

Fractal Image Compression Techniques

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Abstract:- Digital image are used in several areas. Digital image includes large amount of data. So transmission of such large amount of data require large storage space. Hence to deal which such problems, image compression is used. Image compression is a technique in which redundant information of image is removed, such that only essential information remain. Image compression technique is also helpful in reduce storage size, transmission bandwidth and transmission time. This paper provides review and comparison of different image compression techniques like DCT (Discrete Cosine Transform) , DWT (Discrete Wavelet Transform) and Hybrid (DCT and DWT) and Fractal Image compression by using Affine Transformation and Iterated function system (FIS). Research finding of this paper helps to build new and more effective image compression technique.

Keywords:-DCT (Discrete Cosine Transform), DWT (Discrete Wavelet Transform), Fractal image compression (FIC), Affine Transformation, Iterated function system (FIS).

I. INTRODUCTION

Now a days, millions of multimedia contents are circulated on internet all over the world .In transmission of multimedia over internet, transmission speed and storage capacity are two major issues. Increase in devices which support higher quality and less expensive image lead to increase image size and image resolution which further increase demand of generation of image compression techniques. In general, this paper investigate some compression techniques to reduce image storage size and transmission bandwidth. The main objective behind compression technique is to decrease number of bit used to show an image. In computer system an image is represented by array of number which specified as – Digital Image. If image is Black and White then it is two dimensional (2D) image, if it is color image then it is three dimensional (3D) image.

Image compression is most used technique in image processing. JPEG (Joint Photographic file format) using the Discrete Image Transformation (DCT) which is of two type lossless and lossy compression .but here lossy compression is used because in lossless compression techniques reformed image is same as original image but in Lossy Compression lost some amount of data after compression but it completely remove repeated information . soLossy Compression schemes are able to provide higher compression ratio.

Discrete Wavelet Transformation (DWT) is also most popular compression technique in which image is displayed in different resolution i.e. low frequency and high frequency.

If combined DWT and DCT are combindly used then they give better result than individual one.

Fractal image compression technique works on fractal of image. It divided image into partition based on quad tree partitioning . In this paper two fractal image compression techniques are analyzed which are affine transformation and IFS.

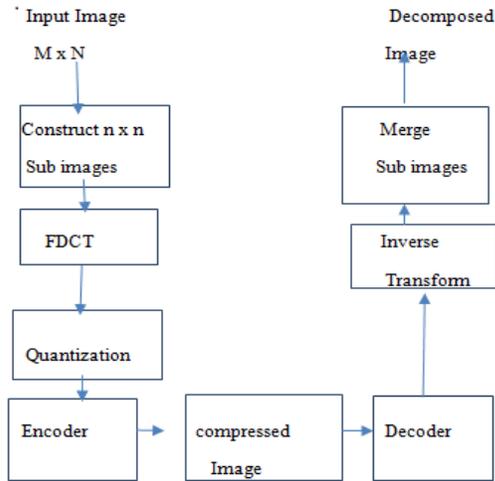
Second section of this paper gives the introduction of different image compression standard. Literature study is presented in section 3. Research findings are presented in tabular form in section 4. Finally conclusion of paper is in section 5.

II. DIFFERENT IMAGE COMPRESSION STANDARDS

2.1 DCT (Discrete Cosine Transform):-

JPEG (TheJoint Photographic Expert Group) is most widely used technique for image compression using lossy image compression technique .JPEG uses the DCT approach for get higher image compression ratio.

DCT converts spatial domain $f(a,b)$ into frequency domain . It break input image into $M \times M$ sub images which are converted frequency domain coefficient $f(p,q)$. Compressed images are obtained after passing through quatizer and encoder. To get reconstructed image inverse transform is applied and all sub images are combined into one image which is decomposed image.



Fig>1.1 Image compression by DCT

Conversion of spatial into time domain :

$$T(p,q) = \sum_{a=0}^{m-1} \sum_{b=0}^{m-1} f(a,b) r(a,b,p,q)$$

Here matrix is formed for p and q . For ist row value of pis :

$$\alpha p = \sqrt{1/m} \quad \text{if } p=0, \quad \sqrt{2/m} \text{ if } p \neq 0$$

Frequency domain coefficient are :

$$F(p,q) = \sum_{p=0}^{m-1} \sum_{q=0}^{m-1} T(p,q) S(a,b,p,q)$$

Here , $r(a,b,p,q) = S(a,b,p,q)$

$$= \alpha(p) \alpha(q) \frac{\cos(2a+1)p\pi}{2m} \cdot \frac{\cos(2b+1)q\pi}{2m}$$

2.2 DWT (Discrete Wavelet Transform):

DCT maps time domain to frequency domain. Frequency domain spectrum can be compressed by truncate low intensity regions. DCT has many disadvantages like DCT take long time to compress image the only solution to this disadvantage is to partition the frame into small blocks and apply DCT on each. Which may further lead to poor image quality.

DWT also maps time domain to frequency domain but DWT has advantage that can be computed by digital filter. DWT capture more information than DCT .DWT separate frequency component from rest of image and resize and rearrange them to form new one. DWT available in 1-D and 2-D.

Wavelet transform has two filter these are Low pass filter and High pass filter. These filters separate input to frequency band. When input signal passed through filters it decompose into four bands: LL, HL, LH and HH.

2.3 Fractal Image Compression (FIC):

Techniques of image compression based on fractal are developed to get better compression performance. It is

developed because natural scenes can be better explained by fractals. In this technique an image is encode whose fixed point is near to original image then it is decoded. DCT based JPEG compression has effective compression ratio up to 20 to 25 to 1. But after DCT compression image become blocky. so to overcome these problem FIC is developed .

The first to recognize fractal method are Michal Barnsley and his coworker at the Georgia Institute of Technology. Fractals are partitioned using quad tree partition method. In this image is portioning into small rectangles. Which are combined at reconstruction time.

2.4 Affine Transformation:

Affine Transformation is combination of rotation, translation ,dilation. More than two transformation are applied on image with use of affine Transformation.

$$W : \mathbb{R}^2 \rightarrow \mathbb{R}^3$$

$$W(u,v) = (gu + hv + i, ju + kv + l)$$

Where g , h , i , j , k and l are real number called affine transformation .

General form of affine Transformation in \mathbb{R}^2 is [1,9, 3, 3]

2.5 Iterated Function System (IFS) :

IFS is very popular compression technique. The power of compression of IFS for color image are rate over 10,000 to 1. From the word iteration we consider something which repeat itself. Output of first iteration is taken as input of second iteration. It repeat further until it reached the last iteration. Apply IFS to original image, provide map to reduce distance so to bring point together (contractive) , final result of input is attractor image .

Iteration function together with probability of IFS are –

$$[X : V_1, V_2, \dots, V_m]$$

$$[R_1, R_2, \dots, R_m] \text{ such that } R_1 + R_2 + \dots, R_m = 1, R_j > 0$$

For $j = 1, 2, \dots, m$

Full Notation of IFS is -

$$X : [V_1, V_2, \dots, V_m : R_1, R_2, \dots, R_m]$$

III. LITERATURE REVIEW

A Jain –

A Jain [1] describes the digital image processing and how to apply various transform techniques such as DFT (Discrete Fourier Transform) and DCT. He uses stochastic model for digital image compression and various algorithm (software, firmware).But he only define digital image processing techniques.

M. Rabbani and P.Jones -

M. Rabbani and P. Jones[2] presents different compression techniques to remove redundancy of data without affecting essential information .They suggested different compression algorithms on lossless and lossy techniques (bit rate / quality performance) .

A Lewis and G. Knowles –

A Lewis and G. Knowles [3] describes the 2-D Wavelet Transform. It decompose image into spatial and spectrally local coefficients. The obtained coefficients are encoded into human visual system (HVS) . For lena monochrome image technique it gave high compression ratio of 0.64 0.43 bit per pixel (bpp).

Dan Liu ,Peter K, Jimack –

Dan liu , Peter K and Jimack [4] proposed parallel approach for FIC .It signifies the higher encoding cost of image . DauLiu , Peter K, Jimack introduced load balancing , data partitioning and complexity reduction . The advantage of encoding of fractal image compression is not high because decoding algorithm is prove fastest.

Zhi – liangzhu, Chong Fu -

Zhi – Liang Zhu , Chong Fu [5] designed a classification method based on the edge of an image block . Here, are three steps of DCT implementation .In first step, partition the image into set of pixel block in which some are overlapping block and some are non- overlapping block. In second step, ranges and domains are divided into three parts based on DCT lower frequency coefficients and in third step domain block and range block with same class are calculated. It classified on the base of lower frequency horizontal and vertical DCT.

Aree Ali Mahammed and Jnal Ali Hussein -

Aree Ali Mahammed and Jnal Ali Hussein[6] proposed a scheme for medical image compression Hybrid (DCT +DWT) .The aim to obtain higher compression rate by applying different compression threshold on DWT and DCT . Finally, entropy coding is used to encode quantization indices.

Er. Ramandeep kaur ,Navneet Randhawa -

Er. Ramandeep kaur and Navneet Randhawa [7] describes an architecture of DCT & DWT image compression. This paper objective is to show how DCT & DWT used for image compression and used hybrid of both compression techniques. An image without losing resolution done with dwt and obtain value less than prescribed threshold standard.

A.G.Ananth ,Veenadevi S.V. –

A.G Ananth ,Veenadevi S .V[8] presents FIC approach using quad tree and Huffman coding . In quad tree divide gray level image into block to get high compression ratio and high PSNR value. But using both algorithm can complicate the compression techniques.

Dr. Sphin Seelil ,Dr. M.K Jeya Kumar –

Dr. Sphin Seelil and Dr. M.K. Jeya Kumar[9] illustrate some compression techniques on bases of encoding time and PSNR . They deal with different FIC algorithm to acquire high CR .The new proposed FIC (fractal image

compression) method used most eminent techniques to perform image compression.

ManjinderKaur ,Gaganpreet Kaur –

Manjinderkaur and Gaganpreetkaur[10] describes to analyse the lossless and lossy compression techniques . Lossy compression is used to obtain more compression ratio and lossless is used to obtain identical image to original image. In this paper , Lossy compression techniques are used

Rasha Adel Ibrahim et al -

Rasha Adel Ibrahim[11] introduced a model on quantized quad tree and entropy coding for fractal image compression . Quantized Quad tree partition grey scale image into block depending upon their threshold value .It divide image into small fractals to map point closer to original image point value.

Jyotsna Kumar Mandal ,Utpal Nandi et.al -

Jyotsna Kumar Mandal ,Utpal Nandi[12] presents Quad tree portioning principle in which partition an image into sub image and ranges are compared with domain . To obtain domain it take large time in encoding. The fractal image coding with proposed partitioning reduces encoding time without reducing image quality and compression rate.

Sonali V. Kolekar and Prof. PrachiSorte –

Sonali V. Kolekar and Prof. PrachiSorte [13] Proposed a color image compression schemes which results reflects the effective performance of the system to compress image on basis of PSNR , SSIM and UIQI measurements . This method give better result than DCT and JPEG. But at decompression side there are some blocking parameter which affects when threshold value increases.

SunwoongKim ,Hyuk – Jae Lee –

Sunwoongkim ,Hyukjae lee [14] introduced the frame memory compression for image compression . It reduces the size of the frame in display panel memory. Such as in LCD and OLED technologies. LCD uses RGBW Color domain to enhance brightness which will increases memory frame but necessitates a compression algorithms. Compression algorithm of RGBW is BTC (block truncating coding). He introduced (Low complexity adaptive multi-level block truncating coding) LAM – BTC algorithm. BTC four level for quality of image coding. But it select 2- level BTC and PSNR of algorithm is high.

Ryan Rey , M. Daga –

Ryan Rey and M. Daga [15] Proposed (K-D Tree Segmented block truncating coding) KTS-BTC for color image. Transmitting and storing of data require large amount of bandwidth and disc space. If file size is reduced then it increased transmission of data and no. of image can be stored in disc must be increased .BTC is a compression techniques which is used for low computational. Which

make it best for application. KTS- BTC reduce bit rate of image quality in compression.

IV. COMPARISION AND FINDINGS

S. N.	Author	Year	Findings/Methodology	Research Gap
1	A Jain	1989	Define stochastic model for image compression and various algorithms (Software, Filmfare).	Required an algorithm for high compression ratio and less encoding time.
2.	M. Rabbani and P. Jones	1991	Analyze different lossless and lossy compression techniques.	Need to illustrate an algorithm for better PSNR and quality of image.
3	A Lewis, G. Knowles	1992	Work in Human Visual System (HVS)	Reconstruction of an image should require a better method.
4.	Dan Liu, Peter K, Jimack	2007	Use parallel approach on FIC	Need to reduce encoding cost on FIC
5	Zhi Liang Zhu, Chang Fu	2009	Describe classification of image block.	A Deterministic procedure for big size image block reconstruction is required.
6	Aree Ali Mahammad, Janal Ali Hussein	2011	Use Hybrid (DCT+DWT) with set partitioning in hierarchical tree (SPIHT).	Should maintain coding speed due to Dynamic processing.
7	Er. Ramandeep Kaur and Navneet Randhawa	2012	Compute value less than prescribed threshold.	threshold value with image compression must be identified
8	Veenadevi S. V, A.G. Ananth	2012	Use quadtree decomposition and Huffman coding.	Need to reduce Complexity in combination of quadtree and Huffman coding.
9	Dr. Sophinseelil	2012	Analyze different FIC techniques	An algorithm is required

	and Dr. Jeyakumar		based on CR and PSNR.	for higher CR.
10	Manjinder Kaur, Gaganpreetkaur	2013	Analyze different lossless and lossy compression techniques.	Need to specify an algorithm for fast processing and high image quality.
11	Rasha Adel Ibrahim et. al	2015	Use Quadtree and entropy coding.	Should illustrate an algorithm for decrease encoding time.
12	Jyotsna Kumar Mandal, Utpal Nandi	2015	Use Quadtree partitioning principle	Need a algorithm for Gray scale Images.
13	Sonali V. kolekar and Professor Prachisorte	2016	Proposed a scheme for color image to achieve better PSNR, UIQ and SSIM measurements.	Must illustrate blocking parameters and its causes.
14	Sunwoongkim, Hyukjaelee	2016	Use adaptive multilevel Block Truncating coding	Need to improve blocky appearance in reconstructed image
15	Ryan Rey, M. Daga	2017	Use KTS – BTC	Need to select a better KTS based on partitioning and use of bigger block.

V. CONCLUSION

After Studying various fractal image compression techniques, merit and demerit it is found that DWT give good compression ratio without losing useful information of image. DWT require high processing time but DCT is used to overcome this disadvantage and require less processing time but it give less compression ratio. Hybrid Transform give higher compression ratio but clarity of image is less. So, It is best for normal image compression. Fractal image compression techniques are also give high compression ratio. Fractal compression divide image in fractals and the combine them to reform object image but quality of object image not same as source image so another research must be applied to improve compression image quality and large blocks of image can be used for compression such that it consume less encoding cost and give better result.

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