INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

**ISSN: 2454-132X**
**Impact factor: 4.295**
***(Volume3, Issue4)***
Available online at www.ijariit.com

# Robust Approach of Compressing Images Using DCT and Analysis of Parameters PSNR, CR

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***Abstract:*** ***Image compression is one of the tedious tasks in the field of image transmission via the internet and to store in the binary or digital form on computers and other storage devices. The necessity of bandwidth of channel relies on many aspects of data and size of the file to be transferred. Compressing an image is significantly different than compressing raw binary data. If we used the general or outdated technique to compression images then result would be not optimal as it should be. This is because images have definitely statistical properties which can be triggered or exploited by encoders which are implemented or design for them. In the image we have to give up some fine details for the sake of saving a little more bandwidth or storage space. So we can say that lossy compression technology. In this dissertation compression of digital images are done with the help of DCT. Several encoding techniques have also been used together with DCT to improve the performance of compression. A computational analysis of picture quality is also made with respect to compression ratio and PSNR.***

***Keywords: Processing Time, Lossy, DCT, PSNR, Scaling Factor, Compression Ratio, Redundancy.***

## I. INTRODUCTION

Digital image processing allows the use of complicated algorithms for image processing, and hence, can offer both more sophisticated performance at simple tasks and the implementation of a different approach which would be impossible by analog means. In particular, digital image processing is one of the best practical technology for Classification, Feature extraction, Projection, Multi-scale signal analysis. The JPEG has four distinct modes of operation. The Lossy Sequential DCT Based Mode is most popular among them since it can achieve highest compression ratio besides preserving maximum possible image quality. Although the expanded lossy mode can achieve more compression, it has not been generalized to the end users since the amount of data loss is much higher. Because the achievable compression ratio is lower, the lossless mode is also not in consideration [1-3]. Therefore, the Baseline JPEG stands as a standard for compressing digital images. Generally, a digital image contains three distinguished types of redundancy; namely, Inter-Pixel Redundancy, Coding Redundancy, and Psycho visual Redundancy. Since a digital image contains a huge amount of psycho visually redundant data, Baseline JPEG focused on removing this redundancy. For color images, the color planes are separated before the algorithm is applied and the RGB color domain is transformed to Y CbCr color domain in order to separate the luminance and chrominance signals. The separation of color space is mandatory for color images, but the transformation to Y CbCr color domain, in addition, has been kept optional. The Baseline JPEG uses a default Huffman Coding Table in Entropy Encoding stage so that the encoded bit stream can be uniquely decoded. However, Run-length or Arithmetic Coding can also be applied in this stage without compromising the resulting number of bits since all of them are optimal coding. As an already optimally compressed bit stream cannot further be compressed, any effort to further compression of a JPEG coded bit stream is meaningless [9-11]. However, since the Baseline JPEG Default Huffman Coding results in different depending on the distribution of the frequency of the input data set, if the data set of an image applied for Huffman Coding is modified, obtaining a more optimum result is still possible. The coordinate system approach to the following representation of a digitized image function:

 

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0,N-1) \\ f(1,0) & f(1,1) & \cdots & f(1,N-1) \\ \vdots & \vdots & \ddots & \vdots \\ f(M-1,0) & f(M-1,1) & \cdots & f(M-1,N-1) \end{bmatrix}$$

Each element of this array is called an image element, pixel, picture element. There is two type of vector one is row vector whose dimensions is equal 1*N and another is column vector whose dimensions is equal M*1.

## II. LITERATURE SURVEY

Introduce JPEG error analysis to the study of image forensics. The main errors of JPEG include an error due to quantization process, rounding, and truncation errors. Through theoretically we can analysing the effects of these errors on single and double Photographic Expert Group standard compression, in these paper three novel schemes have developed for image forensics or verification including identifying whether a bitmap image has previously been JPEG compressed, estimating the quantization steps of a JPEG image, and the last one is to detecting the quantization table of a JPEG image [7]. Joint Photographic Expert Group standard consist two basic compression techniques. A DCT-based method is either specified loss compression technique or a predictive method for lossless technique. JPEG features a simple lossy technique known ASTHE Baseline technique. The Baseline method has been so adapted till now that it is one of the best methods for compression and applicable for a variety of application as per required [4]. JPEG standard was designed for compressing photographic digital data or images, but it can also work well on digitized documents with only a limited number of shades of gray images. For those documents in which compression and legibility are more crucial than preserving all of the intermediate values, pre processed the images to lower their dynamic range can boost JPEG compression, as it selectively rejects various noise. If enhanced quantization tables are replaced or substituted for the encoding quantization tables in the JPEG compressed data line, an unchanged JPEG decoder can restore the dynamic range and increase image contrast [5]. This paper proposes a novel reversible JPEG-to-JPEG data hiding technique. It uses a compressed JPEG image as a cover and embeds secret data into selected tuples in 8 × 8 quantized DCT coefficient blocks to generate a JPEG stego image finally. Just as the confidential data can be easily fetched from the stego image, so can the original cover image be fully recovered. Proposed scheme provides more excellent visual quality and higher embedding capacity than previous schemes [6]. Zheng et al. presented that the PSNR decreases with the increase of compression ratio in the case of DCT based compression scheme such as JPEG. That abundant amount of information loss with the increase of compression ratio and the performance of compressed image becomes worse [8].

## III.PLANNING OF WORK/METHODOLOGY

**DCT:** DCT is a Fourier-related transform similar to the DFT but we have to use only real numbers. DCTs and DFTs both are same but the only difference in length that is DCTs is twice the length of DFTs, which operate on data which must be real with even symmetry, where in some variants the IO (Input output) data are changed or shifted behalf sample. It transforms a signal or image from one domain to another domain here we transform spatial domain into frequency domain.The image is transformed to the frequency domain to get better quality [13-14]. When we transform an image from one domain to another domain then image divided into three part of frequency that is low medium and high-frequency component. JPEG compression algorithm used DCT mechanism to transform successive 8×8-pixel blocks of the image from the spatial domain to 64 DCT coefficients in each frequency domain. DCT has an advantage over other transforms is the ability to minimize the block-like appearance. The statistical properties of the JPEG files are also preserved [15-16].

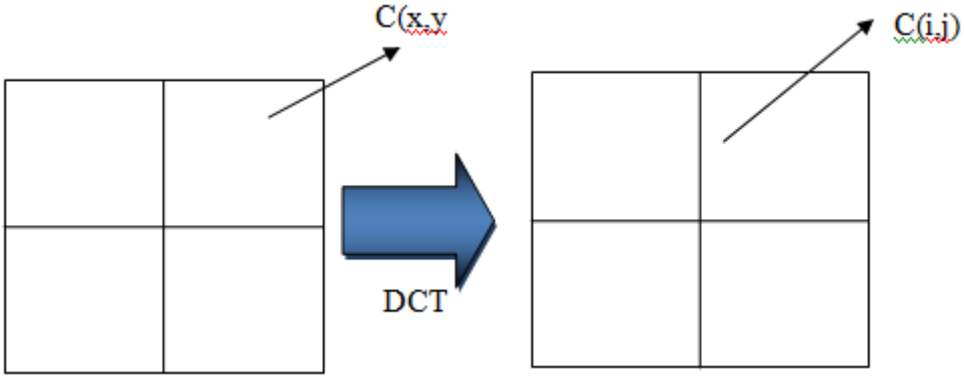


**Figure.1 Discrete Cosine Transform of an Image**

 

There are a lot of reasons to choose an 8 × 8 block size. Hardware or software implementation viewpoint, an 8 × 8 block size does not impose significant memory requirements. Moreover, the computational complexity of an 8×8 DCT is manageable on most computing standards. Block size larger than 8 × 8 does not offer energy compaction efficiency [12]. The discrete cosine transform of a list of n real numbers p(x, y), is given by

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

$$C(u) = \begin{cases} \frac{1}{\sqrt{2}} & \text{if } u = 0 \\ 1 & \text{if } u > 0 \end{cases}$$

$$D(i,j) = \frac{1}{\sqrt{2N}} C(i)C(j) \sum_{x=0}^{7} \sum_{y=0}^{7} P(x,y) \cos\left[\frac{(2x+1)i\pi}{2N}\right] \cos\left[\frac{(2y+1)i\pi}{2N}\right]$$

With the pace of time, there is an improvement in technology and there is two type of compression lossy and lossless. Predictive coding is a spatial domain technique [10]. In predictive coding, information already sent or available is used to predict future values, and the difference is coded. Since this is done in the image or spatial domain, it is relatively simple to implement and is readily adapted to local image characteristics.

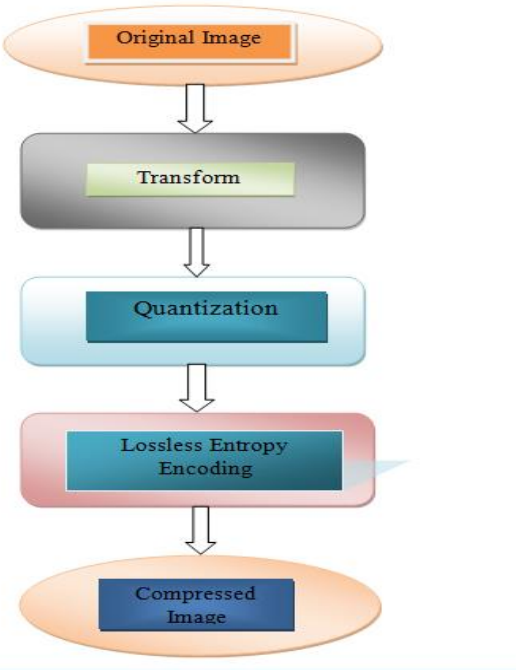


**Figure.2 Encoder for Image compression**

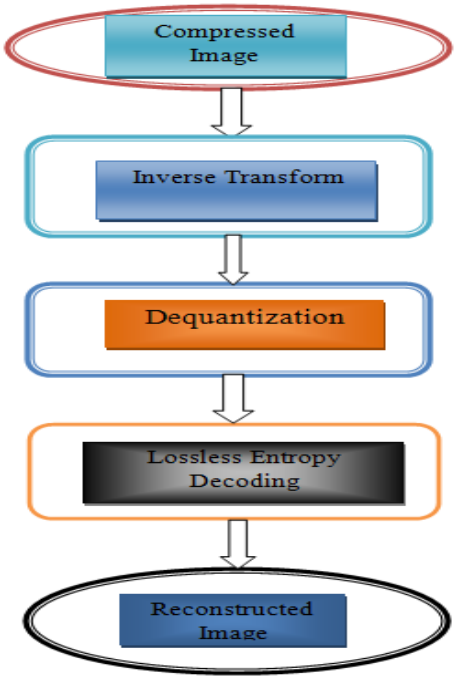


**Figure.3 Decoder for Image compression**

Differential Pulse Code Modulation (DPCM) is one particular example of predictive coding. Transform coding, on the other hand, first transforms the image from its spatial domain representation to a different type of representation using some well-known transform and then codes the transformed values (coefficients). This method provides greater data compression compared to predictive methods, although at the expense of greater computational requirements [7]. We will work with two methods of image compression. However, both are based on DCT but the encoding technique has been changed. In this section, a brief overview of these two approaches is explained with the help of flow chart

 

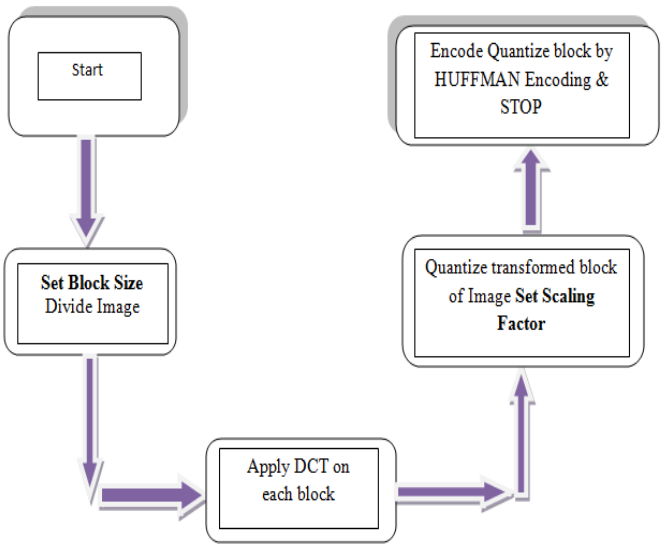


**Figure.4 Flow Chart for DCT Image compression with Huffman Encoding**

Why use 8×8 pixel groups instead of, for instance, 16×16. The 8×8 grouping was based on the maximum size that IC technology could handle at the time the JPEG standard was developed.

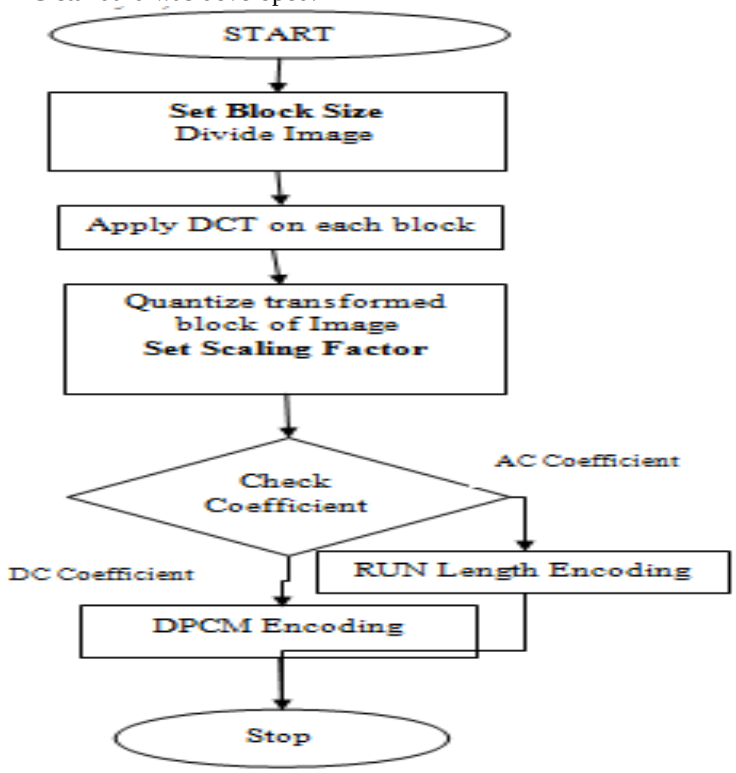


**Figure.5 Flow Chart for DCT Image compression with RLE-DPCM Encoding**

## IV. SOFTWARE USED AND SIMULATION RESULT

**Software: MATLAB Version R2015a:** It is powerful software that provides an environment for numerical computation as well as a graphical display of outputs. In Matlab, the data input is in the ASCII format as well as binary format. It is a high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation. We have presented the relationship between the compression ratio and the scaling factor of quantization tables. As we know default quantization table which is universal standard for discreet cosine transform is depicted below

 

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

We can change the scaling value for different value to analyze the behaviour of the different parameter and to access out correlation and regression. Generally, we take the range from one to five to derive the relationship between CR and PSNR. Now we are going to arrange our simulation result in a fashion such that when we change the value of quality factor in increasing order and due to which we got different parameter variation like DCT CPU elapsed time CR (compression), inverse discrete cosine transforms central processing unit time and peak signal to noise ratio. And after that gamma correction result for various images are carried out and region growing result of JPEG image also stimulated. Always keep one thing in mind that these two are applicable for only black and white image. We will see different result obtained from an algorithm which we applied on the different image.

**Table I PSNR and CR Analysis with Quality Factor**

| Sr. No | Quality Factor | DCT CPU Processing Time | Compression Ratio | IDCT CPU Processing Time | PSNR DB |
|---|---|---|---|---|---|
| 1 | 1 | 0.094 | 78.384 | 0.109 | 33.574 |
| 2 | 2 | 0.010 | 81.583 | 0.125 | 30.967 |
| 3 | 3 | 0.078 | 83.008 | 0.078 | 29.583 |
| 4 | 4 | 0.125 | 83.835 | 0.125 | 28.531 |
| 5 | 5 | 0.094 | 84.473 | 0.078 | 27.778 |
| 6 | 6 | 0.125 | 84.879 | 0.156 | 27.007 |
| 7 | 7 | 0.078 | 85.229 | 0.078 | 26.373 |
| 8 | 8 | 0.078 | 85.498 | 0.078 | 25.953 |
| 9 | 9 | 0.109 | 85.699 | 0.094 | 25.386 |
| 10 | 10 | 0.109 | 85.876 | 0.094 | 24.678 |

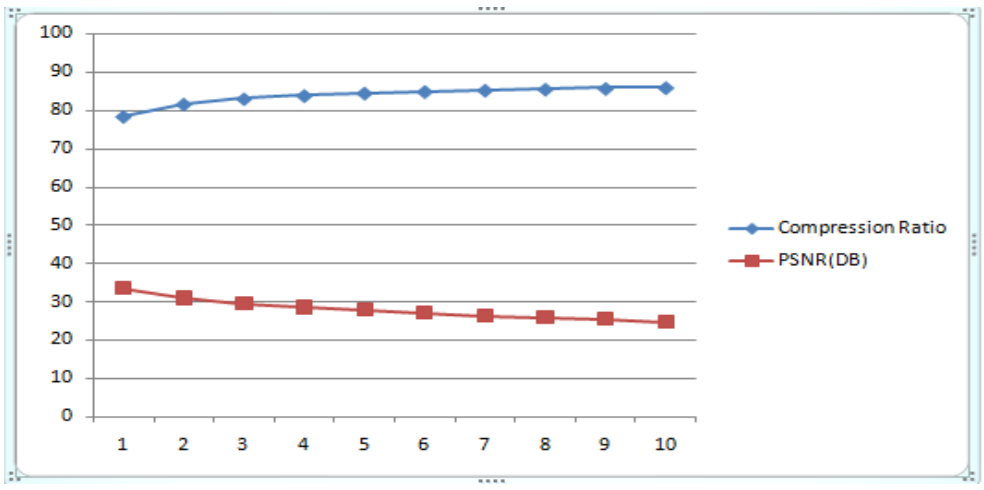


**Figure.6 Graph Analysis of CR and PSNR**

 

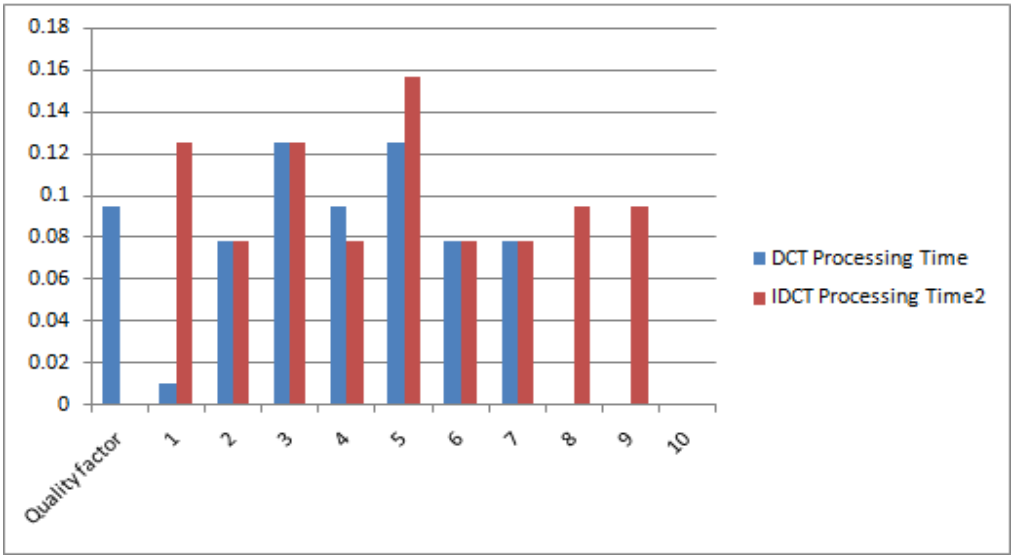


**Figure.7 Graph Analysis of DCT and IDCT processing time**

In this section we performed a lot of experiment with an image by changing quality factor value by changing from one to ten and corresponding this we get different result mean to say for each quality factor we got different discrete cosine transform CPU time, compression ratio, inverse discrete cosine transform CPU time and peak signal to noise ratio. From this observation finally we able to conclude a result

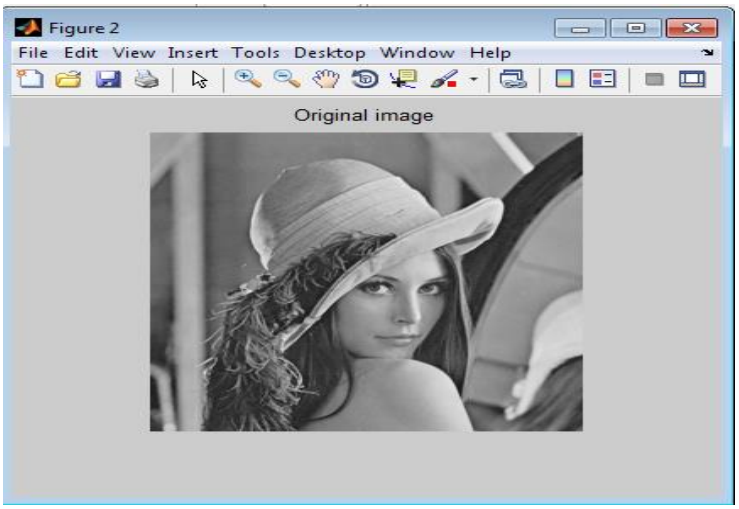


**Figure.8 Original image for jpeg reconstruction**

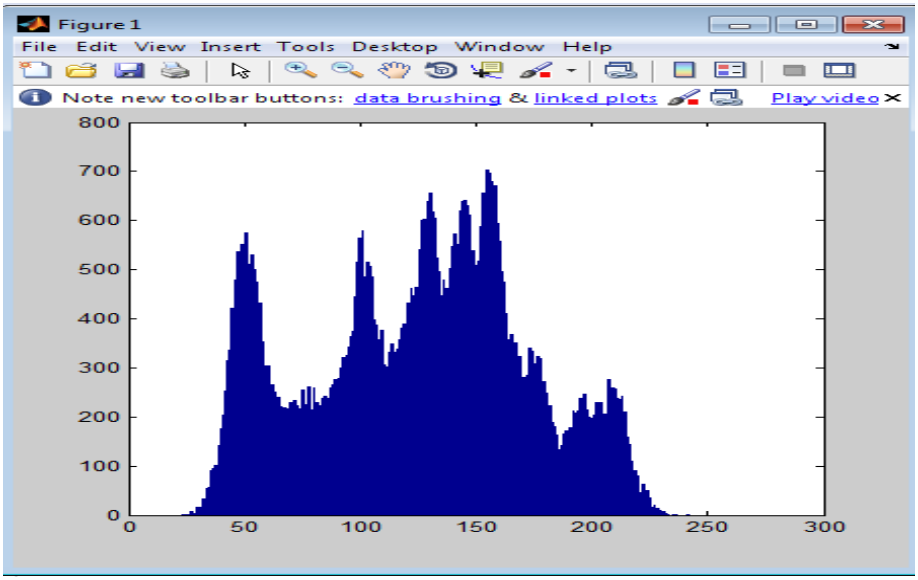


 

**Figure.9 Histogram of Fig.8**

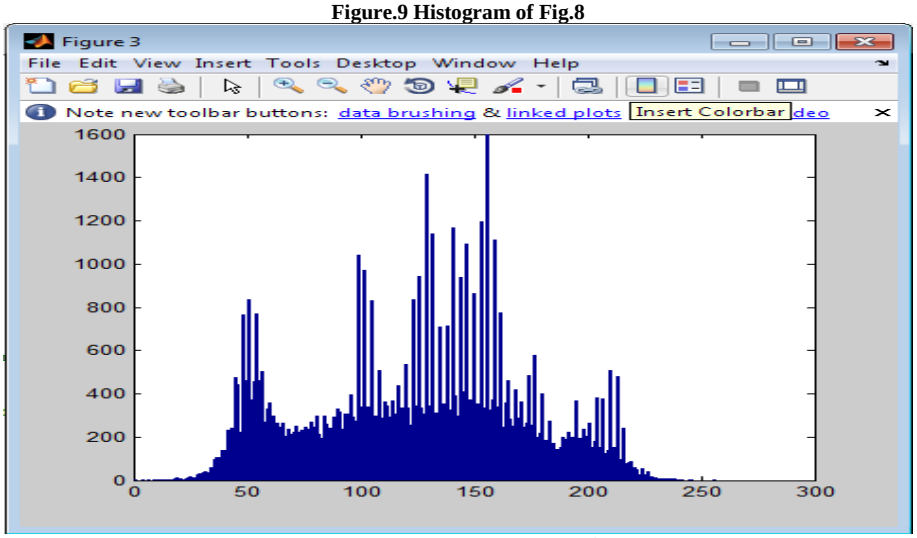


**Figure.10 Histogram equalization of Fig.8**

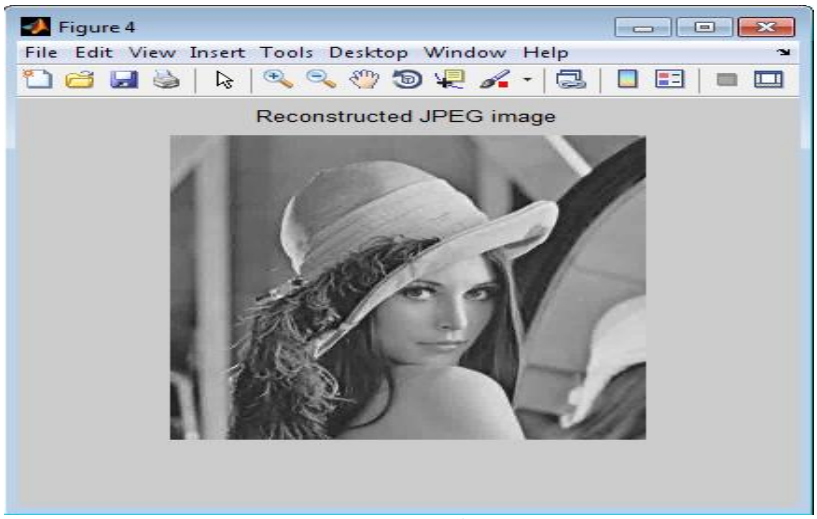


**Figure.11 Reconstructed image after DCT compression**

## V. CONCLUSION

In this thesis, we worked on the different field like image compression using DCT. In which we analyze what will be the impact of a quality factor on the image when we will increase the value of quality factor value and observe the impact on the following parameter for example peak signal to noise ratio, the processing time of DCT, compression ratio and processing time of IDCT. As we change the value of quality factor then all these parameters value changes. Now we have to analyse the pattern to carry out a final conclusion. As we increase the value of quality factor then image compression ratio will be increased it means that quality of image degraded but the size of image will be decreased so that when we have to transmit image over channel or through electromagnetic waves it can be transmitted easily and take less time. One point is very crucial that we did not increase value of quality factor so much high that its quality will be so degraded that at receiver side we cannot access valuable information so over all we can say if compression ratio will be high image quality will be worst so we have to take a trade off of these parameters. On another hand very peak signal to noise ratio is a very important parameter. We know PSNR should me maximum for optimizing the result. As we increase the quality factor PSNR value reduced in a proportion and we analyze that Compression ratio increased so from this observation we can say that PSNR and CR (compression ratio) both are reciprocal to each other. Besides this, we also perform region growing segmentation part and also observed the impact of gamma factor for different images to extract out crucial information and as we change value of gamma factor then obviously we can clearly see the effect on images.

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