RESEARCH ARTICLE OPEN ACCESS

A Robust Approach for Image Compression Using PCA and DCT Algorithms

Yashodha Devi
Under the guidance of
Er. Priyanka Mehta
Assistant Professor (CSE)
Universal Institute of Engineering and Technology, Lalru
India

ABSTRACT
The basic goal of image data compression is to reduce the bit rate for transmission and storage while either maintaining the original quality or providing an acceptable fidelity. JPEG is one of the hottest topics in image compression technology. JPEG is different because it is primarily a lossy method of compression. It converts the spatial domain into frequency domain. PCA and DCT algorithms are used to implement the thesis objectives. The proposed model focuses on reducing the size of image & time elapsed in compression with minimum distortion in reconstructed image and is practically implemented using MATLAB 7.5 environment. The aim of compression is to achieve good quality compressed image making the storage and transmission more efficient. The proposed method is implemented using some images. The implementation of the PCA and DCT based JPEG obtains the higher PSNR value. The higher the PSNR value higher the quality of an image. The higher PSNR is obtained for compressed image by using PCA and DCT based JPEG compression as compared to JPEG compression.

Keywords: - Image processing, image compression, DCT algorithm andPCA algorithm.

I. IMAGE COMPRESSION

Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages.

There are several different ways in which image files can be compressed. For Internet use, the two most common compressed graphic image formats are the JPEG format and the GIF format. The JPEG method is more often used for photographs, while the GIF method is commonly used for line art and other images in which geometric shapes are relatively simple.

Other techniques for image compression include the use of fractals and wavelets. These methods have not gained widespread acceptance for use on the Internet as of this writing. However, both methods offer promise because they offer higher compression ratios than the JPEG or GIF methods for some types of images. Another new method that may in time replace the GIF format is the PNG format.

II. DCT ALGORITHM

The discrete cosine transform (DCT) is a technique for converting a signal into elementary frequency components. Like other transforms, the Discrete Cosine Transform (DCT) attempts to de correlate the image data. After de correlation each transform coefficient can be encoded independently without losing compression efficiency.

III. PROPOSED DCT ALGORITHM

- The following is a general overview of the JPEG process.
- The image is broken into 8x8 blocks of pixels.
- Working from left to right, top to bottom, the DCT is applied to each block.
- Each block is compressed through quantization.
- The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space.
- When desired, the image is reconstructed through decompression, a process that uses
- the inverse Discrete Cosine Transform (IDCT)

DCT (Discrete Cosine Transform)

- The following is a general overview of the JPEG process.
- The image is broken into 8x8 blocks of pixels.
- Working from left to right, top to bottom, the DCT is applied to each block.
- Each block is compressed through quantization.
- The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space.
- When desired, the image is reconstructed through decompression, a process that uses the inverse Discrete Cosine Transform (IDCT)

PCA (Principal component Analysis) algorithm

Principal Components Analysis (PCA) is a mathematical formulation used in the reduction of data dimensions. Thus, the PCA technique allows the identification of standards in data and their expression in such a way that their similarities and differences are emphasized. Once patterns are found, they can be compressed, i.e., their dimensions can be reduced without much loss of information. In summary, the PCA formulation may be used as a digital image compression algorithm with a low level of loss.
In the PCA approach, the information contained in a set of data is stored in a computational structure with reduced dimensions based on the integral projection of the data set onto a subspace generated by a system of orthogonal axes. The optimal system of axes may be obtained using the Singular Values Decomposition (SVD) method. The reduced dimension computational structure is selected so that relevant data characteristics are identified with little loss of information. Such a reduction is advantageous in several instances: for image compression, data representation, calculation reduction necessary in subsequent processing, etc.

Let the source images be arranged in two-column vectors. The steps followed to project this data into 2-D subspaces are:

1. From the input images matrices arrange the data into column vectors. The resulting matrix Z is of dimension 2xn.

2. Then Compute the empirical mean along each column. The empirical mean vector Me has a dimension of 1 x 2.

3. Subtracting the empirical mean vector Me from each column of the data matrix S. The resulting matrix X is of dimension 2 x n.

4. Find the covariance matrix C of X i.e. C=XXT mean of expectation = cov(X)

5. Compute the eigenvectors V and eigenvalue D of C and sort them by decreasing eigenvalue. Both V and D are of dimension 2 x 2. 6. Finally consider the first column of V which corresponds to larger eigenvalue to compute PI and P2 as,

IV. STATEMENT OF THE PROBLEM

To analyze the image compression algorithm using 2-dimension DCT. According to the DCT properties, a DC is transformed to discrete delta-function at zero frequency. Hence, the transform image contains only the DC component. To transformed an image into 8 x 8 subsets by applying DCT in 2 dimensions. Also, a subset of DCT coefficients has been prepared in order to perform inverse DCT to get the reconstructed image. The work to be done is to perform the inverse transform of the transformed image and also to generate the error image in order to give the results in terms of MSE (Mean Square Error), as MSE increases, the image quality degrades and as the MSE would decrease, image quality would be enhanced with the help of changing the co-efficient for DCT Blocks. The same operation will also be implemented using Principal Analysis Component (PCA) algorithms to improve the previous parameters.

Objectives of the thesis

The main objectives of my thesis are

- To reduce the size of compressed image.
- To reduce the elapsed time of compression by using DCT.
- Compute Mean Square Error.
- Comparing on the basis of Peak Signal to Noise Ratio.
- Calculate execution time for the Code

V. RESULTS

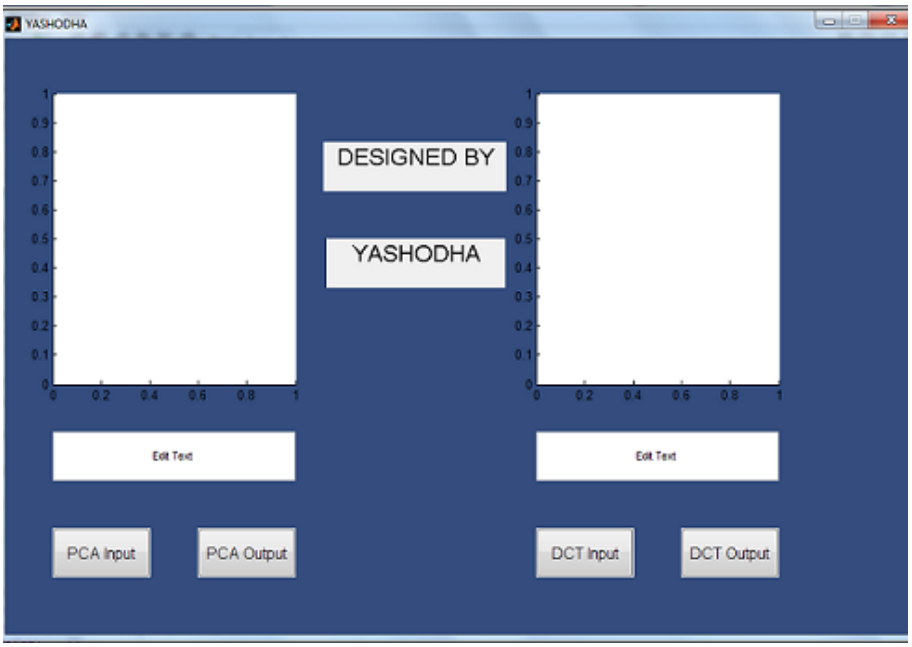

Figure 1: GUI design for algorithms

Figure 2: Input image (PCA)

Figure 3: Compressed image (PCA)

Figure 4: Input image (DCT)

Figure 5: Compressed image (DCT)

All the images above show the performance of DCT and PCA algorithms. Figure 1 shows the GUI design for inserting input images for both algorithms. Figure 2 and figure 4 shows the input images for both algorithms, Figure 3 shows output from PCA algorithm and Figure 5 shows the output of DCT algorithm. The performance tables are shown below.

Table for PCA Algorithm

Input Image Name	Size of Input Image(Pixel)	Size of Output Image(Pixel)	PSNR	MSE	Time Taken (second)
girl.bmp	65536	52139	39.62	2.6640	0.927053
home.bmp	65536	52139	38.77	2.9367	0.946557
cameraman.jpeg	65536	52139	38.82	2.9204	0.904296
pepper.jpeg	65536	52139	38.78	2.9329	0.863818
lena.jpeg	65536	52139	38.82	2.9195	0.865360
helicopter.png	65536	52139	38.76	2.9400	0.900701

Table for DCT Algorithm

Input Image Name	Size of Input Image(Pixel)	Size of Output Image(Pixel)	PSNR	MSE	Time Taken (second)
girl.bmp	65536	57938	37.10	0.0015	1.344337
home.bmp	65536	57938	37.11	0.0015	1.403294
cameraman.jpeg	65536	57938	37.10	0.0015	1.365969
pepper.jpeg	65536	57938	37.10	0.0015	1.308874
lena.jpeg	65536	57938	37.10	0.0015	1.226110
helicopter.png	65536	57938	37.10	0.0015	1.247366

Comparative graph for PCA and DCT algorithms with previous paper

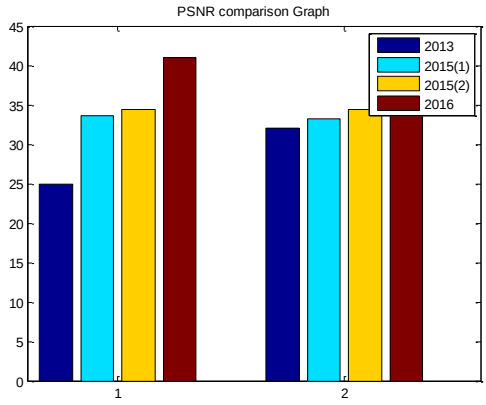

Figure 1: Comparison Graph for PCA

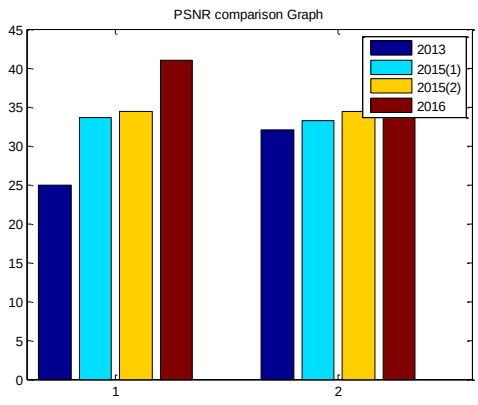

Figure 2: Comparison Graph for DCT

VI. CONCLUSION

In this research it has been considered that DCT and PCA for image compression and decompression. By considering several images as inputs, it is observed that MSE is low and PSNR is high in PCA than DCT based compression. From the results it is concluded that overall performance of PCA is better than DCT on the basis of compression rates. PCA algorithm has proven better because of its improved PSNR. Average PSNR by PCA algorithm is 42, and Average PSNR by DCT algorithm is approximately 37.5.

VII. FUTURE SCOPE

The work can be by developing an image technique that will become efficient for compressing images. To enhance better add some GUI design and calculate some more performance check parameters. Also the design can be improved for reduced the time taken for execution our code and improved PSNR and MSE. Some more algorithms can also be implemented to calculate more parameter.

REFERENCES

[1] A.M.Raid, W.M.Khedr, M. A. El-dosuky and Wesam Ahmed, "*Jpeg Image Compression Using Discrete Cosine Transform - A Survey*" in International Journal of Computer Science & Engineering Survey (IJCSES) 2014.

[2] Bhawana Gupta, Manju Gupta and Banita Chadha, "*Image Compression Technique under JPEG by Wavelets Transformation*" in International Journal of Advanced Research in Computer Science and Software Engineering 2014.

[3] C.Rajeswari, S.Babu and P.Venkatesan, *"Analysis of MPC Image Compression using DCT 2 in Matlab"* in International Journal of Computer Applications in 2013.

[4] Deepak Kumar Jain, Devansh Gaur, Kavya Gaur and Neha Jain, "*Image Compression using Discrete Cosine Transform and Adaptive Huffman Coding"* in International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) in 2014.

[5] Dr.E.Kannan and G.Muruganin, "*Lossless Image Compression Algorithm for Transmitting over Low Band width Line*" in International Journal of Advanced Research in Computer Science and Software Engineering in 2012.

[6] Gaurav Vijayvargiya, Dr. Sanjay Silakari and Dr. Rajeev Pandeyin, "*A Survey: Various Techniques of Image Compression*" in International Journal of Computer Science and Information Security in 2013.

[7] Jagadish H. Pujar and Lohit M. Kadlaskar in , "*A New Lossless Method Of Image Compression And Decompression Using Huffman Coding Techniques"* in Journal of Theoretical and Applied Information Technology in 2010 .

[8] K.Saraswathy, D.Vaithiyanathan and R.Seshasayanan, "A *DCT Approximation with Low Complexity for Image Compression*" in IEEE in 2013.

[9] K. Ayyappa Swamy, C. Somasundar Reddy and K. Durga Sreenivas, *"International Journal of Advanced Research in Computer Science and Software Engineering"* in 2015.

[10] Prabhakar.Telagarapu, V.Jagan Naveen, A.Lakshmi.Prasanthi and G.VijayaSanthiin, "*Image Compression Using DCT and Wavelet Transformations*" in International Journal of Signal Processing, Image Processing and Pattern Recognition in 2011.

[11] Priyatosh Halder, "*An Efficient Image Compression Algorithm Using DCT-Biorthogonal Wavelet Transform with Arithmetic Coding"* in International Journal of Research in Engineering and Technology in 2015.

[12] Rajesh K. Yadav, S.P. Gangwar and Harsh V. Singh in, "*Study and analysis of wavelet based image compression techniques"* in International Journal of Engineering, Science and Technology in 2012.

[13] Vikas Gupta, Dhanvir Kaur and SimratPal Kaur, *"International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering" in* 2014.