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Good Quality and High Image Compression using DWT-DCT Technique

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ABSTRACT
The issue of minimizing the amount of data needed to denote the digitized image is addressed by image compression. It is specially used for compression of images, where tolerable degradation is needed. The world has found itself among large amount of data due to the significant technology growth and presence into Digital Age. Dealing with such massive information can often introduce some difficulties. The compression reduces the size of the image in bytes without corrupting the image quality to unacceptable level. When the image size is reduced, various images are saved in particular allocated disk or memory space. It also minimizes the time needed to upload or download the images in web pages.
This research work have been aimed to develop an efficient image compression for improving compression ratio and PSNR value based on DWT-DCT technique is designed to improve the performance and to reduce the memory consumption of the compression system.
Keywords: Image Compression, DWT, IDWT, DCT, PSNR

I. INTRODUCTION

This transformation coding scheme uses different transforms like Discrete Fourier Transform (DFT) and Discrete Cosine Transform (DCT) to convert the original image pixels into transform coefficient. Here, the wavelet plays a vital role in image processing applications. The Discrete Wavelet Transform (DWT) is performed based on sub-band coding, so that it is simple to implement, and minimizes the computation time and needed resources. The advantage of DWT is the temporal resolution in both frequency and time. The decomposition into sub-bands is highly flexible in terms of resolution scalability. Therefore, in this DWT, the spatial domain pixels are converted into frequency domain information by using DWT processor. The data selection and transmission process is performed by decomposing the data available in the lower sub-band region. Based on the needed information content, the data in the higher sub-band region is discarded. The major benefit of Discrete Cosine Transform (DCT) is that it has better flexibility at block-by-block level. It is also a sub-optimal transform to compress the image and video data. Feature extraction is the process of capturing visual content of the images for indexing and retrieval. General image features such as color, texture and shape or domain specific features are extracted in this process. It is an important factor in wide range of image processing applications. To determine the data, the amount of needed resources is facilitated. A statistical approach, namely, Gray Level Co-occurrence Matrix (GLCM) method is used for texture feature extraction. It deals with the relationship of two neighboring pixels and the relationship of gray value is converted into the co-occurrence matrix by the corresponding mask of a kernel. Hence, the defined and reverse directions are encompassed and employed for the neighboring pixels. Correlation analysis is one of the most widely used numerical measures in various fields. It is defined as the degree that is used to predict the relationship that exists between two different sub-bands. Hence, the bands are divided into high correlation and low correlation bands based on the threshold value. This threshold value is estimated based on the estimation of correlation coefficient. It is evaluated by feature vector and matrix of the HSI bands by performing feature extraction.

II. RELATIVE WORK

Gaurav Kumar et al. (2016), due to the increasing requirements for transmission of images in computer, mobile environments, the research in the field of image compression has increased significantly. When we compute the number of bits per image resulting from typical sampling rates and quantization methods, we find that Image compression is needed. Therefore development of efficient techniques for image compression has become necessary .This paper is a for lossy image compression using wavelet, Discrete Cosine Transform and neural network, it covers JPEG compression algorithm which is used for full-color still image applications and describes all the components of it.

V Srinivasa Rao et al. (2016), the CHF successfully speak to the shading dispersion inside a picture, while the BHF portrays the picture edge and surface. The trial comes about exhibit that the proposed technique is not just better than the previous BTC-based picture ordering plans, additionally the previous existing strategies in the writing identified with the substance based picture recovery [2]. To accomplish higher recovery precision, another component can be included into the EDBTC ordering plan with the other shading spaces, for example, Y Cb Cr, Hue-Saturation-Intensity, lab, and so forth. An expansion of the EDBTC picture recovery framework can be conveyed to list video by considering the video as a grouping of pictures. This system should consider the transient data of the video arrangement to meet the client necessity in the CBIR setting.

Ahmed A. Nashat et al. (2016), the assessment of execution utilizing target criteria including MSE and PSNR demonstrate that the proposed technique accomplishes a decent pressure proportion while keeping a decent nature of the remade pictures [3]. A relative examination between the proposed half and half technique and the BTC and WHT demonstrates that the proposed strategy performs superior to the BTC and WHT. Since this strategy includes less number of basic calculations, the time taken by this calculation is likewise less when contrasted and BTC.

C. Senthil Kumar et al. (2016), dot diffusion based block truncation code with vector quantization is proposed [4]. This technique is applied to the different block size and different image dimension. Dot diffusion based block truncation codes are applied to the all pixel block and calculate bit rate. In encoder part, dot diffusion based block truncation code compressed an image pixel value into corresponding quantization and bitmap image. Dot diffusion based algorithm is very useful of the medical image but more time consumed.

Jing-Ming Guo et al. (2014), the absolute moment block truncation code for color image compression is proposed [5]. This compression technique reduces the computational complexity and achieves the optimum minimum mean square error and PSNR. It is an improvised version of BTC, obtained by preserving absolute moments. AMBTC is an encoding technique that preserves the spatial details of digital images while achieving a reasonable compression ratio. The simulation results obtained indicate that both the computational complexity of and the reconstructed image quality obtained using AMBTC algorithm are better than those obtainable with other existing BTC algorithms.

Ki-Won Oh et al. (2014), parallel implementation of block truncation code with vector quantization is proposed [6]. These techniques are based on the hybrid vector quantization based block truncation code using mobile display stream compression. Processing dependency in the conventional algorithm is removed by partitioning the input image and modifying neighbouring reference pixel configuration [6]. To minimize processing dependency in the conventional algorithm, they modify the usage of RVT and the neighbouring reference pixel configuration. Where each block is encoded either by VQ-BTC by utilizing a representative vector table (RVT) keeping a fixed number of representatives recently used. In order to further improve the coding performance, a small number of entries in the RVT were used for indicating reconstructed neighbouring pixel values within adjacent coded blocks in. This approach, however, results in causality and dependency that hinder parallel implementation. Such modification leads to not only parallel implementation but also higher coding performance. Experimental results show that the parallel implementation drastically reduce processing time by 6~7 times with significant visual quality improvement.

III. PROPOSED METHODOLOGY

2-D Discrete Wavelet Transforms

In DWT, image pixels are transformed into coefficient that is real values. The image is segregated into four regions, where the upper left of this region is the low resolution sub-band in which the energy of the image is concentrated. Then, it is combined with the other sub-bands to obtain the original reconstructed image. The wavelets transform decomposes the signal into group of basic function. These functions are known as wavelet as follows,

$$\Psi_{x,y}(z \qquad \frac{1}{\sqrt{x}}\Psi\left(\frac{z-b}{x}\right) \tag{1}$$

Here, x denotes the scaling parameter, b represents the shifting parameter, Ψ is the wavelet coefficient and z is 1, 2… n size of the image. This work depends on transformation of HSI into DWT. The core tensor is decomposed in the coefficient resulted from the transform, and then perform inverse transform in order to obtain the original image. The major benefit of wavelet is that they allow both spatial and spectral resolution.

DWT decomposes the signals into lower resolution with finer details. DWT consists of consecutive low-pass filter (LPF) and high-pass filter (HPF). A high pass filter is defined as an electronic filter, which passes signals with a frequency higher than a certain cutoff frequency and attenuates signals with frequencies lower than the cutoff frequency. At each decomposition level, the HPF generates main

information given as horizontal (H), vertical (V), and diagonal (D) information. Low Pass Filter (LPF) is also called as smoothing or blurring filter, this averages out rapid changes in intensity. This filter calculates the average of a pixel for its immediate neighbors. The LPF affiliated with the scaling function generates the finer details represented as approximate (A) information. Figure 1 show the decomposition of HSIs using filters.

LL: The upper left quadrant contains all coefficients that are filtered by the analysis of low pass filter along with the rows. After that, the filtering process is performed along with the corresponding columns with the analysis of low pass filter. The symbolic representation of the sub block is LL, and also represents the approximated version of the original at half the resolution.

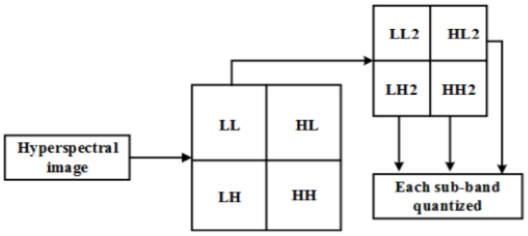

Figure 1: Decomposition of HSIs Images using Filters

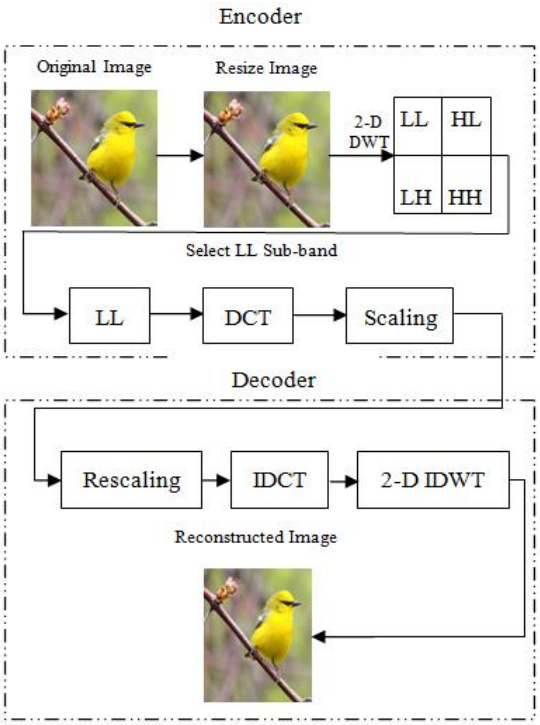

Figure 2: Flow Chart of Proposed Methodology

HL/LH: The lower left and the upper right blocks are alternatively filtered along the rows and columns with low and high pass filter. The LH block mostly holds the vertical edges. In contrast, the HL block clearly defines horizontal edges.

HH: The low right quadrant is analogously derived from the upper left quadrant. However, the analyzing portion of high pass filter belongs to the wavelet.

IV. SIMULATION RESULT

In the real world communication, the requirement of image storage and transmission are increasing exponentially. As a result, the need for better compression technology is always in demand. The limited bandwidth of internet also asks for transmission of desired objects only. Progressive image transmission provides such facilities, where transmission is done in steps and the transmission of undesired image can be stopped at an early stage. Modern applications, in addition to high compression ratio, also demand for efficient encoding and decoding processes, so that computational constraint of many real-time applications is satisfied. In some applications, multimedia objects are compressed just once but are reconstructed frequently and most of the times the compressed objects are available on the local storage device. In such cases, the compression methods should be such that efficient reconstruction of the objects must be possible along with high quality. This dissertation concentrates on image coding that leads to fast decoding. Such techniques are suitable for image search and retrieval.

In order to improve the peak signal to noise ratio (PSNR) and decrease the mean square error (MSE) of discrete cosine transform images, the best values for the low component 'L' and high component 'H' for the DWT image blocks can be estimated using hybrid DWT and DCT algorithm. A suitable technique has been developed in this research and the procedure is described next, using a 4×4 block example. The procedure can be used for large size blocks also, such as 8×8, 16×16 block pixel etc.

For the 4×4 block pixel, first the image (m×n) is divided in a 4×4 block pixel then if there is any residue it is adjusted to fit in this size. DCT algorithm is applied on this image and the image is compressed. The obtained image having comparable resolution than the original image but the image size is reduced significantly. This algorithm is applied for different images and result has been analyzed.

(a) Original Image (b) Resize Image

(c) 2-D DWT Resize Image (d) 2×2 Window Size Image

(e) 4×4 Window Size Image (f) 8×8 Window Size Image

(g) 16×16 Window Size Image

Figure 3: DWT-DCT Algorithm applied on Horse Image

Figure 3; show the Horse image of different block pixel. In this figure 3 (a) show the random image of the Horse image and resized the image of the 256×256 in the Horse image is shown in figure 3 (b). 2-D DWT applied to the resize image is shown in figure 3 (c). The compressed image of 2×2 block pixel of Horse image is shown in figure 3 (d) respectively.

Table 1: Experiment Result for Horse Image

	Window Size			
	2×2	4×4	8×8	16×16
MSE	3.132	21.460	37.781	49.780
PSNR (dB)	43.250	34.860	32.398	31.201

Table II: Comparison Result

	Window Size			
		2×2	4×4	8×8
MSE	Gaurav Kumar et al. [1]	32.0437	150.760	341.773
	Proposed Algorithm	3.132	21.460	37.781
PSNR (dB)	Gaurav Kumar et al. [1]	33.073	26.347	22.793
	Proposed Algorithm	43.250	34.860	32.398

V. CONCLUSION

In this work, lossy method for image compression, to be specified by the hybrid DWT and DCT algorithm has been implemented. This method depends on partitioning the image into (4×4 block size) non covering squares and uses mean and standard deviation of each block pixel.

The proposed hybrid DWT and DCT algorithm is applied to the color image which results in lower bit rate and good quality image is obtained.

The reconstructed images obtained after applying this technique have excellent performance. For a block size of 4*4, MSE for real image is least and the PSNR value is highest. The similar results are obtained of block sizes 8*8 & 16*16 images respectively.

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