International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-4, November 2019

High Quality Color Image Compression for Discrete Transform Domain Downward Conversion Block Based Image Coding

Deepak Kumar Gupta, Neetesh Kumar Gupta

Abstract: ***Text and image data are important elements for information processing almost in all the computer applications. Uncompressed image or text data require high transmission bandwidth and significant storage capacity. Designing and compression scheme is more critical with the recent growth of computer applications. Among the various spatial domain image compression techniques, multi-level Block partition Coding (ML-BTC) is one of the best methods which has the least computational complexity. The parameters such as Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) are measured and it is found that the implemented methods of BTC are superior to the traditional BTC. This paves the way for a nearly error free and compressed transmission of the images through the communication channel.***

Keywords: Multi-level Block Truncation Code (ML-BTC), Bit Map, Multi-level Quantization (MLQ), Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE))

I. INTRODUCTION

Memory is a valuable and significant imperative in putting away and transmission of the computerized information. The advanced information have turned into a significant wellspring of data in the present universe of correspondence frameworks. In this Web age the intensity of the computerized pictures to pass on data as looked at to the content information is clear to all [4, 6]. This intensity of the pictures can be open furthermore, conceivable through the advanced innovation that improves the power through its capacity to process, transmit and imitate with unmatched steadfastness to the first pictures. For the most part, advanced picture does make an effort not to speak to a complete remaking of an item; rather it tests the article at a high rate just to make the deception of a total portrayal. Be that as it may, even at this examining rate with their crude arrangements, the framework requires a lot of memory to store the information. For instance, a 8.5 x 11 inch record filtered at 300 pixels/inch with lbit/pixel creates 8.4 Mbits information, which requires about 15 minutes of transmission time over a 9600-baud line. An advanced picture of 256 x 256 pixels estimate with 8 bits for each pixel needs a large portion of a million bits for its portrayal [2, 3]. The data contained in a succession of pictures for video requests significantly higher memory space because of its worldly bearing. Further, to pass the data to the opposite end, the gigantic measure of information turns into a requirement for the transmission framework.

Revised Manuscript Received on November 15, 2019.

Deepak Kumar Gupta, Scholar, Department of Computer Science & Engineering, Technocrats Institute of Technology & Science, Bhopal.

Dr. Neetesh Kumar Gupta, Scholar, Department of Computer Science & Engineering, Technocrats Institute of Technology & Science, Bhopal.

The colossal measure of information consequently created might be high to such an extent that it brings about illogical capacity, handling and correspondence necessities [8].

To satisfy these needs of memory protection what's more, effective usage of the correspondence framework in various down to earth applications, the decrease in the measure of information without trading off with the nature of the sign or picture or video is fundamental. This can be accomplished by compacting the measure of information expected to speak to a specific article that is to limit the quantity of bits required to make a conspicuous plot of a specific article. As a matter of fact the information and the data are not something very similar rather the information are the methods by which the data is passed on [7].

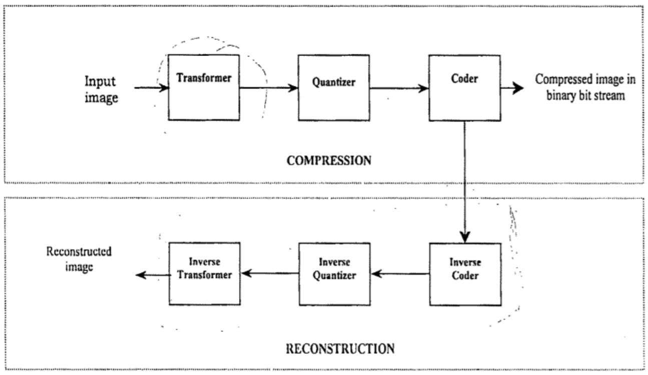

Figure 1: Elements of data compression and reconstruction model

Hence while passing on a similar data by various arrangements of the information, there is each probability that a few information are normal between the methods for speaking to the data and can be evacuated as repetitive. The essential thought process behind the information pressure is to scan for such excess and after that to expel them dependably without trading off with the nature of the reproduced data.

The component of an information pressure and remaking model is appeared in Fig. 1. In the primary phase of the picture pressure model the mapper/transformer changes the info information into another configuration/area intended to diminish the between pixel repetition present in the info picture. This task is a reversible one and could conceivably lessen straightforwardly the measure of information required to speak to the first picture. The point behind the portrayal of a picture into a variety of change coefficients is that it causes its to bury pixel redundancies increasingly available for pressure in later phase of the encoding activity [1, 10].

II. LOSSY AND LOSSLESS IMAGE COMPRESSION SYSTEM

The information pressure methods are of two sorts relying upon their capacities and applications. These are lossy and lossless [13]. The lossy pressure methods depend on the idea of bargaining the precision of the remade information. Applications like papers or sight and sound can endure to forfeit the visual properties in return of speed what's more, cost brought about by high CR. These applications are going under the lossy pressure gathering. By and large lossy pressure method gives CR of 10 to 40 contingent on the procedures utilized. Applications requiring a high and precise rate of subtleties like medicinal imaging, satellite photography and computerized radiography, where both the utilization and cost of gathering the information makes any misfortune bothersome and in this way they need lossless pressure [12].

The lossless pressure ordinarily gives CR of 2 to 10 and they are similarly relevant to both twofold and dim scale pictures. Blunder free or lossless pressure procedures for the most part made out of two generally free tasks:

- Formulating an elective portrayal of the picture in which its inter pixel repetition are diminished and
- Coding the portrayal to dispense with coding redundancies
- These means relate to the mapping and image coding activities of the source coding model.

Changing the first information into a flood of message images

plays out the principal activity. All the message extraction techniques depend on the mapping of the first information into another portrayal area [10].

Out of the over four message extraction techniques prescient strategy is a low pressure picture coder and the staying three techniques have a place with the high pressure coder. Prescient technique for message extraction is the least complex of all the above strategies. This is accomplished in three stages First, it contrasts the present pixel esteem and the previous one, at that point figures the distinction among them and from that distinction esteem it predicts the incentive in the accompanying pixels. By dispensing with the need to rehash the steady information focusing just on the dynamic information, both fantastic imaging and noteworthy piece rate pressure can be acknowledged by the prescient technique. The prescient strategy is utilized in the lossless picture pressure system.

The fractal pressure strategy otherwise called the subsequent age methods, endeavors to depict a picture regarding visual significant natives like shape and surface, where the entire picture is considered as the incorporation of all its littler parts or form or surface. This strategy breaks down the information into visual natives. Along these lines the entire picture can be communicated by extrapolating a lot of elements of one of those parts. This procedure accomplishes an extensive outcome at high CR or pressure rate.

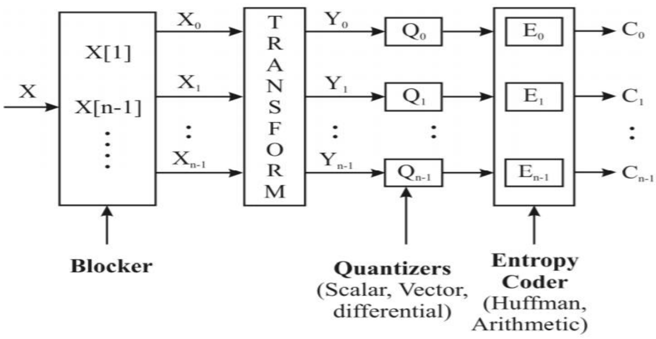

Figure 2: Transform-based image compression system

A N x N info picture is first subdivided into sub-pictures of size n x n. The point of the change activity is to decor relate the pixels of each sub image or to minimized to such an extent data as conceivable inside few changed coefficients. The quantization arrange then specifically disposes of the coefficients those have least sway on the remade picture quality. The quantized coefficients are at that point coded utilizing different coding procedures. The sub band change or a square change accomplishes this. On account of the quantization activity the coded picture is experienced with some mutilation like ringing and blocking antiques, which is brought about by the transformer and the Gibbs marvel of straight channels, however in returns the change coding plan gives a nearly high CR. Therefore less is the bending in the recreated information best is the change coder [8, 9]

III. METHODOLOGY

- Discrete Wavelet Transform

The DWT is appropriate to wide band flag that may not be intermittent. In specific the capacity of the wavelet to concentrate on brief time interims for high recurrence parts and long interims for low recurrence segments improves the examination of the sign. In this manner better is the examination, the more precise is the use of the change to information pressure [8]. A. change that is helpful for information pressure ought to have the following properties.

To make a portrayal for the information that makes less relationship among the changed coefficients esteem. This activity is regularly alluded to as decorrelating the information. Actually, the perfect change is one that makes a zero connection between's the coefficients esteems. The Karhunen-Loeve Transform (KLT) is one of such change, which fulfills the reason. Be that as it may, for all intents and purposes the KLT isn't implementable. The pressure of information requires a change with information autonomous networks that lessens the relationship among the change coefficients as much as conceivable instead of wiping out the relationship totally. The motivation behind the decorrelation is to diminish the excess, which empowers the client to quantize every coefficient autonomously,

The change ought to have a portrayal where it is conceivable to quantize various coefficients with various accuracy. That implies the pressure requires a change that focuses the greater part of the vitality of the information signal inside a little number of coefficients.

Retrieval Number: C5562098319/2019©BEIESP
DOI:10.35940/ijrte.C5562.118419

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

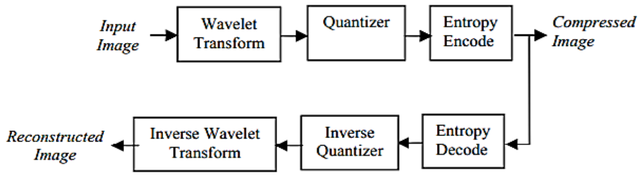

Figure 3: The structure of the wavelet transform based compression.

The steps of compression algorithm based on DWT are described below:

I. Decompose Choose a wavelet; choose a level N. Compute the wavelet. Decompose the signals at level N.
II. Threshold detail coefficients for each level from 1 to N, a threshold is selected and hard thresholding is applied to the detail coefficients.

IV. PROPOSED METHODOLOGY

Transmission and capacity of crude pictures require enormous amount of circle space. Henceforth, there is an earnest need to decrease the extent of picture before sending or putting away.

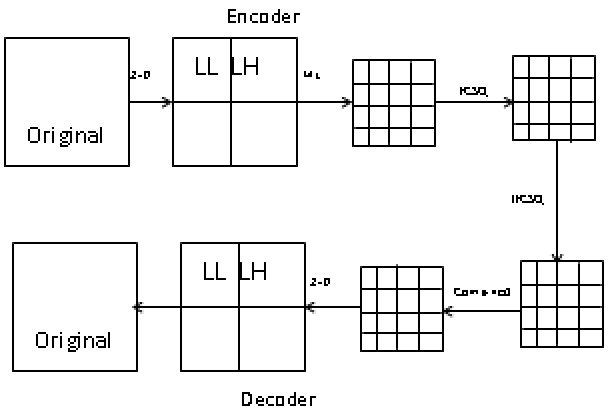

Figure 4: Proposed Methodology

The most ideal answer for the issue is to utilize pressure techniques where the pressure of information on advanced pictures are made to diminish insignificance and repetition of the picture information to have the capacity to proficiently store or transmit information. A large portion of the current pressure systems utilized have their negatives and an improved method which is quicker, successful and memory productive can fulfill the prerequisites of the client.

ML-BTC

Encoder part of the proposed technique shows that the original image is divided into three parts i.e. R component, G component and B component. Each R, G, B component of the image is divided into non overlapping block of equal size and threshold value for each block size is being calculated.

Threshold value means the average of the maximum value (max) of ‘k × k’ pixels block, minimum value (min) of ‘k × k’ pixels block and m_1 is the mean value of ‘k × k’ pixels block. Where k represents block size of the color image. So threshold value is:

$$T = \frac{\max + \min + m_1}{3} \quad (1)$$

Each threshold value is passing through the quantization block. Quantization is the process of mapping a set of input fractional values to a whole number. Suppose the fractional value is less than 0.5, then the quantization is replaced by previous whole number and if the fractional value is greater than 0.5, then the quantization is replaced by next whole number. Each quantization value is passing through the bit map block. Bit map means each block is represented by ‘0’ and ‘1’ bit map. If the Threshold value is less than or equal to the input image value then the pixel value of the image is represent by ‘0’ and if the threshold value is greater than the input image value then the pixel value of the image is represented by ‘1’.

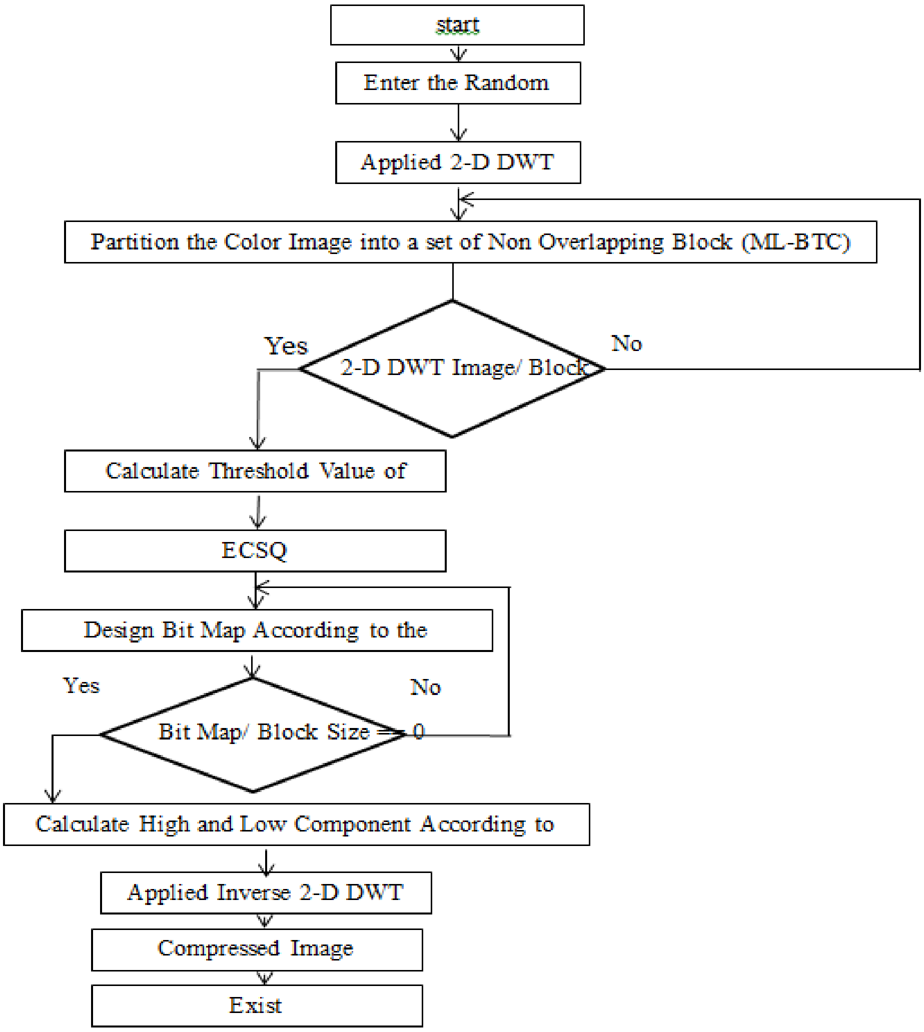

Figure 5: Flow Chart of Proposed Algorithm

Bit map is directly connected to the high and low component of the proposed decoder multi-level BTC algorithm. High (H) and low (L) component is directly connected to the bit map, bitmap converted the '1' and '0' pixel value to high and low pixel value and arrange the entire block.

$$L = \frac{1}{q}\sum_{i=1}^{p} W_i \quad W_i \le T$$

(2)

$$H = \frac{1}{p}\sum_{i=1}^{p} W_i \quad W_i > T$$

(3)

W_i represent the input color image block, q is the number of zeros in the bit plane, p is the number of ones in the bit plane. In the combine block of decoder, the values obtained from the pattern fitting block of individual R, G,B components are combined after that all the individual combined block are merged into a single block . Finally compressed image and all the parameter relative to that image will be obtained.

- **Error-compensated scalar quantization**

The application of ICDF in the TDDC-based coding aims at a better interpolation and a lower compression cost. However, when the compression happens, the interpolation efficiency as well as the coding efficiency will be limited by the distortion occurring on those filtered pixels (denoted as ~x) that will be used for interpolation. To solve this problem, we purpose to reduce the sum of square error (SSE) distortion of ~x as much as possible via controlling the quantization error of the transformed macro-block based on an error-compensated scalar quantization (ECSQ).

V. IMAGE QUALITY MEASURES

It is based on the assumption that the digital image is represented as $N_1 \times N_2$ matrix, where N_1 and N_2 denote the number of rows and columns of the image respectively. Also, $f(i, j)$ and $g(i, j)$ denote pixel values of the original image before compression and degraded image after compression respectively.

Mean Square Error (MSE)

$$= \frac{1}{N_1 N_2} \sum_{j=1}^{N_2} \sum_{i=1}^{N_1} (f(i,j) - g(i,j))^2 \quad (4)$$

N_1 = Row Dimension of Image
N_2 = Column Dimension of Image
f(i, j) = Original Image
g(i,j) = De-noising Image
Peak Signal to Noise Ratio (PSNR) in dB

$$= 10 \times \log_{10}\left(\frac{M \times N}{MSE}\right) \quad (5)$$

Evidently, smaller MSE and larger PSNR values correspond to lower levels of distortion. Although these metrics are frequently employed, it can be observed that the MSE and PSNR metrics do not always correlate well with image quality as perceived by the human visual system.

VI. SIMULATION RESULT

Shows the building, buildings, sailing, ocean and light house images are implemented MATLAB tool. All the images are divided into three part i.e. original image, resize image and compressed image.

Table I: Experimental MSE Results for Different Types of Image

Image of Size 512×512	4×4 Block Pixel	8×8 Block Pixel	16×16 Block Pixel	32×32 Block Pixel
Airplane Image	9.431	17.338	29.672	44.543
House Image	4.929	6.136	15.342	23.953
Peppers Image	8.753	18.543	28.553	42.107
Flower Image	4.657	14.556	22.554	37.834
Parrot Image	10.257	21.001	33.512	47.353
Butterfly Image	26.914	33.882	45.771	57.441

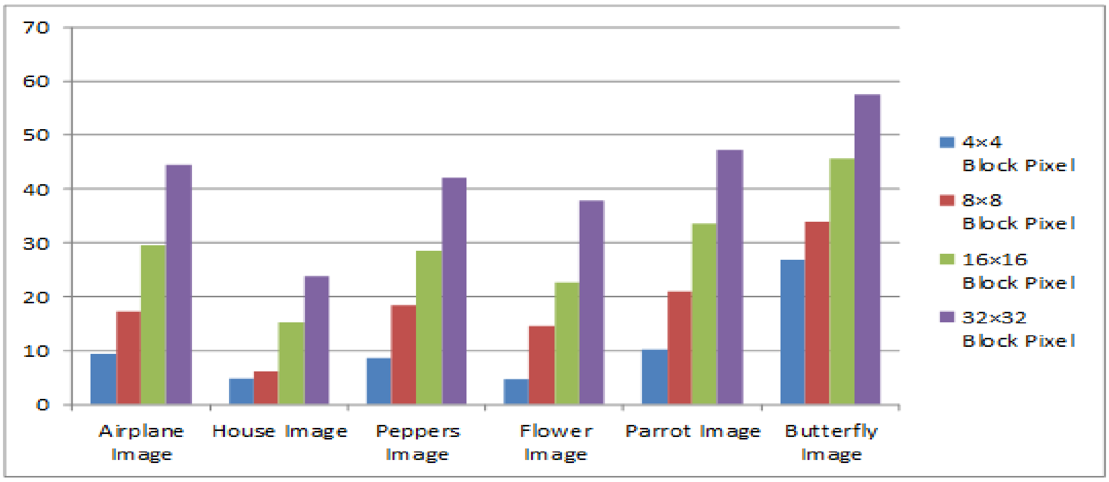

Figure 6: Bar Graph of MSE results for different types of images

Table II: Experimental PSNR Results for Different Types of Image

Image of Size 512×512	4×4 Block Pixel	8×8 Block Pixel	16×16 Block Pixel	32×32 Block Pixel
Airplane Image	44.44 dB	41.79 dB	38.25 dB	36.50 dB
House Image	50.96 dB	46.32 dB	38.57 dB	40.42 dB
Peppers Image	44.82 dB	42.10 dB	39.86 dB	37.96 dB
Flower Image	47.51 dB	44.56 dB	41.43 dB	38.41 dB
Parrot Image	44.08 dB	42.05 dB	38.89 dB	37.44 dB
Butterfly Image	39.89 dB	38.79 dB	37.95 dB	36.62 dB

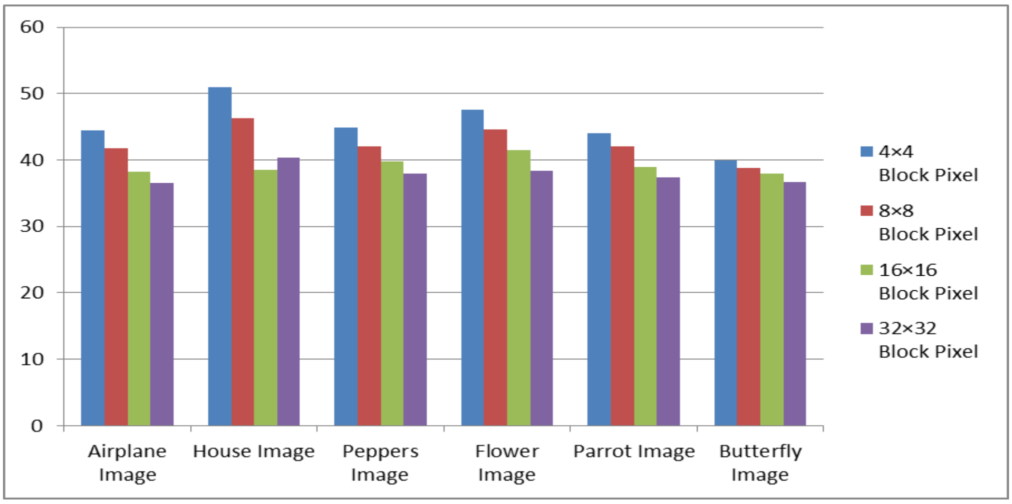

Figure 7: Bar Graph of PSNR results for different types of images

Table III: Comparison Result

Images	Previous Algorithm et al. [1]	Proposed Algorithm
	PSNR (dB)	PSNR (dB)
Airplane Image	34.8	44.44
House Image	34.4	50.96
Peppers Image	32.2	44.82
Flower Image	37.2	47.51
Parrot Image	38.1	44.08
Butterfly Image	36.4	39.89

VII. CONCLUSION

In this paper a spatial domain technique for image data compression, namely, the multi-level block truncation coding (ML-BTC) has been considered. This technique is based on dividing the image into non overlapping blocks and uses a two-level quantize. The ML-BTC technique has been applied to different grey level test image each contains. The multi-level block partition encoder and decoder technique is presented. 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.

REFRENCES

1. Shuyuan Zhu, Zhiying He, Xiandong Meng, Jiantao Zhou and Bing Zeng, "Compression-dependent Transform Domain Downward Conversion for Block-based Image Coding", IEEE Transactions on Image Processing, Volume: 27, Issue: 6, June 2018.
2. Julio Cesar Stacchini de Souza, Tatiana Mariano Lessa Assis, and Bikash Chandra Pal, "Data Compression in Smart Distribution Systems via Singular Value Decomposition", IEEE Transactions on Smart Grid, Vol. 8, NO. 1, January 2017.
3. Sunwoong Kim and Hyuk-Jae Lee, "RGBW Image Compression by Low-Complexity Adaptive Multi-Level Block Truncation Coding", IEEE Transactions on Consumer Electronics, Vol. 62, No. 4, November 2016.
4. Jing-Ming Guo, *Senior Member, IEEE*, and Yun-Fu Liu, *Member, IEEE*, "Improved Block Truncation Coding Using Optimized Dot Diffusion", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 23, NO. 3, MARCH 2014.
5. C. Senthil kumar, "Color and Multispectral Image Compression using Enhanced Block Truncation Coding [E-BTC] Scheme", *accepted to be presented at the IEEE WiSPNET*, PP. 01-06, 2016 IEEE
6. Jayamol Mathews, Madhu S. Nair, "Modified BTC Algorithm for Gray Scale Images using max-min Quantizer", 978-1-4673-5090-7/13/$31.00 ©2013 IEEE.
7. Ki-Won Oh and Kang-Sun Choi, "Parallel Implementation of Hybrid Vector Quantizerbased Block Truncation Coding for Mobile Display Stream Compression", IEEE ISCE 2014 1569954165.
8. Seddeq E. Ghrare and Ahmed R. Khobaiz, "Digital Image Compression using Block Truncation Coding and Walsh Hadamard Transform Hybrid Technique", 2014 IEEE 2014 International Conference on Computer, Communication, and Control Technology (I4CT 2014), September 2 - 4, 2014 - Langkawi, Kedah, Malaysia.
9. M. Brunig and W. Niehsen. Fast full search block matching. IEEE Transactions on Circuits and Systems for Video Technology, 11:241 – 247, 2001.
10. K. W. Chan and K. L. Chan. Optimisation of multi-level block truncation coding. Signal Processing: Image Communication, 16:445 – 459, 2001.
11. C. C. Chang and T. S. Chen. New tree-structured vector quantization with closed-coupled multipath searching method. Optical Engineering, 36:1713 – 1720, 1997.
12. C. C. Chang, H. C. Hsia, and T. S. Chen. A progressive image transmission scheme based on block truncation coding. In LNCS Vol 2105, pages 383–397, 2001.
13. William H.Equitz, 1989: " A New Vector Quantization Clustering Algorithm" IEEE Transactions on Acoustics, Speech and Signal Processing, Vol. 37, No. 10, pp. 1568-1575.
14. Wu X. and Zhang K., 1991: " A Better Tree-Structured Vector Quantizer", in IEEE Proceedings of Data Compression Conference, Snowbird, UT, pp. 392-4