International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 3 Issue 7, July-2014, pp: (406-411), Impact Factor: 1.252, Available online at: www.erpublications.com

Image compression using hybrid of DWT, DCT, DPCM and Huffman Coding Technique

Ramakant Katiyar[1], Akhilesh Kosta[2]
Assistant Professor, CSE Dept.[1]
[1,2]Department of computer science & Engineering, Kanpur Institute of Technology, Kanpur, Uttar Pradesh, India

Abstract: In present scenario, among researchers development of hybrid schemes for an effective image compression has enhance to an enormous popularity. This research paper gives a recommended plan for medical image compression build on hybrid image compression proficiency (DWT and DCT).The objective for the wavelet coefficients of every DWT band(HH and LL) is to gain a hike on compression rates by exercising various compression thresholds whereas for maintaining the quality of reconstructed medical image DCT transfigure is applied. Based on the type of transformation the retained coefficients are calculated by the help of adaptive calculation. Finally for encrypting the calculation indices the entropy coding is used. Experimental consequences presents that the coding performance can be notably improved by the hybrid DWT-DCT algorithm.

Keywords: Hybrid scheme; quasi lossless compression; Huffman encoding; adaptive calculation; medical image; image Compression; DWT; DCT; DPCM.

I. Introduction

With the help of computers many of the hospitals administer their medical image data. For the possible distribution of the image data within the staff efficiently the computers and the networks are used. The series of images are produced with the help of X-RAY and CT [1]. The number of data produced with these techniques is enormous so this may be a problem when sending the data through a network. In the field of medical, image compression has been introduced to overcome this problem [2]. There have been number of compression research studies which examines the use of compression as when applied to medical images. The hybrid scheme of DWT, DCT and Huffman encoding compression technique have to be choosed for achieving higher degree of compression [3]. This thesis will provide a method to improve the performance of medical image compression while satisfying medical team who need to use it. In case of biomedical images the loss of diagonasability of the image is unavoidable although there are several types of image compressions available [4]. The design flow of effective compression technique is described in this paper. On the RGB parts of the extracted input image an effective DWT algorithm has been performed individually [5]. After the DWT is performed on the image the next step is to apply DCT by dividing the image into 8*8 blocks for making the components of frequency of the images which are greater than 8 as 0 [6]. After this for all RGB components the histogram probability reduction function are calculated using mean intensities. For calculating probability index for each unique quantity an image quantization is performed using ‘q’ factor [7]. To compress the image using Huffman compression Huffman code for each unique symbol is calculated after quantization. At the end to represent a given quantity of information the compression ratio and Peak-signal-to-noise ratio is calculated reducing the amount of data required [8].The diagram of proposed system is shown in the Figure 1.

The major steps involved in the proposed system are:

1. The initial step is to load the image.
2. The RCB image is then to be converted into YCbCr image
3. After conversion using multi resolution technique apply Forward discrete wavelet transform on the image.
4. For the wavelet pass divide LH and HL into non overlapped 8*8 blocks
5. On LH and HL bands each of 8*8 blocks apply DCT transform.
6. On DCT coefficient bands (LH and HL) adaptive quantization technique is applied.
7. And then on DWT coefficient bands (LL and HH) apply quantization.
8. On quantized indices apply differential pulse code modulation technique.
9. On quantized indices apply Huffman coding algorithm.

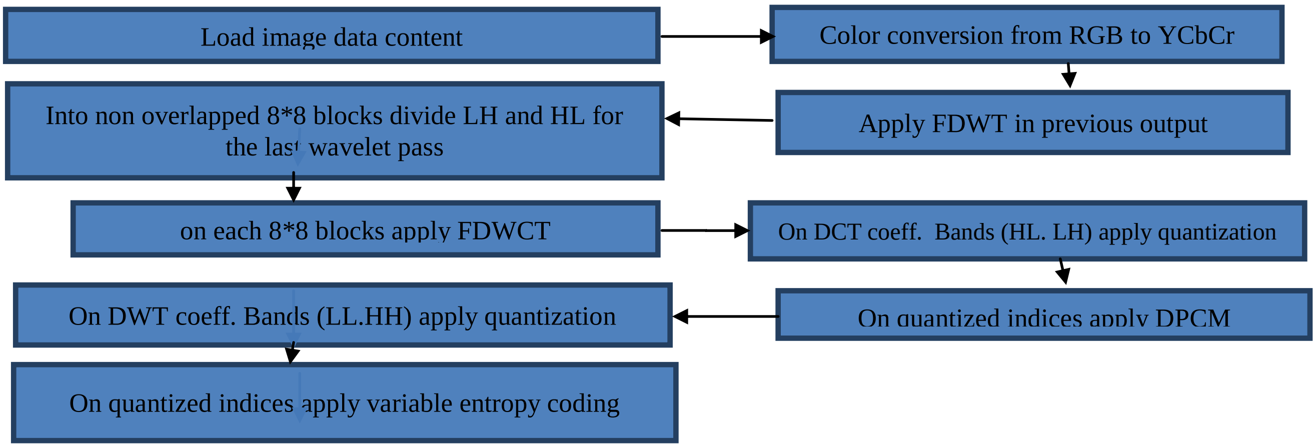

Figure 1: Proposed system diagram

The proposed algorithm and its implementation are shown in section-2. The directed test which is calculating the proposed system is detailed in section-3. In section-4, finally the main conclusions are concise.

II. PROPOSED CODING ALGORITHM STEPS

The thorough steps for proposed medical image compression are as under:

A. *Color space conversion from RGB to YCbCr*

Chrominance is associated to the opinion of hue and saturation of color whereas luminance is related with the perceived brightness. With the color perception of the HVS it approves more. So for color image processing it is much suitable. YCbCr is a family of color galaxies used as a slice of the color image pipeline in video and digital photography schemes where Y is the luma constituent and Cb and Cr are the red-difference and blue-difference chroma constituents. The chroma constituents represent the color information whereas the luma shows the achromatic image. YCbCr states to the color resolution of digital constituents. Cb and Cr are experimented at lower rate than Y for compressing the bandwidth, which is technically identified as “chroma subsampling”. This shows that brightness (luma) information is not being discarded but some color information in the image is being discarded.

$$Y = 0.2989*R + 0.5866*G + 0.1145*B$$

$$Cb = 0.1687*R - 0.3312*G + 0.5*B$$

$$Cr = 0.5*R - 0.4183*G - 0.816*B$$

B. *Forward Discrete Wavelet Transform(FDWT)*

With various location and scales Discrete Wavelet Transform (DWT) signifies an image as a sum of wavelet functions. Any disintegration of an image into wavelets include a pair of waveforms: one for the low frequencies (scaling function) and one to signify the high frequencies corresponding to the detailed constituents of an image (wavelet function). A nonreversible filter (real to real transform 9/7 Tap) is used for this type of transformation and can be only used for lossy coding. One can attain various level of bands after applying FDWT on the medical images data. According to the nature of bands LL and HH bands are openly directed to adaptive quantizer. The lingering bands (HL and LH) coefficients are exposed to DCT transformation.

C. *Forward Discrete Consine Transform(FDCT)*

Into 8*8 blocks each of HL and LH bands are divided and by using 2D FDCT equation, are transformed to frequency domain:

$$D(u,v) = \frac{1}{\sqrt{2N}} C(u) * C(v)$$

$$\sum_{x=0}^{N-1}\sum_{y=0}^{N-1}\left(\cos\frac{U\pi(2x+1)}{2N}*\cos\frac{V\pi(2y+1)}{2N}*P(x,y)\right)$$

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

D. DCT Quantization

Then with the help of quantization tables discretely for Y, Cb and Cr constituents the DCT transformed coefficients are quantized. As shown in equation 2 the corresponding elements in the Q table divides the each value of transformed coefficients and they are then rounded off to the nearby integer.

S'(u,v)=round S(u,v)/ Q(u,v)….(2)

Where
Q(u,v)=Quantization matrix
S(u,v)=DCT coefficient matrix
For avoiding redundant information remaining all value is approximated to zeros

16	11	10	16	24	40	51	61
12	12	14	19	26	58	60	55
14	13	16	24	40	57	60	59
14	17	22	29	51	87	80	62
18	22	37	56	68	109	103	77
24	35	55	64	81	104	113	92
49	64	78	87	103	121	120	101
72	92	95	98	112	100	103	99

(a)

17	18	24	47	99	99	99	99
18	21	26	66	99	99	99	99
24	26	55	99	99	99	99	99
47	66	99	99	99	99	99	99
99	99	99	99	99	99	99	99
99	99	99	99	99	99	99	99
99	99	99	99	99	99	99	99
99	99	99	99	99	99	99	99

(b)

FIG 2. DCT Standard Quantization Tables

(a) Quantization table for Y space
(b) Quantization table for Cb,Cr space

In the resultant matrix numerous of the remaining frequency constituents become small positive or negative numbers and the higher frequency constituents are rounded to zero.

E. Quantization of DWT

While using adaptive quantization the LL, HH coefficients must be quantized. The luminance constituent Y need the lesser step of quantization whereas Cb and Cr require a large step. Mainly in HH slice of the image a large series of zeros is obtained, after this step.

F. Mapping to positive and DPCM

For decreasing transmission rate of digital picture information, differential pulse code modulation (DPCM) is useful which an effective data compression technique is. To predictive coding DPCM is the most common method. This system predict the value of pixel founded on the connection between certain adjoining pixel value using certain prediction coefficients the variance between expected value and the actual value of a pixel gives differential image which is less interrelated to the original one. The differential image is then encrypted and quantized.

On the quantized DC coefficients and quantized wavelet coefficients of DCT transform the forward differential pulse code modulation is applied. And then by mapping to positive technique all the coefficients must be transformed into positive values.

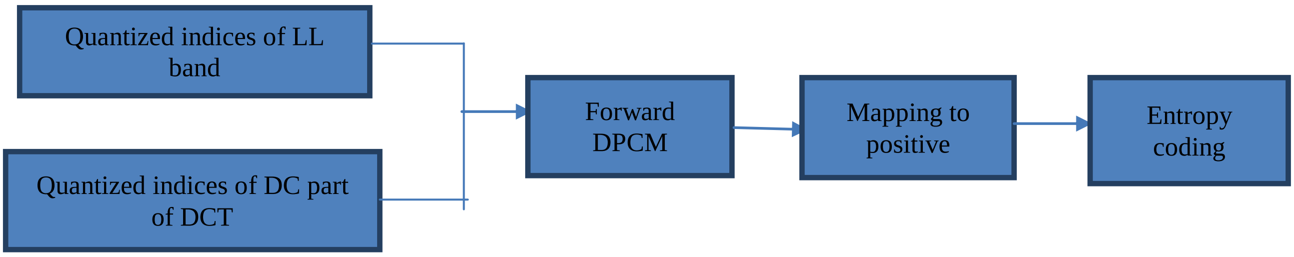

Figure 3: Block diagram of DPCM and Mapping

G. Variable Entropy Coding

Different coding techniques are there which can be broadly classified into fixed length and variable length coding where variable length coding is more efficient for representing the information. The number of bits will be less for variable length coding compared to fixed length coding for representing the same amount of information which supports more compression. The proposed coding scheme is a variable shift coding techniques which provides a few bits to the long code word.

III. ALGORITHM FOR DECODING

By applying the reverse steps of coding process the recreated image is attained. 'Coding and decoding processes' steps are shown in figure 4 and 5.

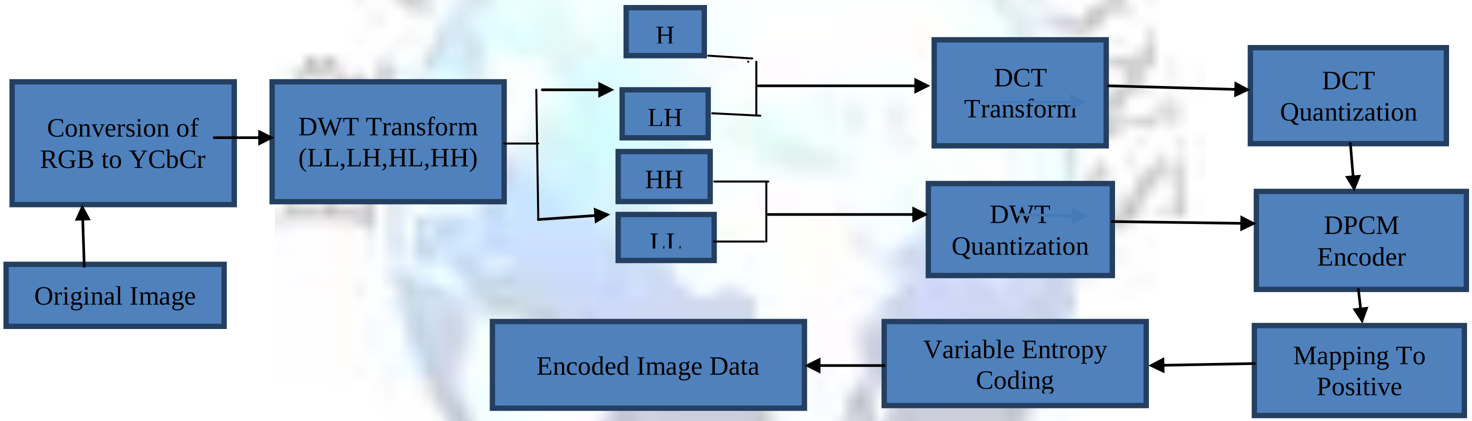

Figure 4: Coding Process

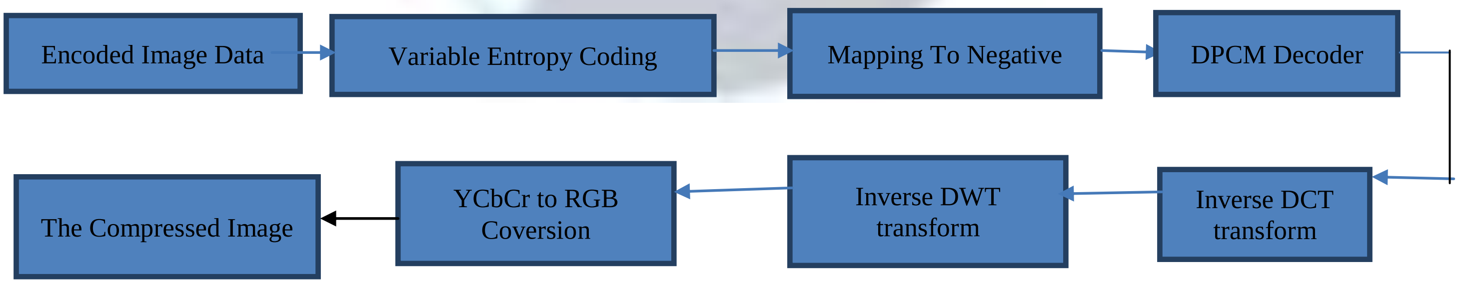

Figure 5: Decoding Process

IV. CRITERION FOR EVALUATION

By using peak signal to noise ratio(PSNR) and compression ratio (CR) the performance of the hybrid DWT-DCT technique can be.

$$PNSR= 10\log10(I/MSE)\ dB$$

Where I is the maximum intensity level.

CR= Discarded Data/Original Data

Between 0 to1 the value of CR lies. According to the level of compression depending on quantization and the excellence of the image the resulting CR can be varied.

V. TEST RESULT

See figure 6, on medical images the tests are performed by taking MRI with two dissimilar sizes, brain (256*256) and pulmonary (512*512). Dissimilar values of scaling factor (α) are used to show the influence of involved parameters on the compression ratio. See figure 7, for both DWT and DCT coefficients α affects the quantization steps (QY and QCr, QCb). For the number of pass 2 and 3 table 1 and 2 signify the test results respectively. QY=35, QCb=40, QCr=40 are fixed as the quantization parameters.

Table 1: Resulting Parameters where no of pass =2

Image	DWT Quantization factor	DCT Quantization factor	Compression Ratio	PSNR
brain	0.2	0.2	27.4601	33.3901
	0.5	0.5	31.0154	29.1168
	1.0	1.0	32.2384	29.1052
lung	0.2	0.2	43.4442	23.7988
	0.5	0.5	44.3870	23.7863
	1.0	1.0	44.71111	21.9268

Table 2: Resulting Parameters where no of pass =3

Image	DWT Quantization factor	DCT Quantization factor	Compression Ratio	PSNR
brain	0.2	0.2	43.1288	26.2689
	0.5	0.5	55.3954	26.2445
	1.0	1.0	57.1172	26.1813
lung	0.2	0.2	63.9270	20.4091
	0.5	0.5	66.3677	20.3910
	1.0	1.0	66.3683	14.7981

VI. CONCLUSION AND FUTURE WORKS

In this paper, hybrid of DCT, DWT, DPCM and Huffman Coding Techniques for image compression and decompression has been proposed. This scheme is centered on both DWT and DCT techniques. Using dissimilar values of compression factors (i.e. DWT and DCT quantization factors) this hybrid technique is tested against dissimilar medical images. As the quantization factor increases the quality measurement (PNSR) decreases and the compression ratio increases. It is concluded that overall performance of hybrid is better than both DCT and DWT on the basis of compression rates. It achieves high compression ratio then both DCT and DWT without much loss of the image information. The image compressed with hybrid technique will require less space for storage and less bandwidth while transmission over the network

Experimental consequence shows that where quantization factor is less than 0.5 these compressed medical images preserve its excellence. The created image will began losing its quality slowly where quantization factor is greater than 0.5

REFERENCES

[1]. M. Antonini, M. Barlaud, P. Mathieu, and I.Daubechies, “Image Coding Using Wavelet Transform”, IEEE trans. on image processing, vol.1, april 1992,pp.205-220.
[2]. G.Strang and T. Nguyen, “Wavelets and Filter Banks”, Wellesly Cambridge Press (1996).
[3]. “JPEG 2000 Image coding system”, ISO/IEC CD15444-1:1999(Version 1.0).
[4]. His-Chin Hsin, Jenn-Jier Lien, AAND Tze-Yun Sung, “A Hybrid SPHIT-EBC Image coder”, IAENG International Journal of computer science , Volume 34, Issue 1,2007.

[5]. D. Rawat, S.Meher ,"A Hybrid Coding Scheme Combining SPIHT and SOFM Based Vector Quantization for Effectual Image Compression", European Journal of Scientific Research Vol.38(2009),pp.425-440.

[6]. Yung-Gi Wu and Shen-ChuanTai,"medical image compression by discrete cosine transform spectral similarity strategy ". IEEE Transactions on Information Technology in Biomedicine, 2001 Sep, Volume 5, issue 3,pp.236-243.

[7]. Wen-Chien Yan and Yen-Yu Chen ,"DCT- Based Image Compression Using Wavelet Based Algorithm Efficient Deblocking Filter", 14th European Signal Processing Conference (EUSIPCO 2006), Florence ,Italy, September 4-8,2006.

[8]. Loay A. George, Aree A. Mohammad, "Intra Frame Compression Using Lifting Scheme Wavelet-Based Transformation(9/7-Tap Cdf Filter)",International Conference on Multimedia Systems and Applications, MSA 2007, June 25-28,2007,Las Vegas Nevada , USA.