Fractal Dimension Based Compression Methods by Advance Wavelet Coding

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Abstract: We have made picture/photograph compression using efficient fractal decomposition on this work. We have used quad tree set of rules for this purpose. We opt for fractal primarily based technique as it's far considered strong device to deal with vagueness. When pix are indistinct in terms of pixel values fractal decomposition is taken into consideration suitable good judgment for its evaluation. In proposed technique one area block is taken into consideration for each range block & searched best for matched contrast scaling. So consequences fractal code does no longer comprise coordinates of matched domain block. Quad tree algorithm can be here applied in such case & length of variety block may be minimized as small as 2x2 pixels. Proposed studies offers with integration of quad tree algorithm with traditional DCT primarily based fractal image compression if you want to produce higher compression ratio PSNR with much less compression mistakes. Our important objective is to review the photograph of excessive compression and backbone and so as to compress it we use a novice set of rules and implements it in photograph in order that the pixels of the photograph were given compressed. In order to gain this objective we use fractal decomposition. Sub block processing of a photograph leads to the reduction in the contrast and brightness of input picture to be compressed. The advantage of this reduction in assessment and brightness is that this reduction leads to growth the pixel redundancy and therefore assists to boom the compression ratio (CR) and peak sign to noise ratio (PSNR) during the photo compression. And the algorithm which we are the usage of is Quad tree Algorithm. Through Quad tree Algorithm the dimensions of the variety block can be reduce as small as 2X2 pixels. Hence the best of decoded picture may be advanced at the same time as the compression ratio may be maintained.

Index Terms - — Image restoration, nonlocal similarity, Fractal decomposition, harmonic encryption.

I. INTRODUCTION

Rapid development of the technology has affected all of the clinical regions. Medicine, automation, records evaluation, finances, biology, chemistry, economics and lots of, many extra have benefited from the generation growth. Those big changes have additionally stimulated fields as a picture processing.
Enhancement of noisy image facts is a very difficult trouble in many research and application regions. Image enhancement strategies can be divided into 3 vast classes:

1. Spatial area techniques, which perform at once on pixels the use of gray degree modifications or histogram processing (classical histogram equalization).
2. Frequency area techniques, which operate at the Fourier transform of a photograph.
3. Fractal area strategies which contain using rule-base structures that are able to mimicking the conduct of a human professional using fractal based totally decomposition.

Classical frequency domain method has proved to be a simple and powerful photo contrast enhancement approach .But this has a downside that it does no longer hold the brightness of the input photo on the output one. This makes HE no longer suitable for picture contrast enhancement on customer digital merchandise, inclusive of video surveillance, where preserving the enter brightness is important to keep away from the generation of non-present artifacts inside the output photograph. To overcome such disadvantage, variations of the classic HE approach have proposed to first decompose the input picture into two sub-pix, after which carry out HE independently in each sub-picture. Although these techniques preserve the enter brightness at the output photograph with a great comparison enhancement, they will produce pictures which do not appearance as natural because the input ones.

1.1. MOTIVATION

Digital picture processing method enables within the manipulation of virtual photo by way of using computer systems. It has wide vicinity of software like in far flung sensing, defence surveillance, biomedical imaging techniques, client electronics to perceive defective additives, etc.. There are many reasons to do this. The maximum vital of them are follows:

- Fractal and DCT is influential tool to knowledge illustration
- Fractal techniques can handle the ambiguity and vagueness (an image can be represented as a fractional block set) of an image competently.

1.2. GENERAL OBSERVATIONS ABOUT THE FRACTAL DECOMPOSITION TECHNIQUES

- Fractal decomposition is flexible. With any given system, it's easy to manage it or layer more functionality on top of it without starting again from scratch.
- Fractal decomposition is conceptually easy to understand. The mathematical concepts behind reasoning are very simple.

- Fractal decomposition is tolerant of imprecise data. Everything is imprecise if we look closely enough, but more than that, most things are imprecise even on careful inspection. Thresholding of error reasoning builds this understanding into the process rather than taking it to the end.
- Fractal decomposition can be blended with conventional control techniques. Fractal decomposition systems don't necessarily replace conventional control methods. In many cases systems augment them and simplify their implementation.
- Fractal decomposition is based on natural language. The basis for fractal decomposition is the basis for human decisions. This observation underpins many of the other statements about fractal decomposition.
- Fractal decomposition can model nonlinear functions of arbitrary complexity.
- Fractal decomposition can be built on top of the experience of experts

II. PREVIOUS WORK

[1] 1952, DAVID A. HUFFMAN

A top of the line technique of coding an ensemble of messages inclusive of a finite range of participants is advanced. A minimum-redundancy code is one built in the sort of way that the average variety of coding digits in keeping with message is minimized.

[2]1974, N. AHMED

A discrete cosine rework (DCT) is described and an set of rules to compute it using the quick Fourier remodel is advanced. It is proven that the discrete cosine rework may be used inside the location of digital processing for the purposes of sample popularity and Wiener filtering. Its overall performance is compared with that of a category of orthogonal transforms and is found to evaluate carefully to that of the Karhunen-Lo'eve remodel, which is known to be most fulfilling. The performances of the Karhunen-Lo'eve and discrete cosine transforms are also found to evaluate intently with recognize to the rate-distortion criterion.

[3] 1991, TASSOS MARKA

Traditionally, lossy compression schemes have targeted on compressing statistics at constant bit prices so that you can speak facts over limited bandwidth conversation channels, or to shop data in a set-length garage media. In this work we present a category of lossy records compression algorithms which might be able to encoding snap shots in order that the loss of facts complies with positive distortion requirements. The evolved algorithms are primarily based at the Tree-Structured Vector Quantizers (TSVQ). The first distortion controlled algorithm uses variable-length image blocks, encoded on quad-tree information systems, to efficiently encode picture areas with distinctive information content.

4]1992, ARNAUD E. JACQUIN,

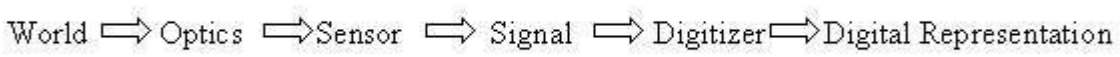
The concept of virtual image coding techniques is of great interest in numerous regions worried with the garage or transmission of images. For the past few years, there has been an inclination to mix one-of-a-kind classical coding strategies so that it will gain greater coding efficiency. In this work, we suggest an independent and novel approach to picture coding, primarily based on a fractal theory of iterated adjustments. The predominant characteristics of this method are that i) it relies on the belief that photograph redundancy can be correctly exploited through self-transformability on a block wise foundation, and ii) it approximates a n original photo via a fractal image.

[5] BRENDT WOHLBERG,1999

Fractal photograph compression is a relatively recent method primarily based on the illustration of an picture by using a contractive remodel, on the space of snap shots, for which the fixed factor is close to the authentic photo. This vast precept encompasses a totally wide type of coding schemes, lots of that have been explored within the swiftly developing body of published studies. While certain theoretical elements of this illustration are well hooked up, rather little interest has been given to the development of a coherent underlying photograph model that might justify its use. Most basically fractal-based schemes are not aggressive with the modern country of the art, however hybrid schemes incorporating fractal compression and alternative techniques have executed considerably more achievement. This assessment represents a survey of the most good sized advances, each realistic and theoretical, because the guide in 1990 of Jacquin's unique fractal coding scheme.

III. FUNDAMENTAL STEPS IN DIGITAL IMAGE PROCESSING

3.1 Image acquisition: Camera/digitizer converts the image into a form suitable for input to digital computer.



where,

- World refers to reality;
- Optics allows light from world to focus onto sensor;
- Sensor converts light to electrical energy
- Signal is a representation of incident light as continuous electrical energy;
- Digitizer converts continuous signal to discrete signal;
- Digital Rep. is the final representation of reality in computer memory.

After the image has been obtained, numerous techniques of processing may be applied to the picture to perform the numerous distinctive vision responsibilities required these days. However, if the photograph has no longer been received satisfactorily then the intended tasks might not be practicable, inspite of the resource of a few shape of photograph processing.

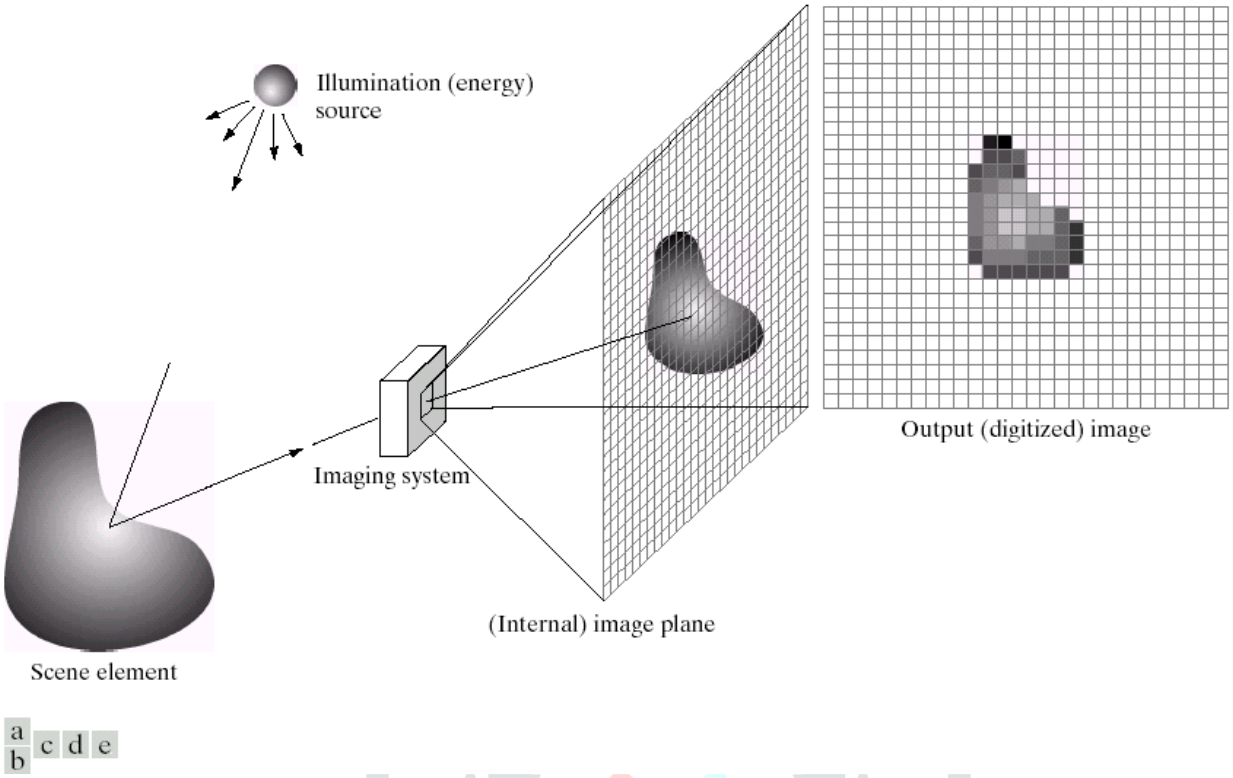
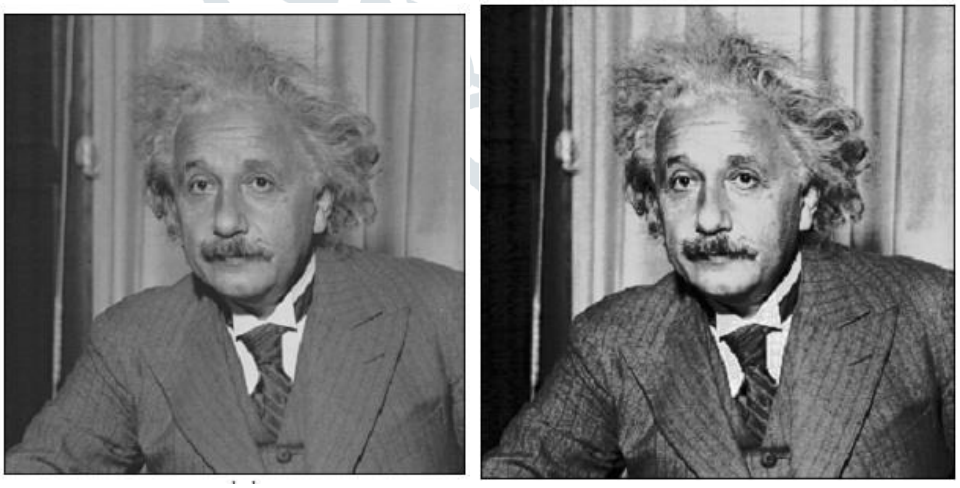


Fig.1 An example of digital image acquisition process (a) Energy(illumination) source (b)an element of a scene (c) imaging system (d) projection of scene on image plane (e) digitized image

3.2. Image Compression: Image compression method getting a clearer photo after reconstruction. Image compression can be dealt with as reworking one image to some other small size data set so that once reconstruction the look and experience of an photo can be similar for system evaluation or visual perception of human beings.

(a)



(b)

Fig 2 Einstein's (a) original image (b) reconstructed image

3.3. Image Restoration:

Image recuperation refers to removal or minimization of degradations in an photo. Image recuperation differs from photo enhancement. Restoration strategies frequently rely handiest on the magnificence or ensemble properties of a statistics set .Where as photograph enhancement techniques are a great deal extra photograph established.

Fig 3.1. (a) Blurred image (b) Restored image

Fig 3.2. (a) Blurred image (b) Restored image

3.4 Color image processing:

Color photograph processing is a place that has been gaining in importance because of the massive growth inside the use of virtual images over the net.

Fractals DCT: They are used for representing images in various degrees of frequency resolution.
Image Data Compression: Image data compression techniques are concerned with reduction of the number of bits required to store or transmit images without any appreciable loss of information.

(a) **(b)**

Fig 4 (a) original image (b) Compressed image

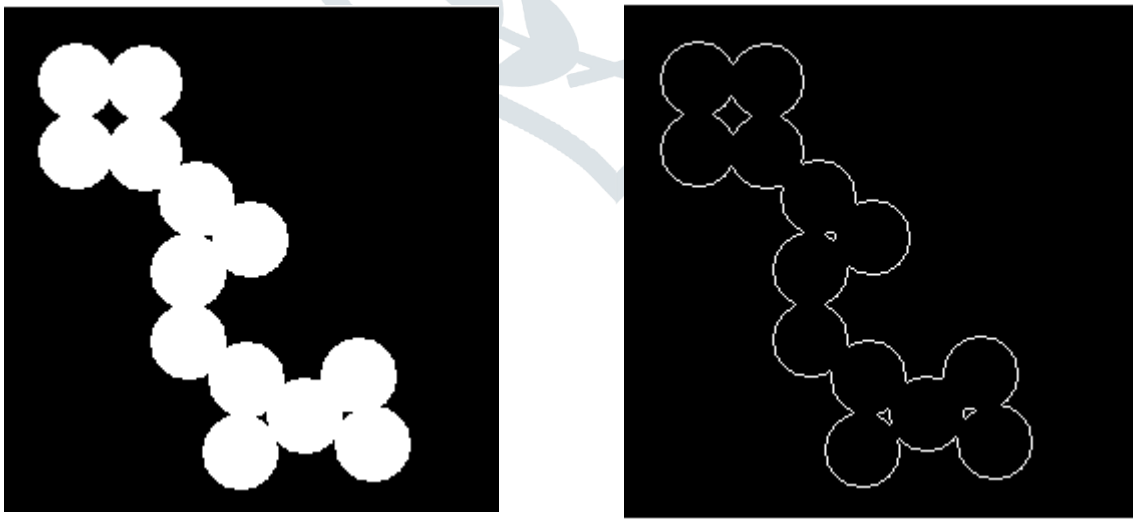
3.5. Image Segmentation: The process of partitioning a digital image into multiple regions (set of pixel) is called image segmentation. Segmentation of an image entails the division or separation of the image into regions of similar attribute.

(a) Original
(b) Segmentation

(a) **(b)**

Fig 5 (a) Original Image (b) Segmentation image

3.6. Morphological Processing: It deals with tools for extracting image components which are useful in representing and describing shape of an image.



(a) **(b)**

Fig 6 (a) original image (b) Morphologically processed image

3.7. Representation and description: These constantly follow the output of a segmentation stage that's raw pixel statistics constituting either boundary of a place or all the points in the location itself. Choosing a representation is best a part of solution for remodeling raw data into a form suitable for subsequent computer processing. Description also referred to as

function selection offers with extracting attributes that result in some quantitative facts of interest or primary for differentiating one class of items from every other.

3.8. Recognition: It is a process that assigns a label to an object based on descriptor.

III. PROPOSED WORK

- In this implementation first of all the algorithm reads an image and defines the size of the range blocks & domain blocks.
- As per the defined size of range blocks and domain blocks the algorithm breaks the image in respective horizontal and vertical address of blocks.
- The image blocks of size 16 X 16 are saved as TP. These blocks are further modified by reducing the pixel values by half.
- DCT is applied on each block and saved as TRR. Same operation is to be performed on domain blocks and they are saved as TD in a size of 32 X 32.
- Then the DCT of domain blocks are saved as TDM.
- Then the domain blocks are down sampled to the size of 16 X 16. Then the error between range blocks and domain blocks will be evaluated.
- As per the array values logic will decide the no. of fractals prior to applying encoding the pixels.

IV. RESULT

Table 1: Errors threshold values for different image compression analysis test cases.

S. No.	Errors Threshold E1	Errors Threshold E2	Errors Threshold E3
1	10	8	6
2	10	6	2
3	10	5	1
4	8	7	6
5	8	6	4
6	8	4	1
7	6	4	3
8	6	3	1
9	6	2	0.5
10	4	3	2
11	4	2	1
12	4	1	0.5
13	3	2	1
14	2	1	0.5

It can be observed that the error E1 is varied from to 10 to 2 and different slots of E2 and E3 are considered. At these values the image compression is performed and all the results are tabulated an explained in upcoming sections.

Table 2:Different test combinations of error threshold for deciding fractal decompositions.

S. No.	Errors (E1,E2,E3)	S. No.	Errors (E1,E2,E3)
1	(10,8,6)	11	(4,2,1)
2	(10,6,2)	12	(4,1,0.5)
3	(10,5,1)	13	(3,2,1)
4	(8,7,6)	14	(2,1,0.5)
5	(8,6,4)		
6	(8,4,1)		
7	(6,4,3)		
8	(6,3,1)		
9	(6,2,0.5)		
10	(4,3,2)		

		
Figure:2(a) (a) (E1,E2,E3)= (10,8,6) (b)PSNR= 28.2826 (c)C.R.= 29.8657	Figure:2(b) (a) (E1,E2,E3)= (10,6,2) (b)PSNR=30.8909 (c)C.R.= 16.4992	Figure:2() (a) (E1,E2,E3)= (10,5,1) (b)PSNR=31.2755 (c)C.R.= 13.3466

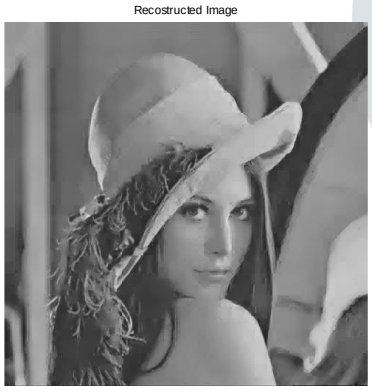
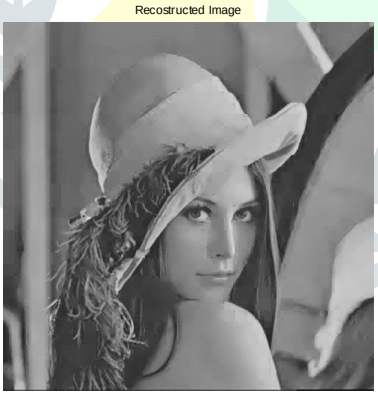
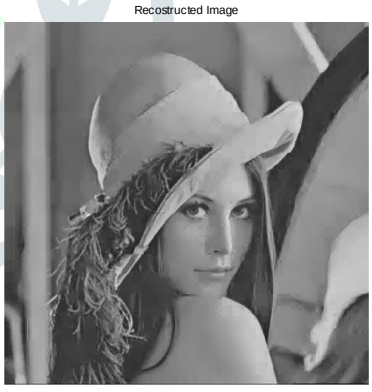

		

Figure:2(d) (a) (E1,E2,E3)= (8,7,6) (b)PSNR=30.8001 (c)C.R.= 24.1861	Figure:2(e) (a) (E1,E2,E3)= (8,6,4) (b)PSNR=18.4140 (c)C.R.= 24.1861	Figure:2(f) (a) (E1,E2,E3)= (8,4,1) (b)PSNR=32.5046 (c)C.R.= 11.0695

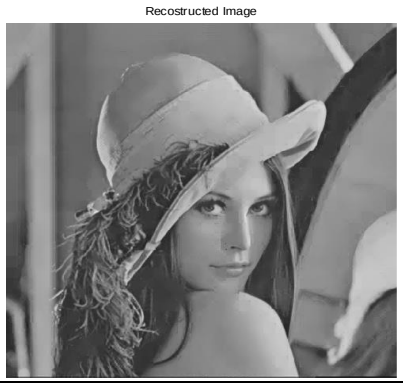


Figure:2(g) (a) (E1,E2,E3)= (6,4,3) (b)PSNR=33.1988 (c)C.R.= 13.3692	Figure:2(h) (a) (E1,E2,E3)= (6,3,1) (b)PSNR=33.8508 (c)C.R.= 8.7230	Figure:2(i) (a) (E1,E2,E3)= (6,2,0.5) (b)PSNR=34.2213 (c)C.R.= 6.8971
		
Figure:2(j) (a) (E1,E2,E3)= (4,3,2) (b)PSNR=34.5114 (c)C.R.= 9.6384	Figure:2(k) (a) (E1,E2,E3)= (4,2,1) (b)PSNR=35.1839 (c)C.R.= 6.6161	Figure:2(l) (a) (E1,E2,E3)= (4,1,0.5) (b)PSNR=35.4648 (c)C.R.= 4.9364

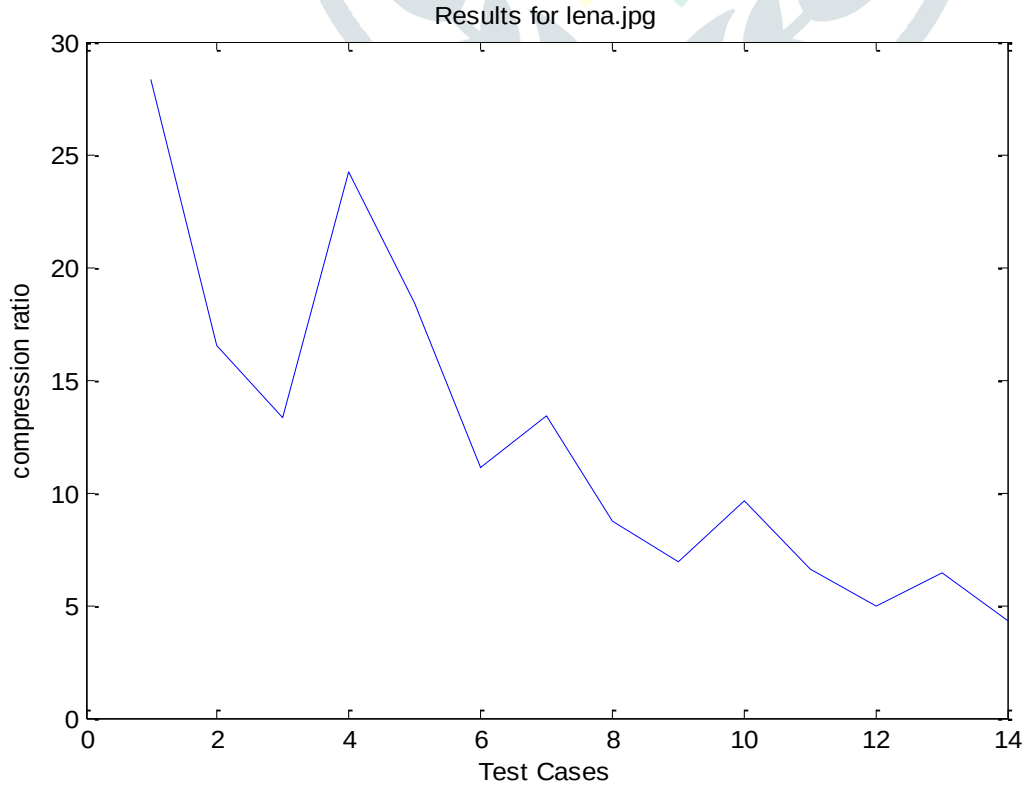


Figure 7: Compression Ratio for lena.jpg image at different error threshold cases.

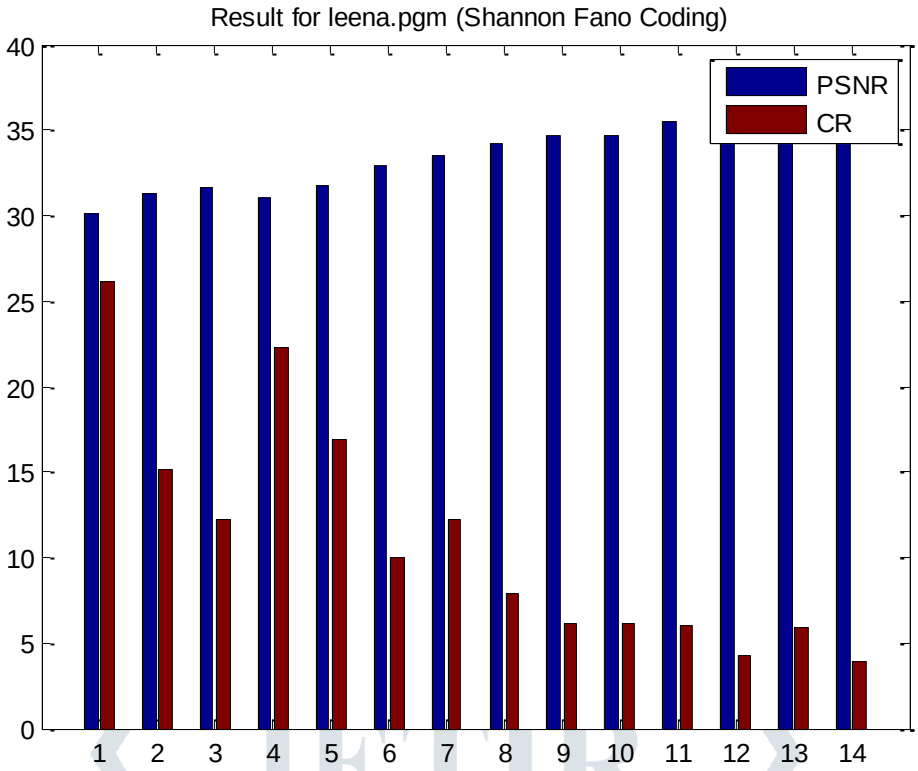


Figure 8. PSNR for lena.jpg image at different error threshold cases by Shannon Fano Coding.

Table 3: Summarized result for different coding scheme

			Huffman Coding Results		Shannon Fano Results			
E1,E2,E3	Leena	Jet	Cameraman	Football	Leena	Jet	Cameraman	Football
(10,8,6)	PSNR= 29.8657 CR=28. 2826	PSNR= 29.7080 CR=16. 1582	PSNR=26.70 52 CR= 42.6181	PSNR= 28.7786 CR= 109.6894	PSNR=30.0 863 CR=26.113 9	PSNR= 29.8327 CR=15.107 7	PSNR=26.7 601 CR= 40.2920	PSNR= 28.8590 CR= 106.4501
(10,6,2)	PSNR= 30.8909 CR= 16.4992	PSNR= 30.8974 CR= 10.4600	PSNR=27.05 20 CR=34.2694	PSNR=27.15 59 CR=86.6771	PSNR=31.2 493 CR= 15.0934	PSNR=31.0 859 CR= 9.7403	PSNR= 27.1153 CR= 32.2310	PSNR= 28.9726 CR= 92.0902
(10,5,1)	PSNR= 31.2755 CR=13. 3466	PSNR= 31.4035 CR=8.7 703	PSNR=27.15 59 CR=31.3213	PSNR=28.68 87 (c)CR=104.19 60	PSNR=31.6 724 CR=12.216 8	PSNR=31.6 436 CR=8.1198	PSNR= 27.2353 CR= 29.1203	PSNR= 29.0867 CR= 82.3679
(8,7,6)	PSNR= 30.8001 CR= 24.1861	PSNR= 30.4551 CR= 15.0138	PSNR=27.02 34 CR=40.3508	PSNR=29.10 15 CR=101.7245	PSNR=31.0 042 CR= 22.2473	PSNR=30.5 652 CR= 14.0290	PSNR= 27.0727 CR= 37.8679	PSNR= 29.3920 CR= 92.1744
(8,6,4)	PSNR= 31.5150 CR= 18.4140	PSNR= 31.1877 CR= 11.9888	PSNR=27.12 94 CR=36.6911	PSNR=29.16 76 CR=94.6197	PSNR=31.7 780 CR= 16.9405	PSNR= 31.3533 CR= 11.1572	PSNR= 27.1950 CR= 34.0650	PSNR= 29.5115 CR= 83.4428
(8,4,1)	PSNR= 32.5046 CR= 11.0695	PSNR= 32.3760 CR= 7.6974	PSNR=27.38 32 CR=28.2281	PSNR=29.39 47 CR=71.0706	PSNR=32.9 080 CR= 10.0580	PSNR= 32.6515 CR= 7.0900	PSNR= 25.7706 CR= 27.4803	PSNR= 29.8774 CR= 57.6394
(6,4,3)	PSNR= 33.1988 CR= 13.3692	PSNR= 32.7091 CR= 9.1615	PSNR=27.61 80 CR= 28.2498	PSNR=30.10 26 CR= 63.6852	PSNR=33.4 534 CR= 12.1748	PSNR=32.8 226 CR= 8.5377	PSNR= 27.7469 CR=25.300 1	PSNR=30 .5672 CR=52.43 40

(6,3,1)	PSNR= 33.8508 CR=8.7 230	PSNR= 33.3306 CR= 6.7373	PSNR=27.76 01 CR=23.3567	PSNR= 29.6337 CR=76.9823	PSNR=34.2 308 CR=7.8515	PSNR= 33.3719 CR= 6.243	PSNR= 27.9225 CR= 20.6976	PSNR=30 .9352 (c)CR= 35.3356
(6,2,0.5)	PSNR= 34.2213 CR=6.8 971	PSNR= 33.4310 CR= 5.8857	PSNR=27.80 31 CR=20.9841	PSNR= 29.6337 CR=76.9823	PSNR=34.6 90 CR=6.1138	(b)PSNR= 33.6091 (c)CR= 5.4026	PSNR= 27.9225 CR= 20.6976	PSNR= 31.1142 CR= 29.1339
(4,3,2)	PSNR= 34.5114 CR=9.6 384	PSNR= 33.4326 CR=7.4 551	PSNR=28.00 80 CR=22.1380	PSNR=30.84 36 CR=47.3601	PSNR=34.6 90 CR=6.1138	PSNR=33.5 628 CR=6.9220	PSNR=28.0 24 CR=20.850 8	PSNR= 31.6900 CR=31.42 46
(4,2,1)	PSNR= 35.1839 CR=6.6 161	PSNR= 33.7515 CR=5.9 614	PSNR=28.07 30 CR=19.4219	PSNR=30.83 93 CR=44.0977	PSNR=35.5 092 CR=6.0215	PSNR=33.9 038 CR=5.5082	PSNR=28.0 894 CR=18.276 0	PSNR=32 .0718 CR=22.02 22
(4,1,0.5)	PSNR= 35.5092 CR= 4.9364	PSNR= 33.8715 CR=4.9 566	PSNR=28.09 37 CR= 17.8125	PSNR=30.83 95 CR= 43.9314	PSNR=35.8 924 CR= 4.3191	PSNR=34.0 670 CR=4.3944	PSNR=28.1 118 CR=16.659 3	PSNR=32 .2901 CR=14.92 20
(3,2,1)	PSNR= 35.5092 CR=6.4 102	PSNR= 34.9038 CR= 5.8645	PSNR=28.08 94 CR=19.3521	PSNR= 31.6761 CR=29.9080	PSNR=35.6 731 CR=5.8839	PSNR= 34.0074 CR= 5.4279	PSNR= 28.0960 CR= 18.2161	PSNR=32 .2434 CR= 20.8683
(2,1,0.5)	PSNR= 36.1556 CR= 4.3036	PSNR= 34.2310 CR= 4.3217	PSNR=28.12 06 CR= 17.4675	PSNR=32.23 86 CR= 21.7886	PSNR= 36.2483 CR= 3.9021	PSNR= 34.3240 CR= 3.8263	PSNR= 28.1339 CR= 15.6850	PSNR= 32.6718 CR= 11.7112

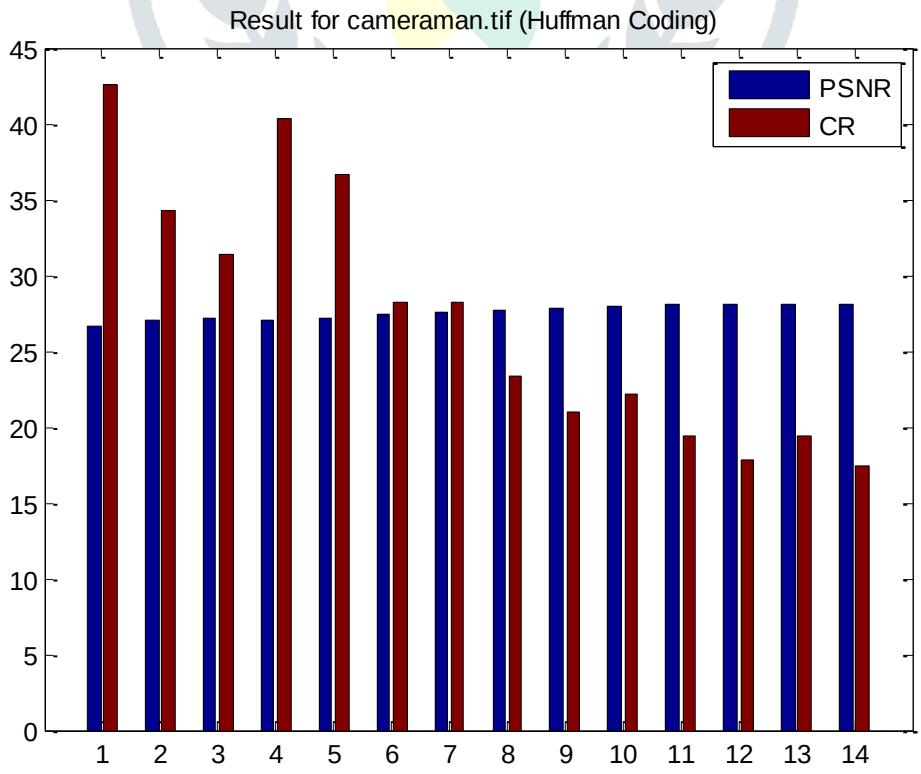


Figure 9: Compression Ratio for cameraman. If image at different error threshold cases by Huffman coding.

V. CONCLUSION AND FUTURE SCOPE

In this work a high diploma of photo compression algorithm is advanced and examined on virtual photograph. For this purpose literature survey of diverse conventional photo compression schemes used to encode the snap shots through pixel-based totally and statistical methods is completed. Fractal based totally image compression is found to be exciting and green at the structure-based photo compression techniques. Fractal picture compression is implemented and is discovered that it may be used now not best in photograph compression coding however additionally in different photograph processing packages like pattern recognition and biometric identification. The most important disadvantage on this set of rules turned into that this photo coding generation of compression faces excessive computational complexity in encoding because of involvement of photo partitioning into some square fractals after which those square fractals compose a large pool set. Because of different kind of block length an picture is partitioned into different pool sets. These pool sets composed of the blocks of large length is called the area pool set and the other pool set is called because the variety pool set. The cells of the variety pool set blocks are encoded. The blocks in the area pool set are shrunk in the identical length because the range blocks pool set, after which fractal photograph compression takes the area pool set price as a virtual listing of the codebook. In this paintings we've implemented no looking of minimal difference matching area block from domain pool set for each range block which become to be searched in preceding algorithms. In this manner this set of rules of fractal image compression removed the exhaustive seek of required in matching block pair's expenses and time, which is one of the fundamental difficulties in Fractal picture compression. In destiny we are able to involve different A.I. Techniques like neural network, ANFIS in hybrid with fractal decomposition rule for finding out mechanism of photograph sub fractals.

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