Volume 5, Issue 6, June 2015 ISSN: 2277 128X

International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper

Available online at: www.ijarcsse.com

Fractal Image Compression Using Quad Tree Decomposition & DWT

Er. Chetan[1], Er. Deepak Sharma[2]

[1]M.Tech Department of Information Technology,

[2]Asstt. Profs. Department of computer science & engineering,

[1, 2] Adesh Institute of Engineering and Technology, Faridkot, Punjab, India

Abstract: Image compression plays an important role in our day to day activities. Image compression is the process of reducing the amount of data required to represent given quantity of information in image to reduce storage requirements and many other reasons. In a computer image is represented as an array of numbers, integers and is known as digital image. Image array is mainly of two dimensional and three dimensional, if the image is two dimensional than the image is black and white and if image is colour than it is three dimensional. Fractal Image Compression is an approach for better image compression. The main objective of this method is to provide simple and better compression results, which is based on proposed Quad tree Decomposition and Discrete Wavelet Transform method for a color image. Fractal image compression can be obtained by dividing the ycbcr image into unoverlapped blocks depending on a quantization value and the well known techniques of Quad tree decomposition. The compression ratio (CR) and Peak Signal to Noise Ratio (PSNR) values are determined for three types of images namely standard Lena image, Baboon image and Pepper image.

Keywords: RGB color model, DWT, Quad tree decomposition, CR, PSNR.

I. INTRODUCTION

Image compression means reducing the size in bytes of a graphics file without destroying the quality of the images which reduce both spatial and spectral redundancy in the image data for storing or transmission. The process of Image compression is two types which are known as lossy and lossless compression method. Lossless compression method is mostly used for medical imaging, technical drawings, and clip art. In lossless method original image can be perfectly recovered from compressed image. Lossy compression methods, mostly used at low bit rates, generates compression artifacts. The suitable methods for natural images such as cloud, tree, and mountain are named as a lossy method where imperceptible loss of fidelity is acceptable, to gain a substantial reduction in bit rate .Most of the methods are used can be classified under the lossy compression. This means that in lossy compression the reconstructed picture is an approximation of the real picture .Now a day, a new compression method is widely used for compressing image i.e. fractal image compression. It is useful in different application areas and research fields to compress the image.

II. RGB COLOR MODEL

RGB is a color space in which red, blue, green lights are added together in different different ways to reproduce a broad array of colors. The color comes out after the combination of the color is based on their primary colors red, blue, and green. Mostly RGB color model is used in sensing and visual display devices like CRT monitor, computer monitor, televisions etc. The RGB color space is denoted by three dimensions, single axis for each of the colors. [Wikipedia] A huge range of colors can be represented with the RGB model it can be seen that red and blue gives magenta, while blue and green gives cyan, etc. Within the cube, grey scale shades are also represented, and it runs diagonally between the black and white corners of the RGB cube, where each color consists of an equal amount of red, green and blue.

III. DISCRETE WAVELET TRANSFORM

Discrete wavelet transform is simplest method of compression and also known as DWT in which wavelets are a mathematical tool for changing the coordinate system in which we represent the signal from one domain to another domain that is best suitable for compression. Wavelet based coding is more powerful under transmission and decoding errors. Due to their inherent multi resolution nature, they are suitable for applications where scalability and tolerable degradation are important. Wavelets are tool for decomposing signals such as images, into a hierarchy of increasing resolutions. The more resolution layers, the more detailed features of the image are shown. This means that first one layer is higher resolution than others and a small change is seen with naked eye more easily. They are localized waves that drop to zero. They come from iteration of filters together with rescaling. Wavelet produces a natural multi resolution of every image, including the all of the important edges. The output from the low pass channel is useful compression. [sakshi saharma, et.al, oct 2012,ijetae]. In this multi resolution effect plays an important role to represent signals, where a single event will be decomposed into finer and coarse details. A signal is represented by a coarse approximation and finer details. The coarse and the detail subspaces are orthogonal to each other. By applying successive approximation recursively the space of the input signal can be spanned by spaces of successive details at all resolutions. Sampling rate is discussed with decimator and interprator, Decimator or down sampler lowers the sampling rate whereas interpolator or the up-sampler raises the sampling rate. The down sampler takes a signal x (n) and down samples by a factor of two and vice versa. The DWT represents an image as a sum of wavelet functions, known as wavelets, with different location and scale. It represents the data into a set of high pass (detail) and low pass (approximate) coefficients. The input data is passed through set of low pass and high pass filters Used. The output of high pass and low pass filters are down sampled by 2. The output from low pass filter is an approximate coefficient and the output from the high pass filter is a detail coefficient. In case of 2-D DWT, the input data is passed through set of both low pass and high pass filter in two directions rows and columns. The outputs are then down sampled by 2 in each direction as in case of 1-D DWT. As shown in Figure 1, output is obtained in set of four coefficients namely as a four approximation, horizontal, vertical and diagonal as a LL, HL, LH and HH respectively.

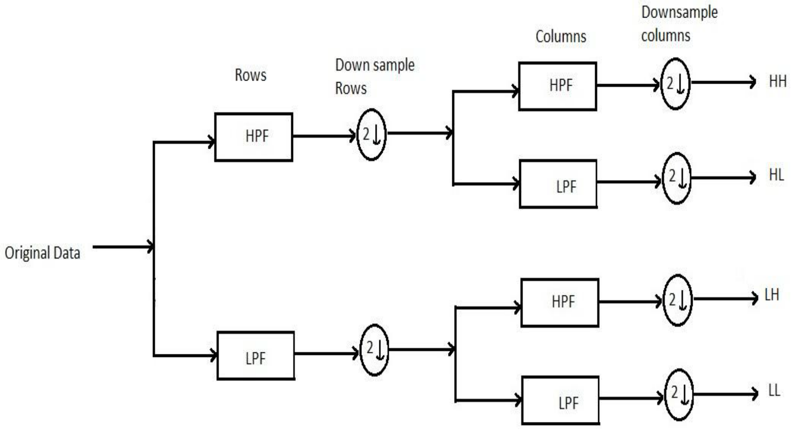


Figure 1 Block diagram of 2-D forward DWT

The first alphabet represents the transform in row whereas the second alphabet represents transform in column. The alphabet L means low pass signal and H means high pass signal. LH signal is a low pass signal in row and a high pass in column. Hence, LH signal contain horizontal elements. Similarly, HL and HH contains vertical and diagonal elements, respectively. In 2D, the images are considered to be matrices with N rows and M columns. Any decomposition of an image into wavelets involves a pair of waveforms One to represent the high frequency corresponding to the detailed part of the image (wavelet function).One for low frequency or smooth parts of an image (scaling function). [Ms. Pallavi M.sune,et.al,aprl2013,ijarcsse] At every level of decomposition the horizontal data is filtered, and then the approximation and details produced from this are filtered on columns. At every level, four sub-images are obtained; the approximation, the vertical detail, the horizontal detail and the diagonal detail. Wavelet function for 2-D DWT can be obtained by multiplying wavelet functions (Ψ (x, y)) and scaling function (φ(x, y)). After first level decomposition we get four details of image those are,

Approximate details – $\Psi(x, y) = \varphi(x)\ \varphi(y)$
Horizontal details – $\Psi(x, y) = \Psi(y)\ \varphi(x)$
Vertical details – $\Psi(x, y) = \Psi(x)\ \varphi(y)$
Diagonal details – $\Psi(x, y) = \Psi(x)\ \Psi(y)$

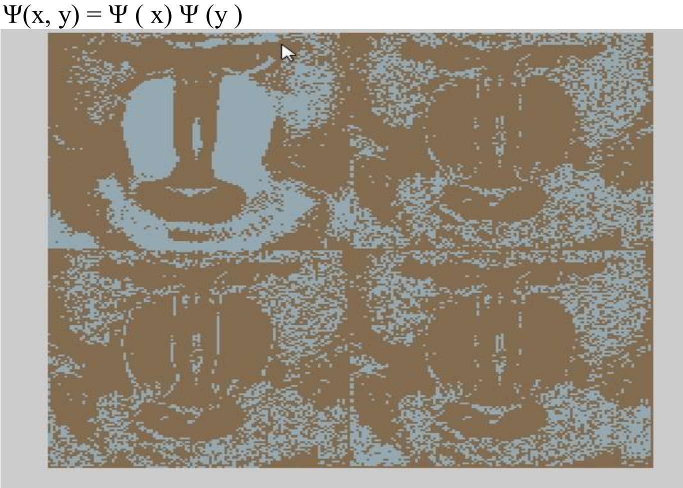


Figure 2 dwt on image

In our purposed technique first we convert color image into ycbcr and then apply dwt on image as shown in figure 2. In this first tile shows approximation detail, second level shows horizontal details, third level shows vertical details and fourth level shows the diagonal details.

IV. FRACTAL IMAGE COMPRESSION

In our methodology, Image Compression technique uses quad tree decomposition and dwt method. The Fractal Image Compression is suitable techniques for image compression. Benoit Mandelbrot first introduces the idea about fractal geometry in 1973; the fractal geometry has found self-similarity feature in an image. The idea of the self-similarity can be efficiently discussed by means of block self-affine transformations may call the fractal image compression (FIC). The fractal compression technique is based on the facts that are some images; parts of the images that contain some similarity with other parts of the same image. Amaud Jacquin and Michal Barnsley introduced an automatic fractal encoding system in 1989. In 1990, Jaquin was first suggested block forming technique for Fractal image compression method. In fractal image compression main limitation is high encoding time because of exhaustive search technique. Therefore, decreasing the encoding time is an interesting research topic for FIC. Fractal compression is very efficient because of its high Compression ratio. Fractal image compression is also called as fractal image programming where compressed images are represented as contractive transforms. A contractive mapping is a mapping of the source image through a series of transformations such as scaling, translation, rotation. The mappings are contractive because when the transformation is applied, the points on the plane are brought closer together. Fractal compression is a lossy compression method used in digital images, based on fractals. The method is based on the fact that parts of an image mostly resemble with other parts of the same image. Fractal algorithms convert these parts into mathematical data known as "fractal codes" which are used to change the encoded image.[Veenadevi.S.V,et.al,2012,sipij].

4.1 Fractal Compression Using Quad Tree

In fractal compression firstly Image is divided into a number of square blocks called range, later the image is divided into bigger square blocks, called domain blocks, which are usually four times larger than the range block. After that, the domain blocks are searched for the best match for every range block. For every range block the number of the appropriate domain and relevant information needed to retrieve that range are stored. The fractal affine transformation is constructed by searching all of the domain block to find the most similar one and the parameters representing the fractal affine transformation will form the fractal compression code. [Nisar Ahmed,et.al,2009,ijste] Hence the compression is achieved in place of storing a range block only the parameters are stored. The decoder performs a number of iterative operations in order to reconstruct the original image. This process is very time consuming and during encoding time it takes a lot of time. it is very difficult to calculate domain block for every range block and it is very time consuming so we calculate the mean value of every block. It is too much difficult to remember the huge data base for searching the best one domain block for respective range block with affine transformation formulas and we go for calculate mean value of every block with respective to their x and y coordinates. To calculate the mean value of every block for quad tree decomposition given formula is used.

Mean (I) = S I(X, Y)/n

Variance = S (I(X, Y)-M) *2/n

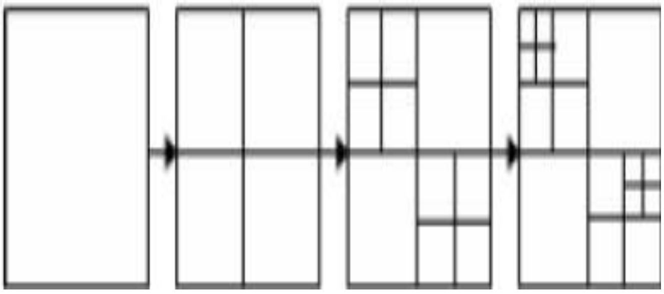
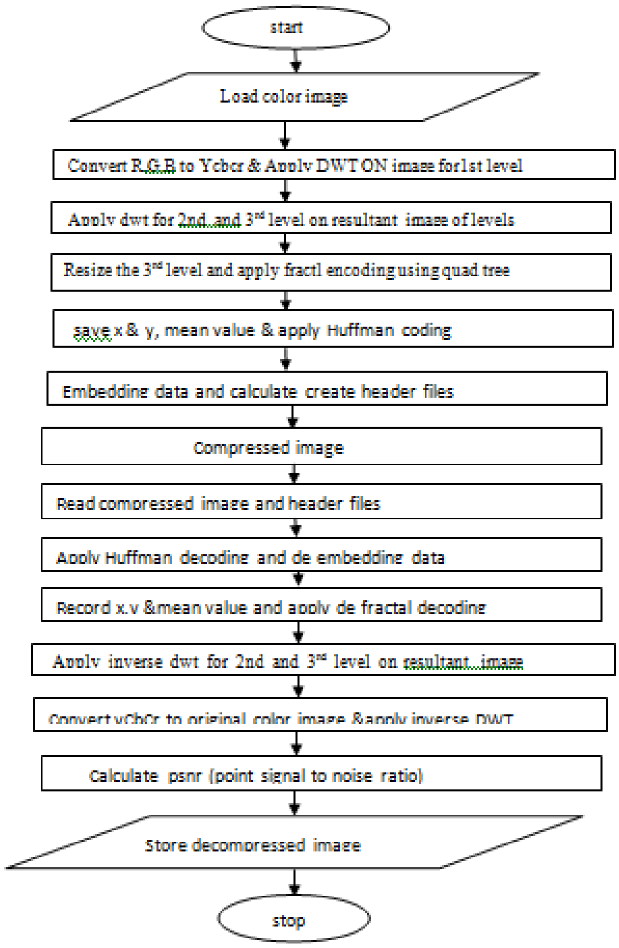


Figure 3 quad tree decomposition

V. PROPOSED ALGORITHM

1. Read the input color image.
2. Change the original color of an image R, G, B into Ycbcr.
3. Apply the DWT on the image for 1st level compression. After applying the DWT image is divided into 4 tiles known as a Approximation, horizontal, vertical and diagonal.
4. Apply DWT for 2nd level on the resultant image of 1st level DWT. From here we get resultant image LL2.
5. Apply DWT for 3rd level on the resultant image of 2nd level DWT. from here we get resultant image LL3.
6. We apply fractal encoding using quad tree decomposition on resultant image of 3rd level DWT after resizing the resultant image.
7. Divides the original image using Quad tree decomposition of quantization is 0.5; minimum Dimension and maximum dimension is 2 and 64 respectively.
8. Record the values of x and y coordinates, mean value and block size from Quad tree Decomposition.
9. Record the fractal coding information of the image and by using Huffman Coding we create binary codes and embed the data using lsb and calculating the compression ratio, original size and storage saving.
10. For the encoding image applying Huffman decoding to reconstruct the image and Calculating PSNR.

VI. FLOW CHART OF ALGORITHM



VII. RESULTS

Purposed method is a combination of DWT and fractal encoding using Quad tree decomposition. We done compression and decompression procedure using hybrid for improving results as compared to DCT and DWT method. Here we are applying purposed method on baboon image for compression and decompression procedure .During compression we will calculate original size of baboon color image in kb, compression ratio in percentage and compressed size of image in kb. During decompression we will calculate PSNR value of the image in decibel. During compression the compression ratio is 46 percentages and the original size of baboon image is 137.978kb and compressed size is 74.3564kb. When we done decompression procedure we will calculate PSNR (point signal noise ratio) is 16.1814db.

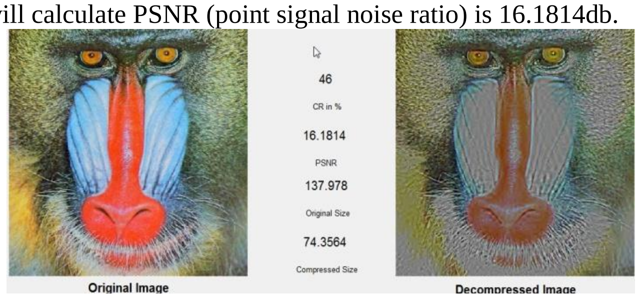


Figure 4 results for baboon image

During purposed method compression of color Lena image for fractal compression using quad tree compression decomposition with dwt the compression ratio is 64 percentages and the original size of Lena image is 99.5918kb and compressed size is 36.0469kb. When we done decompression procedure we will calculate PSNR is 19.4496db.

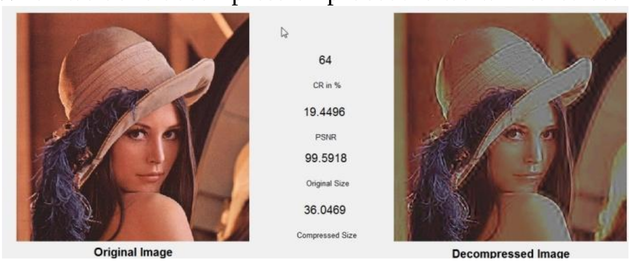


Figure 5 results for Lena image

At last for compression and decompression procedure we calculate purposed method compression for pepper color image. During compression the compression ratio is 52 percentages and the original size of pepper image is 90.5078kb and compressed size is 43.7383kb. When we done decompression procedure we will calculate PSNR is 16.9306db.

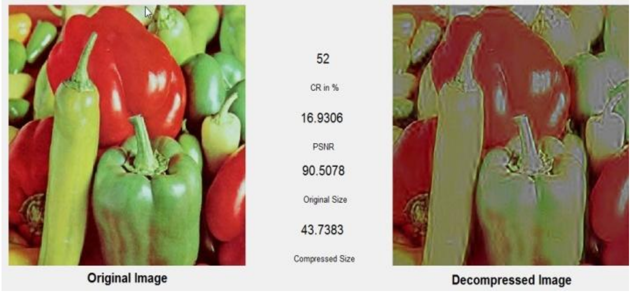


Figure 6 hybrid results for pepper image

From different color images baboon, Lena, pepper compression ratio of Lena image is higher than others. Lena image show higher compression ratio and PSNR value for compression and decompression procedure.

VIII. GRAPHICAL REPRESENTATION

In graphically section we plot graph for purposed method for different images. In this firstly we shows the compression ratio analysis with baboon, Lena, and pepper images. Compression ratio is Compression ratio is defined as the ratio of an original image to compressed image. CR=original size-compressed size*100/original size.

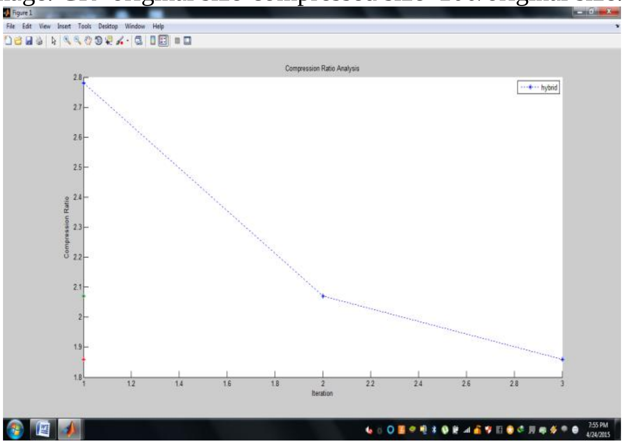


Figure 7 Graphical representations of CR

PSNR is the PSNR is peak signal to noise ratio is the ratio between the maximum possible power of signal to the corrupting noise that effect the fidelity of its representation. Inn psnr we measure PSNR ratio for three different different images baboon, Lena and pepper.

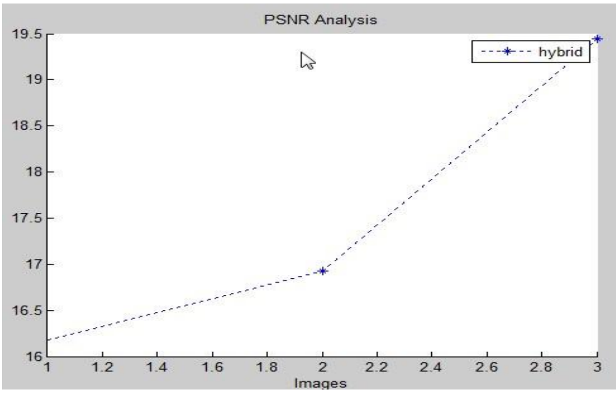


Figure 9 PSNR analysis

Table 1 show the results of an different image

Image name	Compressi on ratio	Psnr	Origial size	Compress size
Lena	**64**	**19.4**	**99.5918**	**36.04**
Bamboo	**46**	**16.9**	**137.978**	**74.3564**
Pepper	**52**	**16.1**	**90.5078**	**43.7383**

IX. CONCLUSION & FUTURE SCOPE

In fractal image compression the block size play a very important role. The quality of image and time is depended on the block size according to their dimensions and quantization value. We show compression and decompression results for various different images. The future scope of this methodology is that we will change the dimensions of the image and we will also calculate the threshold value and calculate the time of compression and decompression.

REFERENCES

[1] Sonal, Dinesh Kumar, "A study of various image compression techniques," Guru Jhambheswar University of Science and Technology, Hisar.
[2] Chuanwei s, quanbin, jingao, "The study of digital image compression based on wavelets," 2010.
[3] Ying Chen, pengwei hao, "integer reversible transformation to make jpeg lossless," Peking University, Beijing, 2004.
[4] Amandeep Kour, "a review on image processing (2013)", international journal of electronics communications and computer engineering, vol 4
[5] Sachin Dhawan, "A review of image compression and comparison of its algorithms (2011)", vol 2 issue1, international journal of electronics& communications technology.
[6] Bernd Meyer, Peter Tischer, "TMW – a new method for lossless image compression (2009).
[7] LOHIT M.KADLASKAR, "A new lossless method of image compression and decompression using Huffman coding techniques". Journal of theoretical and applied information technology.
[5] REZA Jafari, Ziou, Mohammad mehdi rashidi, "increasing image compression rate using steganography (2013)"ELSEVIER.
[6] WANG WEI, WANG Rang –ding, "the analysis and detection of double jpeg2000 compression based on statistical characteristics of DWT (2012)" ELSEVIER.
[7] Pallvi M.sune, "image compression techniques based on wavelet and Huffman coding (2013)", international journal of advanced research in computer science and software engineering.
[8] Veenadevi.S.V. And A.G.Ananth, "Fractal Image Compression Using Quad tree Decomposition and Huffman Coding (2012)" Signal & Image Processing: An International Journal (SIPIJ) Vol.3.
[9] Archna parkhe, "enhancing the image compression rate using steganography (2014)", The International Journal of Engineering and Science (IJES).
[11] Meenu Kumari, "JPEG compression steganography & cryptography using Image Adaption Technique (2010)", Journal of Advance in Information Technology.
[12] Rafael C. Gonzalez, Richard e woods "digital image processing", second Edition PAGE 410.
[13] Jain, fundamentals of digital image processing, prentice-hall Inc, 1982.
[14] Springer, digital image processing, bred jahne, 5th edition.

