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Efficient Image Compression using all the Coefficients of 16x16 DCT Image Sub-Block

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Abstract— Image compression is the prominent need of modern digital image processing devices as well as codes to save large digital images in small images. And for the same reason we need the image compression algorithms which has optimum performance of compression without losing visuality of image. Here we are implementing the compression technique which is based on discrete cosine transform (DCT) image sub-block. The main idea behind applying this algorithm is the utilization of all the coefficients of DCT sub-blocks. The results of different number of coefficients are compared with the value of PSNR, compressed size of image, compression percentage and compression time of algorithm. After analysis of technique we found it optimum for visualisation, compressed file size and compression time.

Key Terms— **Colour image compression, DCT, Edge detection & JPEG.**

I. INTRODUCTION

The aim of an image compression technique is to represent an image with smaller number of bits without introducing appreciable degradation of visual quality of decompressed image. These two goals are mutually conflict in nature. In a digital true color image, each color component that is R, G, B components, each contains 8 bits data [1]. Also image usually contains a lot of data redundancy and requires a large amount of storage space. In order to lower the transmission and storage cost, image compression is desired [2]. Most color images are recorded in RGB model, which is the most well known color model. However, RGB model is not suited for image processing purpose. For compression, aluminance-chrominance representation is considered superior to the RGB representation. Therefore, RGB images are transformed to one of the luminance-chrominance models, performing the compression process, and then transform back to RGB model because displays are most often provided output image with direct RGB model. The luminance component represents the intensity of the image and look likes a gray scale version. The chrominance components represent the color information in the image [3,4]. Douak et al. [5] have proposed a new algorithm for color images compression.

After a pre-processing step, the DCT transform is applied and followed by an iterative phase including the threshold, the quantization, de-quantization and the inverse DCT. To obtain the best possible compression ratio, the next step is the application of a proposed adaptive scanning providing, for each (n, n) DCT block a corresponding (16×16) vector containing the maximum possible run of zeros at its end. The last step is the application of a modified systematic lossless encoder. The efficiency of their proposed scheme is demonstrated by results. Mohamed et al. [6] proposed a hybrid image compression method, which the background of the image is compressed using lossy compression and the rest of the image is compressed using lossless compression. In hybrid compression of color images with larger trivial background by histogram segmentation, input color image is subjected to binary segmentation using histogram to detect the background. The color image is compressed by standard lossy compression method. The difference between the lossy image and the original image is computed and is called as residue. The residue at the background area is dropped and rest of the area is compressed by standard lossless compression method. This method gives lower bit rate than the lossless compression methods and is well suited to any color image with larger trivial background.

In this paper, the proposed method for color image compression using 16X16 blocks makes a balance on compression ratio and image quality by compressing the vital parts of the image with high quality. In this approach the main subject in the image is very important than the background image. Considering the importance of image components and the effect of smoothness in image compression, this method classifies the image as edge blocks (main subject) and non-edge blocks (background), then the background of the image is subjected to low quality lossy compression and the main subject is compressed with high quality lossy compression. We tested our algorithm with different kind of image and the experimental results show the effectiveness of our approach. The rest of our paper is organized as follow, The JPEG Compression method and detect edges used in the proposed work are described in section II. Section III describes the proposed algorithm. Section IV presents the experimental results obtained in this paper. Section V draws the conclusion of this work.

The discrete cosine transform, which is applied to each nXn block of the partitioned image. Compression is then achieved by performing quantization of each of those 16x16 coefficient blocks.

Image transforms coding for JPEG compression algorithm. In the image compression algorithm, the input image is divided into 16 by 16 non overlapping blocks, and the two dimensional DCT is computed for each block. The DCT coefficients are then quantized, coded, and transmitted. The JPEG receiver decodes the quantized DCT coefficients, computes the inverse two dimensional DCT of each block, and then puts the blocks back together into a single image. For typical images, many of the DCT coefficients have values close to zero; these coefficients can be discarded without seriously affecting the quality of the

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reconstructed image. A two dimensional DCT of an N by N matrix pixel is defined as follows

$$DCT(i,j)=\frac{1}{\sqrt{2N}}C(i)C(j)\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}pixel(x,y)\ Cos\left[\frac{(2x+1)i\pi}{2N}\right]Cos\left[\frac{(2y+1)j\pi}{2N}\right]$$

$$\text{where}\quad C(x)=\begin{cases}\frac{1}{\sqrt{2}} & \text{if } x=0\\ 1 & \text{otherwise}\end{cases}$$

For decoding purpose there is an inverse DCT (IDCT):

$$pixel(x,y)=\frac{1}{\sqrt{2N}}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}C(i)C(j)DCT(i,j)Cos\left[\frac{(2x+1)i\pi}{2N}\right]Cos\left[\frac{(2y+1)j\pi}{2N}\right]$$

The DCT based encoder can be thought of as essentially compression of a stream of 8x8 blocks of image samples. Each 8 X 8 block makes its way through each processing step, and yields output in compressed form into the data stream. Because adjacent image pixels are highly correlated, the forward DCT (FDCT) processing step lays the foundation for achieving data compression by concentrating most of the signal in the lower spatial frequencies. For a typical 8x8 sample block from a typical source image, most of the spatial frequencies have zero or near6ero amplitude and need not be encoded. In principle, the DCT introduces no loss to the source image samples; it merely transforms them to a domain in which they can be more efficiently encoded. After output from the FDCT, each of the 64 DCT coefficients is uniformly quantized in conjunction with a carefully designed 64– element quantization table (QT). At the decoder, the quantized values are multiplied by the corresponding QT elements to recover the original un-quantized values. After quantization, all of the quantized coefficients are ordered into the "zigzag" sequence as shown in figure 2.

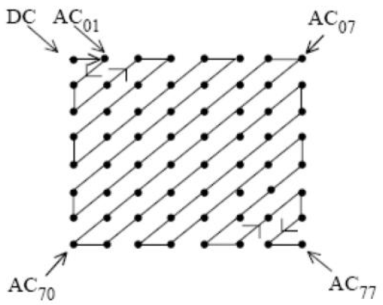

Fig 2: Zig Zag Sequence

This ordering helps to facilitate entropy encoding by placing low frequency non-Zero coefficients before high frequency coefficients. The DC coefficient, which contains a significant fraction of the total image energy, is differentially encoded. Figure 1 (b) show the JPEG decoder architecture, which is the reverse procedure described for compression.

II. PROPOSED METHODOLOGY

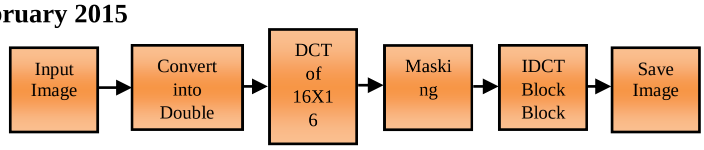

Fig.1 Block Diagram of Proposed Methodology

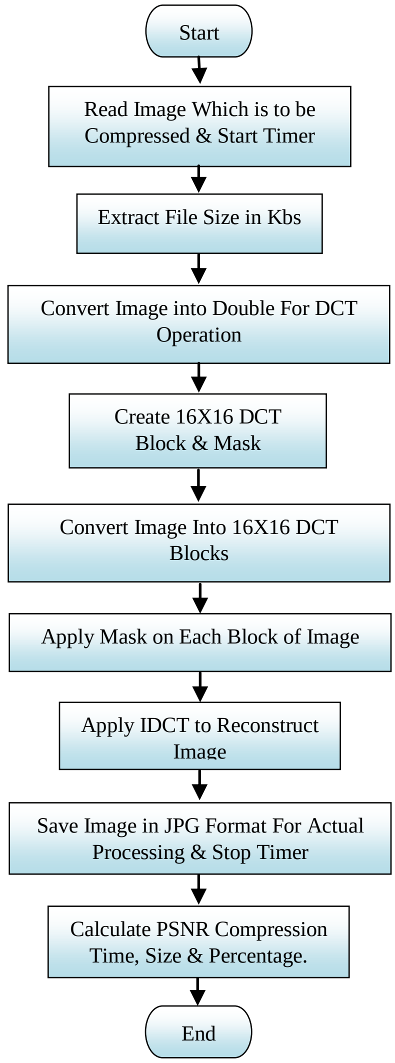

Fig.2 Flow Graph of Proposed Methodology

III. SIMULATION RESULTS

The simulation performed on MATLAB R2011a. The image compression is very useful idea to save space as well as to store the images with considerable visualisation. Here we have simulated the compression technique which significantly reduces the size of the image without losing its visualisation. In the below figures the results are shown and compared.

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Fig. 3 Original Image without any compression

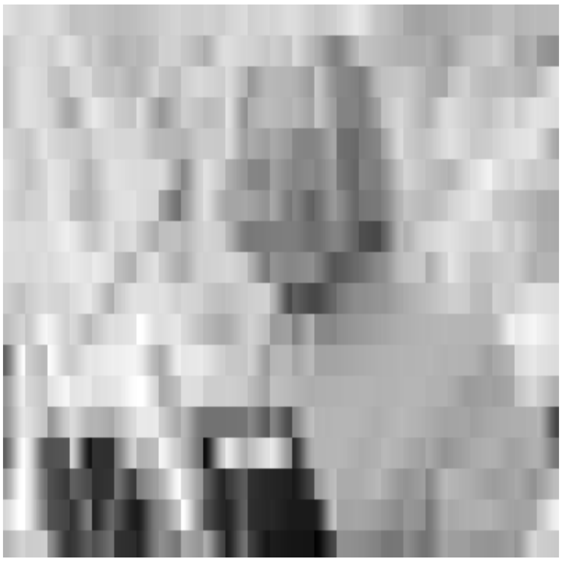

Fig. 4 Image after applying DCT compressed of 2 coefficients in 16x16 image sub-block.

Fig. 5 Image after applying DCT compressed of 6 coefficients in 16x16 image sub-block.

Fig. 6 Image after applying DCT compressed of 10 coefficients in 16x16 image sub-block.

Fig. 7 Image after applying DCT compressed of 120 coefficients in 16x16 image sub-block.

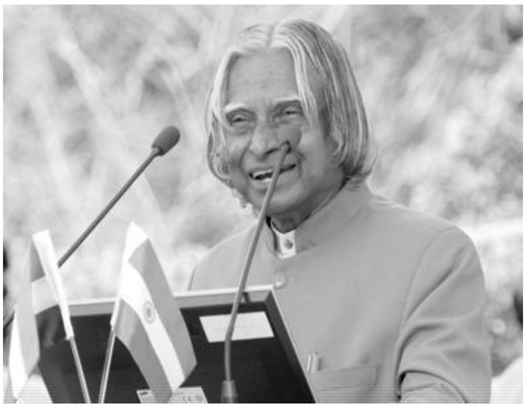

Fig. 8 Image after applying DCT compressed of 120 coefficients in 16x16 image sub-block.

The PSNR may be defined, respectively, as

$$PSNR = 10 \times \log_{10} \frac{255^2 \times 3}{MSE(Y) + MSE(Cb) + MSE(Cr)}$$

Where MSE is the mean square error for each space.

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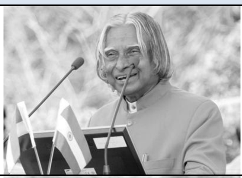
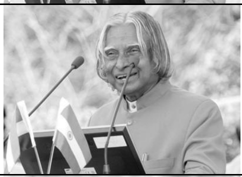
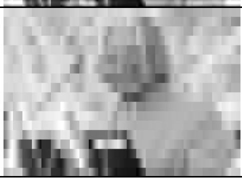
Table 1: Comparison of Compression Techniques

Technique (Following coefficients of 16x16 Image sub-block)	Results	Results (Original File Size = 67.501 KBs)			
		PSNR	Compressed File Size	Percentage Compression	Compression Time
All		38.341 dB	14.703 KBs	78.22%	0.708 sec
120		37.306 dB	14.442 KBs	78.60%	0.393 sec
10		25.624 dB	8.695 KBs	87.12%	0.348 sec
6		24.199 dB	7.592 KBs	88.75%	0.391 sec
2		21.699 dB	5.258 KBs	92.21%	0.624 sec

IV. CONCLUSION & FUTURE SCOPE

In this paper a block based coding scheme was proposed along with its applications to compress colour images. The obtained results shows the improvement of the proposed method over the recent published paper both in quantitative PSNR terms and very particularly, in visual quality of the reconstructed images. Furthermore, it increased the compression rate.

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