A Novel Approach On Image Compression Based On Discrete Cosine Transform With MATLAB GUI Coding

Lalit G. Patil
Faculty of Technology and Engineering, Department of Electrical Engineering,
The M.S.University of Baroda, Vadodara, Gujarat, India
lalit.gecgnr@gmail.com

ABSTRACT

In real life, there are many practical implementation which needs of image compression. Image compression is almost need to use where there is much little storage capacity, like web pages. Each private domain have a limited storage capacity. When there is a need to upload high resolution images, it consumes more space. But by applying image compression algorithm to those images, compresses images, it means it reduces size of that particular image without disturbing its quality. This benefit makes a need to develop an image compression algorithm. Various algorithms were available for image compression called lossless compression and lossy compression. But always there is a trade-off between image quality and compression size. But this proposed algorithm overcomes this limitation is called discrete cosine transform. This paper deals with the development of Graphical user interface based image compression algorithm and making a software on MATLAB.

Key words-

Discrete cosine transform (DCT); GUI; Image Compression; jpeg, quantization

1. INTRODUCTION

Image compression is related with reducing the size of Image without degrading its quality to an acceptable level. This helps in storing an images in a given amount of space on a disk. This also helps in reducing a time to send image over an internet. There are several ways over which image is compressed. Mostly over internet photographs of jpeg format file is compressed. GIF format is used for geometric shapes and line art. Other methods which are used for compression is fractals and wavelets. This methods have wide compression ratio and accepted widely. But they have degradation in quality. Our proposed method implements an algorithm which is compromise of quality and compression ratio.

2. ALGORITHM

The algorithm which is to be implemented for proposed system is following the flow of sequence as follows.

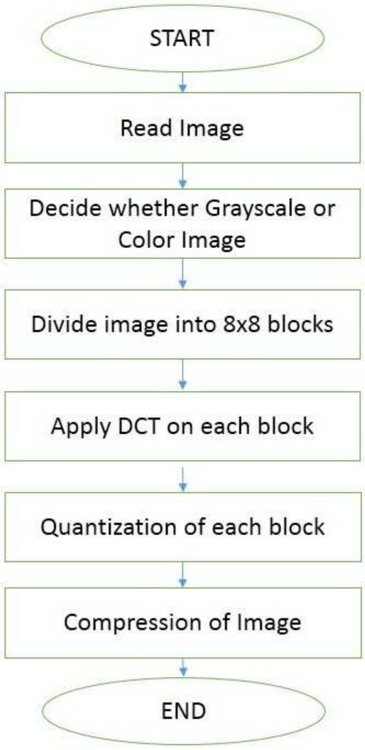


Figure 1 : Algorithm for proposed DCT

The discrete cosine transform is related to the discrete Fourier transform. The Equation of the two-dimensional DCT for an input image and output image is

$$B_{pq} = \alpha_p \alpha_q \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} A_{mn} \cos\frac{\pi(2m+1)p}{2M} \cos\frac{\pi(2n+1)q}{2N}, \begin{matrix} 0 \le p \le M-1 \\ 0 \le q \le N-1 \end{matrix}$$

Where,

$$\alpha_p = \begin{cases} \frac{1}{\sqrt{M}}, p = 0 \\ \sqrt{\frac{2}{M}}, 1 \le p \le M-1 \end{cases}$$

And

$$\alpha_q = \begin{cases} \frac{1}{\sqrt{N}}, q = 0 \\ \sqrt{\frac{2}{N}}, 1 \le q \le N-1 \end{cases}$$

M and N are the row and column size of Image A, respectively. As we applied the DCT to real data, the result is also real. The DCT tends to concentrate image information, making it useful for image compression application.

This will give the DCT matrix as follows for 8x8block image.

```
[cc,rr] = meshgrid(0:n-1);
c = sqrt(2 / n) * cos(pi * (2*cc + 1) .* rr / (2 * n));
c(1,:) = c(1,:) / sqrt(2);
```

$$\begin{bmatrix} 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 & 0.3536 \\ 0.4904 & 0.4157 & 0.2778 & 0.0975 & -0.0975 & -0.2778 & -0.4157 & -0.4904 \\ 0.4619 & 0.1913 & -0.1913 & -0.4619 & -0.4619 & -0.1913 & 0.1913 & 0.4619 \\ 0.4157 & -0.0975 & -0.4904 & -0.2778 & 0.2778 & 0.4904 & 0.0975 & -0.4157 \\ 0.3536 & -0.3536 & -0.3536 & 0.3536 & 0.3536 & -0.3536 & -0.3536 & 0.3536 \\ 0.2778 & -0.4904 & 0.0975 & 0.4157 & -0.4157 & -0.0975 & 0.4904 & -0.2778 \\ 0.1913 & -0.4619 & 0.4619 & -0.1913 & -0.1913 & 0.4619 & -0.4619 & 0.1913 \\ 0.0975 & -0.2778 & 0.4157 & -0.4904 & 0.4904 & -0.4157 & 0.2778 & -0.0975 \end{bmatrix}$$

This is an orthogonal matrix.

And Mask Matrix will be

$$\begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

We are designing a DCT matrix for 8x8 block. We take a particular only one block of image.Our original image pixel matrix is

$$\begin{bmatrix} 195 & 196 & 197 & 196 & 194 & 194 & 196 & 199 \\ 199 & 199 & 199 & 199 & 200 & 200 & 200 & 200 \\ 200 & 198 & 198 & 200 & 203 & 203 & 200 & 197 \\ 201 & 201 & 201 & 202 & 203 & 204 & 202 & 201 \\ 200 & 201 & 201 & 200 & 199 & 199 & 201 & 203 \\ 197 & 199 & 199 & 198 & 196 & 196 & 199 & 202 \\ 200 & 200 & 200 & 200 & 200 & 200 & 201 & 202 \\ 200 & 198 & 198 & 200 & 202 & 203 & 200 & 198 \end{bmatrix}$$

$2^{M-1} = 2^7 = 128$. Here M = 8

So, We Subtract 128 from each element.Then we get a matrix

$$\begin{bmatrix} 67 & 68 & 69 & 68 & 66 & 66 & 68 & 71 \\ 71 & 71 & 71 & 71 & 72 & 72 & 72 & 72 \\ 72 & 70 & 70 & 72 & 75 & 75 & 72 & 69 \\ 73 & 73 & 73 & 74 & 75 & 76 & 74 & 73 \\ 72 & 73 & 73 & 72 & 71 & 71 & 73 & 75 \\ 69 & 71 & 71 & 70 & 68 & 68 & 71 & 74 \\ 72 & 72 & 72 & 72 & 72 & 72 & 73 & 74 \\ 72 & 70 & 70 & 72 & 74 & 75 & 72 & 70 \end{bmatrix}$$

We are now performing a discrete cosine transformation. Which is performed by matrix manipulation.

D = T*M*Ti’

$$\begin{bmatrix} 8.3750 & 11.7898 & 11.2691 & 9.9949 & 8.2500 & 6.4820 & 4.6002 & 2.4486 \\ 12.3100 & 12.2713 & 3.7738 & -.6756 & 2.4831 & 9.8081 & 13.8272 & 9.8081 \\ 11.7591 & 3.7206 & 2.5628 & 16.3103 & 12.2490 & -1.3998 & 6.3640 & 13.2511 \\ 10.7299 & -0.6946 & 16.5368 & 5.7102 & 7.3659 & 15.4944 & -1.3812 & 14.8828 \\ 9 & 2.5176 & 11.9224 & 7.0713 & 8.8750 & 10.4359 & 4.9384 & 13.0035 \\ 6.7766 & 9.6719 & -1.3252 & 14.2711 & 9.9949 & 0.6470 & 16.0838 & 8.5459 \\ 4.8708 & 13.8272 & 6.3640 & -1.3438 & 4.8708 & 16.3103 & 15.5773 & 3.9332 \\ 2.4831 & 9.5357 & 13.4431 & 14.6789 & 12.8301 & 8.6614 & 3.8269 & 0.6661 \end{bmatrix}$$

Here there are much low and high frequencies in this matrix. Human eyes are most sensitive to low frequencies. And quantization performs this operation.This block contains total of 64 dct coefficients with eight rows and eight columns.After quantization we get the following matrix.

$$\begin{bmatrix} 6.2593 & -0.0134 & 0.00101 & 3.2435 & 0 & 0 & 0 & 0 \\ -0.0193 & 0.0014 & -0.0016 & 0 & 0 & 0 & 0 & 0 \\ -0.0302 & -0.0005 & 0 & 0 & 0 & 0 & 0 & 0 \\ -0.0306 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The coefficients situated near the upper left corner correspond to the low frequencies to which human eye is most sensitive. Zero represents the less important part, and higher frequencies are discarded giving rise to lossy part of compression. The only remaining nonzero coefficients were used to reconstruct the image.

3.RESULTS

The following table shows the result of implemented algorithm which is tested upon different images. The whole script is written in MATLAB and Graphical user interface is also prepared in MATLAB.

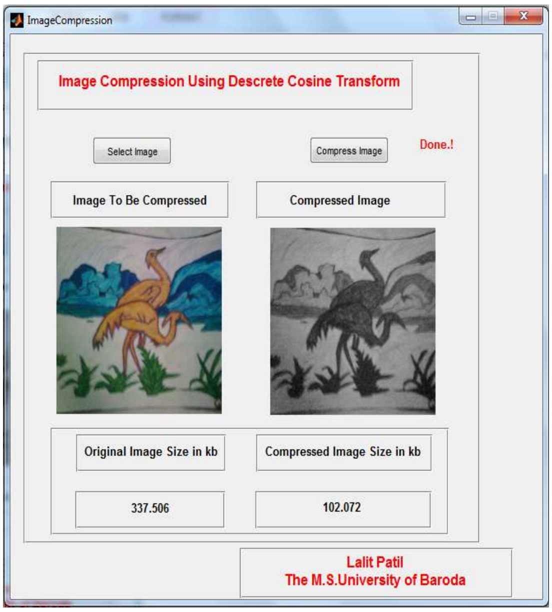
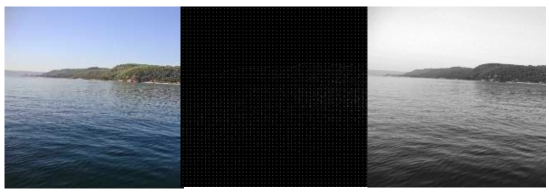


Figure 2 : MATLAB GUI for Proposed Algorithm



a. Original image b. DCT imagec. Compressed Image

Table for Result Images

Image Name	Original Image Size(kb)	Compressed Image Size(kb)
Cameraman.bmp	65.0547	5.75391

Lena.png	592.883	21.2852
Scene.jpg	364.83	86.5059
Personal.jpg	337.506	102.072

Table 1 : Result table

4. CONCLUSION

The algorithm is implemented for jpg, bmp, png and tiff format images. After running above algorithm implemented program, the compression ratio of original images to compressed images, obtained is 1:4 for jpg images, 1:13 for bmp images and 1:28 for png images.And it is also observed thatthere is no or negligible reduction in image quality. We can conclude that above proposed algorithm is much accurate for image compression.

5. APPLICATIONS

Image compression has wide range of applications in our day to day use as well in industrial applications from which some of are listed below.

- ✓ satellite imagery
- ✓ Mini discs
- ✓ MP3 technology
- ✓ Fax
- ✓ Digital cameras
- ✓ DVD technology
- ✓ Modems
- ✓ Wireless telephony
- ✓ Database design
- ✓ Storage and transmission of CT and MRI scans
- ✓ Mammography

6. REFERENCES

[1] Jain, Anil K., Fundamentals of Digital Image Processing, Englewood Cliffs, NJ, Prentice Hall, 1989, pp. 150-153.

[2] Pennebaker, William B., and Joan L. Mitchell, JPEG: Still Image Data Compression Standard, Van Nostrand Reinhold, 1993.

[3] Yen-Yu Chen: Medical image compression using DCT-based subband decomposition and modified SPIHT data organization, International journal of medical informatics 76 (2007) 717-725, journal homepage: www.intl. elsevierhealth.com/journals/ijm.

[4] Alain Horé MOIVRE, DjemelZiou MOIVRE: Image quality metrics: PSNR vs. SSIM, 2010 international conference on pattern recognition, 1051-4651/10 @2010 IEEE. DOI 10.1109/ICPR 2010.579.

[5] Ms.Pallavi M. Sune, Prof.Vijaya K. Shandilya, Image Compression Techniques based On Wavelet and Huffman Coding, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 4, April 2013, ISSN: 2277 128X

[6] Koon-Pong Wong, Fractal image coding for emission tomographic image compression, IEEEXplore Digital library, 4-10 Nov. 2001, ISBN: 0-7803-7324-3

[7] Leung, T. Marcellin,, M.W.Bilgin, Visually Lossless Compression of

Windowed Images,IEEEXplore Digital library, 20-22 March 2013, ISBN: 978-1-4673-6037-1

[8] Donapati, S. Yagain H, A Comparative Study of Effects of CSC on Image Compression Ratios While Using JPEG-XR,IEEEXplore Digital library, 10-12 Dec. 2013, ISBN: 978-0-7695-5143-2

Lalit G Patil, Teaching Assistant, Department of Electrical Engineering, The M.S.University of Baroda. He has completed his B.E in Electronics and Communication Engineering from Gujarat University in 2011. During his academics he has an experience of Technical Industrial training at Hitachi-Home and Life Solutions as well at Sify technologies. He has completed his masters from The M.S.University of Baroda, Gujarat. During Masters he has an experience of Research project at Semitronik Industries. His Current research interest is in the field of Signal Processing, Image Processing as well Robotic applications.