RGB & GRAY SCALE COMPONENT ON MPQ-BTC IN IMAGE COMPRESSION

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Abstract—Block Truncation Coding (BTC) is novel digital technique in image processing using which images can be coded efficiently. BTC has played an important role in the sense that many coding techniques have been developed based on it. Its main attraction being its simple underlying concepts and ease of implementation. We perform compression using two level quantizer and proving minimum Peak Signal Noise Ratio in both RGB and Gray Scale Component in image compression which yield good results in image compression.

Keywords**— *Image Compression, Block Truncation Coding, RGB & Gray Scale Component, Moment Preserving Quantizer(MPQ).***

I. INTRODUCTION

Image compression is used to reduce the cost of storing, retrieving and transmission across a network. Block Truncation Coding (BTC), Vector Quantization (VQ), Discrete Cosine Transform (DCT) and Discrete Wavelet Transform coding (DWT) [1] are some of the widely used image compression methods. Among them Block truncation coding (BTC) is a lossy moment preserving quantization method for compressing digital gray-level images**.** BTC has been used for many years for compressing digital monochrome images. One of the advantages is simplicity, fault tolerance, the relatively high compression efficiency and good image quality of the decoded image [2], little computational cost and providing high image quality. [3].

In this paper we present an image compression on Moment Preserving Quantizer both in RGB&Gray Scale component. Experimental results as standard images show that MPQ method gives better performance in both the component. In section II we perform the literature survey of Block truncation coding. In section III we explain the block truncation coding. In section IV the encoding and decoding algorithm together with example of Moment preserving quantizer are described. In section V results and discussion. Finally we conclude in section VI.

II. LITERATURE SURVEY

Rabiee [4] presented a new multiresolution segmentation based algorithm for image compression which gave high quality low bit rate image compression by recursively coding the Binary Space Partitioning (BSP) tree representation of images with multilevel Block Truncation Coding (BTC). Bibhas [5] presented a color image compression technique based on block truncation coding using pattern fitting (BTC-PF). The result of the proposed method is compared with that of several BTC based methods and proved that performance of the proposed method is a little inferior to that of the JPEG in terms of quality of the reconstructed image.

Kamel[6] presented a variable block truncation coding (BTC) algorithm for image compression and proved that there exists an optimal threshold for the quantization in BTC algorithms (fixed and variable) that minimizes the errors. Somasundaram [7] presented a three and two stage still gray scale image compressor on BTC which achieve an average bit rate of 0.46 bits per pixel (bpp) for standard gray scale images with an average PSNR value of 30.25. Kakkavas Costas [8] introduce a method for enhanced Block Truncation Coding (BTC) and achieves good quality images at 0.5 to 1.0 bits per pixel (bpp). The method promises an improvement over prior methods up to 26% - 32%. Wen-JanChen [9] presented post processing methods to reduce differential entropy about 0.4 bit for a 4x4 block.

III BLOCK TRUNCATION CODING

For continuity, we briefly explain about Block truncation coding. Block truncation coding [10] is a lossy compression technique for gray-level images proposed by Delp and Mitchell. The image is divided into blocks of m pixels and each block is processed separately. The mean value (μ) and the standard deviation(σ) are calculated for each block and the first two sample moments are preserved in the compression. The original block is encoded into a bit plane (B) , where pixels with values less than the mean value are set to '0' and those with values greater than or equal to the mean value are set to '1'. A two level quantization on the block is where we gain the compression; it is performed as follows [11]:

$$y(i,j) = \begin{cases} 1 & x(i,j) > \bar{x} \\ 0 & x(i,j) \leq \bar{x} \end{cases} \quad (1)$$

Where $x(i, j)$ are pixel elements of the original block and $y(i,j)$ are elements of the compressed block.

Reconstruction is made with two values "a" and "b" which preserve the mean and the standard deviation. The values of "a" and "b" can be computed as follows:

$$a = \bar{x} - \sigma\sqrt{\frac{q}{m-q}} \quad (2)$$

$$b = \bar{x} + \sigma\sqrt{\frac{q}{m-q}} \quad (3)$$

Where σ is the standard deviation, m is the total number of pixels in the block and q is the number of pixels greater than the mean ($\bar{x}$).

IV MOMENT PRESERVING QUANTIZER TECHNIQUES

For continuity, we briefly explain about the Encoding and Decoding algorithm of MPQ_BTC together with examples.

A. *ENCODING ALGORITHM*

The encoding algorithm of MPQ follows on block size n x n is

- Assume a 512 x 512 image with 256 gray levels.
- The mean value Xave will be the threshold value.
- For each of block size (n x n) we transmit bit level matrix, considering X_{SD} and Xave as standard deviation and mean value respectively.
- The levels X^+ and X^- can be determined by setting up the expressions that preserve the moments before and after quantization.
- The level selection follows

$$n^2\bar{x} = n^- x^- - n^+ x^+ \quad (4)$$

$$n^2 \overline{x2} = n^- (x^-)^2 - n^+ (x^+)^2 \quad (5)$$

Where n^+ denote the number of pixel above the threshold value and n^- denote the number of pixel below the threshold value.

$$x^- = \bar{x} - \sigma\sqrt{\frac{n+}{n-}} \qquad x^+ = \bar{x} + \sigma\sqrt{\frac{n+}{n-}} \quad (6)$$

1. The output levels are biased symmetrically around the mean level
2. Both positive and negative biases are directly proportional to the standard deviation.

3. The levels are round to the number of allowed bits.

B. EXAMPLE FOR ENCODING PROCESS

Consider the block size of n x n is 4 x 4 with 512 x 512 image

$$x = \begin{pmatrix} 121 & 114 & 56 & 47 \\ 37 & 200 & 247 & 255 \\ 16 & 0 & 12 & 169 \\ 43 & 5 & 7 & 251 \end{pmatrix}$$

Mean Value = 98.75 Standard deviation = 92.95

$n^+ = 7$ and $n^- = 9$

$X^+ = 204$ $X^- = 17$

bpp = (8+8+16) / 16 = 2

The resulting block is

$$x = \begin{pmatrix} 204 & 204 & 17 & 17 \\ 17 & 204 & 204 & 204 \\ 17 & 17 & 17 & 204 \\ 17 & 17 & 17 & 204 \end{pmatrix}$$

Original 4x4 block can be compressed to the 16 bits.

$$x = \begin{pmatrix} 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

C. DECODING ALGORITHM

1. Placing the appropriate reconstruction value at each pixel location as per the bit map.

D. EXAMPLE FOR DECODING PROCESS

From the moment preservation principle

$$x = \begin{pmatrix} 204 & 204 & 17 & 17 \\ 17 & 204 & 204 & 204 \\ 17 & 17 & 17 & 204 \\ 17 & 17 & 17 & 204 \end{pmatrix}$$

For N-level reconstruction we can also use Max-Lyold quantization

V RESULTS AND DISCUSSION

To evaluate the performance of the MPQ-BTC image compression scheme, we use six standard images of gray scale with size 512X512 namely “Baboon”,“Barbara”,”Lena”,”Hills”,”Jet512” and “Pepper”. Like wise we use six standard images of RGB color of size 512x512 pixels of “Lena”, “Jet512”,”pepper”,”checker”,,”awesome” and ”Baboon”. The original and reconstructed images of MPQ-BTC image compression in Gray scale and RGB color scheme is shown in Fig: 1(a) – (h)

(a) Original Image of Baboon

(b) Reconstructed Image of Baboon
PSNR = 24.0581

c) Original image of Barbara

d) Reconstructed Image of Barbara
PSNR = 24.1781

e) Original image of Jet512

f) Reconstructed image of Jet512
PSNR = 23.9895

g) Original image of Pepper

h) Reconstructed image of Pepper
PSNR = 24.1531

Figure 1. Original and Reconstructed image of MPQ-BTC

To implement this image, we have taken mean value as the approximate threshold value. Thereby for each and every block the threshold value will depend upon the xi value.

We calculated the bit rate value having bpp = 2.0 and the results for grayscale component image are given in Table I, RGB component image in Table II. For comparison the results obtained for MPQ-BTC and that of Wen-Jan Chen [9] are also given in Table III.

TABLE I. PSNR VALUES FOR MPQ-BTC , BPP = 2.0 FOR EACH GRAY-SCALE COMPONENT IMAGES

Images	Block Size	Bpp	PSNR
Baboon	4 x 4	2.0	24.0581
Barbara	4 x 4	2.0	24.1781
Lena	4 x 4	2.0	24.3694
Hills	4 x 4	2.0	24.3494
Jet512	4 x 4	2.0	24.3422
Pepper	4 x 4	2.0	24.3924

TABLE II. PSNR VALUES FOR MPQ-BTC , BPP = 2.0 FOR EACH RGB COLOR COMPONENT IMAGES

Images	Block Size	Bpp	PSNR
Lena	4 x 4	2.0	24. 1209
Jet512	4 x 4	2.0	23.9895
Pepper	4 x 4	2.0	24.1531
Checker	4 x 4	2.0	23.8156
Awesome	4 x 4	2.0	24.1059
Baboon	4 x 4	2.0	23.9565

TABLE III. PSNR VALUES FOR MPQ-BTC , BPP = 2.0 FOR EACH GRAY SCALE COMPONENT IMAGES COMPARED WITH WEN-JAN CHEN[9]

			PNSR	
Images	**Block Size**	**Bpp**	**MPQ-BTC (proposed method)**	**Wen-Jan Chen[9]**
Lena	4 x 4	2.0	24. 1209	31.73
Jet512	4 x 4	2.0	23.9895	30.73
Pepper	4 x 4	2.0	24.1531	31.27
Baboon	4 x 4	2.0	23.9565	25.57

From Table I, Table II and Table III we note that the value of PSNR obtained by the Moment preserving quantizer method is better than Wen-Jan Chen for the bit rates value having bpp =2.0.

VI CONCLUSION

A low bit rate image compression scheme using Moment Preserving Quantizer (MPQ-BTC) is performed. Experimental results of our scheme on standard images shows that at the bit rate of 2.0 bpp giving an average PSNR value of 24.2816 for gray-scale component and 24.0041 for RGB component yield better results to achieve good compression.

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