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Image Compression Using Discrete Cosine Transform

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ABSTRACT: Creation and modification of images in our personal computers for transmission of the image from one place to another over the network is highly prioritised these days. With the rapid growth of social media, sharing of photos has been very common. But we have a problem, that is since the original image generated by the camera has a very high resolution it takes a huge part of the memory storage area and also sending such huge images data over the limited bandwidth systems will cost us more. Therefore, the solution is to compress the image data using efficient tools so that the image is transmitted in such a way that it doesn't lose its quality to the point where the receiver can make no sense of the picture, but considerable compressing so that it travels easily through the bandwidth without any extra charges. JPEG algorithm is one of the most efficient techniques today where the image is compressed with almost no loss. In this paper, we create a MATLAB model to convert an input image to its quantized DCT version and also implement the JPEG algorithm for the same input image.

KEYWORDS: Discrete Cosine Transform, JPEG;

I. INTRODUCTION

JPEG - Joint Photographic Experts Group is a standard method to compress and store image. The images that are compressed by JPEG algorithm have the extension .jpg, jpeg, or .jpeg. The superiority JPEG has over the other methods is that with approximately no loss in the quality of the image, it achieves a high compression ratio. JPEG format is most frequently used in images whose sizes are too large and which keep switching between devices like digital cameras, and Internet is selected in the limited bandwidth environments. This algorithm is the most appropriate for the photos and pragmatic sceneries with smooth changes in tone and colour painting. Moreover, since JPEG formats are not always appropriate to use for images having sharp changes, it is best to use PNG, TIFF or GIF formats which are lossless. Similarly, JPEG file extensions are also not in use for images involving medical and scientific applications, where the images need to be precise and even the slightest error could result in irrelevant and inconclusive theories through the captured data. The disadvantage of JPEG image is that frequent editing, and saving of the image may accept further losses which are mostly caused by decompression and recompression of the same. As a solution to this problem, we can edit and save image in a format that gives minimum loss, and convert it to appropriate format immediately before the transmission through the specific media. Thus the loss in quality due to resaving the image is prevented.

II. RELATED WORK, ISSUES AND POSSIBLE SOLUTIONS

Discrete Cosine Transform is a technique for converting a signal into elementary frequency components, widely used in image compression. The rapid growth of digital imaging applications, including desktop publishing, multimedia, teleconferencing, and high-definition television (HDTV) has increased the need for effective and standardized image compression techniques. Among the emerging standards are JPEG, for compression of still images [Wallace 1991]; MPEG, for compression of motion video [Puri 1992]; and CCITT H.261 (also known as Px64), for compression of video telephony and teleconferencing. There are many research papers that propose 1D Discrete cosine transform technique to modify an image so as to get the compressed data or image model. [1] shows a discrete wavelet technique to compress the images using wavelet theory in VHDL, Verilog. [12] shows FFT approach for data compression. That its histogram has a desired shape. [13] shows the lossless image compression algorithm using FPGA technology. [14]

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has shown an image compression algorithm using verilog with area, time and power constraints. [15] has shown a simple DCT technique to for converting signals into elementary frequency components using mathematica toolbox. [16] shows comparative analysis of various compression methods for medical images depicting lossless and lossy image compression. [17] shows Fourier analysis and Image processing technique. [18] shows Image compression Implementation using Fast Fourier Transform. [19] depicts a comparative study of Image Compression using Curvelet, Ridgilet and Wavelet Transform Techniques.

JPEG is primarily a lossy method of compression.JPEG was designed specifically to discard information that the human eye cannot easily see. Slight changes in color are not perceived well by the human eye, while slight changes in intensity (light and dark) are. Therefore JPEG's lossy encoding tends to be more frugal with the gray-scale part of an image and to be more frivolous with the color .DCT separates images into parts of different frequencies where less important frequencies are discarded through quantization and important frequencies are used to retrieve the image during decompression.

III. METHODOLOGY

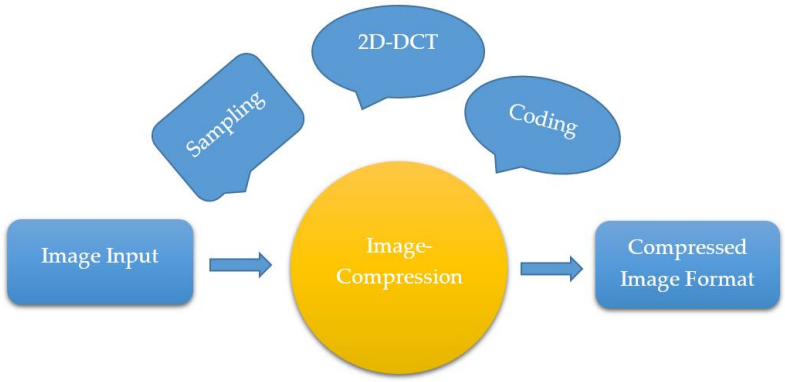

Figure 1: Steps involved in compression algorithm

The steps in the jpeg compression algorithm are listed below
1. The image is initially partitioned into 8×1 or 16×1 or 32×32 blocks of pixels.
2. The traversal of the pixels are left most pixel block to right most pixel block or top pixel block to bottom pixel block.
3. The quantization process starts compressing the image by accessing each pixel block in the image.
4. A reduced amount of space is used to store the collection of compressed blocks that represent image.

Figure 2: Block Diagram of JPEG Image Compression

IV. QUANTIZATION

The naked human eye can relatively see small differences in the images like the change in brightness when seen in reference to a larger area, but when it comes to distinguishing the images based on strength of the high density luminance fluctuation is left unnoticed. This greatly reduces the amount of information that allows a high-frequency component. Division of each component by a constant between 1 to 255 in the frequency domain, reduces the amount

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of information and forms a high-frequency component, which is rounded off to the closest integer. Only this operation causes loss in quality in the entire process of the compression procedure. Such results, are rounded to zero, and because of this many other places become positive or negative, which requires fewer bits to store a lot of the case. The quantization table is always capitulated in addition to the compressed image. The option given to the user to customize the levels of compression at runtime to accurately tune the quality of the image is a one of the major advantages of this method.
The following the quantization table as shown below:

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

Table 1: **QUANTIZATION MATRIX TABLE**

V. ENTROPY CODING

The next step in the compression process is Entropy coding. It is a lossless data compression procedure. It arranges the image items in "zigzag" form with the help of run-length encoding (RLE) algorithm combined with an identical procedure, zero insertion length coding. Huffman coding is used for the remaining components, as JPEG standard allows, but does not require, the use of arithmetic coding, which is mathematically superior to Huffman coding. However, this feature is rarely used because of its subject to patent protection, although the encoding and decoding in this method is much slower compared to.

VI. CONCLUSION

In this paper we focus mainly on the image compression process using the encoding technique resulting a JPEG compression image extension. DCT technique can also be used to achieve Compression by splitting the image into components of different frequencies.This way the unnecessary information is removed from the image by the quantization procedure. This indicates that DCT plays a decisive role in JPEG image compression. Considering the compression ratio, an increase in it can cause loss of information from the image. Therefore, high efficiency of DCT algorithms are to be increased for the improving image compression.

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