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IMAGE COMPRESSION AND PERFORMANCE COMPARISON USING HYBRID (WPT+DCT) TRANSFORM METHOD

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ABSTRACT

In this research paper we proposed a new hybrid algorithm for performing image compression. In this research work we mitigate the effect of two transform method and form a new method which is more efficient than the individual one. Here we proposed as well as compare our new method with the older one. The comparison performed on the basis of compression ratio (CR), Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR). The new Proposed Hybrid (WPT+DCT) method is better than the other method in the manner of visual perception also. This paper provides a good reference for the future selection of image compression method. This work is highly recommended for storage and transmission purpose.

Keywods:- *DCT, WPT, Hybrid Transform.*

I. INTRODUCTION

Increase in image related applications have created an issue of image storing and transmission. Storage and transmission of images require considerable amount of space and bandwidth. Image compression addresses this problem. It reduces the number of bits required to represent the image. Hence, in the era of digital communication, image compression is important field of research. There are two types of compression methods: lossless compression and lossy compression. In lossless compression, reconstructed image is exactly same as compressed image. In lossy image compression high compression ratio is achieved at the cost of some error in reconstructed image. It is always not necessary to obtain exact image after reconstruction. Image with good perceptual quality with some error is acceptable in some applications. For example, for fast transmission of images over internet lossy compression can be used.

Advancements in technology have made considerable changes in the usage of data. Today huge amount of multimedia data is being used and transmitted over the internet. As this multimedia data is continuously increasing day by day, large storage space and transmission bandwidth are the key factors to be considered. Here Image compression plays the vital role. Compression is broadly categorized as lossless and lossy compression. Medical imaging, text data compression are examples of lossless compression where data should be regenerated as it is without any loss. On the other hand, web applications, mobile applications are lossy compressions where some loss of original contents is acceptable. Lossy compression gives high compression than lossless compression.

With naked eyes, viewer cannot detect the difference between original image and decompressed image. Hence many times lossy compression is preferred over lossless compression. In compression algorithms, redundant information in images which is not visible to HVS is removed. Transform based image compression methods have been widely used for image compression as processing of images in frequency domain is easier than spatial domain. Discrete Cosine Transform (DCT) is popular transform used for image compression. DCT has good energy compaction property. After DCT, wavelets have achieved more popularity in image compression because wavelets show higher energy compaction than DCT. Traditional study of wavelet shows that Daubechies wavelet [1] and Haar wavelets have been used and analyzed for image compression application.

Most widely used lossy compression method is transform coding such as Discrete Cosine Transform (DCT) used in JPEG and wavelet transform used in JPEG 2000[2]. In transform coding, initially DCT was popular image compression technique. DCT shows simplicity and satisfactory performance in compression. As it is applied on blocked image correlation across the block boundaries cannot be eliminated. It introduces blocking artifacts specifically at low bit rate. This drawback was overcome by wavelet transform [3]. Since last two to three decades wavelets have come into picture and became an attractive technique for image compression. It gives time and frequency analysis of data.

Wavelet transform can be directly applied to whole image without blocking it. Wavelet based coding is more robust under transmission and decoding errors [4].

Multi resolution property of wavelet transforms help to view the image at different scales. Recent trend is to use hybrid technique for image compression. In hybrid technique, one transform is combined with another

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transform to incorporate the advantages of both transforms. In some cases combination of VQ and transform also has been used.

II. RELATED WORK

Initially focus was on Haar Wavelets. But in recent literature [5, 6, 7, 8] wavelets of other orthogonal transforms have been introduced and studied. These transform include Walsh, DCT and DKT [9], Hartley transform. Generation of hybrid wavelet transform from two different orthogonal transforms is proposed in [10].

Transform Based Image Compression

Image compression plays a vital role in several important and diverse applications including tele-video conferencing, remote sensing, medical imaging and magnetic resonance imaging. Transform based coding is major component of image and video processing applications. It is based on the fact that pixels in an image exhibit a certain level of correlation with their neighboring pixels. A transformation is, therefore defined to map this spatial (correlated) data into transformed (uncorrelated) coefficients. It means that the information content of an individual pixel is relatively small and to a large extent visual contribution of a pixel can be predicted using its neighbors. Transform based compression techniques use a reversible linear mathematical transform to map the pixel values onto a set of coefficients which are then quantized and encoded. It is lossy compression technique. Discrete Cosine Transform (DCT) is most widely used approach in image and video compression.

Discrete Cosine Transform (DCT)

Discrete Cosine Transform (DCT) is widely used transformation technique for image compression. DCT converts the spatial image representation into frequency components. Low frequency components appear at the topmost left corner of the block that contains maximum information of the image.

DCT is the most recent know transform in the image compression field because of its excellent properties of energy compaction [11, 12]. The image to be transformed is divided into square blocks each block consist of nxn pixels, and each block is transformed into nxn DCT coefficient.

After apply DCT on the image we get DCT coefficients for image, non-integer DCT coefficients are quantized to integers. Generally the values of most DCT coefficients are zero or nearly zero. That means there are some information loss, it occurs only in the process of coefficient quantization [13, 14]. In the last decade JPEG image compression standard introduced based on DCT [15, 16].

Wavelet Packet Transform

In the transformation stage, first level of decomposition results in four sets of wavelet coefficients corresponding to four 2-D frequency sub-bands. It consists of one smooth sub-band (LL) called image approximation representing image on lower scale concentrates less than 95% of the total energy. The left 5% is distributed in the other three detail sub-bands namely vertical sub-band (HL), horizontal sub-band (LH) and Diagonal sub-band (HH).

Wavelet Packet offers a more complex and flexible analysis. It represents generalization of multi-resolution decomposition. In WT, approximation component is decomposed whereas in WPT, approximations as well as detailed components are decomposed. The second stage, Quantization/Thresholding focuses on selecting a value that satisfies constraints of HVS for better visual quality and increased CR. The entropy encoder stage reduces the overall number of bits needed to represent the data set. It removes redundancy in the form of repetitive bit pattern in the output of quantizer.

III. METHODOLOGY

In this research we have combined two different transform procedures those are Discrete Cosine Transform (DCT) and Wavelet Packet Transform (WPT). The resultant performance is better than the conventional one in terms of subjective evaluation manner such as Human Visual System (HVS). The Complete Procedure for Compression and Decompression presented stepwise below:

1) Consider any resolution of image.
2) Extract or decompose the image into coefficients using wavelet filter bank.
3) Again pass all the coefficients through the filter bank.
4) Select the appropriate coefficients for further processing.
5) Discard all the other coefficients.

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6) The coefficients are transformed using Discrete Cosine Transform.
7) Now the transformed coefficients are quantized using uniform quantizer.
8) The next step is to perform zigzag scanning of image matrix to convert it into one dimensional vector.
9) Performing the final stage of entropy encoding using Run Length Encoder and output the encoded vector for Decompression.
10) In the decompression procedure first input the vector for operation.
11) Input vector is passed through the decoder i.e. Run length decoder.
12) Now vector is converted to matrix using inverse zigzag traversing.
13) De-quantization is performed on the output from above steps.
14) Now inverse discrete cosine transform and wavelet packet reconstruction steps have been performed to obtain the image of same resolution.
15) Performance evaluation steps performed for analysis in the terms of compression ratio, mean square error and peak signal to noise ratio.

IV. IMPLEMENTATION

Image	Method	Compression Ratio (CR) In percentage	Mean Square Error (MSE)	Peak Signal to Noise Ratio (PSNR) In dB
Bear.jpg (256x256)	DCT	41.9983	0.514	51.021
	WPT	50.6765	0.675	49.8377
	Hybrid	54.1677	0.7127	49.6017
Lion.jpg (800x600)	DCT	84.9372	0.6973	49.6967
	WPT	52.7117	0.0771	59.2594
	Hybrid	59.776	0.1491	56.3956
Ajay.jpg (1024x768)	DCT	60.6363	0.2867	53.5562
	WPT	54.8455	0.4184	51.915
	Hybrid	57.5146	0.6409	50.0632

Table 1 Comparison of result obtained after applying different method

V. EXPERIMENTAL EVALUATION AND ANALYSIS

The experiment is performed between three images of different resolution and different visual perception. The table shows the comparison between DCT, WPT and Hybrid method. The result and test presented below:

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Figure 1 Test Image (a) bear.jpg (b) lion.jpg (c) ajay.jpg

VI. CONCLUSION

As you can see from the analysis part that hybrid method provide overall good performance with acceptable CR, MSE and PSNR. Other method has one parameter good so another parameter with no acceptable value. So method is useful in compression without loss of a large amount of information.
In future work selection of different coefficients can also improve the performance of the image compression.

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