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Comparitive Study of Image Compression Algorithms on Bench Mark Suite

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Abstract: The digital image processing is exponentially increasing in today's world which leads to storage and transmission problems. Many methods have been introduced in last decay that focuses on lossy and lossless compression. In digital network field the image compression does not tolerate the loss of data so lossless compression is preferred. Lossless compression reduces the size of image only to certain limit which is less than lossy compression. This paper compares the compression of bench mark images with various image compression algorithms that compress the images better than previous lossless image compression technique. The proposed algorithm (SEGC-N-D) is compared with DCT, DWT, Fractal, and JPEG. This process focus on identifying the non uniform areas which has high occurrence of gray level images and then segment that image using neural network. The segmented image is send to pre-compress process. In Pre-compress technique each pixel value is converted into binary and arranged in a data file as compressed using our proposed technique. Run length encoding is applied to compress the image further. To get the original image this process is reversed.

Keywords: DCT, DWT, FRACTAL, JPEG, SEGC-N-D Compression Techniques.

I. INTRODUCTION

The majority of modern business involved in digital image processing. The key obstacle for many applications is huge amount of data required to represent a digital image. Use of digital images is not easy or viable due to high storage, transmission costs.[9] Even though the image capture techniques and display devices are quite affordable, the modern image compression technology offers good solution to solve the problems of digital technology. The bit rate of digital data may exceed 1GBPS. Image compression is a technique which minimizes the size of the image file without degrading the quality. If the file size is reduced, it allows to store more images in a given amount of disk (or)in memory space. It also reduces the time required for an image to be upload or download from internet.[2] To implement it there are various compression algorithms. Image compression is used to reduce the file sizes of digital image while maintaining image quality. This is done by applying the data compression methods to the image. An image file size is reduced with a loss in its quality then they are called lossy compression. At the same time the image can be reduced its size without any loss in quality these type of compressions are called lossless compression. The image compression is useful in such cases, when a computer user used to minimize the storage space or to maximize the transfer rates of image. In the lossy compression, a user dramatically seeks to reduce the file size of an image and there will be some reduction in the quality of an image and consequentially reduction in file size. Using the lossy compression method the digital files like pictures & videos are get compressed. But the original image will not able to restore by the user, there will be compression artifacts, or irreversible alterations in that image.[10]

II. MATERIALS AND METHODS

This proposed comparative study is done with the help of MATLAB software tools. The Bench mark images are executed, compressed and decompressed with MATLAB code. The measures such as compression efficiency (or) compression ratio, Peak signal to Noise Ratio(PSNR), Elapsed time of the code, BPP(bit per pixel ratio) are used to measure the quality of the reconstructed images and efficiency of the program code. The following diagram depicts different compression algorithms and their basic concepts.[3]

A. DCT Compression

According to Discrete cosine transformation technique, the given images are divided into 8*8 block of pixels. The transformation algorithm converts the image information from spatial domain to frequency domain. The transformed coefficients are quantized into nearest integers by quantization techniques. Image compression is done followed by encoding. The reverse process is applied to produce reconstructed image with expected quality.[1]

B. DWT Compression

According to DWT transformation, the decomposition of an image is taken place with choosing the low pass filter and high pass filter. These filter pairs are called the Analysis filter pair.

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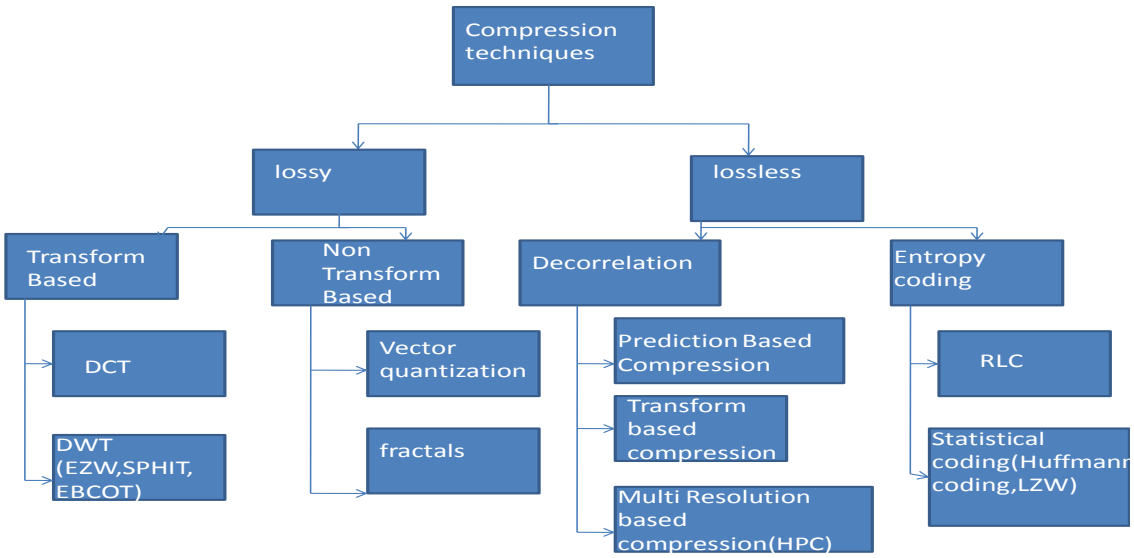

Fig1: Image Compression Algorithms Chart

Initially, the low pass filter is applied for each row of data and observes the low frequency components of the row. Now the output data has frequencies of first half of original frequency range. Because low pass filter is a half band filter, using shannon's sampling theorem, they can be sub sampled by two and therefore the output data now contains only half of the original number of samples. The high pass components are separated by applying high pass filter on the same row of data. The same process is repeated for all the rows.[4] After applying it on rows, the filtering is done with each column of the intermediate data. Now the resultant coefficients contains 4 bands of data which are labeled as LL(Low-Low), HL(High-Low),LH(Low-High),HH(High-High). The LL band can be decomposed further to produce even more sub bands.

C.FRACTAL COMPRESSION

Fractal compression is well suited method for the digital images which are based on fractals. It is lossy compression method and it produces best results for textures and natural images, relying on the fact that parts of an image often resemble other parts of the image. The fractal image compression algorithms convert these parts into mathematical data. The mathematical data (or) fractal codes are used to recreate the encoded image. It is a technique which identifies possible self similarity within the image and that is used to compress the data. Traditionally, this technique is considered as time consuming process.[5] There are some novel methods promise to speed up the process. When compression is apply on noisy or corrupted images, Fractal Produces Poor image quality. Fractal approach is not appropriate for a low bit rate image compression techniques.

D.JPEG Compression

JPEG is a standard committee that has the basis in ISO standards to produce set of rules for transmitting images and graphics over communication network. JPEG is better image compression technique compared to other formats.[8] Because it gives best results for photographs and complex images. It follows a image compression technique which removes non-human visible colors from images and thus the image file data is decreased. JPEG stores images of 6 to 24 bit depths with reasonable speed and compression efficiency.[6] It is found that it is one of the lossy image compression methods. During encoding it tries to remove useless data away from the images and so, it has better and superior compression ratio over most of the lossless technique. [7].

The steps involved in JPEG image compression are as follows:

1. Block preparation

Given image is divided into 8X8 sub matrices.

2. Forward DCT

Apply DCT transformation to each block of pixel, thus removing redundant image data.

3. Quantization

Quantize each block of DCT coefficient using weighting function.

4. Encoding

Apply Run length encoding to remove redundancies in the coefficients.

E.SEGC-N-D Compression

The proposed algorithm is used to compress bench mark images. Convert the given medical image into array of pixels. Using 2-D Maximum entropy threshold method, the threshold value is defined. The original image is segmented with the threshold value. The pixel coefficients are quantized into nearest integer values. Vector Quantization is implemented in this step to increase the accuracy of quantization mechanism. Run length encoding is applied to get compressed file data. The decoding and Decompression steps are applied to get the reconstructed image that is similar to the original data.

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Table.1 Comparative study of different compression algorithms for various measures

MEASURES	DCT	DWT	FRACTAL	JPEG	SEGC-N-D
MEMORY REQUIREMENTS	LOW	MODERATE	LOW	MODERATE	MODERATE
COMPUTATIONAL LOAD	LOW	LOW	VERY HIGH	LOW	LOW
COMPLEXITY	LOW	MODERATE	HIGH	LOW	LOW
POWER CONSUMPTION	MODERATE	LOW	VERY HIGH	MODERATE	MODERATE
COMPRESSION EFFICIENCY	LOW	HIGH	VERY HIGH	HIGH	HIGH
PROCESSING SPEED	HIGH	HIGH	LOW	HIGH	HIGH
RECONSTRUCTED IMAGE QUALITY	LOW	HIGH	VERY HIGH	VERY HIGH	VERY HIGH

III. RESULTS AND DISCUSSIONS

The Bench Mark images are executed and compared with various image compression algorithms such as DCT, DWT, Fractal, JPEG, SEGC-N-D. The MATLAB tool is used for this comparative study. The image compression measures like BPP(Bit Per Pixel),Elapsed Time, Compression Efficiency, Mean squared Error, PSNR are used to measure the Efficiency of the code and Image Quality.

Table.2 Comparative study of the measure of BPP(Bit Per Pixel)

IMAGES	DCT	DWT	FRACTAL	JPEG	SEGC-N-D
BRIDGES	0.62973	6.1141	2.5189	0.6297	0.61
FLOWER-FOVEON	0.62973	0.5061	2.5189	0.6297	0.61
DEER	0.62973	0.5160	2.5189	0.6297	0.612

Table .3 Comparative study of the measure of Elapsed Time (in seconds)

IMAGES	DCT	DWT	FRACTAL	JPEG	SEGC-N-D
BRIDGES	8.01709	9.990567	12.891090	8.271125	8.478
FLOWER-FOVEON	12.60625	5.462099	21.949932	14.953446	14.156
DEER	28.12047	6.043657	32.176929	4.520517	5.234

Chart 1: Comparative study of the Measure Elapsed Time (in Seconds) for various compression algorithms

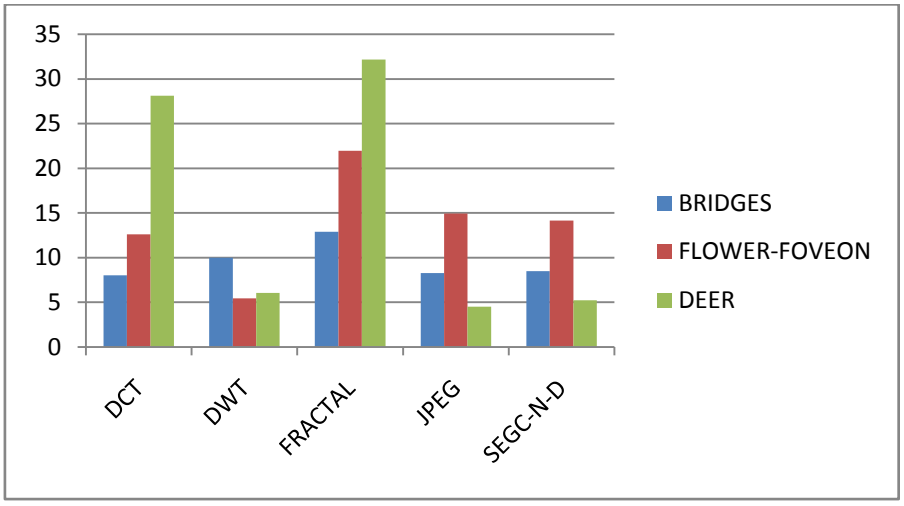

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Table4.2 Comparative study of the error measures for the image Bridges. peg

MEASURES	DCT	DWT	FRACTAL	JPEG	SEGC-N-D
CR	26.85902	3.9864	8.920407	10.9543	9.987
MSE	69.25937	64.2709	5.0286	2.4028	1.234
PSNR	29.72602	30.0507	24.550566	44.3237	42.345

Chart2: Comparative study of various compression algorithms for bridge image

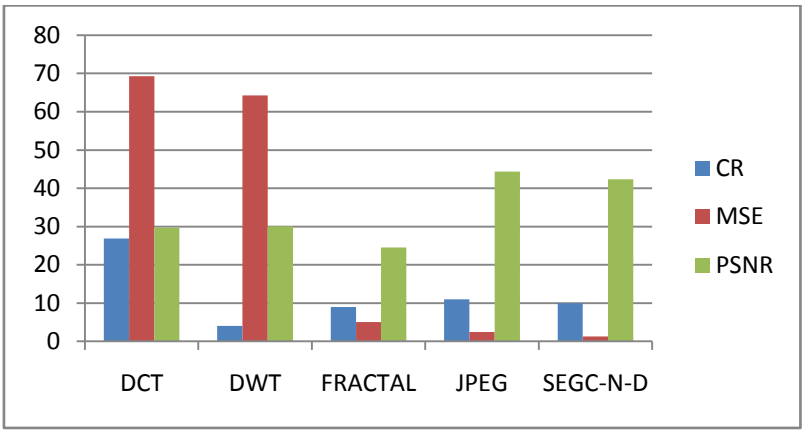

Table5.3 Comparative study of the error measures for the image flower-foveon.Jpeg

MEASURES	DCT	DWT	FRACTAL	JPEG	SEGC-N-D
CR	44.61266	14.7910	29.358719	15.4130	13.456
MSE	62.53581	92.5086	3.4081	1.1597	1.123
PSNR	30.16952	28.4690	28.893255	47.4875	44.235

Chart 3: Comparative study of various compression algorithms for flower-foveon image

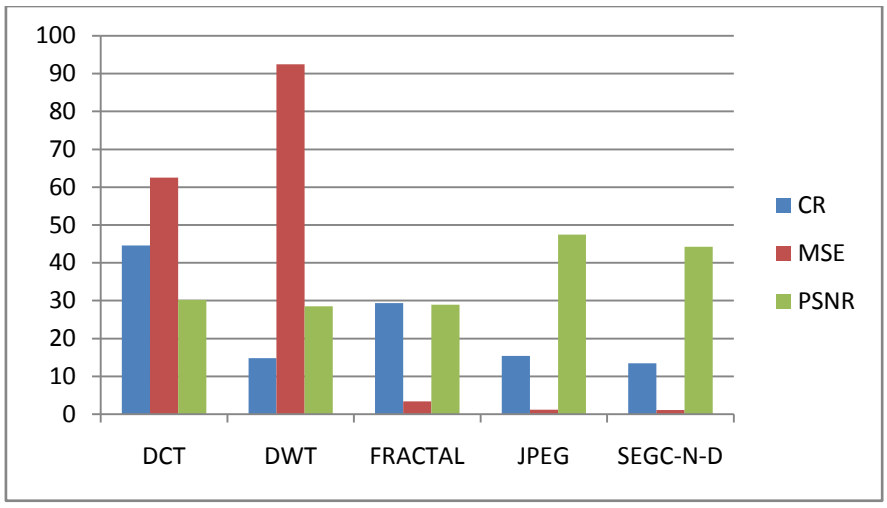

Table6. Comparative study of the error measures for the image Deer.Jpeg

MEASURES	DCT	DWT	FRACTAL	JPEG	SEGC-N-D
CR	36.53066	11.7879	22.969901	15.5495	10.234
MSE	44.30023	52.7883	3.1750	1.4235	1.385
PSNR	31.6674	30.9054	26.673454	46.5972	44.567

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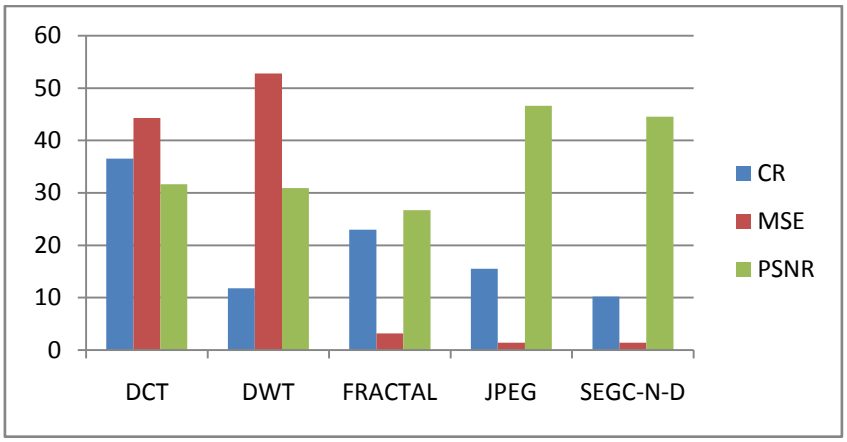
Chart 4: Comparative study of various compression algorithms for Deer image



From the above results and discussions, it is found that the SEG-N-D compression ratio seems to provide better result than the other compression algorithms. SEG-N-D compression also provides good results in PSNR compared to the traditional algorithms.

IV.CONCLUSION

This Study discusses the roles of various image compression techniques. This proposed method is compared with traditional image compression technique for bench mark images. The proposed method produces good compression efficiency and PSNR results for low bit rate values. SEGC-N-D algorithm sustains its high efficiency on maintaining a good compression ratio.. Thus our proposed algorithm seems to provide better results compared to [5] and [7]. Although it provides better compression ratio, MSE and PSNR value compared to the traditional algorithms, it takes much time to compress large size images. It has to be improved in further research applications

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