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Survey on JPEG Image Compression Using DCT

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Abstract: ***This paper covers the analysis process of JPEG (joint picture expert group) standard which is based on the technique called discrete cosine transform (DCT). DCT is method that converts a graphic image as jpeg from spatial domain to frequency domain. In DCT method quantization, transformation used for removal of high frequency bit and redundancy. In subject of image compression for jpeg there is various traditional and efficient techniques available .For achieving higher compression ratio there is requirement of modify and improvement of traditional techniques . In this paper discusses about jpeg encoding and compression.***

Keywords**: *JPEG image compression, DCT method***

I. INTRODUCTION

Image compression means of reducing graphics file with no loss of quality of image thus compression of jpg, png, gif and bmp reduces size .and hence more files can be stored in storage devices. This paper represent various technology of image compression. Today internet is means of common uses for various services internet contain web pages and web pages contain graphics file like jpg, png and gif .if graphic file size not reduce then web page take longer time to load because of larger file so for internet application image compression is required.

A digital image is presented as shown in figure below is 2-D array of pixels. If x and y represents as spatial co-ordinate of pixel .Digital image converted into matrix form before modification and manipulation for image processing in digital computing.[1]

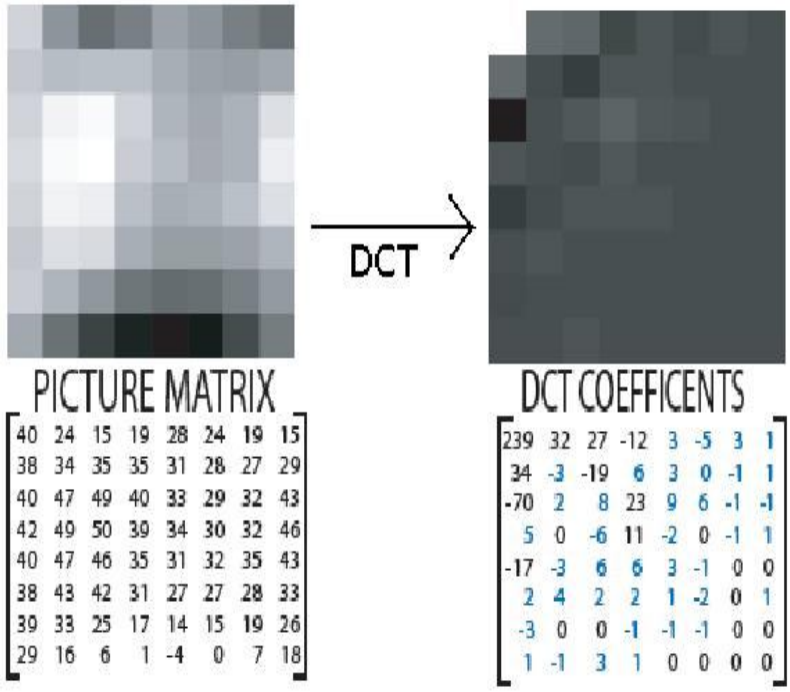

Figure 0. 2-D Matrix Representation of Image

II. JPEG COMPRESSION STANDARD

JPEG is an international standard compression for still images as grayscale and color that was developed by the "joint photographic experts group".jpeg accepted by ISO as standard in 1992.jpeg is lossy method for compression of image.

Jpeg is most common file for graphic and multimedia application and various imaging device camera etc. For better compression and efficiency jpeg standards uses their own methods.

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III.COMPRESSION METHOD OF JPEG IMAGE

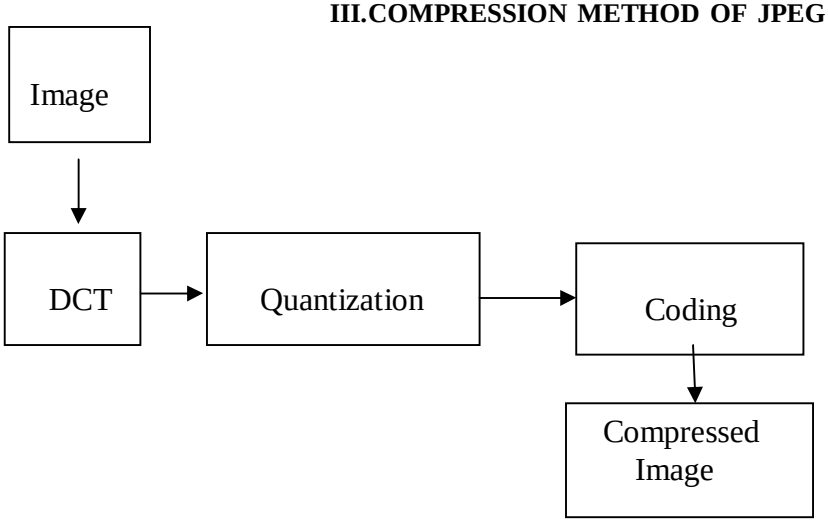

Figure.1 Block diagram of JPEG Image Compression process.

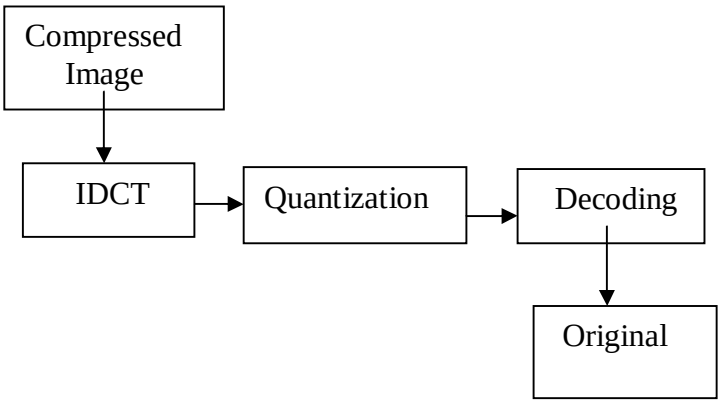

Figure.2 Block diagram of JPEG Image Decompression process.

A. Forward DCT

$$F(u,v) = \frac{1}{4}C(u)C(v)\sum_{x=0}^{7}\sum_{y=0}^{7} f(x,y)\cos\left[\frac{\pi(2x+1)u}{16}\right]\cos\left[\frac{\pi(2y+1)v}{16}\right]$$

for $u = 0,\ldots,7$ and $v = 0,\ldots,7$

where $C(k) = \begin{cases} 1/\sqrt{2} & \text{for } k = 0 \\ 1 & \text{otherwise} \end{cases}$

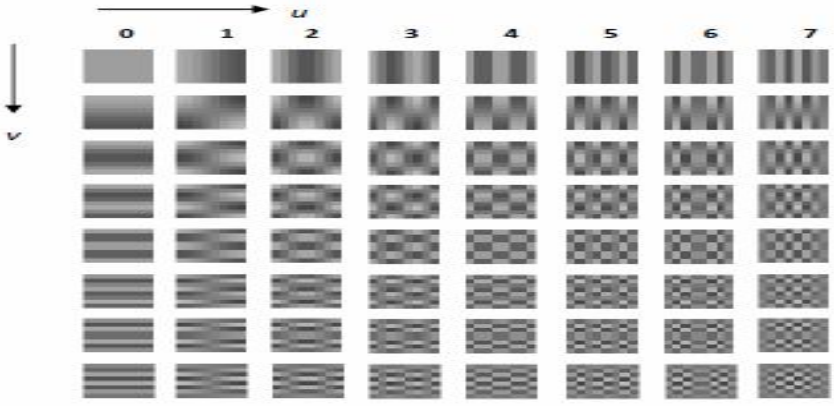

Fig. The 8×8 DCT basis $\omega_{x,y}(u,v)$ [2]

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B. Inverse DCT

$$f(x,y)=\frac{1}{4}\sum_{u=0}^{7}\sum_{v=0}^{7}C(u)C(v)F(u,v)\cos\left[\frac{\pi(2x+1)u}{16}\right]\cos\left[\frac{\pi(2y+1)v}{16}\right]$$

for $x=0,\ldots,7$ and $y=0,\ldots,7$

The $F(u,v)$ is called the DCT coefficient, and the basis of DCT is:

$$\omega_{x,y}(u,v)=\frac{C(u)C(v)}{4}\cos\left[\frac{\pi(2x+1)u}{16}\right]\cos\left[\frac{\pi(2y+1)v}{16}\right]$$

Then we can rewrite the IDCT by **Eq. (24)**:

$$f(x,y)=\sum_{u=0}^{7}\sum_{v=0}^{7}F(u,v)\omega_{x,y}(u,v) \quad \text{for } x=0,\ldots,7 \text{ and } y=0,\ldots,7$$

[2]

1) Steps

a) Original Given Image is broken into any square block. Example block 8 * 8 , 16 * 16, 32 * 32.
Forward DCT equation used for calculate DCT matrix.

b) DCT applied to each and every block of image *f(I , j)*
By multiplying the modified block and DCT matrix.

c) By using quantization each block is compressed.

d) After quantization uses entropy encoding.

e) Compressed file recreated by using reverse CDT.

Quantization is the phase where most of the compression take place **.**For achieve higher compression ratio in JPEG image used quantization. After applying quantization loss of precision and distortion into original image means it's lossy operation. The image compression standard of JPEG defined there own quantization method. Main purpose of quantization is lower most of high frequency bit to 0, the more 0 generate the better image compression. Dividing each co-efficient by an integer ranging from 1 to 255 and rounding off. Hence quantization table generated is attached to compressed file.[3]

From above DCT figure of 8x8 image block it's clear that 8x8 block consist of 64 DCT coefficients .f(0,0) is first DC and remaining 63 are AC component.

$$F(u,v)_{Quantization}=round\left(\frac{F(u,v)}{Q(u,v)}\right)$$

$$F(u,v)_{deQ}=F(u,v)_{Quantization}\times Q(u,v)$$

[4]

A fundamental quantization matrix shown as follows

$$Q_Y=\begin{pmatrix}16&11&10&16&24&40&51&61\\12&12&14&19&26&58&60&55\\14&13&16&24&40&57&69&56\\14&17&22&29&51&87&80&62\\18&22&37&56&68&109&103&77\\24&35&55&64&81&104&113&92\\49&64&78&87&103&121&120&101\\72&92&95&98&112&100&103&99\end{pmatrix} \quad Q_C=\begin{pmatrix}17&18&24&47&99&99&99&99\\18&21&26&66&99&99&99&99\\24&26&56&99&99&99&99&99\\47&66&99&99&99&99&99&99\\99&99&99&99&99&99&99&99\\99&99&99&99&99&99&99&99\\99&99&99&99&99&99&99&99\\99&99&99&99&99&99&99&99\end{pmatrix}$$

[5]

The jpeg does not define any fixed matrix it is user choice to select above defined quantization matrix.

After applying quantization, the algorithm is left with blocks of 8x8 = 64 values, many of which them are zero. Zig zag sequence orders all the quantized coefficient with lower frequencies and after that the higher frequency .finally resulting the sequence of similar data byte stream .providing efficient entropy encoding [6].

Algorithm starting point is at DC values and begins going down to the matrix, as presented in figure below -

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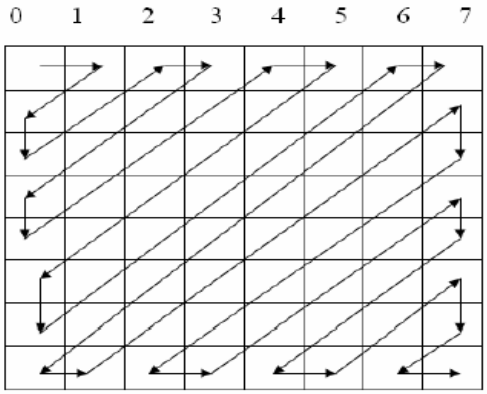

IV. LITERATURE REVIEW

Dinesh V. Rojatkar, Nitesh D. Borkar, Buddhabhushan R. Naik, Ravindra N. Peddiwar : As the use of the digital media is increased. That demand large amount of storage. That require the compression of media. The various types of compression techniques available that are used to compress the digital data. These technique are used in many application to compress the image. The compression of digital data help for reducing the storage cost and for transmition over low bandwidth [1].

Priyanka dixit, Mayanka dixit : The jpeg technique is the part of the lossy compression that uses deiscrete Cosine Transformation. DCT process the input data and seperate image into several part using different frequencies. In the quantization process the unnecessary data are removed and important data are remain that are used in the process of reconstruction of Image [3].

Papiya Chakraborty : when we see any image on computer monitor we actually seeing a huge amount of finite color or pixel. each pixel is composed of the three dots of light which are green, blue, blue we generally called as RGB. Computer present image as 3 matrices values .which is corresponding to brightness of color in each pixel. Intensity values are represent as 8 bit and there are 256 variation and if the intensity present in 16 bit then there 32000 variation between black and white.

V. OBJECTIVE

Today there is various compression techniques available in which of them much efficient proved in terms of performance. Here we are using JPEG compression which is lossy image compression technique that uses DCT (Discrete Cosine Transformation).In the application of multimedia image file usually transmitted in the compressed form by means of various communication technology. For modification and manipulation of JPEG image file must be decompressed in its original form.

Traditional method is not able to satisfy the requirements of available system. So in this paper we are studying the techniques of image processing which is based on the DCT.

VI. CONCLUSION

This paper study the process of JPEG based encoding. Compression is complete by the DCT technique which decompose image into different frequencies component. Then the unnecessary information in image is removed by quantization process. That means in the compression of JPEG encoding DCT role is important. But in DCT technique compression ratio increases , that more information lost. So there are some fast DCT technique are introduced for better performance.

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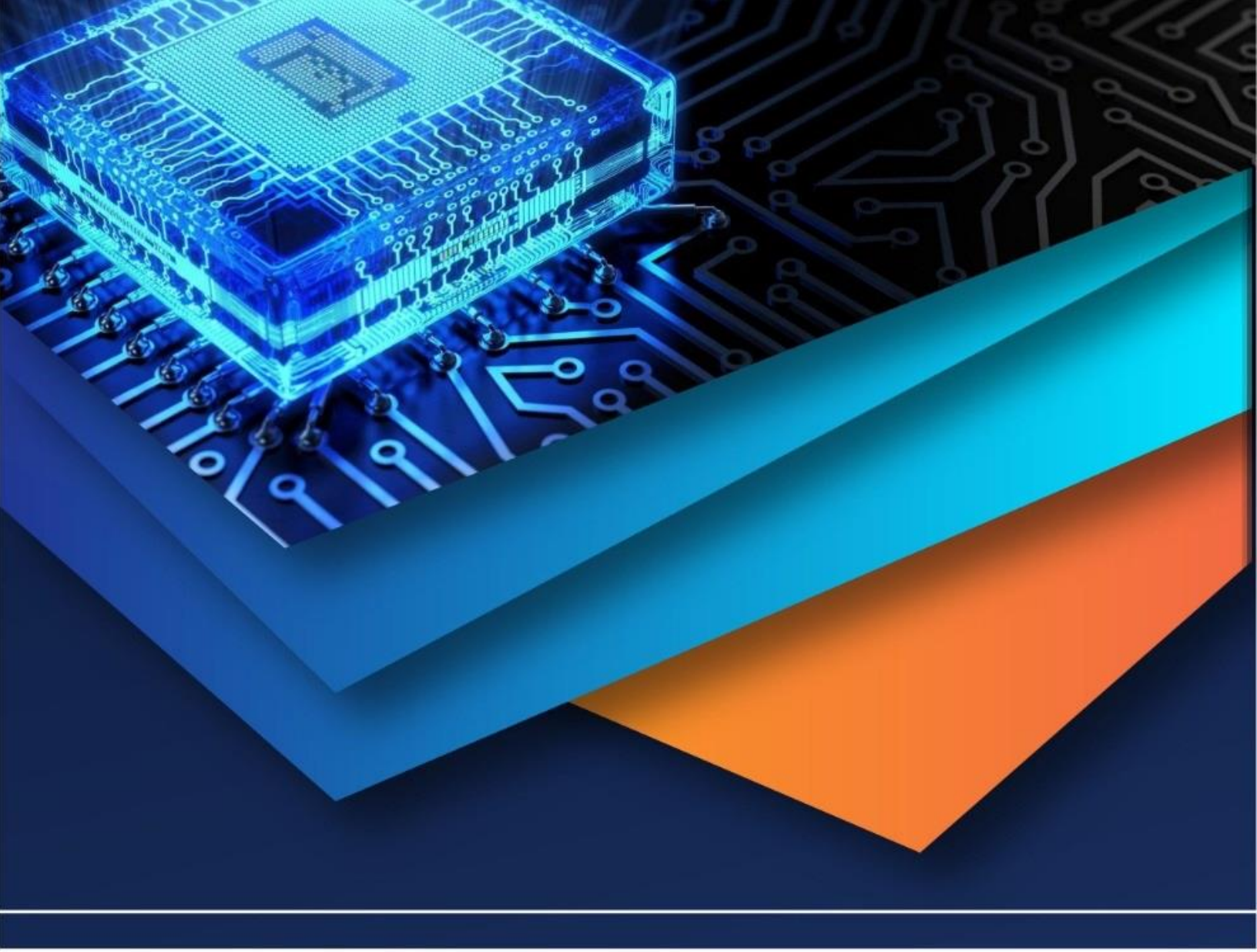

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