Image Compression Hybrid using DCT , DWT , Huffman

Harjeetpal Singh , Sakshi Rana

Abstract-Image compression literally means reducing the size of graphics file, without compromising on its quality. Depending on whether the reconstructed image has to be exactly same as the original or some unidentified loss may be incurred, two techniques for compression exist. Image compression is an essential technology in multimedia and digital communication fields. Ideally, an image compression technique removes redundant and/or irrelevant information, and efficiently encodes what remains. Practically, it is often necessary to throw away both on redundant information and relevant information to achieve the required compression. in either case, the trick is finding methods that allow important information to be efficiently extracted and represented. Most of the existing image coding algorithm is based on the correlation between adjacent pixels and therefore the compression ratio is not high. Fractal coding is a potential image compression method, which is based on the ground breaking work of Barnsley and was developed to a usable state by Jacquin.Its essence is that correlation not only exists in adjacent pixels within a local region, but also in different regions and local regions with global regions. The fractal-based schemes exploit the self-similarities that are inherent in many real world images for the purpose of encoding an image as a collection of transformations. Here in this hybrid model we are going to proposed a Nobel technique which is the combination of several compression techniques. This paper presents DWT and DCT implementation because these are the lossy techniques and in the last we introduce Huffman decoding technique which is lossless. At the last we implement lossless technique so our PSNR and MSE will go better than the old algorithms and due to DWT and DCT we will get good level of compression.

Index Terms- DCT (discrete cosine transform), DWT (discrete wavelet transform), MSE (mean square error), PSNR (peak signal to noise ratio)

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1 Introduction

Image Compression addresses the problem of reducing the amount of data required to represent the digital image. Compression is achieved by the removal of one or more of three basic data redundancies: (1) Coding redundancy, which is present when less than optimal (i.e. the smallest length) code words are used; (2) Interpixel redundancy, which results from correlations between the pixels of an image & (3) psycho visual redundancy which is due to data that is ignored by the human visual system (i.e. visually nonessential information). Huffman codes contain the smallest possible number of code symbols (e.g., bits) per source symbol (e.g., grey level value) subject to the constraint that the source symbols are coded one at a time. So, Huffman coding when combined with technique of reducing the image redundancies using Discrete Cosine Transform (DCT) helps in compressing the image data to a very good extent. The Discrete Cosine Transform (DCT) is an example of transform coding. The current JPEG standard uses the DCT as its basis. The DC relocates the highest energies to the upper left corner of the image. The lesser energy or information is relocated into other areas. The DCT is fast. It can be quickly calculated and is best for images with smooth edges like photos with human subjects. The DCT coefficients are all real numbers unlike the Fourier Transform. The Inverse Discrete Cosine Transform (IDCT) can be used to retrieve the image from its transform representation. The Discrete wavelet transform (DWT) has gained widespread acceptance in signal processing and image compression. 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. Because of their inherent multi-resolution nature, wavelet-coding schemes are especially suitable for applications where scalability and tolerable degradation are important. Recently the JPEG committee has released its new image coding standard, JPEG-2000, which has been based upon DWT.

ISSN 2229-5518

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2 METHODOLOGY

Hybrid model (DCT, DWT, and HUFFMAN) is implemented as follows:

Loading an image is our first step as shown in fig.1 and 2 that image can be in RGB or gray scale format. The two images are taken to show different results .But important is to extract the original size of the image so as to compare it with the compressed image to get the exact results.

Fig.1: Lena image used as a first image

Fig.2: Barbara image used as a second image

The model we are using is hybrid model it is combination of DCT, DWT and HUFFMAN. First DWT (discrete wavelet transform) is implemented .DWT will be applied to r,g and b separetly i.e. have to extract r,g,b matrices from the image because the loaded image will be a input to DWT.Fig.3 and 4are DWT compressed images for different inputs with respective histograms.

Next step is to implement DCT (discrete cosine transforms).It is applied on the obtained image that is output of DWT and using it as an input for DCT. A discrete cosine transform (DCT) expresses a sequence of finitely many data points in terms of a sum of cosine functions oscillating at different frequencies. As shown in fig. 5 and 6 DCT compressed images for two inputs and their histograms .DCTs are important to nu merous applications in science and engineering, from lossy compression of images, a DCT is a Fourier-related transform similar to the discrete Fourier transform (DFT), but using only real number

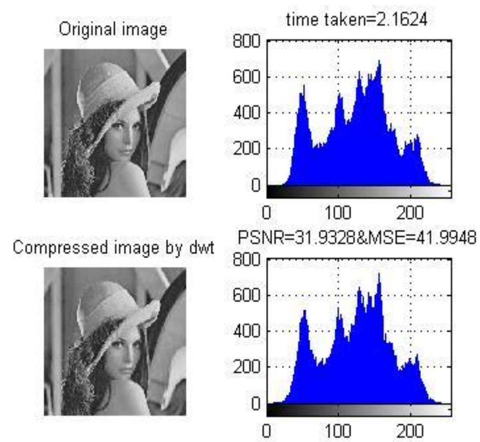

Figure3: DWT compressed Lena image with its received histogram.

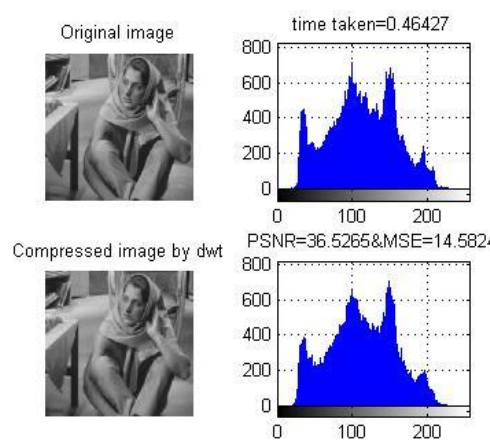

Figure4: DWT compressed Barbara image with its received histogram

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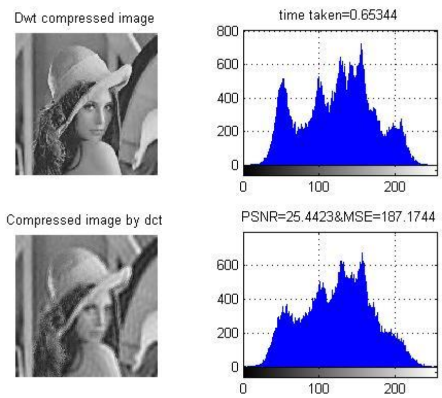

Figure5: DCT compressed Lena image with it received histogram

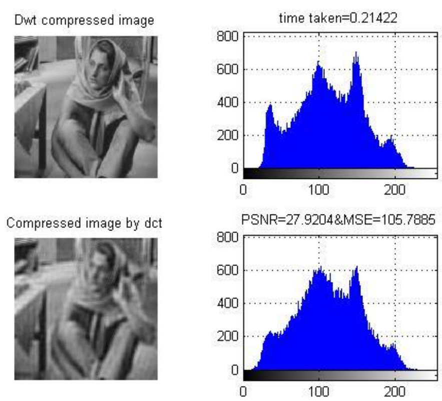

Figure6: DCT compressed Barbara image with its received histogram

And our final step is to implement Huffman, output of DCT is applied as input to it .Above two mention techniques are lossy techniques so at the end step we are going to implement Huffman compression which is lossless technique. For this we have to generate a Huffman tree for the particular image and with the help of that tree we compress this image at the last step.But in this case output is same as that of DCT but we our using this compression as it increases the compression ration of the image which increases the quality. Reverse of this is happen at the decompressing stages and in the last we have to calculate PSNR and MSE of the decompressed image and compare it to the original image. PSNR (probalistic signal to noise ratio) and MSE (mean square error) are the two factors to which depicts the quality of picture. Different filters can be used to reduce the unrelevant information from image.

3.GRAPHS

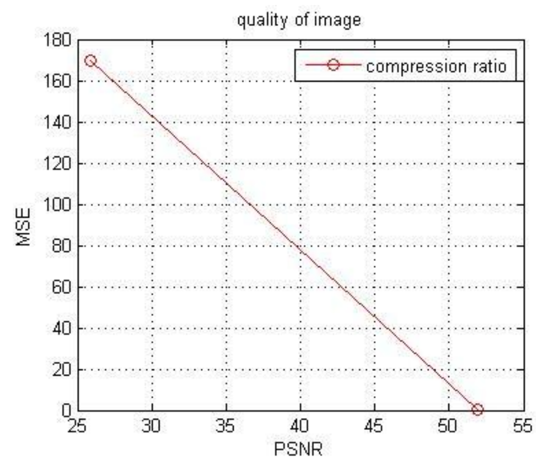

Figure7: Graph showing the varying values of MSE and PSNR for DWT, DCT, and HUFFMAN. This varying compressed values are for Lena as a input

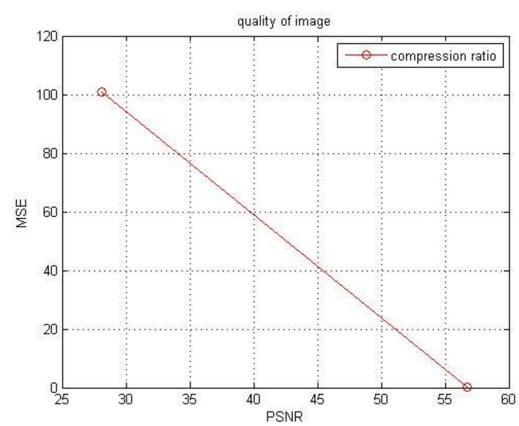

Figure8: Graph showing the varying values of MSE and PSNR for DWT, DCT, and HUFFMAN. This varying compressed values are for Barbara as a input.

4. RESULTS

TABLE 1

IMAGE	LENA		
	DWT	DCT	HUFFMAN
TIME TAKEN	0.3958	0.1637	31.7302
PSNR	51.87	25.87	25.87
MSE	0.4260	169.56	169.56

For Lena as a input time taken, PSNR and MSE values are varying for hybrid compression .As the value of PSNR increases quality improves.

TABLE 2

IMAGE	BARBARA		
	DWT	**DCT**	**HUFFMAN**
TIME TAKEN	0.3404	0.2018	28.0251
PSNR	56.71	28.13	28.131
MSE	0.1395	100.76	100.76

Results showing for Barbara input ,compression ratios will be different for the input

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