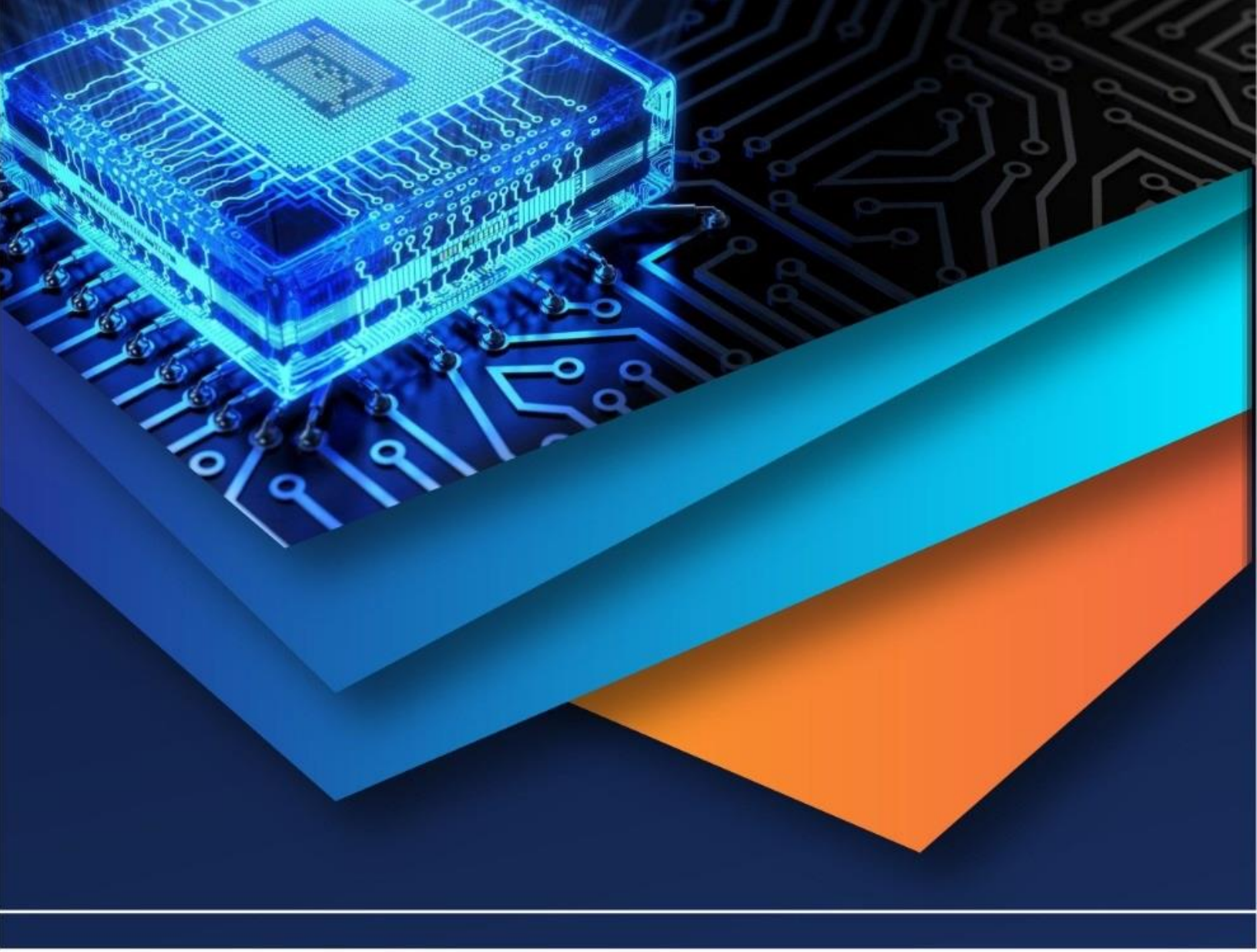

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