Volume 5, Issue 5, May 2015 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Gray Scale X-ray Image Compression Using Block Truncation Coding Technique

Rimjim Gupta, Mauli Joshi

Dept of Computer Science, Maharishi Ved Vyas Engineering College,
Jagadhri, Haryana, India

Abstract— Biomedical images are important factor in health care for diagnosis of disease. As medical imaging faclities are moving towards film less imaging technology, digital image processing techniques plays an important role. Image compression technique is an important multimedia application to effectively store and transmit data at lower bandwidth. In this research paper a new application of block truncation coding (BTC) is presented to compress gray scale X-ray images with square truncation matrix. The compressed image characteristics parameters such as signal to noise ratio (SNR), peak signal to noise ratio (PSNR), root mean square error (RMSE), and mean absolute error (MAE) with respect to original images are computed. Experimental results are presented which demonstrate that at lower value of truncation matrix, the compression rate is low with image characteristic parameters close to the original image values.

Keywords—Image, compression, BTC, PSNR, MAE.

I. INTRODUCTION

Image compression a well-known technique used to reduce the size of a graphics file in bytes without degrading the quality of the image to an unacceptable level. The size reduced allows more images to be stored in a given amount of disk or memory space. The time also gets reduced which is required for the images to be sent over the Internet or downloaded from Web pages. Image compression is required because of the growing need for storage and for the efficient transmission of data. Image compression can be categorized into two different techniques. It can be lossy or lossless [1]. These terms describe whether or not, in the compression of a file, all original data can be recovered when the file is uncompressed [2]. With lossless compression, every single bit of data that was originally in the file remains after the file is uncompressed. All of the information is completely restored. The Graphics Interchange File (GIF) is an image format used on the Web that provides lossless compression. Lossy compression provides much higher compression ratios than lossless compression. By this technique, the decompressed image is not identical to the original image, but reasonably close to it. But this technique is widely used. Lossy methods are especially suitable for natural images such as photographs in applications where minor loss of fidelity is acceptable to achieve a substantial reduction in bit rate. The lossy compression that produces imperceptible differences may be called visually lossless [3].

Efficient compression of medical data (images and reports) would the storage space and overpower the transmission systems. It specifically helps in storage of volumetric medical images due to the sheer volume of data. Hospitals are moving towards the filmless imaging or completely digital imaging due to the advancement in image processing techniques. Medical digital images are available in 2D or 3D forms depending on the applications. 2D medical imaging dominates the use due to its simplicity, lowest cost and resolution efficiency. Even as the capacity of storage media continues to increase, it is expected that the volume of uncompressed data produced by hospitals will exceed capacity and drive up costs. So imaging compression become urgent needs [4-5].

In digital image processing coding schemes have been of great importance due to their application in data compression and developing of fast algorithm. High data compression ratio is obtained from most of the image data compression techniques with some trade off associated with them. At high compression ratio the quality of image degrades. The main goal of image compression is to reduce redundancy in the image as much as possible. Block Truncation Coding (BTC) is one of the simple and easy to implement image compression algorithms. It is also called as moment preserving block truncation. The mathematical formula for BTC is given as [6-7]

$$B = \bar{X} - \sigma\sqrt{\frac{m-q}{q}} \quad (1)$$

where q is the number of pixels greater than or equal to the threshold $\bar{X}$. Steps involve in BTC algorithm are shown in Fig. 1.

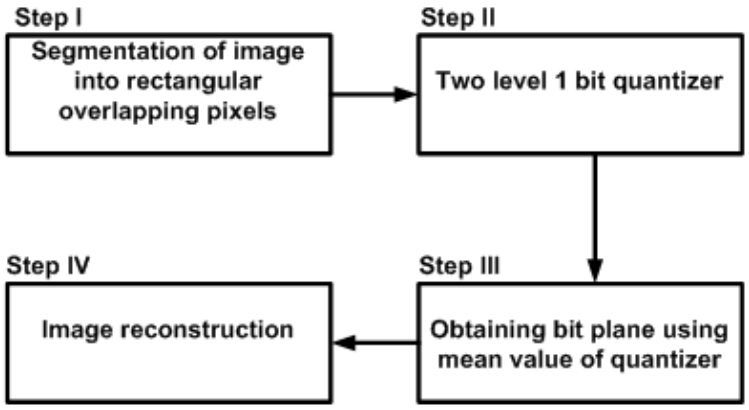


Fig.1 Steps involve in BTC coding.

II. IMAGE CHARACTERISTICS PARAMETERS

Compressed image degrade the quality of the image which needed to be investigated. Root mean square error (RMSE) corresponds to pixels in the reference image I_r and the fused image I_f . If the reference image and fused image are alike give the RMSE value equal to zero and it will increase when the dissimilarity increases between the reference and fused image [8-10].

$$RMSE = \sqrt{\frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}(I_r(x,y) - I_f(x,y))^2} \quad (2)$$

Peak signal to noise ratio (PSNR) value will be high when the fused and reference images are alike and higher value implies better fusion. PSNR is calculated by follow equation.

$$PSNR = 20\log_{10}\left(\frac{L^2}{\sqrt{\frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N}(I_r(x,y) - I_f(x,y))^2}}\right) \quad (3)$$

Signal to noise ratio (SNR) is calculated using following formula [13]

$$SNR = 10\log_{10}\left(\frac{\sum_{x=1}^{M}\sum_{y=1}^{N}(I_r(x,y) - I_f(x,y))^2}{\sum_{x=1}^{M}\sum_{y=1}^{N}(I_r(x,y)}\right) \quad (4)$$

In addition to these parameters MAE is also calculated using following equation

$$MAE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left|I_x(i,j) - I_y(i,j)\right| \quad (5)$$

III. METHODOLOGY

Research work is carried out to compress the gray scale x-ray image using BTC technique. The work is divided into two part. In the first part computer based algorithm is developed to compress the image and second part comprises of image error estimation by calculating SNR, PSNR, MSE, and MAE parameters of the image with respect to the reference image. Computer based algorithm for BTC based image compression is shown in Fig. 1.

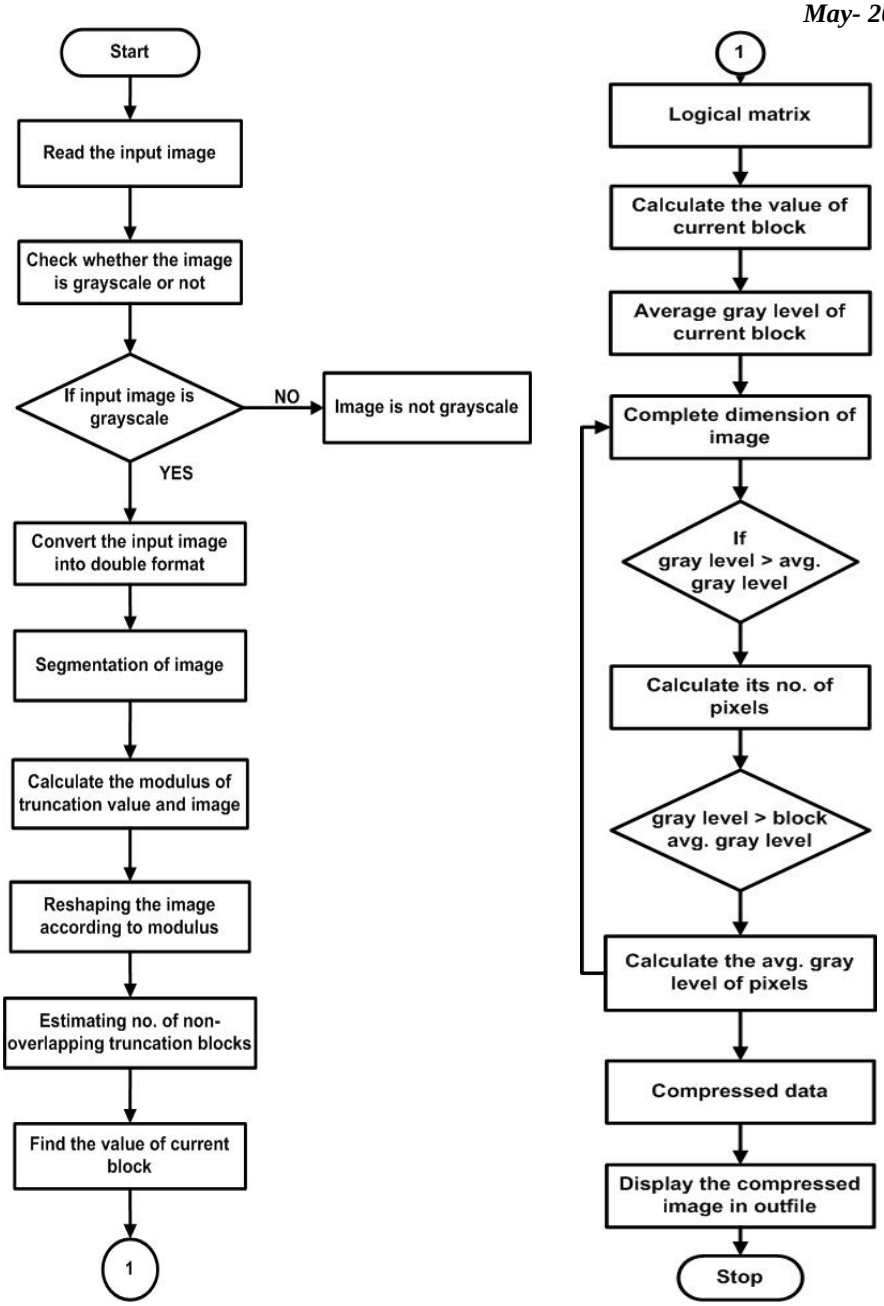


Fig. 2 Flow chart of BTC algorithm.

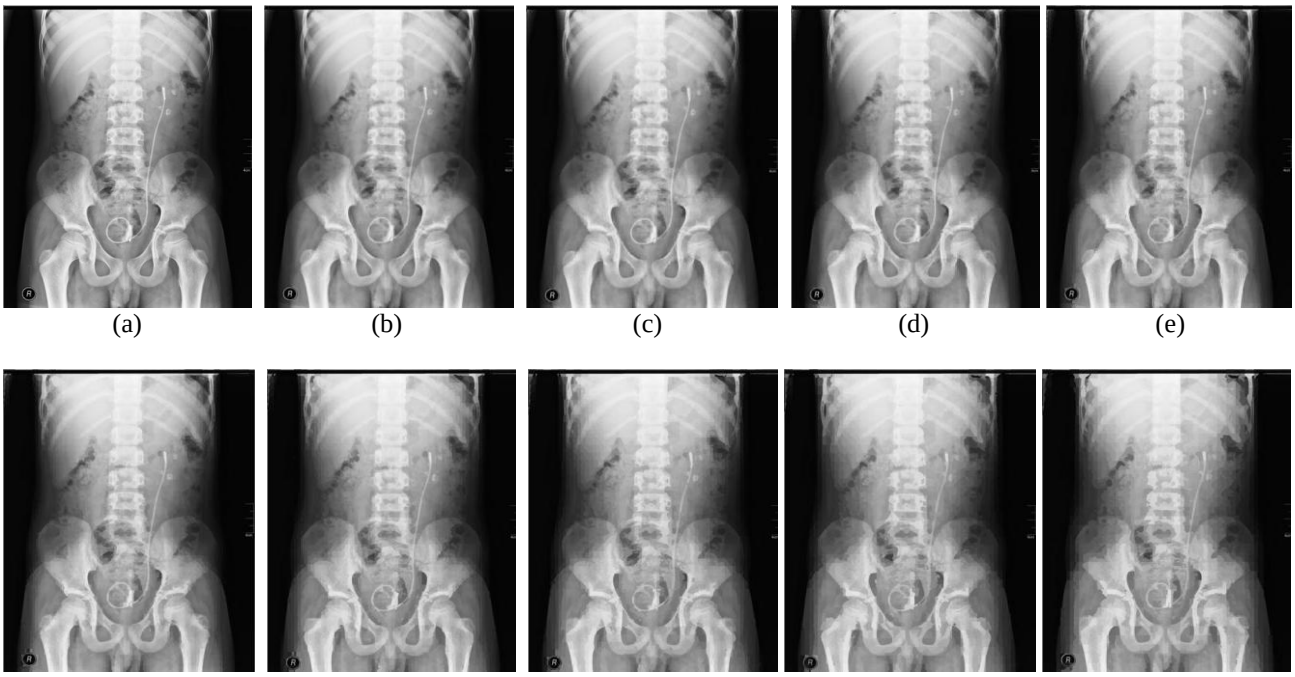
IV. RESULTS AND DISCUSSION

BTC based x-ray image compression is carried out to estimate the compression ratio and image quality parameters. BTC method is applied with various truncation matrix ranges. Table I shows the size of the compressed image with respect to truncation matrix. Figure 3(a)-(j) shows the compressed image with increasing order of truncation matrix. The reconstructed images were used in second algorithm to calculate SNR, PSNR, RMSE, and MAE values with respect to the reference image. Table II shows the calculated values of these parameters. With increasing order of truncation matrix higher image compression is obtained. The evaluation result for all the compressed images showed that the compression of image is acceptable to certain limits i.e. upto truncation value of 125 x 125.

Table I. Compressed image size obtained with various truncation matrix.

Block Truncation Matrix Size		**Input Image Size = 3,125kb**
Length	**Width**	**Output Image Size (KB)**
50	50	2,375
75	75	2,335
100	100	2,164
125	125	2,215
150	150	2,141

175	175	2,134
200	200	1,906
225	225	2,035
250	250	1,995
275	275	2,020



(a) (b) (c) (d) (e)

(f) (g) (h) (i) (j)

Fig. 3 (a)-(j) Compressed X-ray images with n x n truncation matrix of size 50, 75, 100, 125, 150, 175, 200, 225, 250, and 275 respectively.

Table II. Computed compressed image parameters w.r.t original image.

Truncation Matrix Size	**SNR (dB)**	**PSNR (dB)**	**RMSE**	**MAE**
50	-0.00473	32.94852	5.76520	2.29432
75	-0.00226	31.71595	6.64419	2.78351
100	-0.00830	30.97592	7.23509	3.24745
125	-0.00547	30.19729	7.91363	3.65598
150	-0.00671	29.70614	8.37400	4.03875
175	-0.00521	28.85658	9.23444	4.50895
200	-0.00977	28.55063	9.56552	4.87689
225	-0.01776	28.2555	9.89612	5.17152
250	-0.02477	27.70356	10.54537	5.55438
275	-0.03372	27.61237	10.65667	5.80839

V. CONCLUSION

In this work block truncation coding technique is used to compress gray scale X-ray images. An extensive evaluation of the algorithm was performed on a large size of biomedical images. The BTC technique has been applied various truncation matrix sizes. Evaluation method used not only quantitative compressed image (PSNR, SNR, RMSE, MAE), but also subjective visual appearance of these image for diagnosis process. The BTC approach is favorable for X-ray images as the high compression is achieved with low degradation of image.

REFERENCES

[1] D. Sachin, "A Review of Image Compression and Comparison of its Algorithms," *International Journal on Electronics & Communication Technology (IJECT)*, Vol. 2, pp. 22-26, 2011.

[2] S. G. Amruta and L. N. Sanjay, "A Review on Lossy to Lossless Image Coding*," International Journal of Computer Applications (IJCA)*, Vol. 67, pp. 9-16, 2013.

[3] S. Sridevi, V. R. Vijayakuymar, and R. Anuja, "A Survey on Various Compression Methods for Medical Images," *International Journal of Intelligent Systems and Applications*, Vol. 3, pp. 13-19, 2012.

[4] M. Das and S. Burgett, "Lossless Compression of Medical Images Using Two Dimensional Multiplicative Autoregressive Models," *IEEE Transactions on Medical Imaging*, Vol. 12, pp. 721-726, 1993.

[5] M. Das and C. Lin, "Lossless Compression of Medical Images Using Hierarchical Autoregressive Models," *9th IEEE Symposium on Computer-Based Medical Systems*, pp. 6-11, 1996.

[6] E. J. Delp and O. R. Mitchell, "Image coding using block truncation coding," *IEEE Transaction Communication*, Vol. 27, pp. 1335–1342, 1979.

[7] M. D. Lema and O. R. Mitchell, "Absolute Moment Block Truncation Coding and its Application to Color Image", *IEEE Transaction Communication*, Vol. COM-32, pp. 1148-1157, 1984.

[8] A. M. Eskicioglu and P.S. Fisher, "Image quality measures and their performance," *IEEE Transaction Communication*, Vol. 34, pp. 2959-2965, 1995.

[9] N. Yamsang and S. Udomhunsakul, "Image Quality Scale (IQS) for compressed images quality measurement", in *Proc. International Multiconference of Engineers and Computer Scientists*, Vol. 1, pp. 789- 794, 2009.

[10] Z. Wang, A. C. Bovik, H. R. Sheikh, and E. P. Simoncelli, "Image quality assessment: From error measurement to structural similarity," *IEEE Transactions on Image Processing*, Vol. 13, 2004.

