An efficient and Fast Image compression Technique using Hybrid methods

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***Abstract*— Image compression is process to remove the redundant information from the image so that only essential information can be stored to reduce the storage size, transmission bandwidth and transmission time.The essential information is extracted by various transforms techniques such that it can be reconstructed without losing quality and information of the image.In this paper comparative analysis of image compression is done by three transform method, which are Discrete Cosine Transform (DCT) ,Discrete Wavelet Transform(DWT) & Hybrid (DCT+DWT) Transform .Matlab programs were written for each of the above method and concluded based on the results obtained that hybrid DWT-DCT algorithm performs much better than the standalone JPEG-based DCT,DWT algorithms in peak signal to noise ratio (PSNR), Mean Square Error (MSE) ,as well as visual perception at higher compression ratio.**

***Index Terms*— Compression,,DCT,DWT,,Haar Wavelet transform ,Hybrid technique, Compression Ratio(CR),Mean Square Error(MSE),Peak Signal to Noise Ratio(PSNR).**

I. Introduction

Image compression algorithms are used use to reduce the amount of data required to represent a digital image and the basis of the reduction process is the removal of spatial and psychovisual redundancies. Mathematically, visual data compression typically involves transforming (encoding) a 2-D pixel array into a statistically uncorrelated data set. Two types of compression are lossless compression and lossy compression. If same image can be generated from the compressed image then it is Lossless compression otherwise it is lossy compression.

Compression of multimedia data such as images achieved through one lossless algorithm DCT coding and one lossy method DWT transform. Therefore in this paper comparative study of two image compression algorithm and their variety of features discussed and that factors are used to choose best among them for further Hybrid method.

II. DISCRETE COSINE TRANSFORM (DCT)

Typical image compression block is shown in fig.1, which explains flow of process involved in image compression. Discrete Cosine Transform (DCT) exploits cosine functions, it transform a signal from spatial representation into frequency domain. The DCT represents an image as a sum of sinusoids of varying magnitudes and frequencies.

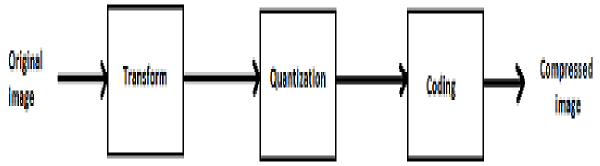

Fig.1 Image compression model

DCT has the property that for a typical image most of the visually significant and information about an image is concentrated in just few coefficients of DCT .After the computation of dct coefficients ,they are normalized according to a quantization table with different scales provided by the JPEG standard .Selection of quantization table affects the entropy and compression ratio.The value of the pixels of black and white image are ranged from 0 to 255,where 0 corresponds to a pure black and 255 corresponds to a pure white.As DCT is designed to work on pixels values ranging from -128 to 127,The original block is leveled off by 128 from every entry.Step by step procedure of getting compressed image using DCT can be illustrated through flow chart as shown in fig 2 .

We choose Qmatrix, with a Quality level of 50, Q50matrix gives both high compression and excellent decompressed image. . After Quantization, all of the quantized coefficients are ordered into the “zigzag” sequence.

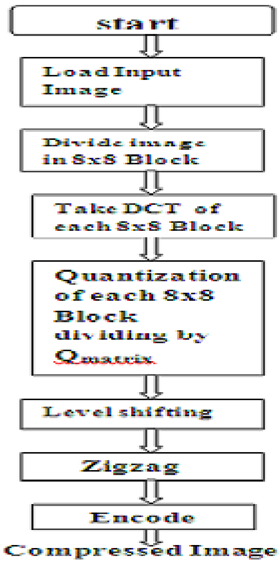

Fig.2Flow chart of Compression Technique

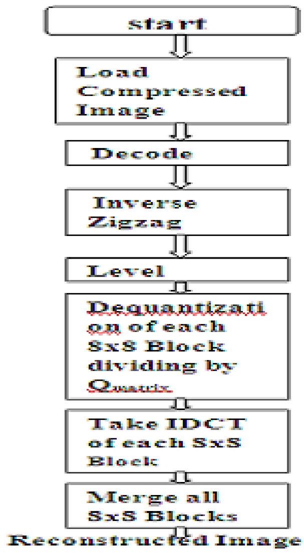

Fig.3 Flow chart of DecompressionTechnique

III. DISCRETE WAVELET TRANSFORM (DWT)

Wavelet decomposition of the images is used due to its inherent multiresolution characteristics. The basic idea of

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usingDiscrete Wavelet Transform is to reduce the size of the image at each level, e.g., a square image of size 2j ×2j pixels at level L reduces to size 2j/2 × 2j/2 pixels at level L+1. Wavelets are useful for compressing signals. They can be used to process and improve signals, in fields such as medical imaging where image degradation is not tolerated. Wavelets can be used to remove noise in an image. Wavelets are mathematical functions that can be used to transform one function representation into another. Wavelet transform performs multiresolution image analysis. Multiresolution means simultaneous representation of image on different resolution levels. Wavelet transform represent an image as a sum of wavelets functions, with different location and scales.

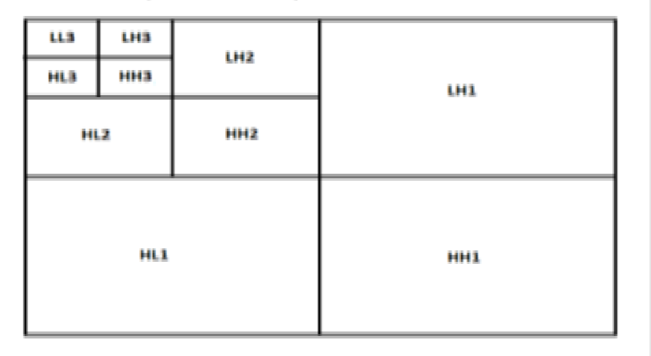

Fig.4 Wavelet Filter Decomposition

At each level, the image is decomposed into four sub images. The sub images are labeled LL, LH, HL and HH.LL corresponds to the coarse level coefficients or the approximation image. This image is used for furtherdecomposition. LH, HL and HH correspond to the vertical, horizontal and diagonal components of the image.

IV. HYBRID (DCT + DWT) TRANSFORM

The aim of image compression is to reduce the storage size with high compression and less loss of information. In section II and III we presented two different ways of achieving the goals of image compression, which have some advantages and disadvantages, in this section we are proposing a transform technique that will exploit advantages of DCT and DWT, to get compressed image. Hybrid DCT-DWT transformation gives more compression ratio compared to JPEG and JPEG2000, preserving most of the image information and create good quality of reconstructed image. Hybrid (DCT+DWT) Transform reduces blocking artifacts, false contouring and ringing effect.

A. Compression procedure

The input image is first converted to gray image from colour image, after this whole image is divided into size of 32x32 pixels blocks. Then 2D-DWT applied on each block of 32x32 block, by applying 2 D-DWT, four details are produced. Out of four sub band details, approximation detail/sub band is further transformed again by 2 D-DWT which gives another four sub-band of 16x16 blocks. Above step is followed to decompose the 16x16 block of approximated detail to get new set of four sub band/ details of size 8x8. The level of decomposition is depend on size processing block obtained initially, i.e. here we are dividing image initially into size of 32x32, hence the level of decomposition is 2.

B. Decompression procedure

At receiver side, we decode the quantized DCT coefficients and compute the inverse two dimensional DCT (IDCT) of each block. Then block is dequantized. Further we take inverse wavelet transform of the dequantized block. Since the level of decomposition while compressing was two, we take inverse wavelet transform two times to get the same block size i.e. 32x32. This procedure followed for each block received. When all received blocks are converted to 32x32 by following decompression procedure, explained above. We arrange all blocks to get reconstructed image. The complete coding and decoding procedure is explained in fig.5& fig.6.

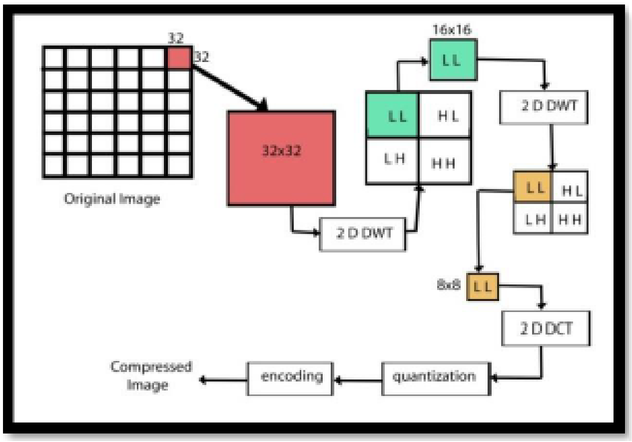

Fig.5 Compression using Hybrid transform

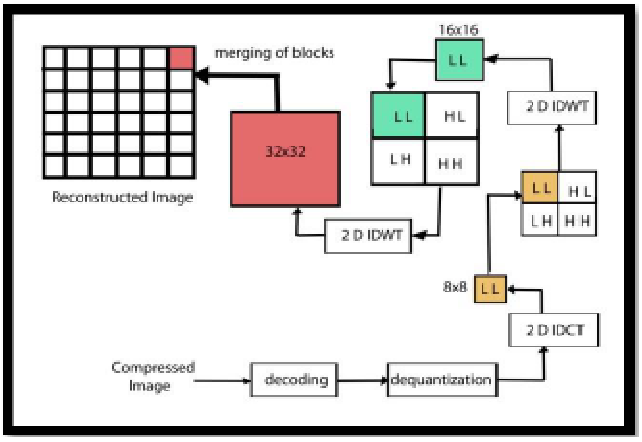

Fig.6 Decompression using Hybrid transform

C. Phase Correlation

This is an elegant method used for template matching applications . Figure 6 shows phase correlation between two blocks. The ratio R between two images ‘img1’ and ‘img2’ iscalculated as follows:

$$R = \frac{F(img1) \times conj(F(img2))}{\|F(img1) \times conj(F(img2))\|}$$

where ‘F’ is the Fourier Transform, and ‘conj’ is the complex conjugate. The inverse Fourier Transform of ‘R’ is the phase correlation ρ. Figure 6 shows phase correlation between two blocks.

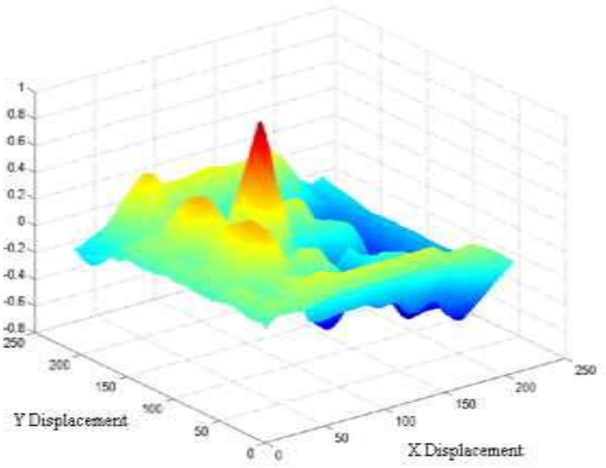

Fig7.Phase Correlation between two blocks

V. HAAR WAVELET TRANSFORM

Haar wavelet transform is the simplest transform for image compression, the principle behind this is very simple as calculating averages and differences of adjacent pixels. The Haar DWT is more computationally efficient than the sinusoidal based discrete transforms, but this quality is a tradeoff with decreased energy compaction compared to the DCT.

In order to implement the image compression algorithm we chose, we divided the process into
various steps:

- calculate the sums and differences of every row of the image
- calculate the sums and differences of every column of the resulting matrix
- repeat this process until we get down to squares of 16x16
- quantize the final matrix using different bit allocation schemes
- write the quantized matrix out to a binary file

VI. RESULT AND ANALYSIS

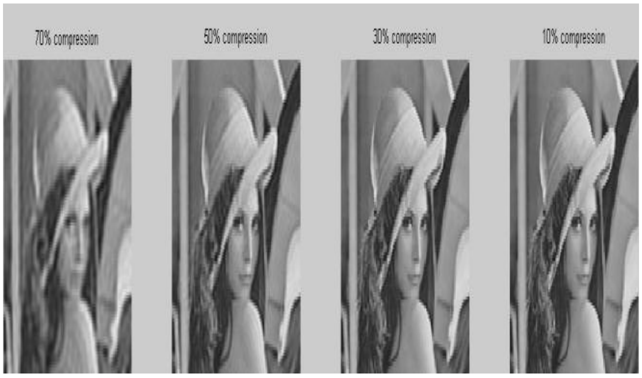

Fig8. Image compression using DCT technique

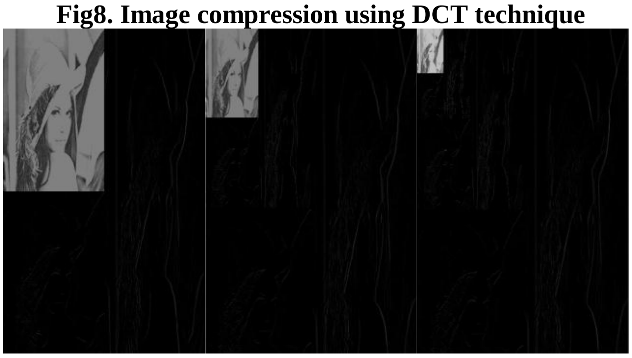

Fig9. Image compression using using DWT Technique

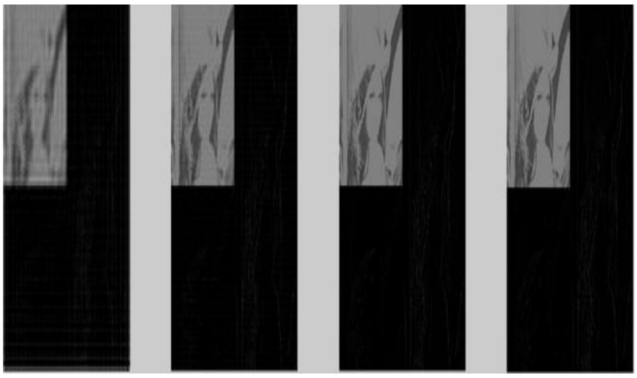

Fig10.image compression using Hybrid Method

Fig11. Reconstructed Image using

DCT,DWT,HYBRID(DCT-DWT)

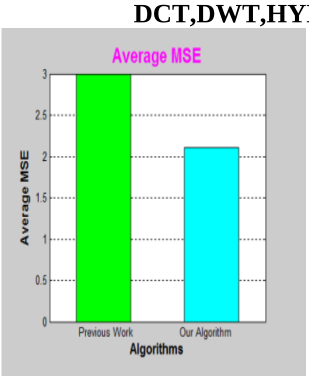

Figure 12: MSE Graph

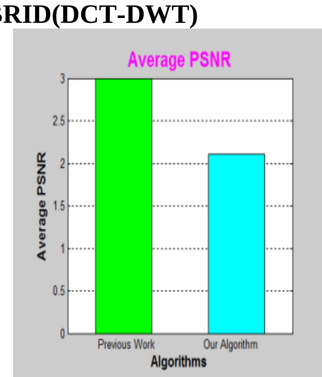

Figure 13: PSNR Graph

VII. CONCLUSION

In this paper comparative analysis of various Image compression techniques for different images is done based on three parameters compression ratio(CR), mean square error (MSE), peak signal to noise ratio (PSNR). Our results shows that we can achieve higher compression ratio using Hybrid technique but loss of information is more. DWT gives better compression ratio without losing more information of image. Pitfall of DWT is, it requires more processing power. DCT overcomes this disadvantage since it needs less processing power, but it gives less compression ratio. DCT based standard JPEG uses blocks of image,but there is still correlation exits across blocks. Block boundaries are noticeable in some cases. Blocking artifacts can be seen at low bit rates. In wavelet, there is no need to block the image. More robust under transmission errors . It facilitates progressive transmission of the image (scalability). Hybrid transform gives higher compression ratio but for getting that clarity of the image is partially trade off. It is more suitable for regular applications as it is having a good compression ratio along with preserving most of the information.

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