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JPEG IMAGE COMPRESSION ALGORITHM

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ABSTRACT

The use of digital media is rapidly increases. Every printed media is converting into digital form. It is necessary to compress images or videos due to the growing amount of visual data to make efficient transfer and storage of data. Visual data is stored in form of bits, which represents pixels. An image often contains redundant and/or irrelevant data. Redundancy is the statistical properties of an image and irrelevancy is the subject/viewer perception of an image. These redundancies are reduced through different techniques during the compression. The main purpose of compression is to reduce the number of bits as much as possible. It also maintains the visual quality of the reconstructed image close to the original image. JPEG is one of the image compression algorithms. It is the best or excellent algorithm for image compression. This algorithm can be adjusting the image compression ratio. That is the main features of the image compression algorithm.

KEYWORDS
Redundancy, Pixel, Compression, Reconstruct, Visual Data.

1. INTRODUCTION

The Joint Photographic Experts Group developed the JPEG algorithm in the late 1980's and early 1990's. JPEG standard has been established by International Standards Organization (ISO) and International Electro-Technical Commission (IEC). The performance of these coders generally degrades at low bit rates mainly because of the underlying block-based Discrete Cosine Transform (DCT) scheme.

2. JPEG IMAGE COMPRESSION PROCESS

A different set of standards has to be created for compressing images of any size. Joint Photographic Expert Group is the first standard, which is known as JPEG and it is most widely used one. It is a very simple and easy to use standard that is based on the Discrete Cosine Transform (DCT). In JPEG compression there are main two processes: Encoder and Decoder.

Below figure shows the block diagram of JPEG Encoder and JPEG Decoder.

FIG-1: DCT BASED ENCODER PROCESS

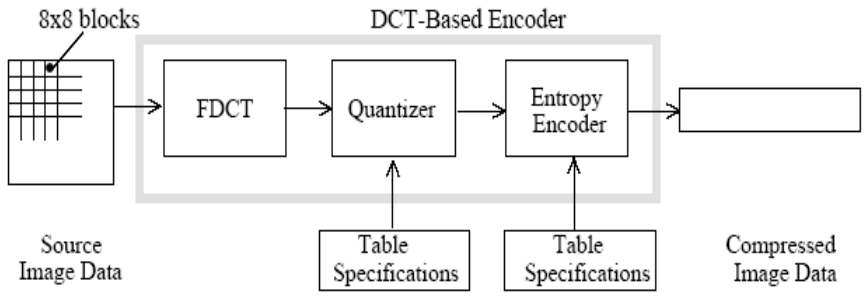
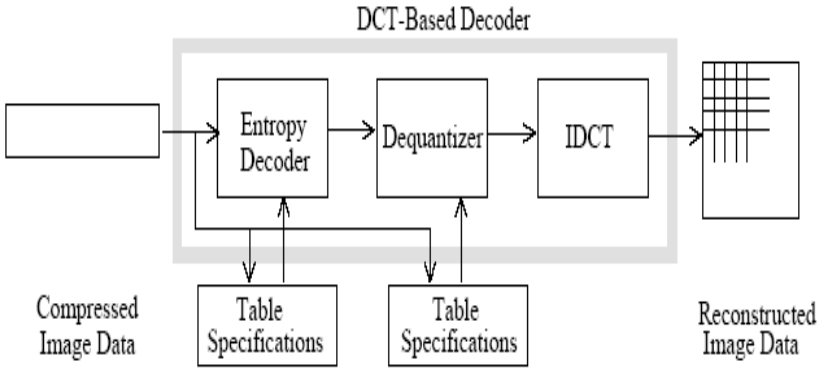


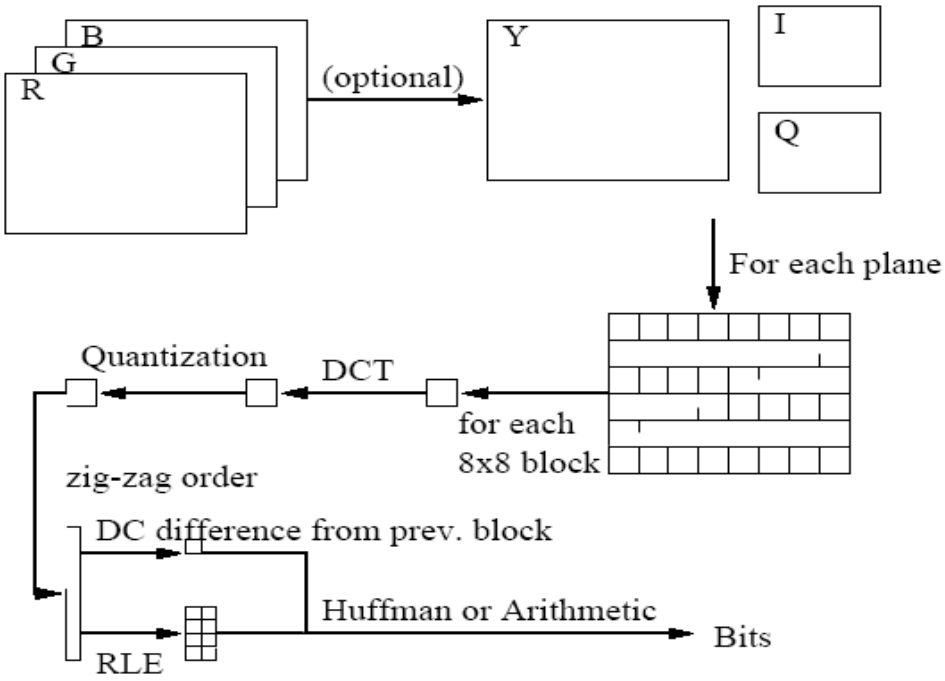
FIG-2: DCT BASED DECODER PROCESS



JPEG is a lossy compression scheme for color and gray scale images. It works on full 24-bit color. It is designed to be used with photographic material and naturalistic artwork. It is not the ideal format for line-drawings, textual images, or other images with large areas of solid color or a very limited number of distinct colors. Below figure shows the step in JPEG image compression process.

The input to JPEG is three color planes of 8-bits per-pixel each representing Red, Blue and Green (RGB). These colors are used by hardware to generate images.

FIG-3: JPEG COMPRESSION STEPS



3. JPEG ALGORITHM

JPEG compression and decompression process consist of four distinct and independent steps.

Step – 1 : Divide the Image

In this step image is divided into 8 x 8 pixel blocks.

Step – 2 : Conversion to the Frequency Domain

In this step Discrete cosine Transform is applied to each block to convert the information from the spatial domain to the frequency domain.

Step – 3 : Quantization

In this step the frequency information is quantized to remove unnecessary information.

Step – 4 : Entropy Coding

In this step final bit stream is compressed by using standard compression techniques. The report will analyze the compression of a gray scale image, and will then extend the analysis to decompression and to color images.

4. EXPERIMENTAL STUDY

JPEG image compression algorithm experiment is performed on gray scale image Boat and Barbara and color image Mandrill and Peppers image. In our experiment we perform this study on different image quality level such as 20%(Low Quality), 40%(Good Quality), 60%(Better Quality) and 80%(Great Quality). Below images represent the original images and different image quality level with original image and compressed image.

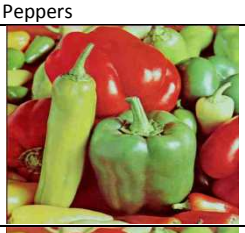
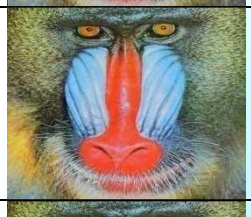
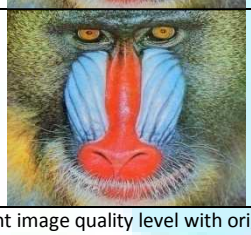
FIG-4: ORIGINAL BOAT AND BARBARA IMAGES

FIG-5: IMAGE QUALITY LEVEL AND COMPRESSED IMAGES OF BOAT AND BARBARA

Quality Level	Boat	Barbara
20% Low Quality		
40% Good Quality		
60% Better Quality		
80% Great Quality		

FIG-6: ORIGINAL MANDRILL AND PEPPERS IMAGES

FIG-7: IMAGE QUALITY LEVEL AND COMPRESSED IMAGES

Quality Level	Mandrill	Peppers
20% Low Quality		
40% Good Quality		
60% Better Quality		
80% Great Quality		

Below table represent the different images at different image quality level with original image size and compressed image size.

TABLE – 1 IMAGE QUALITY LEVEL

Image	Original Size (in KB)	Image Quality Level			
		Low	Good	Better	Best
		20%	40%	60%	80%
Boat	173.6	16.1	24.3	31.8	49.5
Barbara	181.4	18.5	27.6	35.3	51
Mandrill	622.3	26.7	42.6	57	86.7
Peppers	526.1	14.3	21.9	29.8	47.1

TABLE – 2 IMAGE COMPRESSION TIME

Image	Original Size (in KB)	Image Compression Time (in Sec)			
		Low	Good	Better	Best
		20%	40%	60%	80%
Boat	173.6	5.2	7.9	10.3	16
Barbara	181.4	6	9	11.5	16.6
Mandrill	622.3	8.7	13.8	18.5	28.1
Peppers	526.1	4.7	7.1	9.7	15.3

FIG-8: QUALITY LEVEL V/S COMPRESSED IMAGE SIZE OF BOAT IMAGE CHART

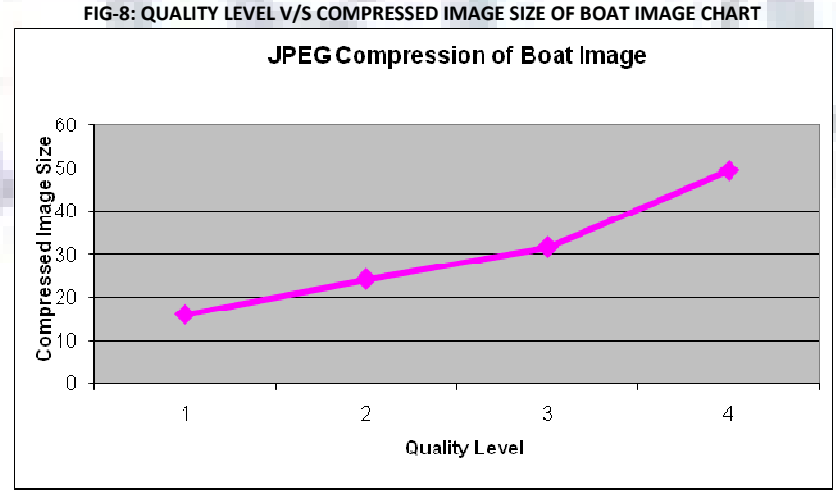


FIG-9: QUALITY LEVEL V/S COMPRESSED IMAGE SIZE OF BARBARA IMAGE CHART

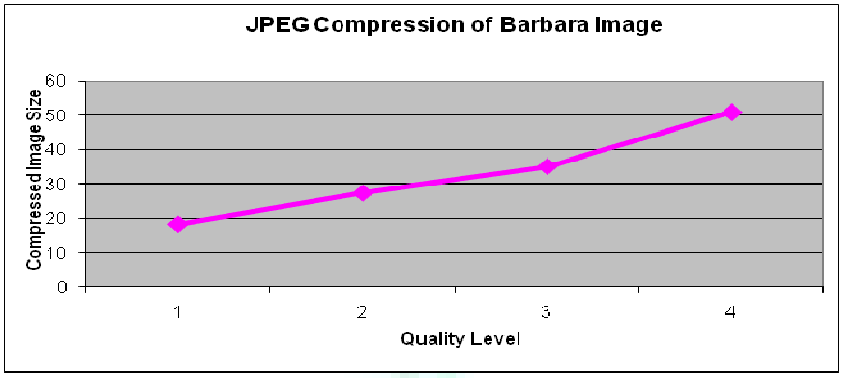


FIG-10: QUALITY LEVEL V/S COMPRESSED IMAGE SIZE OF MANDRILL IMAGE CHART

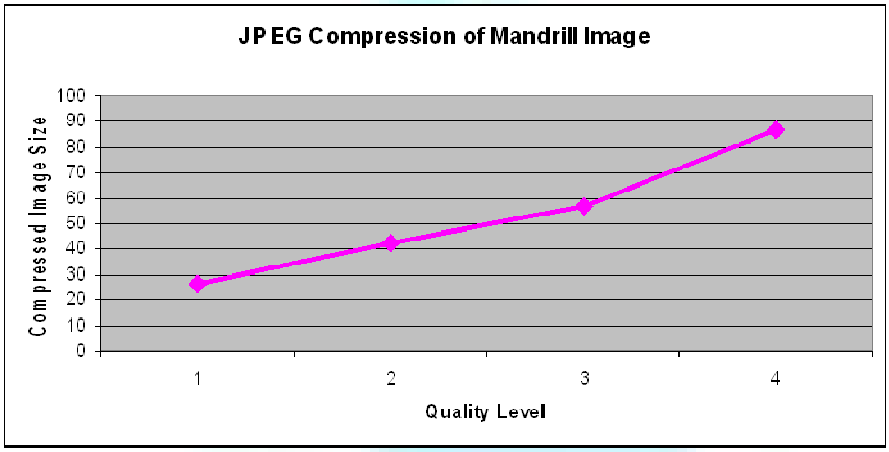


FIG-11: QUALITY LEVEL V/S COMPRESSED IMAGE SIZE OF PEPPERS IMAGE CHART

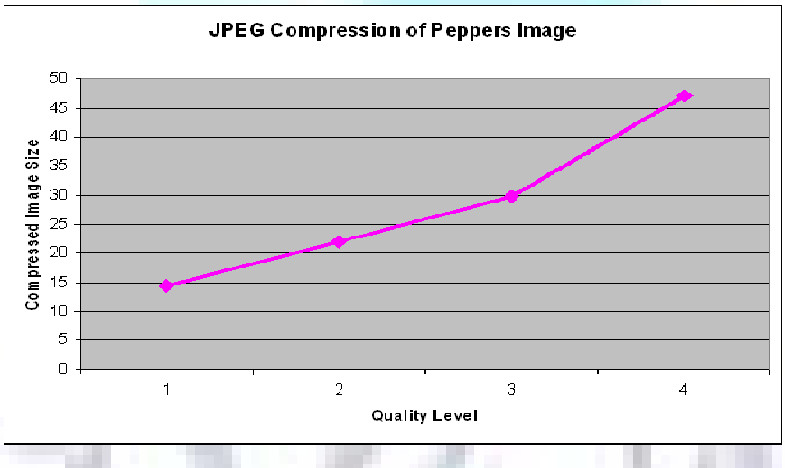


FIG-12: QUALITY LEVEL V/S COMPRESSION TIME OF BOAT IMAGE CHART

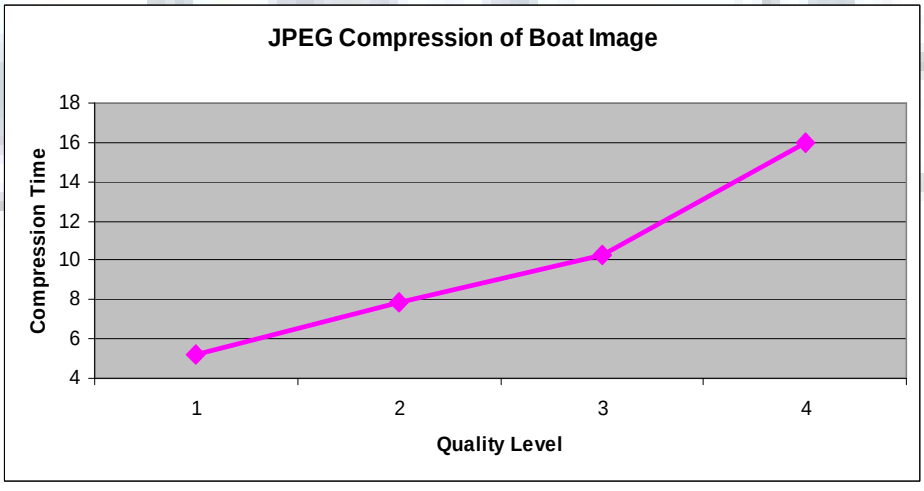


FIG-13: QUALITY LEVEL V/S COMPRESSION TIME OF BARBARA IMAGE CHART

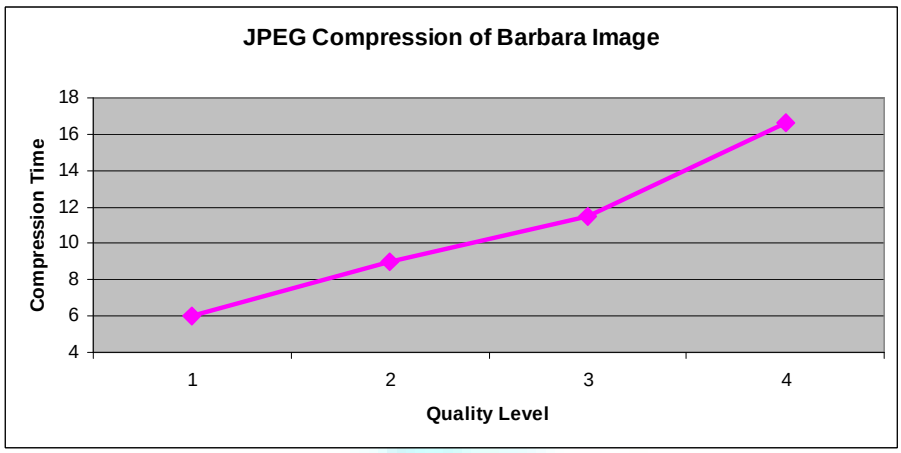


FIG-14: QUALITY LEVEL V/S COMPRESSION TIME OF MANDRILL IMAGE CHART

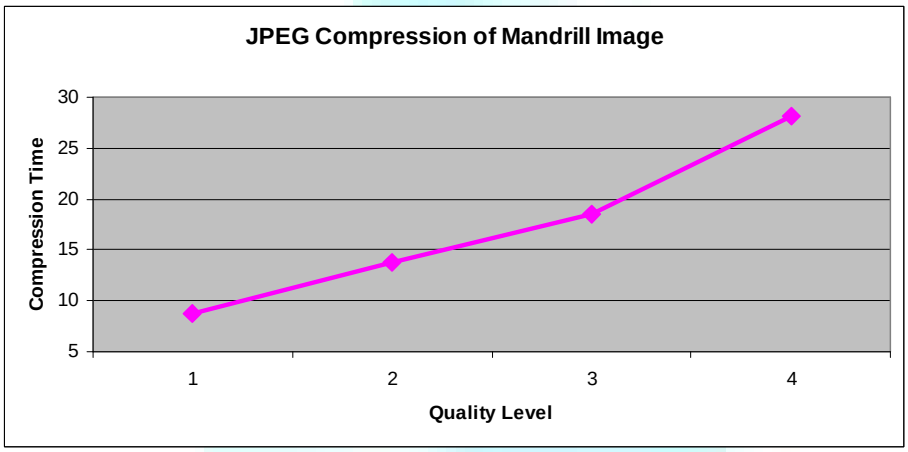
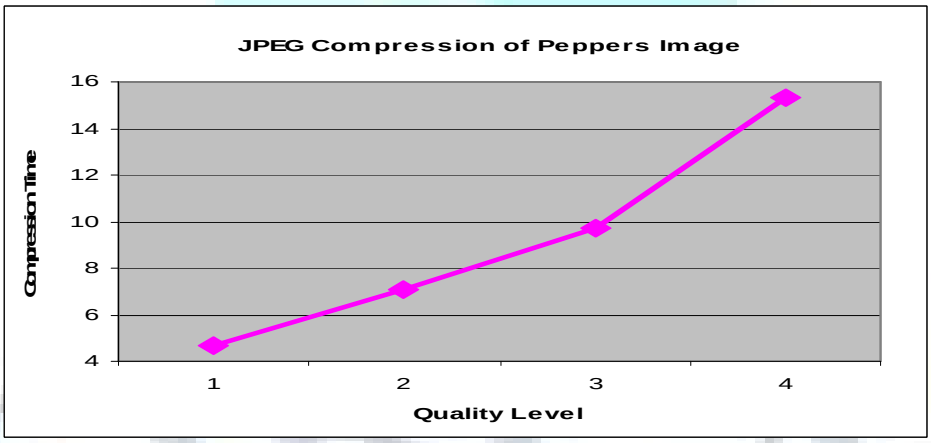


FIG-15: QUALITY LEVEL V/S COMPRESSION TIME OF PEPPERS IMAGE CHART



In above chart quality level-1 represent 20% quality; level-2 represent 40% quality; level-3 represent 60% quality and level-4 represent 80% quality level.

5. CONCLUSION

From the experimental study of different images at different image quality level, it concludes that when you increase the image quality level, the compressed image size is also increase which is shown in above table. When you increase the image quality level, the image compression time required is also increase which is shown in above table.

As per user requirement the size and quality of the final image or compressed image can be determined. Image can highly compressed with less quality or less compressed with high quality. Here the quality and size are the opposite of each other.

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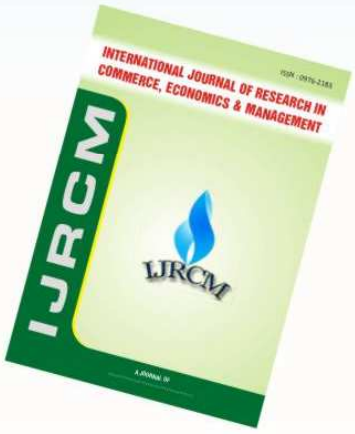
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