IOSR Journal of Computer Engineering (IOSRJCE)
ISSN: 2278-0661 Volume 2, Issue 1 (Sep-Oct. 2012), PP 34-38
www.iosrjournals.org

A Navel approach Image compression based on Luminance and Chrominance using Binary Wavelet Transform (BWT) and Raster Line Technique

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Abstract:- *In rapid development multimedia the Images are awesome use full, image coding is the key and most prevalent in mass communication and storage system. This paper represents image compression based on Luminance and Chrominance using Binary Wavelet Transform[1] and Raster Line technique is proposed. This method shows the results better on standard JPEG and RAW images and reconstructs the images.*
Key Words: - *Image compression, BWT, JPEG compression, Lossy and Lossless, Raster Line Techniques.*

I. Introduction:-

In rapid development multimedia the Images are awesome use full, image coding is the key and most prevalent in mass communication and storage system. Here using Raster Line Technique[6-9] along with Luminance and Chrominance of Lossy and Lossless[2-5] techniques. In a distributed environment large image files remain a major bottleneck within systems. Compression is an important component of the solutions available for creating file sizes of manageable and transmittable dimensions. Increasing the bandwidth is another method, but the cost sometimes makes this a less attractive solution. Platform portability and performance are important in the selection of the compression/decompression technique to be employed. Compression solutions today are more portable due to the change from proprietary high end solutions to accepted and implemented international standards. In most of the applications the exact restoration of stored image is not mandatory. This fact can help to make the storage more effective, and in this way we get the lossy compression methods. JPEG is evolving as the industry standard technique for the compression of continuous tone images. But this has a limitation for the color images that the application where the color integrity is important like correcting chromatic aberration is not suitable for JPEG data. In this paper a lossy image compression is proposed by considering the chrominance aberration correction.

II. Binary Wavelet Transform:-

The wavelet-transform compression technique offers a better compression performance than the DCT-based JPEG compression standard. In addition, many features such as quality and resolution scalability can be achieved with a single bit stream. This would not be possible for the current JPEG. However, DCT-based JPEG has the clear advantage of a very low implementation complexity[4] over the wavelet-based technique. Wavelets representation is suggested in many of the image applications like edge detection, image coding, filtering and time frequency analysis due to its fastness and convenient tree structures. Most of the existing wavelet filters designed in the real field for gray level images have wide range of wavelet coefficients and bring out an expansion in the alphabet size of the symbols, leads to extra passes and bits for representing sign information of the wavelet coefficients. This expansion dramatically increases the model cost of the entropy coder for gray level images which are represented as eight alphabets. The most important feature of the BWT is the conservation of alphabet size of wavelet coefficients, which indicates that the transformed images have the same number of greyscale levels as the original images. In particular, for a K-bit greyscale image, the range of BWT coefficients is still maintained within [0, 2K-1]. Therefore, it is reasonable to expect that the compression efficiency of the BWT coefficients can be improved in that extra bits originally used to code sign information of the transform coefficients which are saved to code more significant coefficients. The compression complexity might be reduced as the BWT contains simple exclusive-or (XOR) operations only and a maximum number of eight coding passes are involved during the encoding procedure[1].

Proposed Method:-

The proposed method is shown in **figure 1**

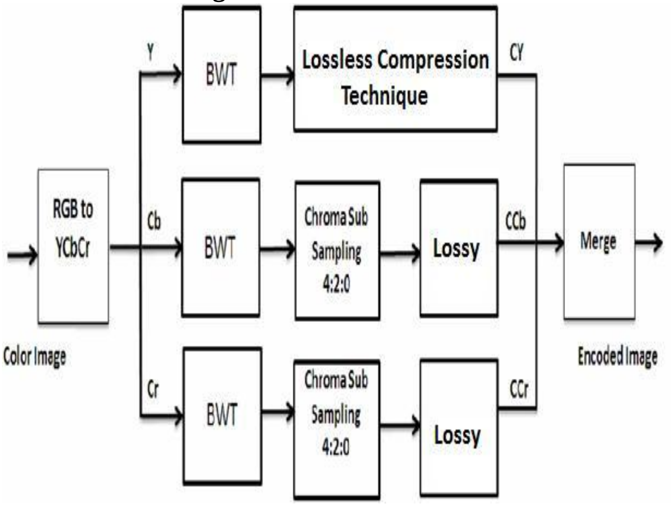

Figure-1: Block diagram for encoding of the proposed method

The given color image (RGB) is translated into YCbCr color space. All these components are decomposed using binary wavelet transform as stated in[1]. Chroma sub sampling of4:2:0 is done for decomposed Cb, Cr components which are followed by lossy mode compression. Decomposed Y components are subjected to lossless technique without sub-sampling. The resultant data tables are merged together to form the entire data table and the binary plane forming encoded image. The decoding procedure is shown in the **figure 2**

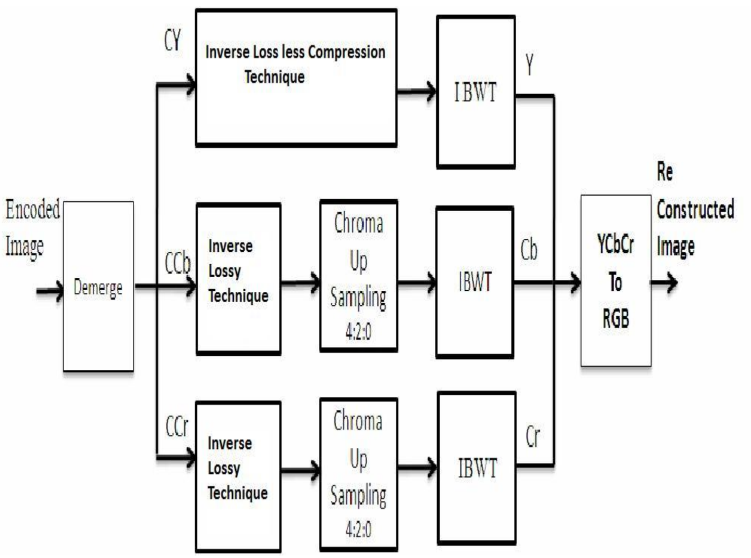

Figure 2: Block Diagram for decoding of the proposed method

Procedure Main:-

BEGIN
callConvertToYCbCr ( )
// dividing the image into Y, Cb,Cr formats
Call Raster_Line_Compress ()
// generate bit plane and data tables
Call Raster_Line_Merge ()
// merge the bit plane and data table
Call lossless compression ()
END
CONVERT_TO_YCbCr( )BEGIN
//converting sourc image to Y,Cr,CbO
pen source image File;
Open Y image file
Open Cb image file
Open Cr image file
y //holds the y image pixel
cb //holds the cb image pixel
cr //holds the cr image pixel
a //holds image current pixel
b //holds image next pixel
c // holds image next next pixel
While((a=read(sours_image)!=eof)
BEGIN
b=read(sours_image)

```
c=read(sours_image)
y=caluclateY using a,b,c
cb=calculate cb using a,b,c
cr=calculate cr using a,b,c
write y to Y_image_file
write cb to Cb_image_file
write cr to Cr_image_file

END
Close source image file
Close Y image file
Close Cb image file
Close Cr image file

END

PROCEDURE
Procedure Raster_Line_BPT_Compress ()
// subroutine generate bit plane and data table
/* Data Item Used */
Prev_pixel  // holds previous pixel
Cur_pixel  // holds current pixel
Bit_plane  /* 8 bit number to hold the
            status bit to indicate wether pixel
            is retained or not retained*/
BEGIN
   Open raw image file
   Open bit plane file
   Open data table file
   Cur_pixel=read(image)
   Write cur_pixel to data table
   Append bit 1 to bit_plane
   Prev_pixel=cur_pixel
   While((cur_pixel=read(image))!=eof)

BEGIN
  /* if repeated consecutive pixel value
      append 0 to bit plane to indicate that
      pixel duplicate so not retained*/
  if(cur_pixel=prev_pixel) then
 append bit 1 to bit_plane
 write cur_pixel to data table file
 prev_pixel=cur_pixel
End
If bit_plane is full then
    Write bit_plane to bitplane file
If bit_plane is not full then
    Write bit_plane to bitplane file
            Close raw image file
            Close bitplane file
            Close data table file
End
PROCEDURE
```

```
Procedure Raster_Line_BPT_Merge ()
/* to merge bit plane and data table files & generate
intermediate compressed file*/
/* Data item used*/
Cur_byte
Begin
Open bit plane file
Open data table file
Open bpds file
While((cur_byte=read(bitplane file))!=eof)

BEGIN
    Write cur_byte to bpds file
End
While((cur_byte=read(data table file))!=eof)
Begin
    Write cur_byte to bpds file
End

PROCEDURE LOSSLESS_COMPRESSION ()
BEGIN

 /*Design code for selecting image Compress
compress buttons*/
Cur_Byte //current byte
Prv_Byte //Previous byte
No of bytes //caluclating the no. of bytes
BEGIN
Open source image file
Open data_table file
Open bit_plane file
Cur_byte=read from source image file
Prv_byte=cur_byte
Write Cur_byte to data_table
while((cur_byte = read source image)!eof)

BEGIN
bpData=(byte) left shift the bit_plane data
compare cur_bytewith prv_byte
then
write cur_byte to data_table
bit_data= 0
prv_Byte=cur_Byte;
increment no of Bits with
compare if no of Bits=8
then
write bit_data to bit_plane file
no of Bits=0
bpData=0
increment bpCount
END
```

Results:-

For this, an experimental analysis is one with the different raw images whose resolution is 128x128.Gruop 1 level based binary wavelet transform decomposition is implemented. The results obtained with the different thresholding values are tabulated.

Figure 3: Sample test images for the experiment

STEP BY STEP ALGORITHM EXECUTION

(f)

Figure 4: (a) Original image (b) YCbCr image (c) Y-component (d) Cb-component (e) Cr-component (f) Restored image with threshold 8 of CR=1.8895 and PSNR=32

In this method of encoding sub sampling of 4:2:0 is done for Cb and Cr components followed by lossy coding. Thus, obtained encoded stream is merged together to form a compressed set of the given image. The encoded image is again split up into Y, Cb and Cr components which are by chroma up sampling. The inverse BWT is applied for details to restore them back to Y Cb and Cr components. These are again reconverted back into RGB to get a best view

TABLE 1: ANALYSIS OF COMPRESSION RATIO FOR VARIOUS THRESHOLD VALUES

THRESHOLD VERSUS CRR					
	TH4	TH8	TH16	TH32	TH64
T32	2.5039	3.789	5.97	10.38	16.009
WIND	1.6946	2.6768	4.3678	4.8998	51.125
SOAP	6.0339	19.5771	19.897	34.075	34.148
LENNA	1.4595	1.8895	2.6125	3.6987	5.985
SANTA	2.711	3.6171	35.6562	58.524	58.5245
KODIM	2.384	3.251	4.7123	6.9357	9.7632
COFFEBEEN	1.7054	2.6043	4.7096	34.077	51.0995
HWA	1.9378	2.5318	3.1032	3.5504	4.2304

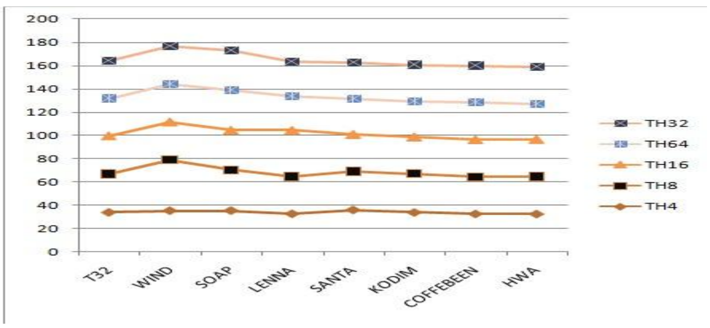

Figure 5: Graphical analysis of threshold Vs compression ratio

TABLE 2: ANALYSIS OF THRESHOLD VALUE AND PSNR FOR DIFFERENT IMAGES

THRESHOLD VERSUS PSNR					
	TH4	TH8	TH16	TH32	TH64
T32	33.716	33.156	32.74	32.26	32.2455
WIND	35.2303	43.4356	32.9	32.5887	32.543
SOAP	35.309	34.768	34.356	34.2565	34.4

LENNA	32.5345	32.00678	39.78	29.456	29.452
SANTA	35.8764	33.234	31.7654	31.3345	30.6579
KODIM	33.6578	33.316	31.6789	31.37654	30.7689
COFFEBEEN	32.3545	31.9987	31.8976	31.9234	31.92
HWA	32.2908	32.1789	32.1032	32.0255	30.4624

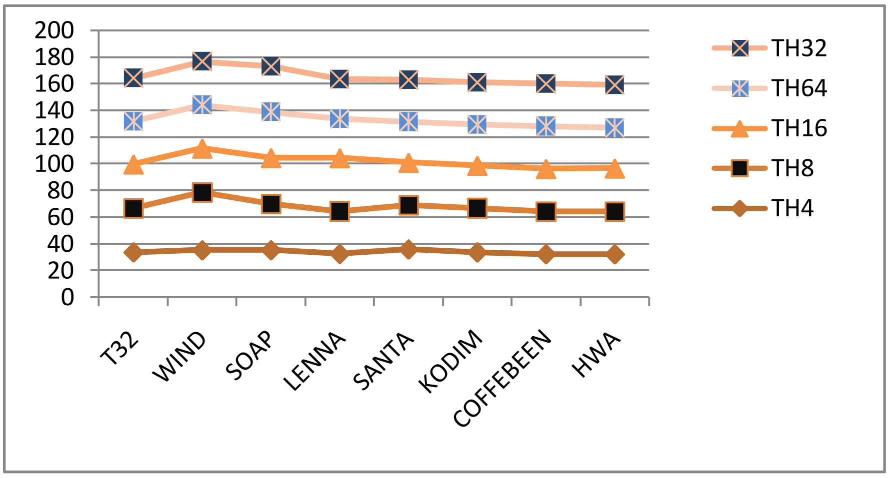

Figure 6: Graphical analysis of threshold Vs PSNR

Conclusion and Recommendations:-

Compressing the color images efficiently is one of the major problems in multimedia applications. So we have tested the efficiency of color image compression using BWT algorithm. The Lossless algorithm is applied for Y (luminance) and Lossy for Cb, Cr (chrominance) of color image. This work may be extended for better compression by applying Huffman and arithmetic coding. The Lossy produces much higher compression rate than all the three techniques but introduces little loss. The loss is visually insignificant when the threshold value is 4 or 8. When the threshold is 16 or 32 the loss is visually observable. The memory requirements for processing the images in all of these techniques are significantly less compared to JPEG. The JPEG technique requires more memory because the entire image needs to be brought into memory. Proposed method require no complex calculations and processing of the data is performed only in terms of integers, so there is no chance of loss of precision. The JPEG technique requires complex calculations. The processing is done in terms of real numbers where there is possibility of loss of precision.

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