Journal of The Gujarat Research Society
ISSN: 0374-8588
Volume 21 Issue 13, December 2019

JPEG Image Compression by Applying Discrete Cosine Transform (DCT): A Review Paper

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ABSTRACT: ***The new research in the domain of image compression has increased dramatically due to the growing requirements for image transmission in computers and mobile environments. In digital image processing, image compression plays a crucial role and is also very critical for efficient image transmission and storage. We notice that image compression is necessary when we measure the number of bits per image resulting from standard sampling rates and quantization methods. The creation of effective image compression techniques has therefore become important.This paper provides a comprehensive survey on Discrete Cosine Transform (DCT) lossy image compression, which covers the JPEG compression algorithm used for full-color still image applications and explains all of its components.Image compression is one of the picture processing techniques. Image compression has many uses and plays an important role in transmitting and storing images efficiently. The goal of image compression is to reduce the redundancy of image data in order to store or transfer only a minimum number of samples.***

KEYWORDS:Communication Channel,Discrete Cosine Transform (DCT),Image Transmission, Image Compression.

INTRODUCTION

The use of digital images is growing tremendously in this era of increasing technology. A digital image is represented with the aid of pixels, which can be considered as little dots on the screen. Each digital image pixel indicates the colour of the image (for coloured images) or the level of grey at a single point in the image (for monochrome images). A digital image is an array of rectangular pixels, also referred to as a bitmap[2].Despite rapid advances in mass storage density, processing speeds, and digital communication system efficiency, the demand for data storage space and data transmission bandwidth continues to outperform the capabilities of available technologies [3].

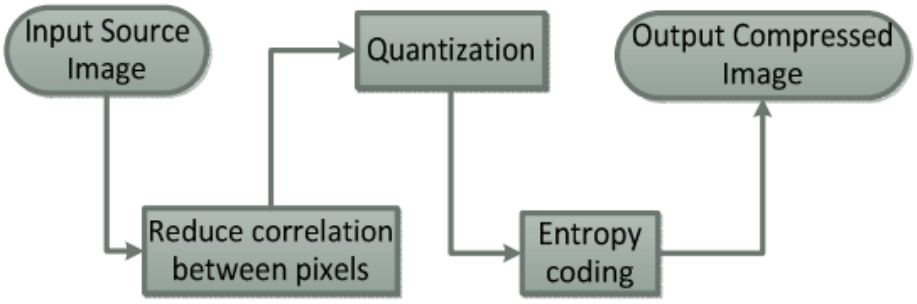

Figure 1: Illustrates encoding of image compression system

In order to reduce their storage sizes and to use a smaller space, different techniques may be used to compress the images. We may use two ways to categorise techniques for compression.

1.1 Lossy Compression System:

Lossy compression techniques is used in images where we can sacrifice some of the finer details in the image to save a little more bandwidth or storage space [4].

1.2 Lossless compression system:

Lossless Compression System aims at reducing the bit rate of the compressed output without any distortion of the image. The bit-stream after decompression is identical to the original bit stream [5].

1.3 Predictive coding:

It is a lossless coding method, which means the value for every element in the decoded image and the original image is identical to Differential Pulse Code Modulation (DPCM).The Figure 1 shows the encoding of image compression system. The correlation analysis of the pictures can be done by using the following equations[6].

$$E(x) = \frac{1}{N}\sum_{i=1}^{N} x_i$$

$$D(x) = \frac{1}{N}\sum_{i=1}^{N} (x_i - E(x))^2$$

$$cov\,(x,y) = \frac{1}{N}\sum_{i=1}^{N} (x_i - E(x))\;(y_i - E(y))$$

$$r_{xy} = \frac{cov\,(x,y)}{\sqrt{D(x)}\sqrt{D(y)}}$$

Herein the $\sqrt{D(x)} \neq 0, \sqrt{D(y)} \neq 0$

The critical parameter used to calculate the absolute difference between the encrypted image E and the original source image P is MAE. Let us consider the width as well as the height of the source image, respectively, for the W and the H. The MAE expression is given below.

$$MAE = \frac{1}{W \times H}\sum_{i=1}^{H}\sum_{j=1}^{W} |p(i,j) - E(i,j)|$$

$$r_{x,y} = \frac{C(x,y)}{\sqrt{D(x)}.\sqrt{D(y)}}$$

Where $C(x,y), D(x)$ and $D(y)$can be evaluated by using the following equations.

$$C(x,y) = \frac{\sum_{i=1}^{K}(x_i - E(x))(y_i - E(y))}{K}$$

$$D(x) = \frac{1}{K}\sum_{i=1}^{K}(x_i - E(x))^2$$

$$D(y) = \frac{1}{K}\sum_{i=1}^{K}(y_i - E(y))^2$$

LITERATURE REVIEW

Zhou et al. conducted a research on image compression based that is rooted on discrete cosine transform and multistage vector quantization. An image compression method based on discrete cosine transformation is suggested in this paper (DCT). This system is a hybrid tool, combining vector quantization (VQ) and modulation of differential pulse code (DPCM). This method starts with the transformation of images using DCT from a spatial domain to a frequency domain. Then the block data, according to zigzag order, is transformed into a vector and then truncated. After that, the vector is divided into DC and AC coefficients.

DISCUSSION AND CONCLUSION

For managing images in digital format, image compression is used. The emphasis of this survey paper was on the rapid and successful JPEG lossy coding algorithms for image compression/decompression using Discrete Cosine transformation. We also briefly introduced the concepts behind the compression of digital images and various methodologies for image compression. And the steps of the jpeg process, including DCT, quantization, entropy encoding.We will make a comparison between two methods of image compression in future work (Discrete cosine transform and Discrete Wavelet transform).In the decompression step, and in the opposite order, the compression phase is reversed. Restoring the Huffman tables from the image and decompressing the Huffman tokens in the image is the first step. Next, the first thing needed to decompress a block would be the DCT values for each block. In each block, the other 63 values are decompressed by JPEG, filling in the required number of zeros.

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