

Smart Fuzzy Scheme Based Image Compression using Quadtree Approach

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Abstract: We have made picture/photograph compression using efficient fractal decomposition on this work. We have used quadtree 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 pixels 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. Quadtree 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 an 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 assist to boom the compression ratio (CR) and peak signal 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.

Keywords: Image Compression, Fuzzy Logic, Quadtree Approach, PSNR.

1. Introduction:

Image enhancement procedures consist of a collection of techniques that are looking for to improve the visible appearance of an photo or to transform the picture to a shape higher suitable for evaluation by a human or a machine. 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 an 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.

Fractal decomposition represents an excellent mathematical framework to deal with uncertainty of statistics. Fractal photograph compression is the gathering of all methods that apprehend represent and procedure the photos, their segments and features as fraction sets.

In the existing thesis, an algorithm is proposed for Fractal Decomposition of DCT distinction blocks as in step with error thresholds. This algorithm enhances image contrast in addition to preserves the brightness very efficiently. This also reduces its computational complexity. This technique makes use of the illustration and processing of virtual image in fractal facts. These pixels in fractal DCT area handle the inexactness of grey-degree values in a better way in comparison to conventional strategies, which improves its overall performance. Hence, proposed set of rules may be used for picture enhancement of negative excellent images. All the implementation paintings has been done in MATLAB 7.5 Image Processing device box.

Data representation in Matlab is the feature that distinguishes this surroundings from others. Every statistics is presented with matrices. The definition of matrix is a rectangular array of numbers. Most pix are kept in -dimensional matrices. Each element corresponds to at least one pixel within the photo. True color pictures require a third measurement to keep the facts approximately intensities of RGB hues. Image Processing Toolbox gives wide range of features responsible for calculations. It lets in consumer to look through the effects of fractal decomposition related computations.

Experimental outcomes show that the quality of photograph is advanced after Fractal DCT difference photograph compression. It is examined on one of a kind commonplace formats of pics taking one of a kind thresholding function.

2. 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.

3. Literature Review:

This chapter covers the literature review within the discipline photo compression methodologies advanced in ultimate many years. It covers all of the complete survey of methods based on fractal and /or Transform concept based applications in photograph compression.

[1] 1952, DAVID A. HUFFMAN

An 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-Loève remodel, which is known to be most fulfilling. The performances of the Karhunen-

Loève and discrete cosine transforms are also found to evaluate

intently with recognize to the rate-distortion criterion. In conclusion, they compare the performance of the DCT with KLT, DFT, and the identity transforms, using the price-distortion criterion. This performance criterion offers a degree of the facts fee R that can be executed whilst nonetheless maintaining a fixed distortion D , for encoding functions. Considering Gaussian assets along with the mean-rectangular mistakes criterion, the rate-distortion performance degree. Where A denotes the orthogonal transformation and the a_j are the principle diagonal phrases of the transform area covariance matrix '1 in (12). The charge-distortion pertaining to $M = 16$ and $p = 0.9$ is shown in Fig. 5:(Compression Ratio for lena.jpg image at different error threshold cases.) from which it's miles obvious that the KLT and DCT compare more closely than the KLT and DFT.

[3]1991, TassosMarka

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. Another magnificence of distortion managed algorithms which might be supplied is primarily based on recursive quantization of errors picture blocks that represent the difference among the current approximation and the unique block. We can even describe the innovative compression homes of these algorithms. Finally, we can gift their compression/distortion performance the usage of satellite images provided by means of NASA, and me will show that they acquire better performance than the TSVQ algorithms at high bit quotes. In this work we've got supplied a class of distortion controlled vector quantizers which are succesful of compacting pictures so that they agree to positive distortion necessities. This magnificence of facts compression algorithms is relevant in instances in which massive lack of facts can't be tolerated. These algorithms may be used in a huge range of applications, from compressing pictures at low fees for short surfing of massive amounts of statistics, to high charges for certain examination of images with high information content material. In conclusion, it's been shown that the performance of these algorithms exceeds the overall performance of conventional TSVQ strategies at low fees primarily based on the MSE distortion degree.

4. Methodology:

2D Image Input: The essential two-dimensional image is a monochrome (gray scale) image which has been digitized.

Portray image as a two-dimensional light intensity function $f(x,y)$ where x and y are spatial coordinates and the value of f at any point (x, y) is comparative to the brightness or gray value of the image at that point. A digitized image is one where:

- spatial and gray scale values have been made discrete.
- intensity measured across a regularly spaced grid in x and y directions
- intensities sampled to 8 bits (256 values).

For computational purposes, we may reflect of a digital image as a two-dimensional array where x and y index an image point. Each element in the array is called a pixel (picture element), shown in Figs. 1 and 2.



Fig 1: Gray scale image and highlighted region

00	71	61	51	40	40	35	53	86	00
03	74	53	56	48	46	48	72	85	102
101	60	57	53	54	52	64	82	88	101
107	82	64	63	50	60	81	00	03	100
114	03	76	60	72	85	04	00	05	00
117	108	04	02	07	101	100	108	105	00
116	114	100	106	105	108	108	102	107	110
115	113	100	114	111	111	113	108	111	115
110	113	111	100	106	108	110	115	120	122
103	107	106	108	100	114	120	124	124	132

Fig 2: Pixel values in highlighted region

An image is an array, or a matrix, of square pixels (picture elements) arranged in columns and rows.

Fundamental Steps in Digital Image Processing

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.

Fractal domain Method

Fractal based image block processing is a collection of various decomposition techniques to picture processing that could understand, represent and process the photograph. It has 3 essential stages, particularly, photograph block processing, change of blunders threshold characteristic values, and decomposition. Fractal photo compression is based totally on DCT block difference degree mapping into errors threshold feature. The aim is to generate an reconstructed image of similar contrast but higher PSNR than the authentic image by using giving a larger weight to the gray levels which can be toward the mean gray degree of the photo which might be further from the imply.

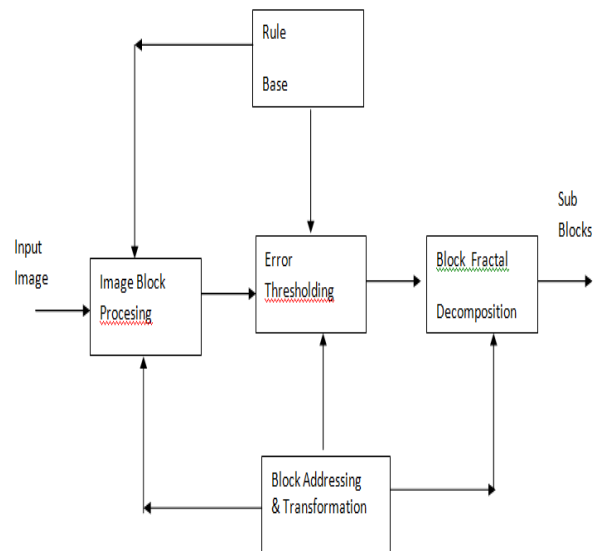


Fig. 3: Fractal image processing

Discrete Cosine Transformation (DCT)

DCT is an orthogonal remodel, the Discrete Cosine Transform (DCT) attempts to decorrelate the photo statistics. After decorrelation each rework coefficient may be encoded independently with out dropping compression performance. DCT separates photographs into parts of different frequencies in which much less important frequencies are discarded thru quantization and crucial frequencies are used to retrieve the photograph during decompression.

DCT Process-

- Original image is divided into 8 x 8 blocks.
- Pixel values of a black and white image range from 0-255 where 0 corresponds to a pure

black and 255 correspond to a pure white. But DCT is designed to work on pixel values ranging from -128 to 127. Therefore each block is modified to work in the range. Then working from left to right, top to bottom the DCT is applied to each block.

□ The two-dimensional DCT is given by follows

$$C(u, v) = D(u)D(v) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x, y) \cos \left[\frac{(2x+1)u\pi}{2N} \right] \cos \left[\frac{(2y+1)v\pi}{2N} \right] \quad \text{Eq1}$$

Where, $u, v=0, 1, 2, 3 \dots N-1$ The inverse 2D-DCT transformation is given by the following equation:

$$f(u, v) = \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} D(u)D(v) d(u, v) \cos \left[\frac{(2x+1)u\pi}{2N} \right] \cos \left[\frac{(2y+1)v\pi}{2N} \right] \quad \text{Eq2}$$

□ Than Each block,s elements are compressed through Quantization means dividing by some specific 8X8 matrix called QMatrix and rounding to the nearest integer value.

□ After Quantization, all of the quantized coefficients are ordered into the zigzag sequence. Compressed image is reconstructed through re-verse process. Inverse DCT is used for decompression.

Proposed Work(Algorithm)

- 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.

5. Results and Discussions

In this chapter The consequences of fractal photograph compression using Fractal decomposition of DCT block difference selection mechanism is explained in exact way. The set of rules is evolved on Matlab primarily based platform the use of picture processing and sign processing toolbox. Several instances are considered for wellknown gray scale photograph to generate compressed image and then the compressed picture is decompressed again to visualise the unique and recovered picture under one-of-a-kind take a look at instances. The losses because of approximation of area block and variety block variations makes failure of high first-class of restoration of photograph data. Due to this mistakes are determined in among recovered and authentic picture for reading the result performance the PSNR values are measured for distinctive mistakes threshold situation.



Fig 4: ' leena.jpg ' original image

Figure 4 shows the original image of leena.jpg on passing this image by block based fractal DCT difference image compression the decompressed images are shown in figure 5.

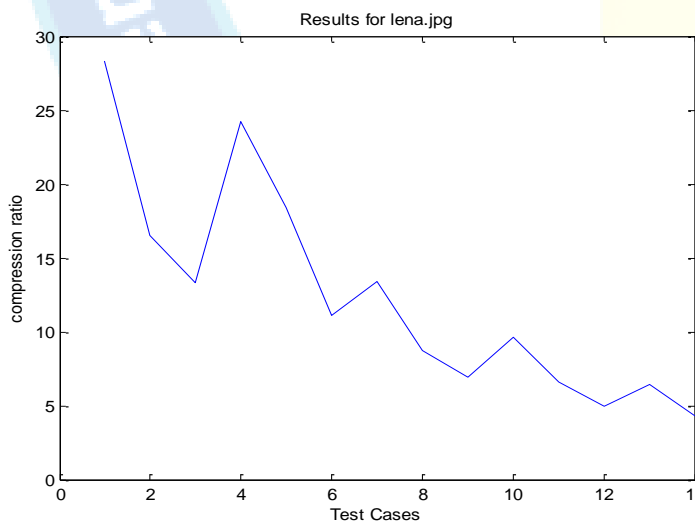


Fig. 6: (a to l) the decompressed images of lena.jpg at different error thresholds are shown the value of PSNR and CR for these results are plotted below:

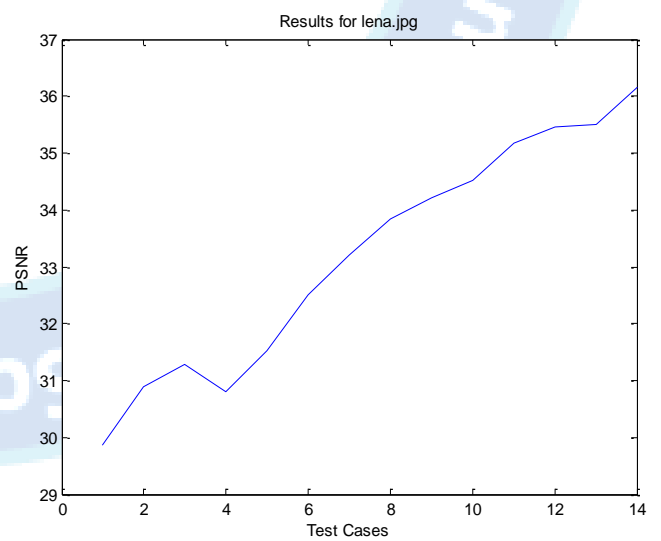


Fig. 7: Compression Ratio for lena.jpg image at different error threshold cases.

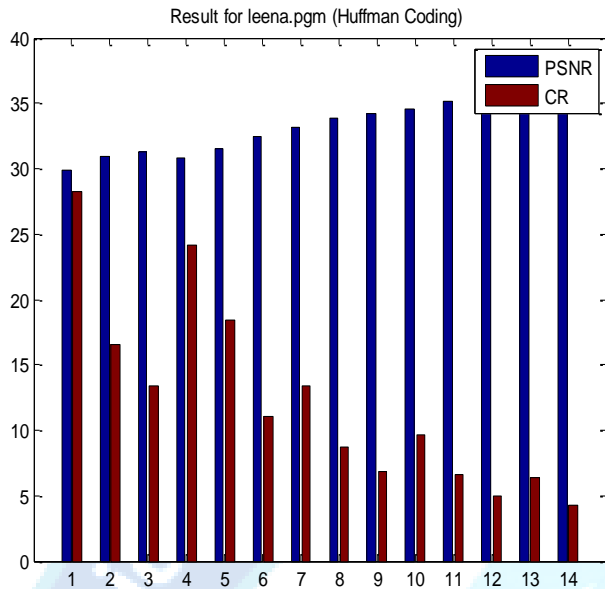


Fig. 8. PSNR for lena.jpg image at different error threshold cases by Huffman Coding.

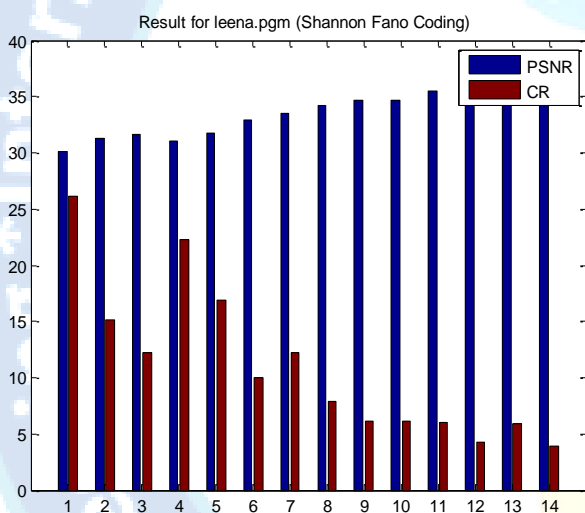


Fig. 9: PSNR for lena.jpg image at different error threshold cases by Shannon Fano Coding.

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 scheme used to encode the snapshot through pixel-based totally and statistical method is completed. Fractal based totally image compression is found to be exciting and green at the structure based photo compression technique. Fractal picture compression is implemented and is discovered that it may be used now not be it in photograph compression coding however additionally in different photograph processing package like pattern recognition and biometric identification. The most important disadvantage on this set of rule turned into that this photo coding generation of compression face excessive computational complexity in encoding because of

involvement of photo partitioning into some square fractal after which those square fractal compose a large pool set. Because of different kind of block length an picture is partitioned into different pool set. The pool set composed of the block of large length is called the area pool set and the other pool sets called because the variety pool set. The cell of the variety pool set block are encoded. The block in the area pool set are hunk in the identical length because the range block pool set, after which fractal photograph compression take the area pool set price as virtual listing of the codebook. In this painting 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 algorithm. In this manner this set of rule of fractal image compression removed the exhaustive seek of required in matching block pair's expense and time, which is one of the fundamental difficulties in Fractal picture compression. In de tiny we are able to involve different A.I. Technique like neural network, ANFI in hybrid with fractal decomposition rule for finding out mechanism of photograph sub fractal.

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