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Comparision Between Dct & Dwt Image Compression TechniquE

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***Abstract*— Image compression has become an important process in today's world of information exchange. Image compression helps in effective utilization of high speed network resources. The main objective is to design a compression system suitable for processing, storage and transmission, as well as providing acceptable computational complexity suitable for practical implementation. The two compresson technique DCT and DWT are widely used. DCT is an orthogonal transform, the Discrete Cosine Transform (DCT) attempts to decorrelate the image data. After decorrelation each transform coefficient can be encoded independently without losing compression efficiency. Discrete Wavelets Transform (DWT) is a mathematical tool for changing the coordinate system in which we represent the signal to another domain that is best suited for compression. The objective of the thesis is to compare two compression techniques (DCT & DWT) and validate the results using MATLAB programming**

***Keywords*— DWT, Image compression, DCT**

I.INTRODUCTION

Modern media is overwhelming with graphics such as images and movies. Constraints on bandwidth and memory space create trade-offs between the size and quality of images. The increasing demand for multimedia content such as digital images and video has led to great interest in research into compression techniques. The development of higher quality and less expensive image acquisition devices has produced steady increases in both image size and resolution, and a greater consequent for the design of efficient compression systems [1]. Although storage capacity and transfer bandwidth has grown accordingly in recent years, many applications still require compression

The reconstructed image is not exactly same as the original image in lossy image compression technique. An important development in image compression is the establishment of the JPEG 2000 standard for compression of color pictures. Using the JPEG2000 method, a 24 bit/pixel color images can be reduced to between 1 to 2 bits/pixel, without obvious visual artifacts. The DWT is an improvement over the discrete Fourier transform (DFT).Here we have computed some codes in MATLAB for compression of images using DWT. The results have been observed in the laboratory for both the compression of gray scale and color images.

II.TYPES OF IMAGE COMPRESSION

There are two types of image compression. These are :

A. *Lossless compression*
B. *Lossy compression*

A. *Lossless Compression*

In lossless image compression algorithm, the original data can be recovered exactly from the compressed data. It is used generally for discrete data such as text, computer generated data, and certain kinds of image and video information.

B. *Lossy compression*

Lossy compression techniques refer to the loss of information when data is compressed. As a result of this distortion, must higher compression ratios are possible as compared to the lossless compression in reconstruction of the image

III.NEED FOR IMAGE COMPRESSION

The amount of data associated with visual information is so large that its storage would require enormous storage capacity. Although the capacities of several storage media are substantial, their access speeds are usually inversely proportional to their capacity. Typical television images generate data rates exceeding 10 million bytes per second. There are other image sources that generate even higher data rates. Storage and/or transmission of such data require large capacity and/or bandwidth, which could be very expensive. Image data compression techniques are concerned with reduction of the number of bits required to store or transmit images without any appreciable loss of information [4]. Image transmission, teleconferencing computer communications and facsimile transmission. Image storage is required most commonly for educational and business documents, medical images used in patient monitoring systems, and the like. Because of their wide applications, data compression is of great importance in digital image processing.

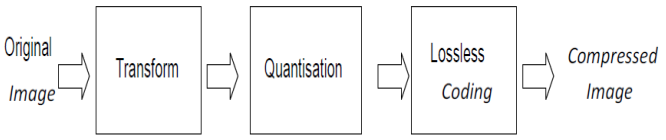

Fig2.1. Image compression system

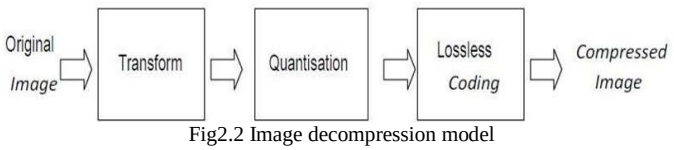

Fig2.2 Image decompression model

IV. DISCRETE COSINE TRANSFORM

The DCT transforms a signal from a spatial representation into a frequency representation. The DCT represent an image as a sum of sinusoids of varying magnitudes and frequencies.DCT has many advantages:[2]

- It has the ability to pack most information in fewest coefficients.
- It minimizes the block like appearance called blocking artefact that results when boundaries between sub-images become visible .

The 2-D DCT for an NXN input sequence can be defined as follows

$$D(i,j) = \frac{1}{\sqrt{2N}} C(i)C(j) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} P(x,y) \times \cos\left(\frac{(2x+1)i\pi}{2N}\right) \cos\left(\frac{(2y+1)j\pi}{2N}\right)$$

Where, P(x, y) is an input matrix image NxN, (x, y) are the coordinate of matrix elements and (i, j) are the coordinate of coefficients, and

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$$C(u) = \begin{cases} \frac{1}{\sqrt{2}} & if\ u = 0 \\ 1 & if\ u > 1 \end{cases}$$

The reconstructed image is computed by using the inverse DCT (IDCT) according to:

$$P(x,y) = \frac{1}{\sqrt{2N}} \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} C(i)C(j)D(i,j) \times \cos\left(\frac{(2x+1)i\pi}{2N}\right) \cos\left(\frac{(2y+1)j\pi}{2N}\right)$$

DCT RESULT

Image Name: Baboon.png
Size on Disk: 86 kb
After DCT Compression: 7.76 kb

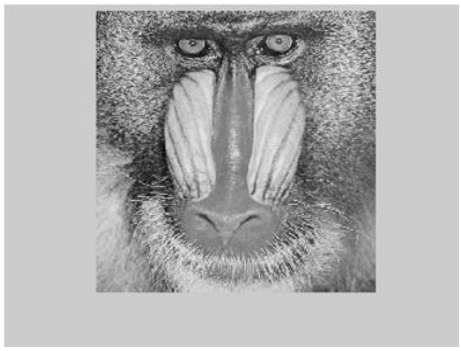

Fig 4.1 a) Input Image

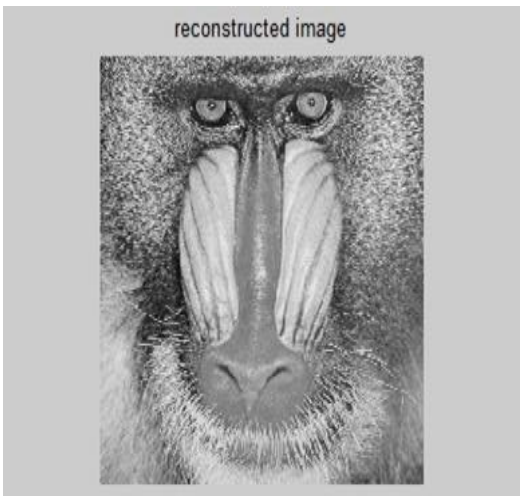

Fig:4.2 b) Output image

V.DISCRETE WAVELET TRANSFORM

Wavelets are mathematical tool for changing the Coordinate system which we represent the signal to another domain that is best suited for compression .

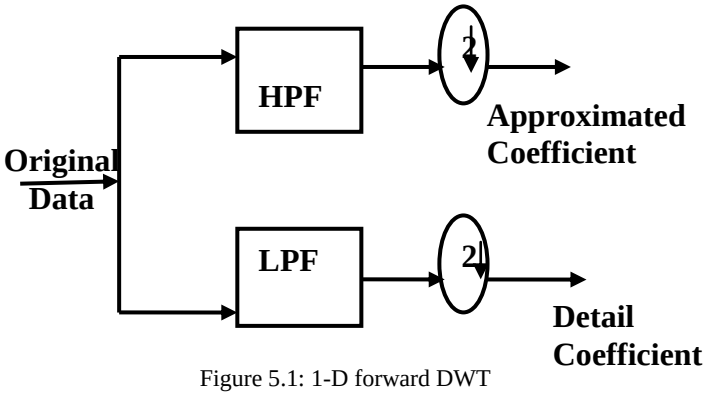

Figure 5.1: 1-D forward DWT

The DWT represents an image as a sum of wavelet functions, known as *wavelets*, with different location and scale. It represents the data into a set of high pass (detail) and low pass (approximate) coefficients. The input data is passed through set of low pass and high pass filters. The output of high pass and low pass filters are down sampled by 2.The output from low pass filter is an approximate coefficient and the output from the high pass filter is a detail coefficient [3]. This procedure is one dimensional (1-D) DWT.

The decomposition filters are applied to obtain the DWT transformed image and then based on a compression threshold value the DWT coefficients are compressed. The compressed DWT domain values are converted back to the spatial domain by using the reconstruction filters.

Dwt result

Image 2: peppers.png
Size on Disk:79.9
DWT Compressed:11.9 kb

Fig 5.2:a) input image

Fig:5.3 b) Compressed image

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VI.DWT RESULTS

Result analysis comparison of DCT and DWT image compression techniques

Image (size in kb)	DCT (size in kb)	DWT (size in kb)	$Cr=_{n1/n2}$ DCT	$Cr=_{n1/n2}$ DWT
86	7.76	11.9	11.36	6.71

VII. CONCLUSION

Image compression is very important for efficient transmission and storage of images. The work in this paper, primarily focused at comparing the two most widely used techniques in the image compression domain i.e. the Discrete Wavelet transform, and the Discrete Cosine Transform on a number of images. The techniques have been applied successfully and the results of compression using both the techniques have been compiled. The implementation has been carried using the MATLAB software and a number of images from the standard database. The DCT technique uses 8x8 blocks conversion. The comparison shows as given in the results chapter that for the same input image the compression in DCT technique is more than the DWT technique. However, the quality of the image decreases. There always lies a trade off between the compression ratio and perceptual quality of the image obtained and it largely depends on the usage to decide the priority of which method to choose over the other.

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