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Study of JPEG Image Compression Technique Using Discrete Cosine Transformation

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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).In this process, DCT, is used for the separating information by different frequencies. Using the processes quantization and encoding the Compression is achieved. There were various algorithms of fast DCT was analyzed. These could be finding efficient for JPEG encoding process. Therefore, it is very hard or difficult to develop algorithm of quantization and coding for enhancing the efficiency of JPEG encoding process. At last, the compression encoding process that was based on JPEG is discussed in detail.**

Keyword: **JPEG, Encoding, Quantization, DCT.**

I. INTRODUCTION

The term image compression is generally used to reduce the size of multimedia without effecting or compromising the originality of it. The reduction in size can provide a facility to store more and more data in storage like hard disk etc. With the growth of computer applications the need of storage is increase for that we such an efficient techniques due to which such need can be easily fulfilled. Image compression is an application of data compression that encodes the original image with few bits. The main purpose of image compression is to reduce the redundancy of the image and efficiently store or transmit the data. Figure1 shows the block diagram of the general image compression system. The main objective of such system is to reduce the storage capacity as much as possible, and the decoded image through which it can be similar to the original image. The large amount of storage is always needed for huge data; hence it will be very expensive one in terms of cost. The jpeg standard is one of the technique that is mostly used and a part of lossy compression that based on DCT. The DCT (Discrete cosine transformation) is based on the workings of separating images into parts of various different frequencies [6]. During the process of quantization, where the each part of compression really occurs, the less important or unnecessary frequencies are discarded and the remaining most important or necessary frequencies are used to retrieve the image in the reconstruction process [5]. As a result, reconstructed multimedia data is a data with distortion but later this distortion is recovered by applying some techniques [6].

II. JPEG METHOD OF COMPRESSION

The following is the overview of jpeg encoding process in image compression using DCT describes in the following steps:

1. The image is firstly broken into 8x8 16x16 or 32x32 blocks of pixels.
2. It Works from left most corners to right most or top to bottom, the DCT can be applied to each block of image.
3. Each block is starts compressing by performing quantization process.
4. The collection of compressed blocks that represent the image is stored in a hugely reduced amount of space as shown in figure 1.

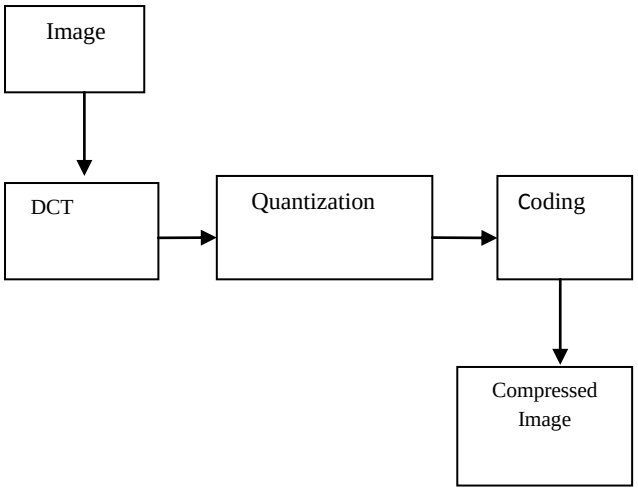

Figure.1 Block diagram of JPEG Image Compression process.

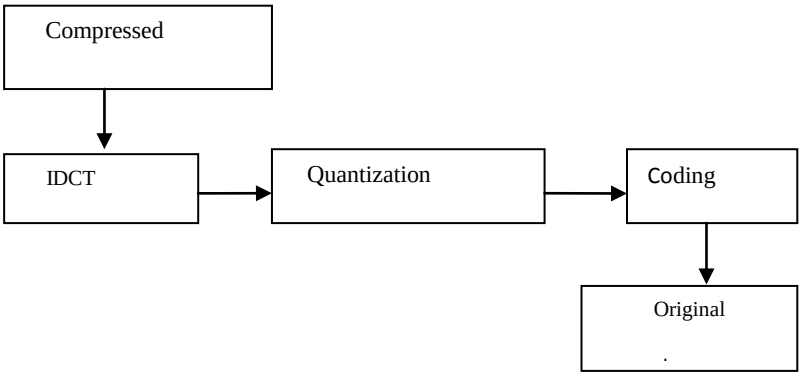

Figure.2 Block diagram of JPEG Image Decompression process.

After the above process, finally the image is reconstructed through decompression, for that Inverse Discrete Cosine Transform (IDCT) process used as shown in figure 2.

III. IMAGE TRANSFORMATION

DCT was firstly projected in 1974, and the foremost time that DCT was applied in image compression was in 1984[2]. Since of its superior decorrelation property and energy compaction properties, the joint ISO committee adopts the DCT in the JPEG international compression standard.

The DCT transform the data from the spatial domain to the frequency domain. The spatial domain can give us an idea about the amplitude of the color as we move through space. The frequency domain explains that the amplitude of the color is varying fast from one pixel to the other pixel in an image data.

$$D(i,j) = \frac{1}{4} C(i) C(j) \sum_{x=0}^{7} \sum_{y=0}^{7} P(x,y) \cos\left[\frac{(2x+1)ix}{16}\right] \cos\left[\frac{(2y+1)jx}{16}\right]$$

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

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

IV. QUANTIZATION

Quantization refers to the process of estimation of the continuous set of values in the image data with a finite set of values. The input values are taken as the original data, and the output values are constantly a finite number of levels [1]. The quantization is function that have a set of output values are distinct, and generally finite. The quantization process is done by essentially dividing each component in the frequency domain by a constant for that component and then rounding to the nearest integer value. It is one of the lossy operations in the whole process of compression [1].

The main goal of quantization is to decrease most of the less important high frequency coefficients to zero, the more the zeros we can generate, better the image will compress. Quantization involves dividing each of the coefficients by an integer value between 1 and 255 and rounding off. The quantization table is selected to reduce the precision of each coefficient to not more than necessary. The quantization table is conceded along with the compressed file. Another expediency of this method is that it allows the user to customize the various level of compression at runtime to fine tune the quality or compression ratio. The following is the quantization table can be show as:

TABLE.1 QUANTIZATION MATIX TABLE

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

V. RUN LENGTH ENCODING

The repeated occurrence of the same type of characters called as run. Number of repetition called the length of the run. In this process the coefficients are arrange in the increasing order of frequency. The higher frequency coefficients are considered to be 0 after quantization process. This process used to improves the compression of run-length encoding. The successive zeros are grouped together and the number of zeros in the group is encoded. This process is called "Run-Length encoding". As an alternative, reading from the rows, row to row, JPEG compression reads along the diagonals. This leads to group the lower coefficients in the starting of the string and allocate the zeros in longer continuous strings. Analyses the image compression algorithm using 2-dimension DCT. According to the DCT properties, DC coefficients are transformed to discrete delta-function at zero frequency. Hence, the transform image contains only the DC component. To transformed an image into 8 x 8 subsets by applying DCT in 2 dimensions. Also, a subset of DCT co-efficient have been prepared in order to perform inverse DCT process to get the reconstructed image.

VI. OBJECTIVE

The various compression techniques are used today to compress multimedia data for storage and transmission some of them are efficient techniques that proved to be the better one in terms of performance. JPEG compression algorithm which is the lossy compression technique uses the Discrete Cosine Transform (DCT). Many multimedia data are usually transmitted in the efficient compressed form, for example, JPEG conventionally; manipulating the JPEG image must be decompressing first. Because the traditional method is not efficient and cannot satisfy the requirements of real-time systems. So studying the technology of image processing based on DCT compressed domain.

VII. CONCLUSION

As the JPEG is a image compression standard this paper study the main process of the JPEG based encoding. Compression could be achieved using the DCT technique which decompose image into dissimilar frequencies components. Then the redundant information with high frequency in an image could be removed by quantization or coding process. It means that DCT plays an important role of compression in JPEG encoding procedure of lossy compression. Because of compression ratio increases, more and more information could be loosed. Therefore some fast DCT algorithms are introduced to contribute high Encoding efficiency for the better performance.

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