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

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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.
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

$$B_{pq} = \alpha_p \alpha_q \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} A_{mn} \cos \left( \frac{(2m+1)p}{2M} \right) \cos \left( \frac{(2n+1)q}{2N} \right), 0 \leq p \leq M - 1, 0 \leq q \leq N - 1$$

Where,

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

And

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

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 8x8 block image.

$$c = \sqrt{2 / n} \cdot \cos(\pi \cdot (2 \cdot cc + 1) \cdot rr / (2 \cdot n))$$

$$c(1, :) = c(1, :) / \sqrt{2}$$

This is an orthogonal matrix.

And Mask Matrix will be

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

$$\begin{bmatrix}
1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\
1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\
1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
195 & 196 & 197 & 196 & 194 & 194 & 196 & 199 \\
199 & 199 & 199 & 199 & 200 & 200 & 200 & 200 \\
200 & 198 & 198 & 200 & 203 & 203 & 204 & 202 \\
201 & 201 & 201 & 202 & 203 & 204 & 202 & 201 \\
200 & 201 & 201 & 200 & 199 & 199 & 201 & 203 \\
197 & 199 & 199 & 198 & 196 & 196 & 199 & 202 \\
200 & 200 & 200 & 200 & 200 & 200 & 201 & 202 \\
200 & 198 & 198 & 200 & 202 & 203 & 200 & 199
\end{bmatrix}$$

$$2^{M-1} = \sqrt{2} = 128.$$  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.

\[
D = T \times M \times T^{'}
\]

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.

<table>
<thead>
<tr>
<th>Image Name</th>
<th>Original Image Size(kb)</th>
<th>Compressed Image Size(kb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameraman.bmp</td>
<td>65.0547</td>
<td>5.75391</td>
</tr>
</tbody>
</table>

Figure 2: MATLAB GUI for Proposed Algorithm

- a. Original image
- b. DCT image
- c. Compressed Image
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 that there 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


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