Using Discrete Cosine Transform 2 to achieve High Peak Signal-to-Noise Ratio in Image Processing

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ABSTRACT

Image compression is the most important process in image Processing. Image compression is one of the process is to reduce redundant information. In Image Compression, the two methods are Lossless Image Compression and Lossy Image Compression. Mostly Lossy image compression is used in Video Conferencing and Video Chat applications.

In DCT2 process, the compressed image quality is based on coefficient values. The PSNR values are almost lies in the range between 40 and 50 dB. Compression ratio of compressed image and input image is above 50%. The quality of output compressed image is also good in quality.

Keywords

DCT2, Compression ratio, Histogram, PSNR and Matlab

1. INTRODUCTION

Image compression is one of the process in Image processing. Mostly Lossy image compression scheme is used in digital images.

1.1 Image Quality Factors

Sharpness: It determines the amount of detail an image can convey.

Noise: It is a random variation of image density, visible as gain in film and pixel level variations in digital image.

Dynamic range: It is the range of light levels a camera can capture.

Tone reproduction: It is the relationship between scene luminance and the reproduced image brightness.

Contrast: It is the slope of tone reproduction curve.

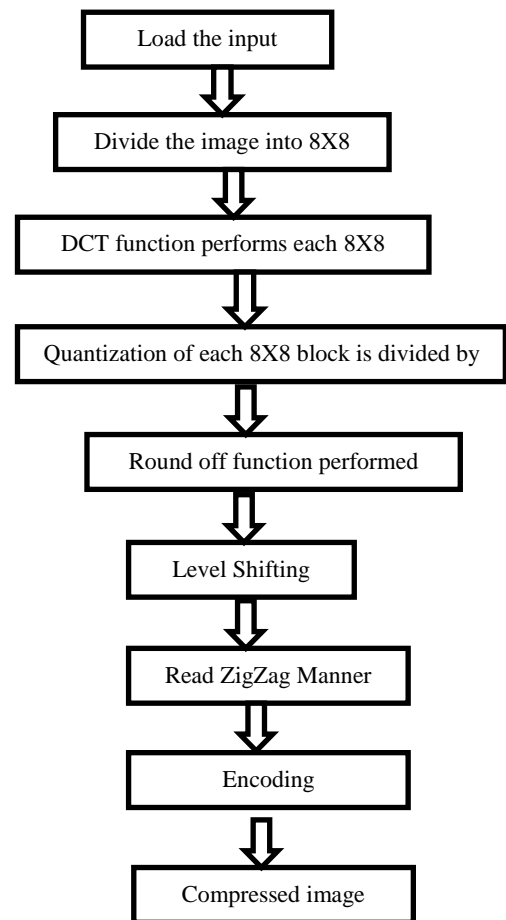**Colour**: It determines image quality and brightness.

Accuracy: It is the image quality.

Artifacts: It is software can cause significant visual effects, including data compression and transmission losses.
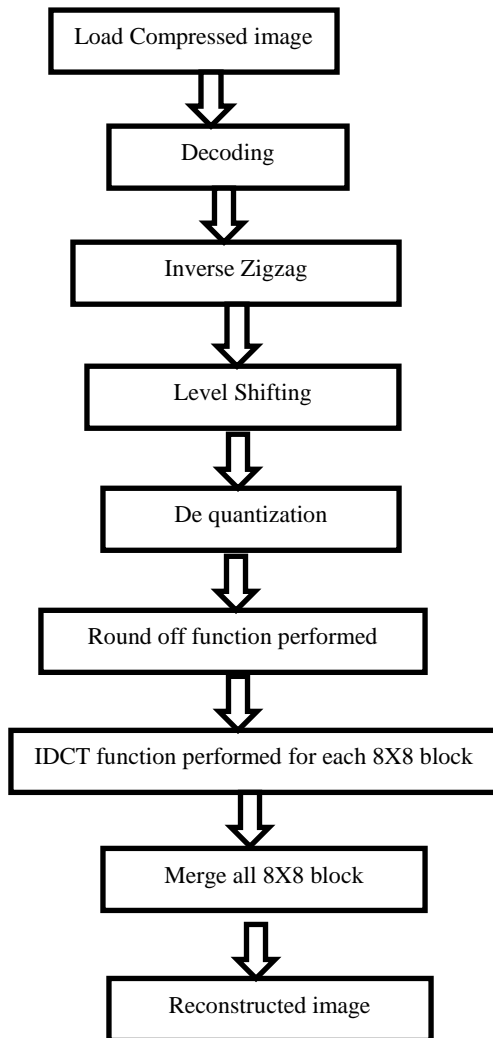
1.2 DCT Process

DCT performs image compression of an 8-bit image. The given input image is divided into 8X8 blocks. After that each 8x8 blocks are processed using quantization and shifting manner.

DCT Compression Process

DCT Decompression Process

```
┌─────────────────────────────┐
│    Load Compressed image    │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│          Decoding           │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│       Inverse Zigzag        │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│       Level Shifting        │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│       De quantization       │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│  Round off function performed │
└─────────────────────────────┘
              ↓
┌──────────────────────────────────┐
│ IDCT function performed for each 8X8 block │
└──────────────────────────────────┘
              ↓
┌─────────────────────────────┐
│      Merge all 8X8 block    │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│      Reconstructed image    │
└─────────────────────────────┘
```

2. LITERATURE REVIEW

Ankit Garg et al.(2014) [1] in this paper, 'A Review on Fractal Image Compression' have described fractal image compression is to reduce the computation time. Fractal image compression is used to partition method. Some of the partition methods are fixed square block, quad tree, horizontal- vertical partitioning, average difference, max difference, normalized correlation, mean absolute error and normalized absolute error. In this paper discussed about four image compression methods are wavelet, JPEG, vector quantization and fractal image compression. Concluded that using fractal image compression, computation time is 10 times longer than JPEG method. Fractal image compression is to provide high compression ratio and the decompression process time is less.

Shrey Kumar G et al. (2014) [2] titled as 'Comparative Analysis of Various Color Image Compression Techniques' discussed about various color image compression method such as JPEG, JPEG2000, DWT, EZW and SPIHT. JPEG and JPEG 2000 deals with encoding, quantization process and decoding process. DWT uses approximation coefficients and detailed coefficient method. JPEG and JPEG 2000 divides the image into blocks and process that blocks. But in DWT the image doesn't divide the blocks. In DWT, 2 filtering schemes are used. These are Low pass filter and high pass filter. EZW is similar to wavelet transform, it has wavelet coefficient provide compact binary tree coding mapping. SPIHT algorithm uses the ordered

planes progressive transmission and it reduces the error correcting code. Concluded that, based on these 4 methods, SPIHT algorithm produced good quality image, high compression ratio and less memory space.

Rajeswari C et al. (2013) [3] titled as, ' Analysis of MPC Image compression using DCT2 in Matlab' described as Maximum PSNR and Coefficient method uses one important variable as Coefficient. Coefficient reads the red, blue and green values of an image individually and processes that values using DCT2 method in iteration manner. Image quality is based on Coefficient only. If coefficient value increases then the image quality is also increases and coefficient value decreases then the image quality is also reduced. Various images are tested in Matlab. It showed that high PSNR values of comparing previous papers. And also the running time is slightly increases.

Preet Kaur et al. (2012) [4] 'Comparative Analysis of DCT, DWT and LWT for Image Compression' presented as comparing the performance of DCT, DWT and Lifting Wavelet Transform for image compression system. Finalized that, DCT shows best results in terms of energy compaction but Mean Squared Error value between the original image and compressed image is not acceptable. DWT produced that speed up that process and good image quality. While comparing with DCT, DWT produced high compression ratio and Peak Signal-to- Noise Ratio of the reconstructed image.

Dinesh Gupta et al. (2012) [5] titled as, ' A comparative study of Image compression between Singular Value Decomposition, Block Truncating Coding, Discrete Cosine Transform and Wavelet' described as lossless compression ratio yields only less compression ratio whereas the lossy compression technique lead high compression ratio. In SVD, when singular value increases the size of compressed image also increases, but quality of compressed image also improves in quality. In BTC, increase in block size of an image, visual quality of image also degrades. In DCT, when coefficient value is increased, the image quality is also increased. In Wavelet, size of compressed image is same as an input image.

3. METHODOLOGY

3.1 PSNR

Peak Signal-to- Noise Ratio is used to measure the quality of compressed images. PSNR ranges between 30dB and 50dB. Compute PSNR value using Input image and Output image as PSNR(IP,OP)

- **Read the row and column value of input image and stored in rows and cols.**

- **Calculate the square of difference of red values of input and output image.**

- **mseRed=(double(IP(:,:,1))-double(OP(:,:,1)).^2**

- **Similarly calculate green and blue values individually.**

- **Add all red values and divide the multiple of rows and cols**

- **mseR=sum(sum(mseRed))/(rows*cols)**

- **Similarly calculate green and blue values individually.**

- **Calculate the average value of red, green and blue values of mse value.**

- **mse=(mseR+mseG+mseB)/3**

- **Calculate PSNR value using MSE and this formula**

  PSNR=10*log 10(255^2/mse)

3.2 Compression Ratio

Compression ratio is the ratio between input and output image. Calculate byte value of an input and output image using Whos function and stored in input and output.

> **a=whos('inputfile')**
>
> **input=a.bytes**
>
> **b=whos('outputfile')**
>
> **output=b.bytes**

Whos function describes the file name, size(rows,columns,dimension), size in bytes, class(uint8/uint16) and additional information.

Compression ratio= Compressed Image size/ Input Image size

Here CRatio=output/input

3.3 *Histogram*

An **image histogram** is one of the types of histogram. It specified as a graphical representation of the digital image. It plots the number of pixels for each image blocks. Image histograms are used in many modern digital cameras. Photographers used them to show the distribution of tones captured, and the image detail has been lost to blown-out highlights or blacked-out shadows.

The horizontal axis of the graph described the tonal variations; the vertical axis represents the number of pixels in particular tone. The left portion of the horizontal axis represents the black and dark areas, the middle portion represents medium grey and the right hand side represents

light and pure white areas. The vertical axis describes the size of the area that is captured in each of these zones. Thus, the histogram for a very dark image will have the majority of its data points on the left side and centre of the graph.

4. MATLAB RESULTS

Using DCT method, processed the input image in Matlab. The dimension of the input image is 761X469 and size is 39.1KB. The dimension of the output image is 761X469 and size is 23.6 KB. The dimension of input image and output image will be same. But the memory capacity only varied. Compressed image means that the memory of the output image is reduced comparing input image.

Various methods are in image compression. But DCT2 method only produced high PSNR values with good image quality. The PSNR value of input and output image is 45.7420 dB. Mostly PSNR value lies between 40dB to 50dB. While comparing with DWT, DCT produced the output image quickly. In DCT method, the image is divided into blocks. So it will perform better than DWT. So the processing time will be reduced. Here the Compression ratio of input and output image is 70%.

The input image Parrot.jpg and its size are shown in Figure1 as below:

Figure 1. Parrot.jpg (39.1KB)

The output compressed image ParrotOP.jpg and its size are shown in Figure 2 as below:

Figure 2. ParrotOP.jpg (23.6KB)

Histogram specifies the graphical reprentation of an image. It has 2 axis such as horizontal and vertical axis. Histogram function in Matlab is imhist(image). The following Figure 3 shows that histogram of parrotOP.jpg image.
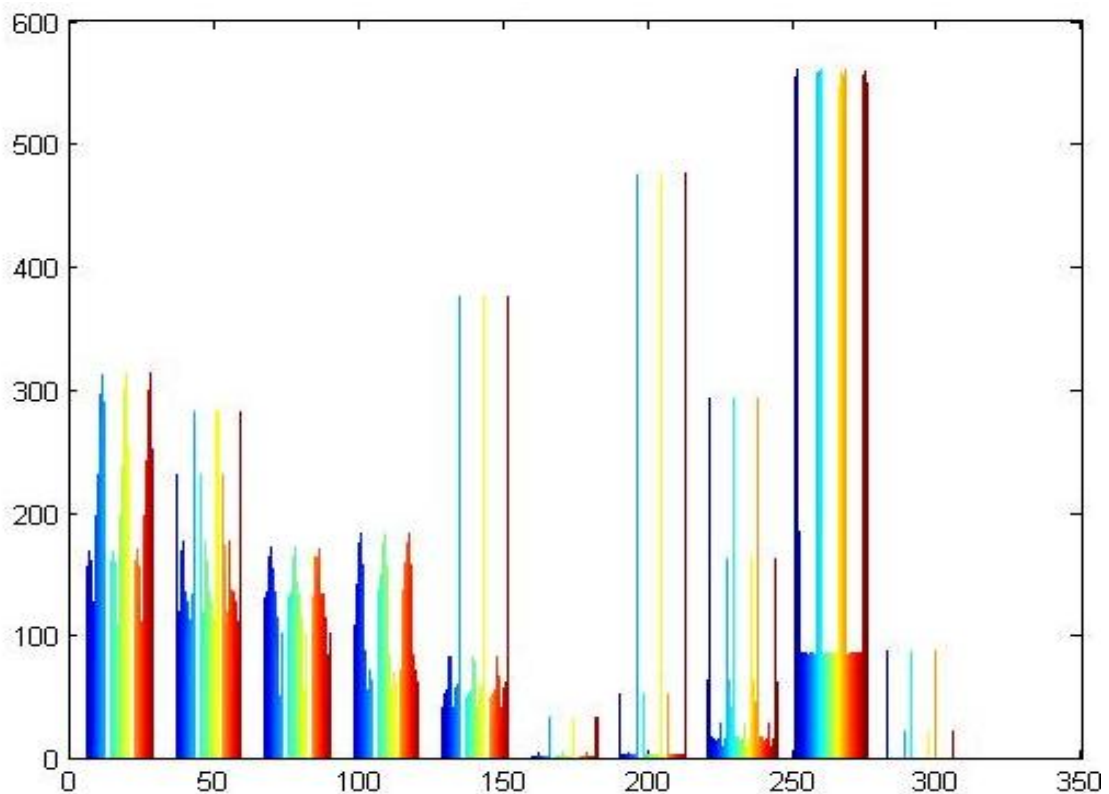

Figure 3. Histogram.jpg

5. CONCLUSION

In Matlab the various methods are there in image compression. The most important methods are DCT and DWT. Focusing on some factors in DCT2 methods only will have high PSNR values, compression ratio and image quality.

Image quality is based on coefficients, quantization matrix and block size. Mostly 8X8 blocks are used in DCT2 method. Image quality also depends on the block size of the image. Whenever the size of blocks increases then the image quality

also reduced. But memory size is reduced and also running time is reduced.

DCT2 method produced good image quality and high PSNR values. And also the memory size is reduced while comparing an input image. The input size is 39000 bytes and the output image will be 23000 bytes. So DCT2 is the best method for high PSNR values. Finally get, PSNR value is 45.7420 dB and compression ratio is 70%. In future work, need to improve high compression ratio.

6. ACKNOWLEDGEMENTS

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