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Comparative Study of Compression Techniques and Compressed Image Face Recognition System

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ABSTRACT : *Now a day, everyone wants to save their memory element more and more by reducing the size of particular data which they use. So the compression of the data in any field put a great advantage to save the memory element as well as it will also save the time to transmit the data to others. Face recognition technology has numerous commercial as well as security applications at various places. For this, requirement of the memory element or capacity for storage of images is one of the major problems for generation of database for face recognition system. In this paper image compression techniques using which maximum utilization of memory element or storage devices can be achieved are discussed. Here techniques used for image compression for face recognition are DWT & DCT. This research is initial part of developing the algorithm to compare the results of mostly used DWT & DCT techniques and use one of the best techniques among them for Face Recognition.*

KEYWORDS : *DWT, DCT, Image Compression, Face Recognition.*

I. INTRODUCTION

Face Recognition technique is one of the most widely used technology in recent era. Now a day we are moving towards the fast, efficient and most secure network at various places like airport, railway station. For fast and efficient in the sense of memory contain we required the image size as law as possible. For this purpose we have to first compress the image and then store it in the database to recognize with captured image.Many researchers have been made on image compression techniques but still there is a need for compression technique which provides higher compression with quality reconstruction. Images contain large amount of information that requires much storage space, large transmission bandwidths and long transmission times, therefore it is advantageous to compress the image by storing only the essential information needed to reconstruct the image. A common characteristic of most images is that the neighboring pixels are correlated and therefore contain redundant information, therefore images having large areas of uniform pixel values will have large redundancies, and conversely images that have frequent and large changes in pixel values have less redundant information and harder to compress. Hare we use two different technologies to compress the image, first is Discrete Wavelet Transform (DWT) and the other is Discrete Cosine Transform (DCT). After compression of the image it is stored into the database and then can be used as the test data to compare with the trained data image.

In the discrete wavelet transform the term 'wavelet' comes from the fact that they integrate to zero; they wave up and down across the axis. This property ensures that data is not over represented. A signal can be decomposed into many shifted and scaled representations to that of the original wavelet. To isolate very fine details in a signal, Very small wavelets can be used; on the other side very large wavelets can identify coarse details. Here sub-band coding is used to design the DWT filter. This technique collects the signal energy into few components by isolating the signal characteristics. Then sub-sampling operation is used to decreases the resolution from one transformation level to the other. In the Discrete Cosine Transform, the finite sequence of data points in terms of sum of cosine function oscillating at different frequency. The reason behind choosing the cosine function (not sine function) is that it is more efficient in terms of fewer function are needed to approximate typical signal. DCT is equivalent to DFT as we only have to transmit few coefficients instead of whole DCT.The Face Recognition system is one of the best techniques for the feature extraction. The first historical way to recognize people was based on face geometry. Face identification from a single image is a challenging task because of variable factors like alterations in scale, location, pose, facial expression, lighting conditions and overall appearance of the face.

All face recognition algorithms consists of two parts: a) Face localization & normalization b) Face identification. Here onwards the use of compressed image (DWT & DCT) is done for creating the database for face recognition.

II. DISCRETE WAVELET TRANSFORM

Wavelets are signals which are local in time and scale and generally have an irregular shape. A wavelet is a waveform of effectively limited duration that has an average value of zero. The term 'wavelet' comes from the fact that they integrate to zero; they wave up and down across the axis. This property ensures that data is not over represented. A signal can be decomposed into many shifted and scaled representations of the original mother wavelet.

A wavelet transform can be used to decompose a signal into component wavelets. Once this is done the coefficients of the wavelets can be decimated to remove some of the details. Wavelets have the great advantage of being able to separate the fine details in a signal. Very small wavelets can be used to isolate very fine details in a signal, while very large wavelets can identify coarse details. The basic idea of the wavelet transform is to represent any arbitrary function (t) as a superposition of a set of such wavelets or basic functions. These basic functions or baby wavelets are obtained from a single prototype wavelet called the mother wavelet, by dilation and translation operation [2].

2.1 DWT Compression Step

- The input images are divided by 8 by 8 or 16 by 16 blocks.
- The image is then applied to the Mapper block.
- Then this mapped image is quantized in different level.
- Symbol Coder is then convert the quantized image into suitable symbols code.
- And then finally we get the compressed image of DWT.

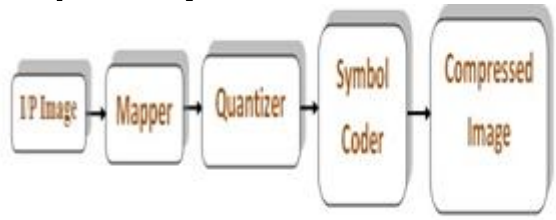


Fig 1: The structure of DWT based compression

For the designing of filters, sub-band coding is used. Sub- band coding is a coding strategy that tries to isolate different characteristics of a signal in a way that collects the signal energy into few components. This is referred to as energy compaction. Energy compaction is desirable because it is easier to efficiently encode these components than the signal. The most commonly used implementation of the discrete wavelet transform (DWT) consists of recursive application of the low-pass/high-pass one-dimensional (1-D) filter bank successively along the horizontal and vertical directions of the image. The low-pass filter provides the smooth approximation coefficients while the high-pass filter is used to extract the detail coefficients at a given resolution.Both low-pass and high-pass filters are called sub-bands. The number of decompositions performed on original image to obtain sub bands is called sub-band decomposition level. The high pass sub-band represents residual information of the original image, needed for the perfect reconstruction of the original image from the low-pass sub-band while the low pass sub-band represents a down sampled low- resolution version of the original image. It is used for computer and human vision, musical tone generation, FBI finger print compression.

The filtering step is followed by a sub-sampling operation that decreases the resolution from one transformation level to the other. After applying the 2-D filler bank at a given level n, the detail coefficients are output, while the whole filter bank is applied again upon the approximation image until the desired maximum resolution is achieved. The sub-bands are labeled by using the following symbols [2].

[1] **LLn** is the approximation image at resolution (level decomposition) n, resulting from low-pass filtering in the vertical and horizontal directions.
[2] **HLn** represents the vertical details at resolution n, and results from vertical low-pass filtering and horizontal high-pass filtering.
[3] **LHn** represents the horizontal details at resolution n, and results from horizontal low-pass filtering and vertical high-pass filtering.
[4] **HHn** represents the diagonal details at resolution n, and results from high-pass filtering in both directions.

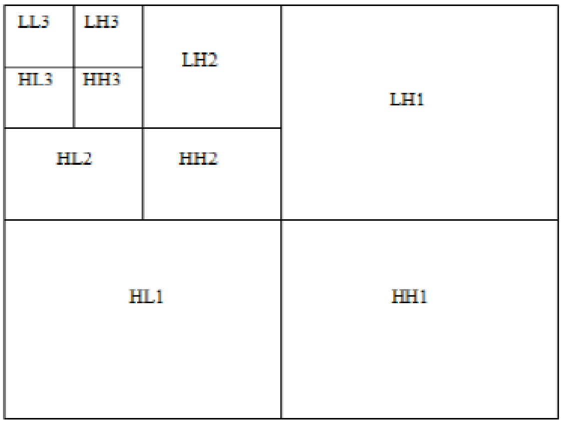


Fig 2: Filtering Sub-band of wavelet transform based compression

III. DISCRETE COSINE TRANSFORM

Compressing an image is significantly different than compressing raw binary data. Of course, general purpose compression programs can be used to compress images, but the result is less than optimal. DCT has been widely used in signal processing of image. The one-dimensional DCT is useful in processing one-dimensional signals such as speech waveforms. For analysis of two-dimensional (2D) signals such as images, we need a 2D version of the DCT data, especially in coding for compression, for its near-optimal performance. JPEG is a commonly used standard method of compression for photographic images. The name JPEG stands for Joint Photographic Experts Group, the name of the committee who created the standard. JPEG provides for lossy compression of images. Image compression is the application of data compression on digital images. In effect, the objective is to reduce redundancy of the image data in order to be able to store or transmit data in an efficient form. The best image quality at a given bit-rate (or compression rate) is the main goal of image compression. The main objectives of this paper are reducing the image storage space, Easy maintenance and providing security, Data loss cannot affect the image clarity, Lower bandwidth requirements for transmission, reducing cost [5].

2.1 DCT Compression Step

- The input images are divided by 8 by 8 or 16 by 16 blocks.
- The two dimensional DCT is computed for each block.
- The DCT coefficient are than quantized, coded, and transmitted.
- The receiver decodes the quantized DCT coefficient; compute the inverse DCT of each block.
- Puts the blocks back together into a single image.

There are eight standard DCT variants, of which four are common. One of the most popular and comprehensive continuous tone, still frame compression standards is the JPEG standard. In the JPEG base line coding system which is based on the discrete cosine transform and is adequate for most compression applications, the input and output images are limited to eight bits, while the quantized DCT coefficient values are restricted to 11 bits. The discrete cosine transform (DCT) is a mathematical function that transforms digital image data from the spatial to the frequency domain. For an M x N image, the spatial domain represents the color value of each pixel. The frequency domain considers the image data as a two dimensional waveform and represents the waveform in terms of its frequency components. A DCT based method is specified for “lossy'' compression [5].

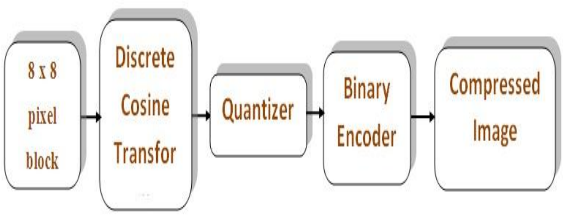


Fig 3: The structure of DCT based compression

The input image is N by M. f (i,j) is the intensity of the pixel in row i and column j. F (u, v) is the DCT coefficient in row k1 and column k2 of the DCT matrix. For most images, much of the signal energy lies at low frequencies; these appear in the upper left corner of the DCT Compression is achieved since the lower right values represent higher frequencies, and are often small - small enough to be neglected with little visible distortion. The DCT input is an 8 by 8 array of integers. This array contains each pixel's gray scale level. 8 bit pixels have levels from 0 to 255. DCT-based image compression relies on two techniques to reduce the data required to represent the image. The first is quantization of the image's DCT coefficients; the second is entropy coding of the quantized coefficients.

Quantization is the process of reducing the number of possible values of a quantity, thereby reducing the number of bits needed to represent it. Entropy coding is a technique for representing the quantized data as compactly as possible. We will develop functions to quantize images and to calculate the level of compression provided by different degrees of quantization. We will not implement the entropy coding required to create a compressed image file. Eye is most sensitive to low frequencies (upper left corner), less sensitive to high frequencies (lower right corner) Standard defines 2 default quantization tables, one for luminance (above), and one for chrominance. Quality factor in most implementations is the scaling factor for default quantization tables. Custom quantization tables can be put in image/scan header. The purpose of the Zigzag Scan is to group low frequency coefficients in top of vector. Maps 8 x 8 to 1 x 64 vector. Figure 4 shows the zigzag pattern for the discrete cosine transform. [1]

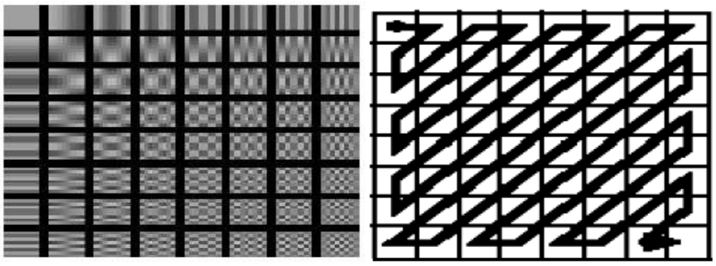


Fig 4: Zigzag pattern of DCT

IV. FACE RECOGNITION SYSTEM

Face recognition is emerging as an active research area spanning several disciplines such as image processing, pattern recognition, computer vision and neural networks. The first historical way to recognize people was based on face geometry. There are a lot of geometric features based on the points. Face recognition technology has numerous commercial and law enforcement applications. Below figure 5 shows the basic block diagram of the face recognition system. [4] In recent years, face recognition has been the subject of intensive research. With the current perceived world security situation, governments as well as businesses require reliable methods to accurately identify individuals, without overly infringing on rights to privacy or requiring significant compliance on the part of the individual being recognized. Face recognition provides an acceptable solution to this problem. Face recognition has drawn attention of the research community. Face identification from a single image is a challenging task because of variable factors like alterations in scale, location, pose, facial expression, occlusion, lighting conditions and overall appearance of the face. With the synergy of efforts from researchers in diverse fields including computer engineering, mathematics, neuroscience and psychophysics, different frameworks have evolved for solving the problem of face recognition all face recognition algorithms consists of two parts: a) Face localization & normalization b) Face identification. Partially automatic algorithms are given a facial image and the coordinates of centre of eyes. Fully automatic algorithms are only given facial images. A multitude of techniques have been applied to face recognition like DWT & DCT.

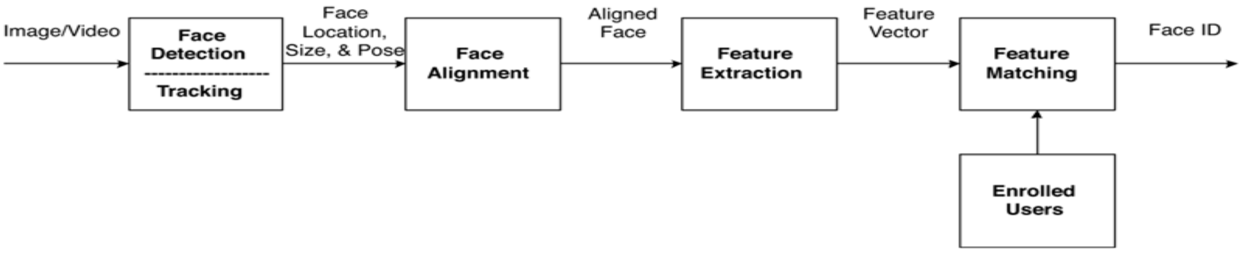


Fig 5: Block diagram of face recognition system

Table 1: Comparative Analysis of DWT & DCT tech [3]

PARAMETER	DWT	DCT
Complexity	Less Complexity	More
Power	More processing power	Less
Compression Ratio	Better Compression Ratio (Adjusted)	Not Adjusted
Information loss	Less loss of Information	More loss of Information
Implementation	Implementation not Easy	Easy to Implementation
Coefficients	Well localized in frequency as well as spatial demine	Well localized in frequency demine
Block Artifacts	No Block Artifacts	Distortion of Media

V. RESULT ANALYSIS

Results obtain through the DWT compression technique is shown in below figure at different level compression.

Fig 6: Image after first level compression by DWT

Image compression after First level, second level and third level are shown here in fig 6, fig 7 and fig 8 respectively. Moreover fig 9 shows the image compression using DCT.

Fig 7: Image after second level compression by DWT

Fig 8: Image after third level compression by DWT

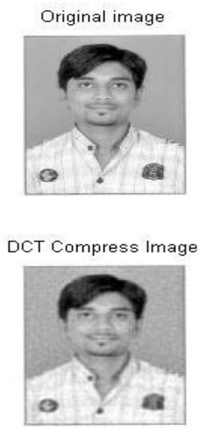
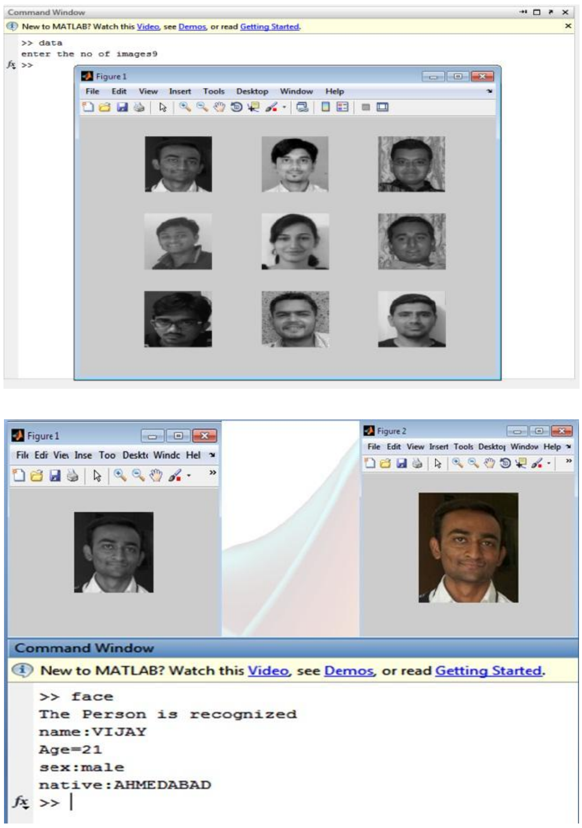


Fig 9: Image compression by DCT

The Result obtain by Face Recognition Technique is also shown here. Fig 10 shows the face recognition output.



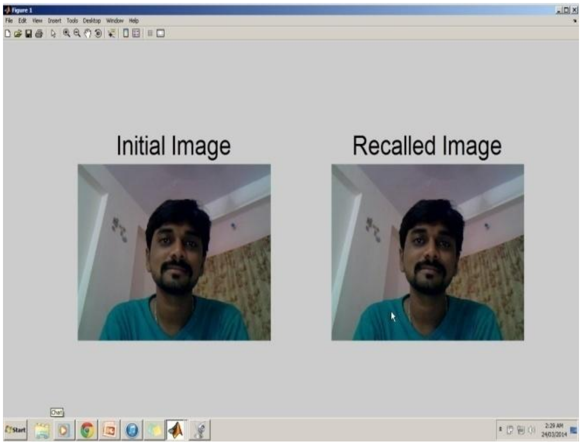


Fig 10: Face Recognition System Output

VI. CONCLUSION

The images compressed using DWT & DCT gives better efficiency and resolution in DWT as compare to the DCT. DWT provides better image quality than DCT, especially at higher threshold values. So we can store the images by compression and can get the better utilization of storage and transmission time. And then these images can be used for the face recognition.

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