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High Quality Image Compression using Lossy DWT-DCT Technique

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Abstract-Wireless Image Compression is embedding scheme for reducing size of image so that image can be store in less disk space and faster attachment possible in communication. Research issues in Image Compression are to increase efficiency in term of the image quality of decompressed image on higher compression ratio and robustness against visual attacks. Discrete Wavelet transform domain based Image Compression is lossy compression technique. The disadvantage of DWT based compression is fraction loss in embedding which increases mean square error and results decreasing PSNR. Quality of decompressed image is proportional to PSNR. The Proposed compression approach use integer wavelet transforms to overcome above fraction loss. The paper presents Hybrid discrete wavelet transform (DWT) and discrete cosine transform (DCT) based compression technique to obtain increased quality of decompressed image compared to DWT+ DCT based compression technique. The proposed combined DWT + DCT based compression technique reduces the fractional loss compared to DWT based compression so the proposed technique provides better image quality of decompressed image on high compression ratio compared to DWT based and hybrid DWT DCT based image compression techniques.

Keywords: - Image Compression, DWT, IWT, DCT, PSNR

I. INTRODUCTION

In The vital purpose of compression technique is reducing information redundancy for minimizing transmission bandwidth and archiving costs [1,2]. Compression approach is classified into data compression and multimedia compression [3]. Multimedia has high size in disk which takes much time uploading and downloading over network. Multimedia can be an image or video file. Spatial domain and frequency domain are the two approach of image compression [4]. For image compression, transform based compression shows better robustness than spatial domain based compression. Compression technique can be either lossless or loosy [5]. In lossy compression, data loss is incurred but compression ratio is very high. In lossless compression approach, decompressed Image is identical to the original one but with compression ratio [6]. We focus on lossy compression approach for image where transform techniques is used. Use of transform technique for compression is dependent on computational complexity and error threshold [7]. The goal of research is to find out a transformation based compression approach which have low computational complexity and able to concentrate the signal energy in the smallest number of parameters [8]. There are discrete Fourier transform (DFT), discrete wavelet transform (DWT) and discrete cosine transform (DCT) based compression technique which have property of reversible, unitary, symmetric and constant energy [9]. Discrete wavelet transform decomposes image into 4 different frequency bands which is called LL, LH, HL and HH where LL sub band represents characteristics of image while HH sub band represents Noise in image [10]. DCT cosine transform image from space domain to frequency domain where low frequency components are top left corner of DCT coefficient matrix and frequency reduce diagonally from top left corner to bottom right corner [11]. Salam Benchikh and Michael Corinthios [12] suggested a scheme of hybrid Compression based on discrete wavelet transformation and discrete cosine transformation but discrete wavelet transform have problem of fraction loss which increases the error between original and recovered image. This paper has contrition to propose a scheme for reduction of loss occurred in dwt and dwt + dct compression and proposed technique subsequently increases the decompressed image quality.

II. RELATIVE WORK

The DWT and DCT transformation technique is describe in following section which is used in proposed work.

A. Discrete Wavelet Transform (DWT)

When an integer data set is mapped into another integer data set, this type of transformation is known as integer wavelet transformation and it is also called s-transformation. The output of smooth(s) and detail (d) are given by the equations 1(a) and 1(b) [13].

S (n) = [X (2n) + X (2n+1)]/2 …………….(1a)

D (n) = X (2n) - X (2n+1) … ……………..(1b)

The inverse of transformation is given by equations 2(a) and 2(b).

X (2n) = s (n) + [(d (n) + 1)/2] …………(2a)

X (2n + 1) = s (n) - d (n)/2 ….. ……..(2b)

B. Discrete Cosine Transform (DCT)

In the proposed technique, DCT transformation is used as JPEG standard [14]. 8x8 block matrix are created and on each matrix is converted into frequency domain using DCT.

For compression process, Quantization is used on DCT matrix and using specific procedure, data are reduced in disk. For reconstruction of image from compressed data, Inverse DCT transform is applied. Discrete Cosine Transform is given as following equation (3).

III. PROPOSED METHODOLOGY

Most of the image compression techniques be it in natural images or medical images are done in either of the two domains i.e., spatial and frequency domain or a combination of both in hybrid method. While spatial techniques involve manipulation of pixels of the cover image, frequency domain techniques involve manipulation of coefficients of the cover image. The coefficients are obtained by transforming the cover image in time domain to a frequency domain through a specific transformation function. Since the manipulation of medical images is involved, spatial domain techniques in spite of their good fidelity criteria exhibit poor tolerance towards a wide range of external attacks which is not desirable. The proposed algorithm is based on dividing the image into non overlapping block of equal size. In digital signal processors, an image is divided into smaller blocks of ‘k ×k’ pixels for processing. Where k represents block size of the colour image. For example a ‘256×256’ frame may be divided into blocks of ‘4×4’, ‘8×8’ and ‘16×16’ pixels.

Figure 4.1 shows the flow chart of the algorithm given. Any random image is given as an input and it is resized. After that form the non-overlapping block of resizing image. Then divide this block by resizing image, if remainder is zero condition is true and calculated the threshold value otherwise this loop is repeated. In the case of true condition we quantized the output of threshold value and design to the bit map according to the quantization value. Then check the bit map size if bit map size is equal to block size then condition is true and bit map is replaced by high and low component value then compressed image is obtained.

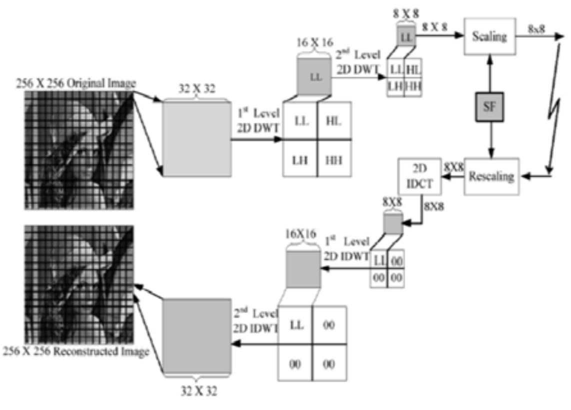

Figure 1: Flow Chart of Proposed Methodology

Proposed Encoder and decoder block of the multi-level block truncation algorithm is shown in figure 4.2. Encoder part of the proposed algorithm shows that the original image is divided into three parts i.e. R component, G component and B component. Each R, G, B component of the image is divided into non overlapping block of equal size and threshold value for each block size is being calculated.

Discrete Wavelet Transform

The discrete wavelet transform is an important class of multi resolution transforms and computed by successive low pass and high pass filtering of the discrete time-domain signal as shown in figure 2. This is called the Mallat algorithm or Mallat tree decomposition.

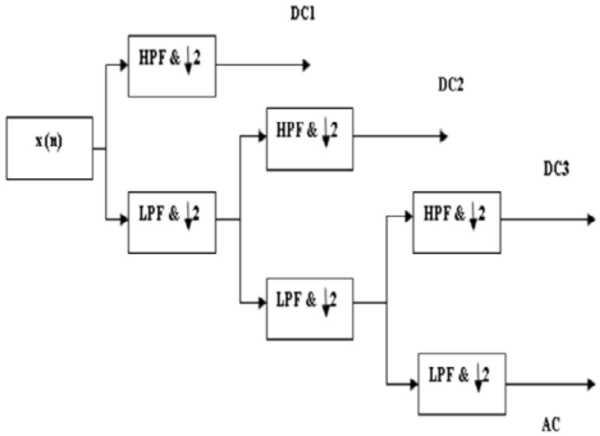

Figure 2: DWT decomposition filter bank structure

The above figure illustrates a 3 level decomposition filter bank structure where the input discrete time signal x(n) is passed through a low pass filter (LPF) and a high pass filter (HPF) followed by a down sampling by 2 to generate an approximation image giving the approximation coefficients (AC) and a directional sub band giving the directional coefficients (DC). Three directional sub bands are generated at every stage known as the horizontal sub band, vertical sub band and diagonal sub band. The approximation image contains the low frequency components while the other three contain the high frequency components like edges etc., The transform at high frequencies, yields good time resolution and poor frequency resolution, while at low frequencies, gives good frequency resolution and poor time resolution. It is just a sampled version of continuous wavelet transform (CWT) and its computation may consume significant amount of time and resources, depending on the resolution required. Once the required number of decomposition levels is obtained, the required processing is done either with the approximation or detailed sub bands and then reconstructed back to get the original time domain signal through the inverse wavelet transform.

IV. SIMULATION RESULT

The original baboon image of 512×512 pixel value is shown in figure 5.10. This figure divided into four parts.

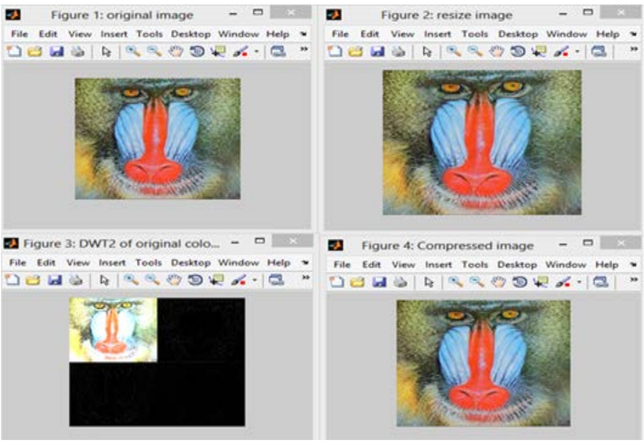

Figure 3: Hybrid DWT and DCT Algorithm applied on Baboon Image of different Block Size

Original random baboon image is shown in first part, second part the original random image is resize of the 512×512, the resize image is passing through the 2-D discrete wavelet transform (DWT) and get low frequency image is shows in third part. Fourth part is shows the compressed image 512×512 pixel value.

Table 1: Experimental Results of Hybrid DWT and DCT algorithm for Mean Square Error (MSE)

Image of Size 512×512	4×4 Window Size	8×8 Window Size	16×16 Window Size
Baboon Image	54.83	133.66	209.33
Flag Image	95.02	154.59	237.72
Peppers Image	163.29	287.48	451.13
Flower Image	175.34	302.34	497.45
Bike Image	203.44	398.56	549.11

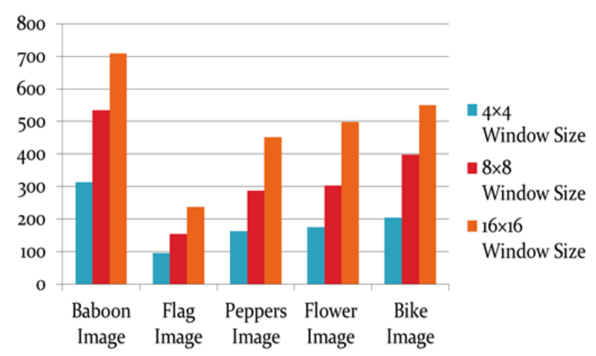

Figure 4: MSE for Different window size using Baboon, Flag, Peppers, Flower and Bike Image

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.

We increase the block size of the images, performance of the algorithm degraded, i.e. as blurred image. But memory space needed to store the image is very less, so if user can compromise with the quality of image, 16 *16 block size takes least memory space. But if balance between the memory size and image quality is needed, block size of 4*4 is the best option. The peak signal-to-noise ratio is used as a measure of the reconstructed image quality comparison of the original and reconstructed image. The result shows that this method provides a good compression without degrading the reconstructed image.

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