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Image Compression using Multiwavelets with SPIHT, EZW and WDR Algorithm

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ABSTRACT: The one of the basic technologies of the multimedia are image, audio and video compression .It is necessary to code image and audio at the lowest possible data rates.The transmission and storage of information becomes costly as bandwidth cost money.The transmission and storage become cheaper if less data is used to represent image and audio.In our daily life signals plays an important role ; examples are speech, music, picture and video signals. A signal is a function of independent variables such as time, distance, position, temperature.A signal is is defined as any physical quantity that carries information which varies with other independent or a dependent variable.Image compression is minimizing the dimensions in bytes of a graphics file without degrading the standard of the image to an unacceptable level. The representation of information in compact form is called compression .The compression is the process used to reduce the bit rate for transmission or storage. While compressing it is also necessary to maintain acceptable fidelity or data quality.

KEYWORDS*:* Compression, SPIHT, EZW,WDR MSE, PSNR, BPP

I. INTRODUCTION

The main objective of data compression is to reduce the amount of redundant information in the stored or communicated data. Data compression techniques are mainly used for speed and performance efficiency along with maintaining the cost of transmission. The different data compression methodologies are used to compress different data formats like text, source code, video, audio, speech and image files. The reduction in file size allows more images to be stored during a given amount of disk or memory space. It also reduces the time required for images to be sent over the web or downloaded from sites.

One of the important aspects of image storage is its efficient compression. To make this fact clear let's see an example. An image, 1024 pixel x 1024 pixel x 24 bit, without compression, would require 3 MB of storage and seven minutes for transmission, utilizing a high speed, 64 Kbit/s, ISDN line. If the image is compressed at a 10:1 compression ratio, the storage requirement is reduced to 300 KB and therefore the transmission time drops to under 6 seconds.

Image compression addresses the problem of reducing the amount of data required to represent a digital image. The underlying basis of the reduction process is the removal of redundant data. From a mathematical viewpoint, this amounts to transforming a 2-D pixel array into a statistically uncorrelated data set. The transformation is applied prior to storage and transmission of the image. The compressed image is decompressed at some later time, to reconstruct the original image or an approximation to it.

II. WAVELET TRANSFORMS AND THRESHOLDING TECHNIQUES

An average value of wavelet waveform is zero and is of limited duration.[1]. Wavelets are irregular and asymmetric in nature.The wavelet analysis breaks a signal into shifted and scaled versions of the original (or mother) wavelet [2]. An irregular wavelet analyzes the signals with sharp changes than with a smooth sinusoid.

A windowing technique with variable-sized regions is the next logical step in wavelet analysis . Wavelet analysis use a time-scale region rather than a time-frequency region . It is possible to compress or de-noise a signal without appreciable degradation by using wavelet analysis.In this work,it is possible to reduce the storage need and transmission bandwidth with the help of wavelet transform .The signal is broken into a shifted and scaled versions of the original wavelet.The biggest advantage of wavelets is its ability to perform local analysis.

III. PROPOSED APPROACH

In this paper, we propose an approach for image compression based on the use of different types of wavelets and various algorithms.

The redundancy and irrelevancy reduction are the two fundamental components of compression. The redundancy reduction aims at removing duplication from the signal source (image/video). The irrelevancy reduction omits parts of the signal that will not be noticed by the signal receiver, namely the Human Visual System . In general, three types of redundancy can be identified:

- Spatial Redundancy -it is the correlation between neighboring pixel values.
- Spectral Redundancy -it is the correlation between different color planes or spectral bands.
- Temporal Redundancy-it is the correlation between adjacent frames in a sequence of images (in video applications).

Two ways of classifying compression techniques are

(a) Lossless vs. Lossy compression: The reconstructed image after compression is numerically identical to the original image in lossless compression schemes. A modest amount of compression is achieved in lossless compression. The reconstructed image after compression contains degradation relative to the original in lossy compression schemes,This is due to the discarding of redundant information in the compression scheme . The lossy schemes of data compression are capable of achieving much higher compression. The quantization of the coefficient in lossy coding is responsible the loss of information.The process of sorting the data into different bits and representing each bit with a value is termed as quantization. The reconstruction value is the value selected to represent a bit . Every item in a bit has the same reconstruction value, which leads to information loss (unless the quantization is so fine that every item gets its own bit).

(b) Predictive vs. Transform coding: In predictive coding the future value is predicted using the information already sent or available, and the difference is coded. It is relatively simple to implement this as this is done on the image or spatial domain, and is readily adapted to local image characteristics. The one particular example of predictive coding is Differential Pulse Code Modulation (DPCM) . In the transform coding, on the other hand, the image is first transformed from its spatial domain representation to a different type of representation using some well-known transform and then codes the transformed values (coefficients). This method provides greater data compression compared to predictive methods, although at the expense of greater computation.The image compression is a type of data compression that encodes the original image with fewer bits.

IV. PROPOSED ALGORITHM

The proposed algorithm for image compression is shown in Fig.1. This algorithm can also be used for compression of audio as well as video.The image is first read and by using transform coding such as wavelet ,it is converted from one kind of representation to other kind of representation.Then the transformed values (coefficients) are encoded by compression algorithms.A better transform coding has the ability to compress the data using less number of coefficients[11].

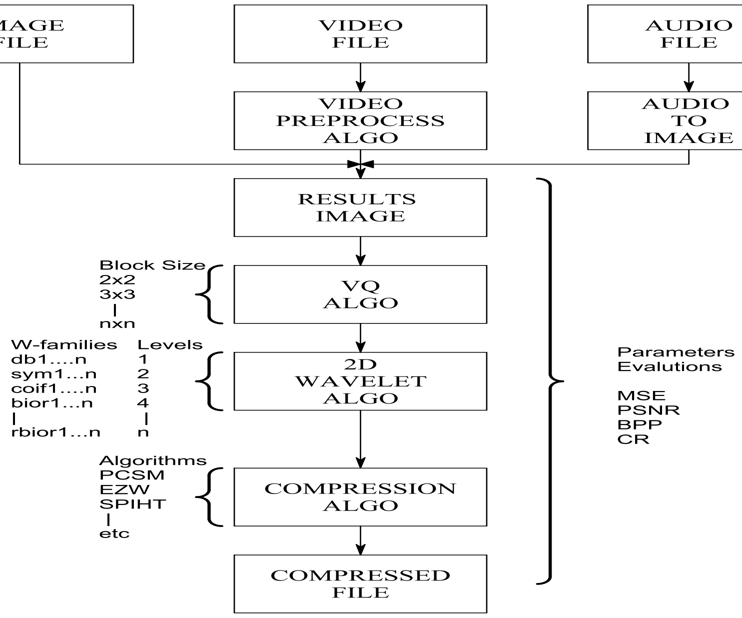

Fig.1. Proposed Algorithm

Procedure to obtain Lossy compression using MWT Algorithm
1:Get total number of pixels for the original input gray image.
2: Identify the total no.of bits required before compression.
3:Calculate the number of sign bits.
4:Identify the total no.of bits required after compression.
5:Calculate the compression ratio by total bits before compression divided by total bits after compression.

V. SIMULATION RESULTS

Here, we report simulation results of the proposed approach using several wavelets and different algorithms.The table 1 shows the result for standard barbara image (gray) for various algorithm indicated.The table also shows various performance measures.The table 2 shows the result for standard lena image (colour) for various algorithm indicated.The table also shows various performance measures.

Table 1 result for standard barbara image (gray) for various algorithm

Performance Measures	Algorithm		
	EZW	SPIHT	WDR
Wavelet	db2	Sym2	bior1.5
Level	2	4	4
Time(Sec)	2.6771	0.20104	0.84391
CR	6.9607 %	1.8463%	10.746%
BPP	0.5568	0.14771	0.85968
MSE	8.48	14.65	8.07
PSNR(dB)	30.2287	26.1208	30.482

For comparison purpose the original image and reconstructed images are shown in figure 2.

Fig 2.Original and reconstructed images for standard barbara.png image(gray)

1] ORIGINAL
2] EZW ,WAVELET = DB2, LEVEL = 2,TIME=1.7293, CR=2.0583, BPP =0.4939, MSE =9.90, PSNR =28.4994
3] SPIHT,WAVELET = SYM2,LEVEL =4, TIME =0.9941, CR=1.4105, BPP =0.3385, MSE =10.79, PSNR =27.9854
4] WDR,WAVELET =BIOR1.5, LEVEL=4,TIME =0.9598, CR =3.0846, BPP =0.7403, MSE =10.06, PSNR =28.1827

Table 2 Result for standard lena.png (colour) for various algorithm

Performance Measures	Algorithm		
	EZW	SPIHT	WDR
Wavelet	db2	Sym2	bior1.5
Level	2	4	4
Time(Sec)	1.7293	0.9941	0.9598
CR	2.0583 %	1.4105 %	3.0846 %
BPP	0.4349	0.3385	0.7403
MSE	9.90	10.79	10.06
PSNR(dB)	28.4994	27.9854	28.1827

For comparison purpose the original image and reconstructed images are shown in figure 3.

Fig 3.Original and reconstructed images for standard lena.png image (colour)

1] ORIGINAL
2] EZW ,WAVELET = DB2, LEVEL = 2,TIME=1.7293, CR=2.0583, BPP =0.4939, MSE =9.90, PSNR =28.4994
3] SPIHT,WAVELET = SYM2, LEVEL = 4, TIME =0.9941, CR=1.4105,BPP =0.3385, MSE =10.79, PSNR =27.9854
4] WDR, WAVELET= BIOR1.5,LEVEL=4,TIME =0.9598, CR =3.0846, BPP =0.7403, MSE =10.06, PSNR =28.1827

VI. RESULTS AND DISCUSSION

An efficient compression method based on DWT is proposed in this paper.The images taken for the experiment are Barbara (gray) and Lena (colour) of size (359 X 359). They are subjected to multiwavelet decomposition. The wavelet filters used in this experiment are “Daubechies”, “Symlet”, ,”Biorthogonal1.5” [8]. The experimental results with the proposed compression method have been arranged in the Table 1 and Table 2 for the different images .The table 1 and 2 represents the corresponding ‘PSNR’, MSE and BPP values for different images for different levels of decomposition . The algorithm has been implemented in MATLAB 2018b.The time required for compression depend on the wavelet used and the level of decomposition.The SPECK algorithm is said to be an efficient algorithm than SPIHT [7]. The time mentioned in the table is in second. The value of MSE (Mean Squared Error) and PSNR (Peak Signal to Noise Ratio) will be low and high respectively for better similarity between the original and reconstructed image .The bits per pixel (BPP) after compression are also indicated in the table 1 and 2.

VII. CONCLUSION

In our research plan, an attempt has been made to study and compare the image compression techniques using DWT and various algorithm of encoding.From the above experimental analysis, it is observed that in comparison to the other experiments, our experiment shows better performance with respect of quality of image after decompression and compression ratio.It can be concluded that the quality of the image is degraded as MSE increases. It can also be concluded that the quality of the image is retained as PSNR increases.So,it can be concluded that by using DWT and inverse DWT, it is possible to compress an image without degrading image quality.Any color image of different image formats can be compressed using this algorithm which is based on DWT and Inverse DWT .

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