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Block Truncation Coding for Image using Bit Map Technique for 4×4 Block Size

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ABSTRACT: In the present era of multimedia, the requirement of image/video storage and transmission for video conferencing, image and video retrieval, video playback, etc. are increasing exponentially. As a result, the need for better compression technology is always in demand. 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.Two widely used spatial domain compression techniques are block truncation coding (BTC) and vector quantization (VQ). BTC method results in good quality image with high bit-rate, while the VQ is well known for low bit-rate but produces poor quality images. In further work of this paper is multi-level BTC includes BTC algorithm as well as vector quantization method for purpose of multi-leveltechnique for gray and color image.

KEYWORDS: Block Truncation Code (BTC), PSNR, Block Size, Compression Ratio

I. INTRODUCTION

The rising multimedia technology and growth of GUIbased software have made digital image data an inherent part of modern life. When a 2-D light intensity function issampled and quantized to create a digital image, the amountof data generated may be large in volume that it results intremendous storage, processing and communicationrequirements. Therefore, the theory of data compressionbecomes more and more important for reducing the dataredundancy to save more hardware space and transmissionbandwidth.

In computer science and information theory,data compression is the process of encoding informationusing less number of bits or some other information bearingunits. Compression is useful as it helps to reduce the consumption of expensive resources such as hard disk spaceor transmission bandwidth [1] [2]. BTC is a simple and fast lossy compression technique for gray scale images. The basic idea of BTC [3] is to perform moment preserving quantization for blocks of pixels. The input image is divided into non-overlapping blocks of pixels of sizes 4×4, 8×8 and so on. Mean and standard deviation ofthe blocks are calculated. Mean is considered as thethreshold and reconstruction values are determined usingmean and standard deviation.

Then a bitmap of the block isderived based on the value of the threshold which is thecompressed or encoded image. Using the reconstructionvalues and the bitmap the reconstructed image is generatedby the decoder. Thus in the encoding process, BTCproduces a bitmap, mean and standard deviation for eachblock. It gives a compression ratio of 4 and bit rate of 2 bitsper pixel when a 4×4 block is considered. This methodprovides a good compression without much degradation onthe reconstructed image. But it shows some artifacts likestaircase effects or raggedness near the edges. Due to itssimplicity and easy implementation, BTC has gained wideinterest in its further development and application for imagecompression.

To improve the quality of the reconstructedimage and for the better compression efficiency severalvariants of BTC have been developed during the last manyyears.Absolute Moment Block Truncation Coding (AMBTC)[4] preserves the higher mean and lower mean of each block and use this quantity to quantize output. AMBTC provides better image quality than image compression using BTC. Moreover, the AMBTC is quite faster compared to BTC. The algorithm is computationally faster because it involves simple analytical formulae to compute the parameters of the edge feature in an image block. Reconstructed images are of good quality in accordance with human perceptual experience. The algorithm represents the image in terms of its binary edge map, mean information, and the intensity information on both sides of the edges.

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II. LITERATURE SURVEY

C.Senthilkumar et al. [1], In this paper, image compression plays vital role in saving memory storage space and saving time while transmissionimages over network. The color and multispectral image is considered as input image for the image compression. The proposed technique with Enhanced Block Truncation Coding [EBTC] is applied on component of color and multispectral image. The component image is divided into various sub blocks. After evaluating mean values, the number of bits can be reduced by Enhanced Block Truncation Coding. Finally, compression ratio table is generated using the parameters such as MSE, SNR, PSNR, CR, BR and CT. The proposed method is implemented through standard color and multispectral images using MATLAB Version 8.1 R2013a.

Jing-Ming Guo et al. [2], Block truncation committal to writing (BTC) has been thought of extremely economical compression technique for many years. Moreover, this method can provide excellent processing efficiency by exploiting the nature parallelism advantage of the dot diffusion, and excellent image quality can also be offered through co-optimizing the class matrix and diffused matrix of the dot diffusion. According to the experimental results, the proposed DDBTC is superior to the former error-diffused BTC in terms of various objective image quality assessment methods as well as processing efficiency.
A modified Block Truncation Coding using max-min quantizer (MBTC) is proposed in this paper to overcome the above mentioned drawbacks. In the conventional BTC, quantization is done based on the mean and standard deviation of the pixel values in each block. In the proposed method, instead of using the mean and standard deviation, an average value of the maximum, minimum and mean of the blocks of pixels is taken as the threshold for quantization.

Jayamol Mathews et al. [3], with the emerging multimedia technology, image data has been generated at high volume. It is thus important to reduce the image file sizes for storage and effective communication. Block Truncation Coding (BTC) is a lossy image compression technique which uses moment preserving quantization method for compressing digital gray level images. Even though this method retains the visual quality of the reconstructed image with good compression ratio, it shows some artifacts like staircase effect, raggedness, etc. near the edges. A set of advanced BTC variants reported in literature were studied and it was found that though the compression efficiency is good, the quality of the image has to be improved. A modified Block Truncation Coding using max-min quantizer (MBTC) is proposed in this paper to overcome the above mentioned drawbacks. In the conventional BTC, quantization is done based on the mean and standard deviation of the pixel values in each block. In the proposed method, instead of using the mean and standard deviation, an average value of the maximum, minimum and mean of the blocks of pixels is taken as the threshold for quantization. Experimental analysis shows an improvement in the visual quality of the reconstructed image by reducing the mean square error between the original and the reconstructed image. Since this method involves less number of simple computations, the time taken by this algorithm is also very less when compared with BTC.

Seddeq E. Ghrare et al. [4], with the continuing growth of modern communication technologies, demand for image data compression is increasing rapidly. Techniques for achieving data compression can be divided into two basic approaches: spatial coding and Transform coding. This research paper presents a proposed method for the compression of digital images using hybrid compression method based on Block Truncation Coding (BTC) and Walsh Hadamard Transform (WHT). The objective of this hybrid approach is to achieve higher compression ratio by applying BTC and WHT. Several grayscale test images are used to evaluate the coding efficency and performance of the hybrid method and compared with the BTC and WHT respectively. It is generally shown that the proposed method gives better results.
Ki-Won Oh et al. [5], this paper presents a parallel implementation of hybrid vector quantizer-based block truncation coding using Open Computing Language (OpenCL). Processing dependency in the conventional algorithm is removed by partitioning the input image and modifying neighboring reference pixel configuration. Experimental results show that the parallel implementation drastically reduce processing time by 6~7 times with significant visual quality improvement.

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III. MATERIAL AND METHODS

- BTC-VQ Method

The encoding method of VQ is time consuming, whereas its decoding method uses table look-up method and is very fast. This method results in higher compression ratio, though quality of the reconstructed image is usually not as good as BTC. BTC is a simple and fast method, which enables high quality reconstruction but bit-rate is alsohigh. Comparatively, the encoder of BTC is faster than that of VQ, while its decoder is little slower. A compromise between these two methods gives a fast decoder, maintains good quality for reconstructed image with moderate bit-rate. Again, this hybrid method can also be used in image feature extraction. That means the compressed data due to this method can directly be used to compute image features like, edge [5-6], and so on.

The method of selection of the best fit pattern for an image block B of size $n \times n$ is as follows. For an image block B, let the pixels coordinates are $x_1, x_2, \ldots\ldots\ldots x_{n2}$ and the corresponding pixel intensities are $f(x_i)$. Available patterns are, say, $P_1, P_2 \ldots\ldots\ldots\ldots, P_M$ of size $n \times n$ and the levels present in a pattern are represented by t where $1 \le t \le Q$. Thus, any pattern is represented as

$$km_1 = k'(A-d) + (k-k')(A+d) \quad (1)$$

$$km_2 = k'(A-d)^2 + (k-k')(A+d)^2 \quad (2)$$

Solving for A and d we get

$$A = m_1 + \frac{\sigma(2k'-k)}{2\sqrt{k'(k-k')}} \quad (3)$$

$$d = m_1 + \frac{\sigma k}{2\sqrt{k'(k-k')}} \quad (4)$$

Hence, intensity $\hat{f}(x_i)$ of the pixels of the corresponding block in the reconstructed image is given by

$$\hat{f}(x_i) = \begin{cases} A+d & if\ x_i \in C_1 \\ A-d & if\ x_i \in C_1 \end{cases} \quad (5)$$

It is clear that a = A − d and b = A + d, where a and b are the quantization levels for partition.

IV. EXPERIMENTAL ANALYSIS

Performance of the MBTC and multi-level BTChave been evaluated for a set of standard test images, viz., 'lena 256×256', 'cameraman 256×256', and 'bird256×256'. Figure 5.1; show the Lena image of 4×4 block pixel. In this figure 1 (a) show the random image of the Lena image and resize the image of the 256×256 in the Lena image show in figure 1 (b). The compressed image is 4×4 block pixel of Lena image shown in figure 1 (c) respectively.

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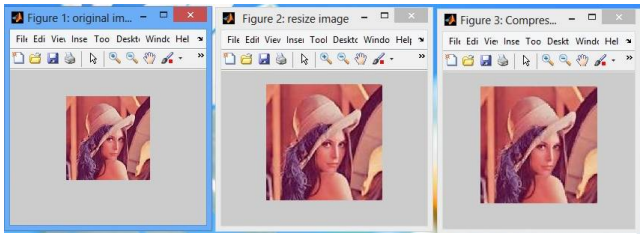

(a) (b) (c)

Figure 1: Multi-level BTC Algorithm applied on Lena Image of block size 4×4

Figure 2; show the Cameraman image of 4×4 block pixel. In this figure 2 (a) show the random image of the Cameraman image and resize the image of the 256×256 in the dog image show in figure 2 (b). The compressed image is 4×4 block pixel of Cameraman image shown in figure 2 (c) respectively.

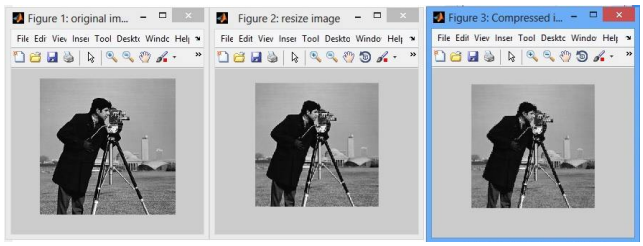

Figure 2: Multi-level BTC Algorithm applied on Cameraman Image of block size 4×4

Figure 3; show the Bird image of 4×4 block pixel. In this figure 3 (a) show the random image of the Bird image and resize the image of the 256×256 in the Bird image show in figure 3 (b). The compressed image is 4×4 block pixel of Bird image shown in figure 3 (c) respectively.

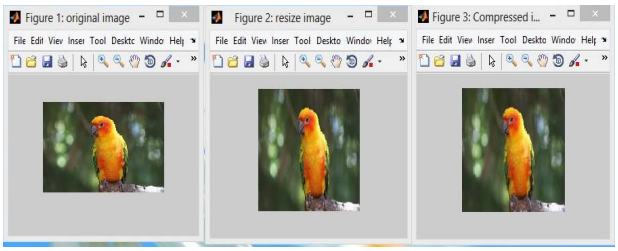

Figure 3: Multi-level BTC Algorithm applied on Bird Image of block size 4×4

Table 1: Experimental Results for Peak to Signal Noise Ratio (PSNR)

Image	Red channel	Green Channel	Blue Channel
Lena image	35.1957 dB	35.1401 dB	34.8256 dB
Cameraman image	36.6889 dB	36.4779 dB	36.8824 dB
Bird Image	33.1614 dB	33.2006 dB	33.1019 dB

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Table II: Experimental Results for Mean Square Error

Image	Red channel	Green Channel	Blue Channel
Cameraman Image	14.1763	14.895	15.754
Lena image	16.943	17.326	16.429
Bird Image	12.352	12.853	13.952

V. CONCLUSION

The objective of this paper is to develop an image compression method for which the decoder would be very efficient. Such method is suitable in situations where image or image is compressed once but decoded frequently. It is clear that the decoding time due to spatial domain based compression is much less than that of the sub-band compression techniques. Two widely used spatial domain compression techniques are block truncation coding (BTC) and vector quantization (VQ). BTC method results in good quality image with high bit-rate, while the VQ is well known for low bit-rate but produces poor quality images. In his paper the study of different types of technique for image compression. In this paper implementation of the proposed algorithm and results are based on that algorithm is discussed for the different block size i.e. 4*4, 8*8 and 16*16.

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