



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4

Issue: X

Month of publication: October 2016

DOI:

www.ijraset.com

Call:  08813907089

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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]

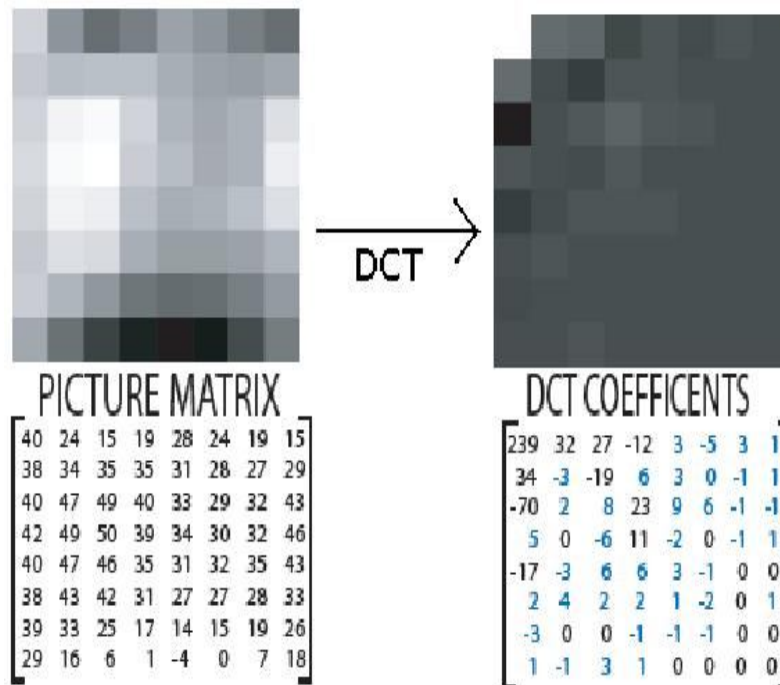


Figure 0. 2-D Matrix Representation of Image

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

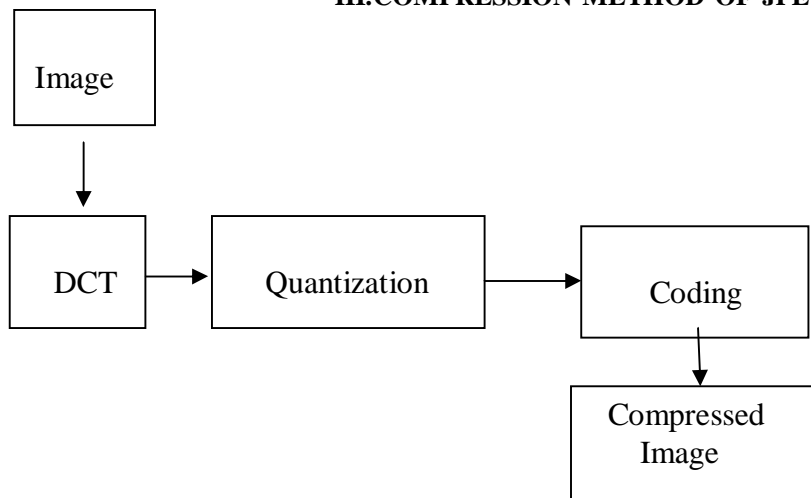


Figure.1 Block diagram of JPEG Image Compression process.

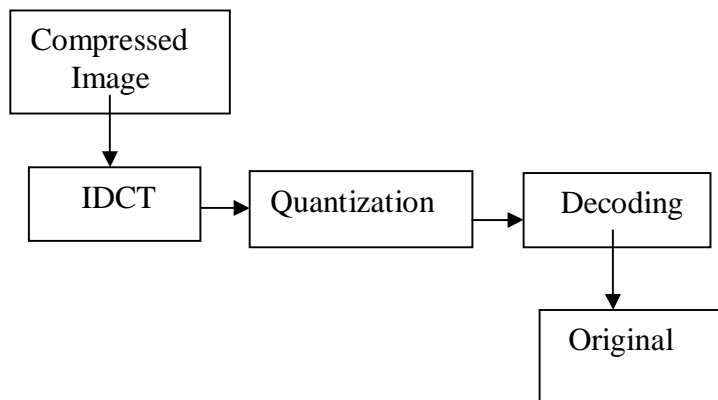


Figure.2 Block diagram of JPEG Image Decompression process.

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 $u = 0, \dots, 7$ and $v = 0, \dots, 7$
 where $C(k) = \begin{cases} 1/\sqrt{2} & \text{for } k = 0 \\ 1 & \text{otherwise} \end{cases}$

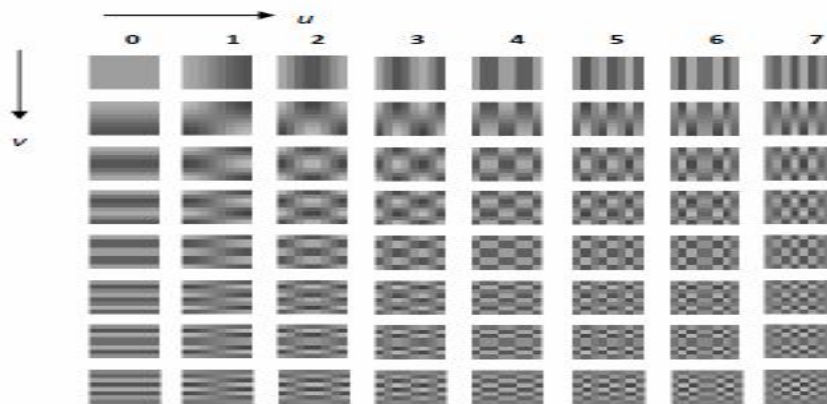


Fig. The 8x8 DCT basis $\omega_{x,y}(u, v)$

[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 $x = 0, \dots, 7$ and $y = 0, \dots, 7$

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):

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

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

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

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

[4]

A fundamental quantization matrix shown as follows

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

[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 $8 \times 8 = 64$ 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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10.22214/IJRASET



45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



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