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Lossy Image Compression using 2-D Wavelet Transform and Block Coding Technique

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Abstract- In the field of HVAC engineering, electricity has been utilized to energize the air-conditioning and refrigeration systems since last decades. Normally one-third to half of the annual total electricity consumption is used forair-conditioning and refrigeration in the metropolis worldwide as reported. The most commercially developed solar cooling technology is the absorption systems. In an absorption cycle, a refrigerant and an absorbent are a pair of substances that work together. NH_3-H_20 andLiBr-H_20 are the most common working pairs in refrigeration and air conditioning absorption refrigeration system. Although the NH_3-H_20 cycle is an older technology, it still remains essentially applied to large scale process plants, and LiBr-H20 absorption cycle concentrates most of the current research.

Keywords- Adsorption refrigeration, coefficient of performance, Exergetic Efficiency

I. INTRODUCTION

In today's electronic world, digital still pictures and video images play a significant role in multimedia based knowledge exchange applications. Such high resolution digital pictures require a lot of memory space for image storage, processing and retrieval by digital computers. Satellite and aerial images generate big data files demanding large transmission time for image transfer. In internet applications, such big data transmission slows down the net speed.

Image compression techniques [1] aim at reducing the transmission file size, by using lesser bits for the images. This is realized by using fewer bits per pixel of the image. Normally this bit reduction will affect the quality of the image reproduced at the receiver. This process is known as 'Lossy Image Compression' [2]. But images could also be compressed without reduction in quality by employing suitable coding techniques. Inherently, such 'Lossless Image Compression' methods [3] yield less compression, compared to 'Lossy' methods [4]. The 'Compression ratio (CR)', the 'Peak Signal to Noise Ratio (PSNR)' and the 'Contrast (C)' are the parameters used to measure the quality of image compression.

Most compression algorithms are based on the assumption that there exists redundancy in the original data. Redundancy means that some symbols (characters or pixels) are more likely to occur than others, i.e. there is some unbalanced probability distribution of symbols in the possible input data. Text compression algorithms work based on the assumption that there are some characters that are often occurring than others in the input data. Compressing text data is achieved by exploiting two types of redundancies, called alphabetic redundancy and contextual redundancy, in the input text data. Often occurrence of characters and combination of characters (patterns) in the input data are called as alphabetic redundancy and contextual redundancy respectively.

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Lossy compression algorithms are based on the principle of removal of subjective redundancy and are extremely important in applications such as transmission of still images over the internet where certain amount of distortion may be tolerated. Traditional image compression techniques such as run length coding, arithmetic coding and Huffman code are lossless coding schemes. Statistical redundancy present in the image can be effectively compressed using such lossless compression but the compression gain achieved is low [5].

The best compression ratio that can be achieved with current lossless compression standards such as Joint Photographic Experts Group (JPEG) is around 3 to 4. Transform coding is a widely applied method for lossy image compression. Image transforms effectively de-correlate the pixels so that pixels representing similar events in the image are grouped together according to their spatial or spectral properties. After transformation, the useful information is concentrated into a few of the low-frequency coefficients and the Human Visual System is more sensitive to such low spatial frequency information than to high spatial frequency [6].

It performs the lossy compression of the still images. However, it suffers from the drawback of blocking artifacts. Recently, the application of Discrete Wavelet Transform (DWT) in image compression has received significant attention and many wavelet based image compression algorithms have been proposed.

The wavelet transform decomposes a signal into its various frequency components. In the case of natural images, one obtains many small or zero-valued coefficients corresponding to the high-frequency components of the image. Due to the large number of small coefficients, the transformed signal is often easier to code than the original signal itself [6]. JPEG 2000 standard is based on transform coding employing DWT. It achieves high compression ratio and improved subjective quality especially at low bit rates than the previous DCT-based JPEG [7].

II.LOSSY AND LOSSLESS IMAGE COMPRESSION SYSTEM

In transform based image compression, the image is subjected to transformation and then the transformed data are encoded to produce the compressed bit stream. An image reconstructed following lossy compression contains degradation relative to the original. Often this is because the compression scheme completely discards redundant information. However, lossy schemes are capable of achieving much higher compression. Lossy methods are especially suitable for natural images such as photos in applications where minor (sometimes imperceptible) loss of fidelity is acceptable to achieve a substantial reduction in bit rate. The lossy compression that produces imperceptible differences can be called visually lossless.

In lossless compression schemes, the reconstructed image, after compression, is numerically identical to the original image. However lossless compression can only achieve a modest amount of compression. Lossless compression is preferred for archival purposes and often medical imaging, technical drawings, clip arts etc. whereas lossy compression methods, especially when used at low bit rates, introduce compression artifacts.

Lossy and lossless transform based image compression system is shown in figure 1. In figure 1, the original image X is passed through the partition block then partition method divide the original image into X_0, X_1,...........X_{n-1} sub part. All sub part is passed through the transform block then transform block change the X_0, X_1,...........X_{n-1} to Y_0, Y_1,...........Y_{n-1} domain.

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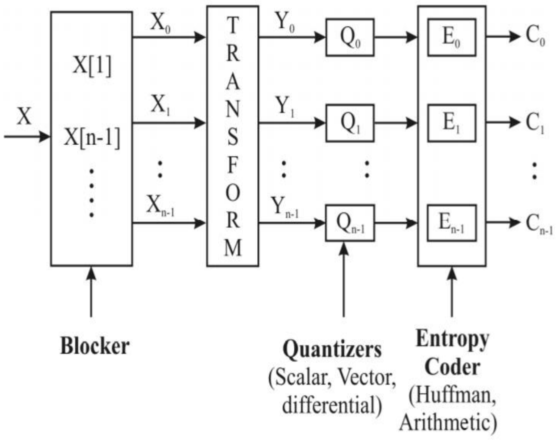

Figure 1: Transform-based image compression system

Finally, the quantized coefficients are coded to produce the compressed bit stream. The coding process typically exploits a statistical model in order to code symbols with fewer bits for symbols that has higher probability of occurrence. In doing so, the size of the compressed bit stream is reduced. Assuming that the transform employed is truly invertible, the only potential cause for information loss is in the coefficient quantization, as the quantized coefficients are coded in a lossless manner [9]. The decompression process simply mirrors the process used for compression. The compressed bit stream is decoded to obtain the quantized transform coefficients. Then, the inverse of the transform used during compression is employed to obtain the reconstructed image.

III.BLOCK TRUNCATION CODE

Divide the image into small sub images ν Reduce the number of gray level within each block ν Base form:

- 4x4 block and codes each block using a two-levels quantize
- The levels are selected so that the mean and variance of the gray levels within the block are preserved
- Select quantization values
- Select the threshold
- Code the quantization values
- Code the bit plane

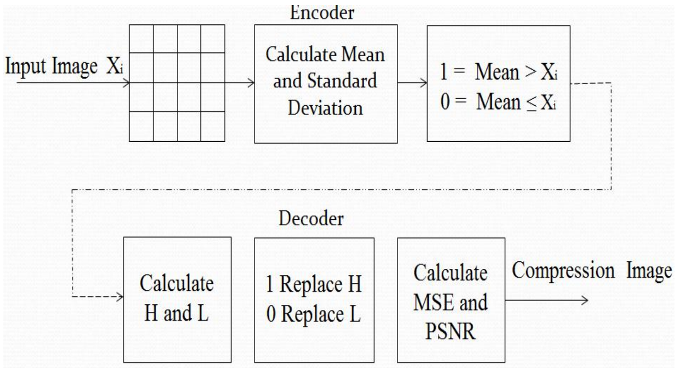

Figure 2: Encoder and Decoder Block for BTC Method

$$H = \mu + \sigma\sqrt{\frac{p}{q}} \quad (1)$$

$$L = \mu - \sigma\sqrt{\frac{q}{P}} \quad (2)$$

p = No. of 0's in the bit map
q = No. of 1's in the bit map
μ = Mean Value
σ = Standard Deviation

IV.PROPOSED METHODOLOGY

Proposed Encoder and decoder block of the multi-level block partition code technique is shown in figure 3. 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:

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

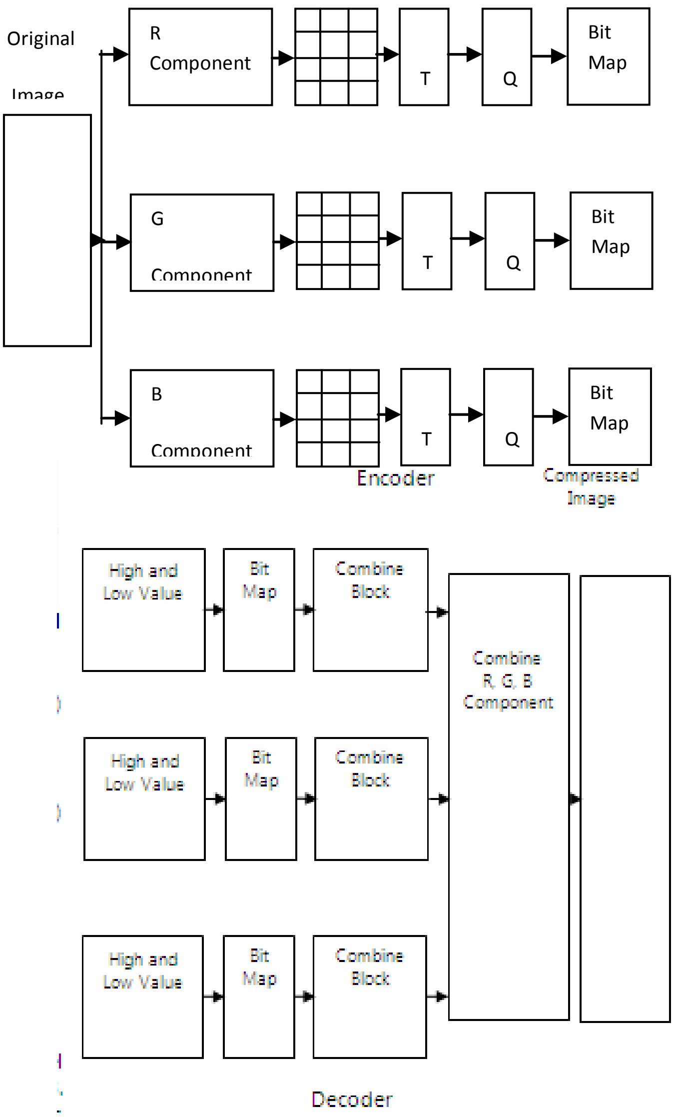

Figure 3: Block Diagram of ML-BTC Algorithm

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'.

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.

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

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

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.

FPGA:-

The initial FPGAs didn't have internal memories but now a day's all new FPGAs have internal memories with that internal memory a lot of real time applications may implement. Generally the FPGA internal structure block illustrations are available to count the number of divide address buses going to the RAM. Every manager has a dedicated address bus and in addition each manager has also a read, a write or both information data buses.

If having both information data user always mean and manager can read and write at the same time. Writing and reading to the RAM is usually done synchronously but can also 20 from time to time be done asynchronously. Xilinx has a group of flexibility in the RAM distribution for the reason that it also allows using the logic cells.

V.IMAGE QUALITY MEASURES

It is a noteworthy assignment in assessing the picture nature of a picture pressure framework to portray the measure of debasement in the remade picture. On account of lossy pressure, the recreated picture is just estimation to the first. The difference between the original and reconstructed signal is referred to as approximation error or distortion. Generally, the performance is evaluated in terms of compression ratio and image fidelity [10].

A good image compression algorithm results in a high compression ratio and high fidelity. Unfortunately, both requirements cannot be achieved simultaneously. Albeit numerous measurements exist for evaluating contortion, it is most generally communicated as far as means squared mistake (MSE) or pinnacle motion to-clamor proportion (PSNR).

The execution of picture pressure frameworks is estimated by the metric characterized in conditions (1) and (2). 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)

$$= \frac{1}{N_1 N_2} \sum_{j=1}^{N_2} \sum_{i=1}^{N_1} (f(i,j) - g(i,j))^2 \qquad (6)$$

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

$$= 10 \times \log_{10}\left(\frac{255^2}{MSE}\right)$$

(7)

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. For this reason, it is preferable to supplement any objective lossy compression performance measurement by subjective tests such as the Mean Opinion Score (MOS) to ensure that the objective results are not misleading [11].

Sometimes compression is quantified by stating the Bit Rate (BR) achieved by compression algorithm expressed in bpp (bits per pixel). Another parameter that measures the amount of compression is the Compression Ratio (CR) which is defined as

$$CR = \frac{Original image size}{Compressed image size}$$

(8)

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.

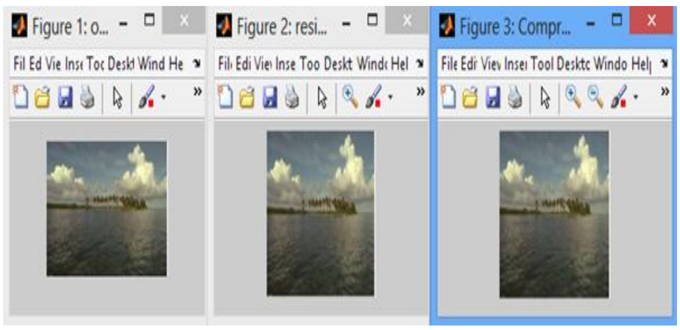

Figure 4: Experiment Result for Ocean Image

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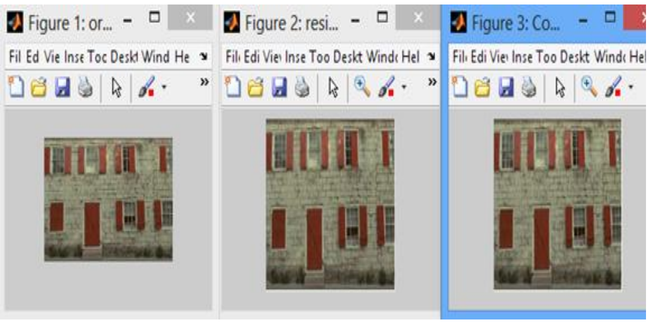

Figure 5: Experiment Result for Building Image

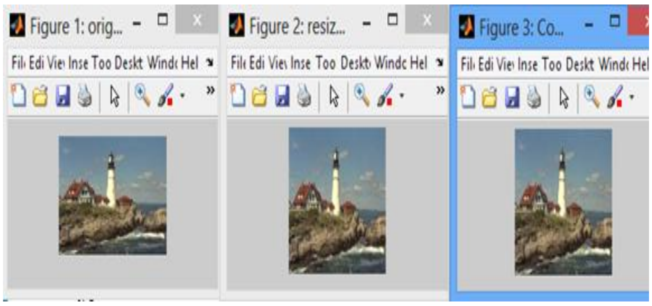

Figure 6: Experiment Result for Lighthouse Image

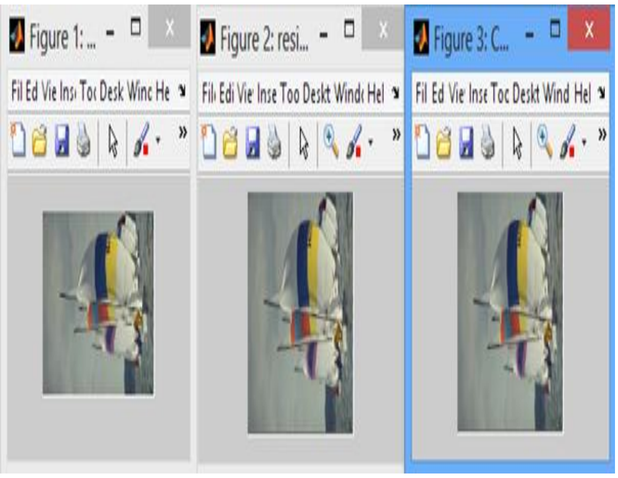

Figure 7: Experiment Result for Sailing Image

Table: Experimental Results for Different Types of Image.

Images	MSE	PSNR (dB)	Computation Time (ns)
Ocean	1.5842	52.1879	2.2328
Building	4.1678	47.9912	2.7117
Lighthouse	3.4187	48.8478	2.9649
Sailing	2.4515	50.2913	2.3547

Table 2 Comparison Result.

Images	Previous Algorithm	Implemented Algorithm
	PSNR (dB)	PSNR (dB)
Ocean	37.98	52.1879
Building	34.28	47.9912
Lighthouse	35.38	48.8478
Sailing	37.89	50.2913

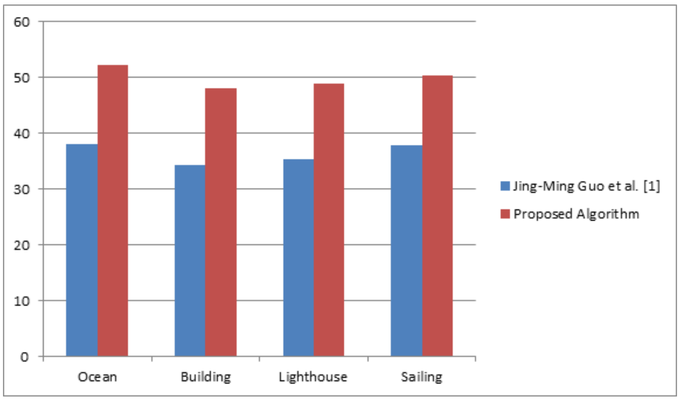

Figure 8: Bar Graph of Previous and Implemented Algorithm

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. The developed technique is increase 27.22% PSNR for ocean image, 28.57% PNSR for building image, 27.57% PSNR for lighthouse and 24.65% PSNR for sailing image compared to previous technique.

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REFRENCES

[1] 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.

[2] 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.

[3] 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.

[4] 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

[5] 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.

[6] 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.

[7] 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.

[8] M. Brunig and W. Niehsen. Fast full search block matching. IEEE Transactions on Circuits and Systems for Video Technology, 11:241 – 247, 2001.

[9] K. W. Chan and K. L. Chan. Optimisation of multi-level block truncation coding. Signal Processing: Image Communication, 16:445 – 459, 2001.

[10] C. C. Chang and T. S. Chen. New tree-structured vector quantization with closed-coupled multipath searching method. Optical Engineering, 36:1713 – 1720, 1997.

[11] 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.

[12] 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.

[13] Wu X. and Zhang K., 1991: " A Better Tree-Structured Vector Quantizer", in IEEE Proceedings of Data Compression Conference, Snowbird, UT, pp. 392-4