Comparative Analysis of Image Compression Techniques

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Abstract— Image Compression is a wide area. Compression of Images increasing because the raw images need large amounts of disk space seems to be a big disadvantage during transmission & storage. Even though there are so many compression technique already present a better technique which is faster, memory efficient and simple surely suit the requirements of the user. The work is to explain use of different compression techniques more suitable for particular data compression algorithm based on compression ratio, Bit per Pixel, Mean Square Error and Peak Signal to Noise Ratio. Using all four parameters image compression works and gives compressed image as an output.

Key words: Image Processing, Image Compression, Compression Techniques, CR, BPP, MSE, PSNR

I. INTRODUCTION

Nowadays the multimedia content like digital images and videos have led to great interest in research application of Image Compression Techniques to these data sets for efficient storage and faster access. The target to achieve advanced quality of image and video with accessibility of less expensive image acquisition devices have formed steady increases in both image size and resolution [14]. There are some formats that equivalent some images better than others depending in what you are looking for to obtain, and the type of image you are working with [2, 12, 15].

II. IMAGE COMPRESSION RELEVANCE

The objective of Image Compression is to reduce side issue and redundancy of the image data in order to be able to store or exceed on data in an competent form. The main advantage of compression is that it reduces the data storage supplies. Image compression is a method through which it can't reduce the storage space of images which will help to increase storage space and transmission performance. In image compression, do not only focus on reducing size but also concentrate on doing it without losing information and quality of image. Compression is nothing but reducing the size of the data to shrink the amount of space required to store the data [18, 21].

III. IMAGE COMPRESSION TECHNIQUES

Image Compression has its importance for efficient storage and transmission of digital images. Compression techniques generally only work well with real-life photography; they often give disastrous results with other types of images such as line art, or text. So a Lossy density should only be used after all processing has been done, it should not be used as an intermediate storage format [11]. The main objective of Image Compression is to reduce or remove this redundancy. Image Compression Techniques aim at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible [7]. The image compression algorithms can be divided into two branches:

1) Lossy Compression
2) Lossless Compression

Image compression may be lossy or lossless. Lossless compression is preferred for archival purposes and often for medical imaging, technical drawings, clip art, or comics [16]. Lossy Compression methods, especially when used at low bit rates, introduce compression artifacts.

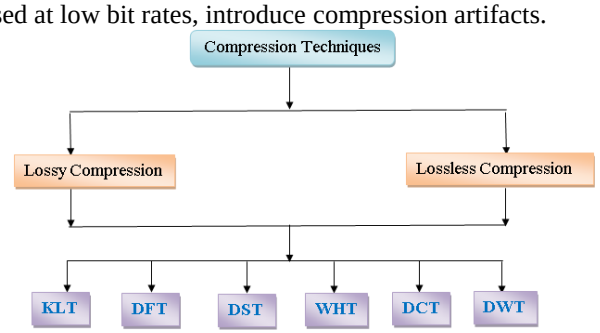

Fig. 1: Compression Techniques

A. *Lossy Compression*

In information Technology "Lossy Compression" is a data encoding process that compresses data by losing some of it. The Procedure aims to minimize the amount of data that needs to be held, Handled or transmitted by a computer. It both removes redundancy and creates an approximation of the original. In this method, the compressed image is not same as the original image; there is some amount of information loss in the image. Lossy methods are especially appropriate for ordinary images such as photographs in applications where minor loss of fidelity is acceptable to achieve extensive reduction in bit rate [10, 19]. Lossy Compression Technique is shown in fig. 2

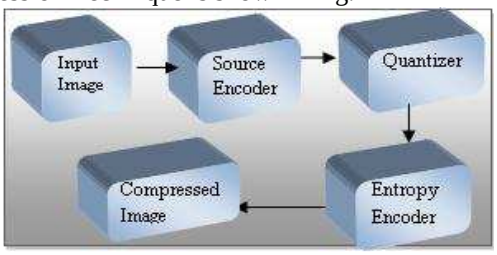

Fig. 2: Lossy Compression Technique

The above figure 2 denotes that first load the image from the web repository then Encoding System takes a creative image as input and after processing on this, it gives compressed image as output. The Quantizer is used to reduce the number of bits and also reduces the data [2, 4]. While Decoding System takes a compressed image as input and gives the image as output which is more like to original image.

B. *Lossless Compression*

In Lossless Image Compression Algorithm, the new data can be recovered exactly from the compressed data. It is used generally for discrete data such as text, computer generated

data, and certain kinds of image and video information [6]. Lossless compression can do only a reserved amount of compression of the data and hence it is not useful for suitably high compression ratios. GIF, Zip file format, and Tiff image format are popular examples of a lossless compression, while smaller lossy audio files are classically used on suitable players and in other cases where storage space is limited or exact duplication of the audio is unnecessary.

IV. DCT IMAGE COMPRESSION PROCESS

The Discrete Cosine Transform process is used to compress the image denotes in following figure 3.

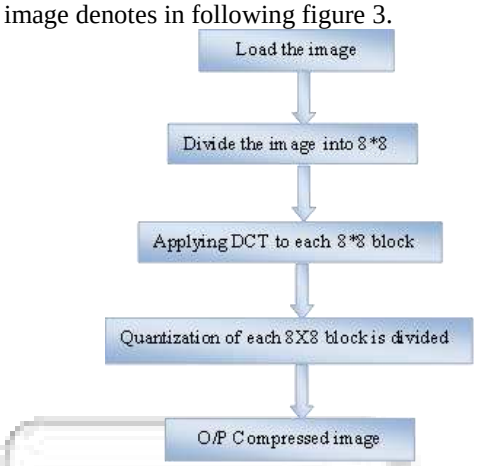

Fig. 3: DCT Image Compression Process

The above figure 1.3.3 shows that first load the image from web repository and It will divides the image into 8*8 blocks then DCT will be apply to each 8*8 blocks. Our 8*8 into block of DCT coefficients is currently prepared for compression by quantization [17, 23].

V. DWT IMAGE COMPRESSION PROCESS

The Discrete Wavelet Transform process compresses the image; calculate the CR, BPP, MSE and PSNR to compress the image. This displayed in following figure.

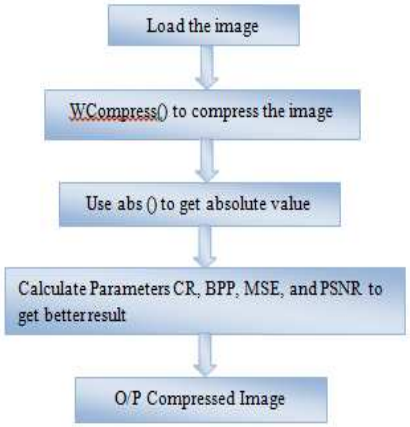

Fig. 4: DWT Image Compression Process

The above figure 1.3.4 denotes that first load the image from web repository and then the WCompress () function is used to compress the image. Sometimes the image contains value in points so use abs () function get the absolute value of matrix. There are four parameters CR, BPP, MSE, PSNR to calculate the ratio of image and after completion of all process compressed image will be given as an output [8, 13].

VI. IMAGE COMPRESSION PARAMETERS

There are four performance parameters are used to measure the performance of the image compression algorithms.CR, BPP, MSE and PSNR. PSNR is the amount of the peak error between the compressed image and original image. The superior the PSNR contains better quality of image to calculate the PSNR first of all MSE is computed [3]. Mean Square Error is the increasing difference between the compressed image and original image. Small amount of MSE reduce the error and get better image quality. Further details are explained below:

A. Parameter Description

1) Bit Per Pixel (BPP):

The number of bits of information stored per pixel of an image or displayed by a graphics adapter. The more bits there are, the more colors can be represented, but the more memory is required to store or display the image [18].

2) Compression Ratio (CR):

Compression ratio indicates the efficiency of compression technique, more the compression ratio, less memory space required [18]. The compression ratio is equal to the size of the original image divided by the size of the compressed image. The compression ratio achieved usually point out the picture quality. Generally, the higher the compression ratio, the poorer the quality of the resulting image.

3) Mean Square Error (MSE):

The MSE is used as part of the digital image processing method to check for errors. It signifies the cumulative squared error between the compressed and the original image. MSEs are calculated and then compared to determine the accuracy of an image.

The MSE of an estimator measures the standard of the squares of the "errors", that is, the difference between the estimator and what is estimated. If the value of MSE is lower, the lower error will be displayed and gives better picture quality [1, 18, 24]. It compares the original data with reconstructed data and then results the level of deformation. The MSE represents the average of the square of the "errors" between our actual image and our noisy image.

4) Peak Signal to Noise Ratio (PSNR):

PSNR value is used to measure the difference between a reconstructed image and original image. In general, the larger PSNR value, the better is image quality, so there is an inverse relationship of MSE and PSNR. There is an inverse relationship between MSE and PSNR. Hence, the larger PSNR value gives the better image quality [18].

VII. IMPLEMENTATION & RESULT ANALYSIS

Analysis is done on the basis of the amount of distortion, which was calculated using important distortion measures: CR, BPP, MSE, and PSNR measured in decibels (dB) measures were used as performance indicators. Image having same PSNR value may have different perceptual quality [18, 22]. A good compression algorithm would reconstruct the image with low MSE and high PSNR. Performance measurement parameters are described in the following sub-sections [14]. Here Phase wise description is given. Two techniques are used in image compression DCT and DWT. There are some parameters CR, BPP, MSE and PSNR which are displayed in below.

VIII. EVALUATION & RESULT ANALYSIS

After processing on image finally result will be displayed after processing on images it gives parameters Compression ratio, Bits per Pixel, Mean Square Error and Peak Signal to Noise Ratio it is shown in following Table 1.

Compression Technique	Types of Image	Name of image	Description
DCT	Gray scale Image	Cameraman.tif	CR and PSNR gives higher value so these two parameters are best
		Rice.png	Ratio of compressed image using BPP and CR is higher so these parameters are optimum to use
DWT	Color	Flowers.gif	MSE and PSNR parameters are calculated. MSE represent low error soothe quality of image may decrease while PSNR gives higher ration so the image quality would be good.
		Guitar.gif	While compressing image, MSE gives error too much and PSNR contains higher ratio
		Fruits.bmp	MSE and PSNR parameters are calculated. MSE represent low error soothe quality of image may decrease while PSNR gives higher ration so the image quality would be good.
DWT	Color	Boll.bmp	MSE represent low error soothe quality of image may decrease while PSNR gives higher ration so the image quality would be good.
		Color.png	MSE and PSNR parameters are calculated. MSE represent low error soothe quality of image may decrease while PSNR gives higher ration so the image quality would be good.
		Forest.png	In this image the MSE gives low error so the quality of image may average, while PSNR gives higher ration so quality of image may good to display.

Table 1: Information Retrieval

The above table denotes the parameter wise description and defines the image quality. First the original image is compressed and parameters are calculated. No results are obtained for CR, BPP.

	Original Image	CR	BPP	MSE	PSNR
Gray Scale Image	T1_I1.tif	18.5135	4.4432	36.4699	32.5115
	T1_I2.tif	1.2390	0.0991	0.0235	64.4197
	T2_I1.gif	31.1066	2.4885	29.7584	68.7443
Colored Image	T2_I2.gif	28.8239	2.3059	29.8342	67.5547
	T3_I1.bmp	7.6833	1.8440	29.4020	33.4470
	T3_I2.bmp	9.9467	2.3872	26.8703	33.8381
	T4_I1.png	25.6968	6.1672	54.3291	30.7805
	T4_I2.png	23.7310	5.6954	61.1225	30.2688

Table 2: DWT Analysis of Parameters

The above table 2 denotes the parameters gives result. Compression ratio indicates the efficiency of compression technique, more the compression ratio, less memory space required. The more bits there are, the more colors can be represented. The lower the value of MSE, the lower the error and better picture quality and In general, the larger PSNR value, the better is image quality, so there is an inverse relationship of MSE and PSNR.

A. Perceptive Phase

After completing evaluation and result phase it is necessary to define which technique is optimum to use. It is displayed in following table.

	Name of	DCT	DWT	OT

	Images	T1	T2	T1/T2
Gray Scale Images	T1_I1.tif	√	√	T1,T2
	T1_I2.tif	×	√	T2
Colored Images	T2_I1.gif	×	√	T2
	T2_I2.gif	×	√	T2
	T3_I1.bmp	×	√	T2
	T3_I2.bmp	×	√	T2
	T4_I1.png	×	√	T2
	T4_I2.png	×	√	T2
Total Score				T1=01 T2=10

Table 3: Image Data set Techniques

The above table represents the optimum technique from DCT & DWT to use. Mainly DWT technique is used.

REFERENCES

[1] Maneesha Gupta, Dr. Amit Kumar Garg, "Analysis of Image Compression Algorithm Using DCT", IJERA, ISSN: 2248-9622 Vol. 2, Issue 1, Jan-Feb 2012,
[2] Bhonde Nilesh, Shinde Sachin, Nagmode Pradip and D.B. Rane, "Image Compression Using Discrete Wavelet Transform", IJCTEE Volume 3, Special Issue, March-April 2013.
[3] Prabhakar Telagarapu, "Image Compression using DCT and Wavelet Transformation", International Journal of Signal Processing, Image Processing and Pattern Recognition Vol. 4, No. 3, September, 2011.
[4] A. M .Raid, W. M. Khedr, M. A. Eldosuky and Wesam Ahmed, "Jpeg Image Compression using Discrete Cosine Transform - A Survey, IJCSES Vol.5, No.2, April 2014.
[5] Kilari Veera Swamy, B. Chandra Mohan, Y. V. Bhaskar Reddy and S. Srinivas Kumar, "Image Compression and Watermarking scheme using Scalar Quantization", IJNGN, Vol. 2, No. 1, March 2010.
[6] Amir Averbuch, Danny Lazar, and Moshe Israeli, "Image Compression using Wavelet Transform and

Multi Resolution Decomposition", IEEE Trans. on Image Processing, Vol. 5, No. 1, January 1996.
[7] A. S. Lewis and G. Knowles, "Image Compression using the 2-D Wavelet Transform", IEEE Trans. on Image Processing, Vol. I, No. 2, April 1992.
[8] Marc. Antonini, M. Barlaud and I. Daubechies, "Image Coding using Wavelet Transform", IEEE Trans. on Image Processing, Vol. 1, No. 2, April 1992.
[9] Ronald A. Devore, Bjorn Jawerth and Bradley J. Lucier, "Image Compression through Wavelet Transform Coding", IEEE Trans. on Information Theory, Vol. 38. NO.2, March 1992.
[10] Harjeet Pal Singh and Sakhi Sharma, "Hybrid Image Compression Using DWT, DCT & Huffman Encoding Techniques", ISSN 2250-2459, Volume 2, Issue 10, October 2012.
[11] Stephane G. Mallat, "A Theory for Multi resolution Signal Decomposition: The Wavelet Representation", IEEE Transactions on Pattern Analysis and Machine Intelligence. Vol. Ii, No. 7. July 1999.
[12] Jacob Ziv and Abraham Lempel, "A Universal Algorithm for Sequential Data Compression", IEEE Transactions On Information Theory, Vol. IT-23, No. 3, MAY 1977.
[13] M. Mozammel Hoque Chowdhury and Amina Khatun, "Image Compression Using Discrete Wavelet Transform", IJCSI International Journal of Computer Science, Vol. 9, Issue 4, No 1, July 2012.
[14] G. Padmajadevi, "Hybrid Compression Using DWT-DCT and Huffman Encoding Techniques for Biomedical Image and Video Applications", International Journal of Computer Science and Mobile Computing, ISSN 2250-2459, Volume 2, Issue 10, October 2012.
[15] Papiya Chakraborty, "A Survey Analysis for Lossy Image Compression using Discrete cosine Transform", International Journal of Scientific & Engineering Research Volume 3, Issue 9, September-2012.
[16] K. Mahendra Babu, Dr. P. Sathyanarayana, "A Comparative Analysis of Image Compression using Various Compression Methods", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 3, Issue 1, January 2014.
[17] Rajesh K. Yadav, S.P. Gangwar and Harsh V. Singh, "Study and analysis of wavelet based image compression techniques", International Journal of Engineering, Science and Technology Vol. 4, No. 1, 2012.
[18] Thaarini. P and Thiyagarajan. J, "Comparative Analysis of Image Compression Using Wavelet and Ridgelet Transform", IJIRSET, Volume 3, Special Issue 2, April 2014.
[19] Dr. E. Kannan, "Lossless Image Compression Algorithm for Transmitting Over Low Bandwidth Line", International Journal of Advanced Research in Computer Science and Software Engineering Volume 2, Issue 2, February 2012.
[20] Amanjot Kaur and Jaspreet Kaur, "Comparison of DCT and DWT of Image Compression Techniques", International Journal of Engineering Research and Development ISSN: 2278-067X, Volume 1, Issue 4 (June 2012), PP.49-52.
[21] Priyanka dixit, Mayanka dixit, "Jpeg Image Compression Using Discrete Cosine Transform - A Survey", International Journal of Interdisciplinary Research and Innovations Vol. 1, Issue 1, October-December 2013.
[22] D. Sophin Seeli and Dr. M. K. Jeyakumar, "A Study on Fractal Image Compression using Soft Computing Techniques", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 6, No 2, November 2012.
[23] Robert Jessop, "Lossy Image Compression", International Journal of Computer Science and Information Security, Vol. 11, No. 10, December 13, 2002.
[24] A. Alarabeyyat, S. Al- Hashemi, T. Khdour, M. Hjouj Btoush, S. Bani-Ahmad, R. A. Hashemi, "Lossless Image Compression Technique Using Combination Methods", Journal of Software Engineering and Applications, 2012, 5, 752-763, October 2012.

