AN EFFICIENT AND RELIABLE IMAGE COMPRESSION FOR HIGH DATA RATE APPLICATIONS

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Abstract*:* The main idea of image compression is to reduce the size of an image without losing its resolution and original information of an image. Fractal image compression is one of the lossy compression techniques, which reduces the image size in large amount but it reduces the image quality also which is not useful for most of the applications. Another drawback of fractal image compression is, it takes much time for encoding the image. So to overcome these drawbacks a hybrid model is proposed. In this technique wavelet based fractal image compression is used along with coding technique called Huffman which reduces the image size by preserving the image quality and encoding the image in less time. This reliable image compression gives the best compression ratio (CR) at required peak signal to noise ratio (PSNR) and low bit rates.

Keywords: — Fractal coding, Wavelet transform, Image compression, Quadtree partition, Huffman coding

I. INTRODUCTION

In present multimedia applications the image compression is most preferable in order to reduce the storage space, time required for communication and to meet other requirements. Hence the fractal image compression technique got much famous for achieving high compression ratio.

The fractal image compression gives the large reduction of image size along with which reduces the image quality also. The compressed image is present with large number of blocking artifacts at low bit rates which increases the encoding time. These are the main drawbacks with fractal image compression, which are not useful for many applications.

Even though fractal compression gives large compression, further this technique is implemented by using different methods in order to overcome its drawbacks.

In present paper the hybrid modal is used which overcomes the problem of less encoding speed and it preserves the image quality with high compression ratio at required PSNR values. Here the image is first subjected to wavelet transform, from this the low frequency components i.e. approximation coefficients are subjected to fractal transform further these fractal codes are encoded by using Huffman coding method. Here the low frequency components are further decomposed to 1 level after fractal decoding to determine the lower resolution subband details [1].

In this paper different parts are given as follows: Part II tells about the existing method. Part III tells about the proposed method. Part IV deals with advantages and applications. Part V explains about experimental results .finally part VI and VII gives the conclusion and Future Scope respectively.

II.FRACTAL IMAGE COMPRESSION

In the existing system fractal image compression method is used. Fractal image compression is a reasonably current method based on the representation of an image by a con-tractive transform, on the space of images, for which the fixed point is close to the original image. This expansive principle encompasses different types of methods; lots of those methods have been explored in the present area of published research. Whereas certain conjectural aspects of this illustration are well recognized, fairly modest attention has been given to the construction of a consistent fundamental image representation which can rationalize its use. Nearly all solely fractal-based methods are not competitive with the existing state of the ability.

BLOCK DIAGRAM OF EXISTING SYSTEM

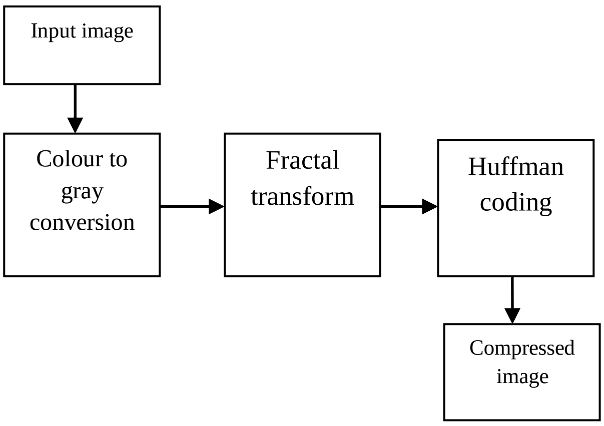


Fig1. Fractal compression

COLOUR TO GRAY CONVERSION :

Here the color image can be converted into gray scale image by using average method or weighted method. This operation would be done for each pixel because color increases the complexity of the model.

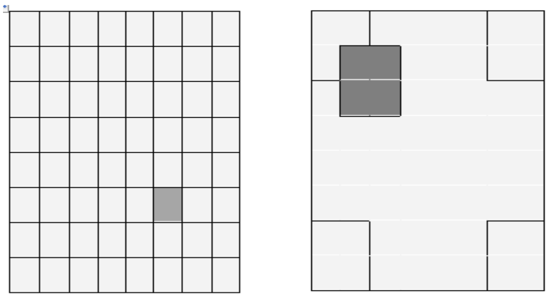
FRACTAL TRANSFORM:

The fractal transform converts the gray scale image which is taken as input into fractals by following below steps,

1. Partition the image domain into range blocks R_i of size $s{\times}s$.
2. For each R_i, search the image to find a block D_i of size $2s{\times}2s$ that is very similar to R_i.
3. Select the mapping functions such that $H(D_i) = R_i$ for each i.

In the second step, it is significant to find a comparable block so that the IFS accurately characterize the input image [2], so an enough number of applicant blocks for D_i need to be measured. On the other hand, a large search considering many blocks is computationally costly.

Specific methods of partitioning the image into range blocks of various configurations and dimensions; speedy strategies for speedy finding a near-sufficient matching area block for every range block in place a close-enough matching domain block, inclusive of speedy movement estimation algorithms[2]; extraordinary ways of encoding the mapping from the area block to the range block; and so forth .



Range block domain block

Partition scheme virtual codebook

Fig2. Block mapping

In this method, the image is partitioned into non-overlapping variety blocks of size BxB and overlapping domain blocks on the same picture of length 2Bx2B.each variety block is as compared with all contracted area block separately the use of affine transformation which minimizes the space among range and area block [13]. Domain block are shriveled to fit variety block length through pixel averaging or down sampling by factor two. The affine transformation consists of the brightness offset o, scaling thing s and 8 isometric operations (four rotations and 4 reflections). The smallest amount of MSE is the matching standards and it is dogged by using

$$E(R_i, D_j) = \frac{1}{n}\sum_{i=1}^{n}(s.d_i + o - r_i)^2 \qquad n=B^2 \qquad (1)$$

where
$$s = \frac{n\sum_{i=1}^{n} d_i r_i - \sum_{i=1}^{n} d_i \sum_{i=1}^{n} r_i}{n\sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2} \qquad (2)$$

and
$$o = \frac{1}{n}\left[\sum_{i=1}^{n} r_i - s\sum_{i=1}^{n} d_i\right] \qquad (3)$$

Where r_i and d_i are the pixel value of range and constricted domain block in that order. The fractal parameters that are needed to be saved in the encoded bit stream are s, o, index of the finest identical domain, and symmetry index. These fractal codes are applied iteratively to any subjective image for decoding and will converge to obtain decoded image[1]. The coefficients s and o make in no doubt that transformation is contractive mapping. Every range block need this comprehensive searching procedure to equivalent domain block and it is answerable for very elevated encoding time.

This fractal transform converts the input image into mathematical data called "fractal codes".

HUFFMAN CODING:

Huffman coding is a lossless data compression algorithm which converts fractal codes into binary data by assigning the variable length codes to input data that is fractal codes, length of the assigned codes based on the frequencies of corresponding character.

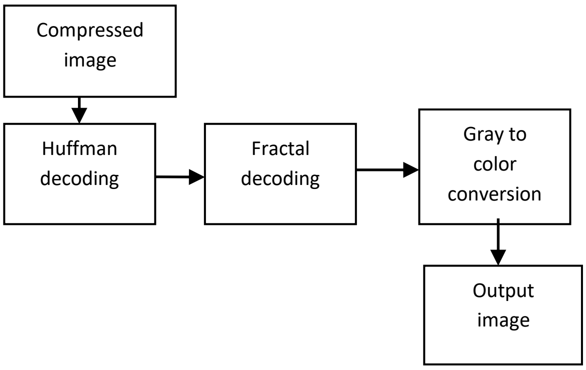


Fig3. Fractal decompression

HUFFMAN DECODING:

Huffman decoder decodes the received data of the compressed image by iterating the encoded data. To find the

Fractal code corresponding to the current bits.We start first root and do following until a leaf is found.

1. We start from root and do following until a leaf is found.
2. If current bit is 0, we move to left node of the tree.
3. If the bit is 1, we move to right node of the tree.
4. If during traversal, we meet a leaf node, we can obtain fractal code of that leaf node and then once more continuous the iteration of the encoded data beginning from step 1.

FRACTAL DECODING:

Fractal image compression is an efficient method for efficiently coding images. In which an image is encoded by a contractive transformation whose fixed point is close to original image and then is decoded by using iteration theorem with a control parameter is presented which provides a novel iteration procedure that progressively approaches the fixed point of a contractive transformation and particularly reverts back to the conventional iteration procedure, a progressive decoding which does not need any specific fractal encoder and is useful for low bandwidth transmission. Hence it can convert fractal codes which are generated from Huffman decoder into gray scale image.

GRAY TO COLOUR CONVERSION:

The gray scale image acquired from fractal decoder or inverse fractal transform can be converted into original color image by using gray to color conversion.

But the decompressed image is not exactly same as input image; because here used technique is fractal image compression which is one of the lossy compression methods a few amount of data was lost. The amount of data separated is considered as redundancy, so here the removal redundancy is a advantage in this method .but there are blocking artifacts still present at low bit rate. In addition to this it takes more time for encoding the data.

DRAWBACKS OF EXISTING SYSTEM:

Fractal compression is much slower to compress than JPEG. It decompresses at a similar rate or even a bit faster. Also, the enhanced compression ratio may have been an illusion. Fractal compression only has a large advantage over JPEG at small image quality levels, which is not what most people want. The claim that fractal compressed images, when enlarged beyond their original size, looked better than similarly enlarged JPEG images seems also to have been an irrelevant distinction.

Today fractal compression seems to be even less relevant, with wavelet compression outperforming it in most applications for those willing to brave the patent problems, and JPEG still out there and working well enough for many people

- A demanding problem of continuing research in fractal image representation is how to prefer the $f_1,\ldots,f_N$ such that its fixed point approximates the input image, and how to do this efficiently.
- Fractal image coding is one of the alternatives for high compression rate but due to comprehensive encoding time, it has imperfect practical applications.

III.PROPOSED HYBRID MODEL

In this project we appraise a hybrid wavelet-fractal image coder, and we experiment its capability to compress the different images and decompress the same. A relative study between the hybrid wavelet fractal coder and standard fractal coding compression technique have been made in order to examine the compression ratio with high quality of the image using peak signal to noise ratio and also computation (encoding) time. We find that the superior performance of the hybrid wavelet-fractal coder (WFC).

The WFC uses the fractal contractive mapping to predict the wavelet coefficients of the higher resolution from those of the lower resolution and then encode the forecast remainder with a bit plane wavelet coder. The fractal forecast is adaptively applied only to regions where the rate saving offered by fractal forecast justifies its visual projection. A rate-distortion criterion is derived to assess the fractal rate saving and used to select the optimal fractal parameter set for WFC.

In this project, we propose a fast, efficient fractal image compression scheme with wavelet structure to increase the Speed and obtain high quality at low bit rates.

Cross correlation with mean square error (MSE) as matching criteria is applied to only low frequency components using quad tree partition. Other wavelet coefficients are predicted using non iterative fractal coding with variable size sub tree representation. Here low frequency information is again decomposed to 1 level after fractal decoding to predict the lower resolution subband details.

BLOCK DIAGRAM OF PROPOSED SYSTEM

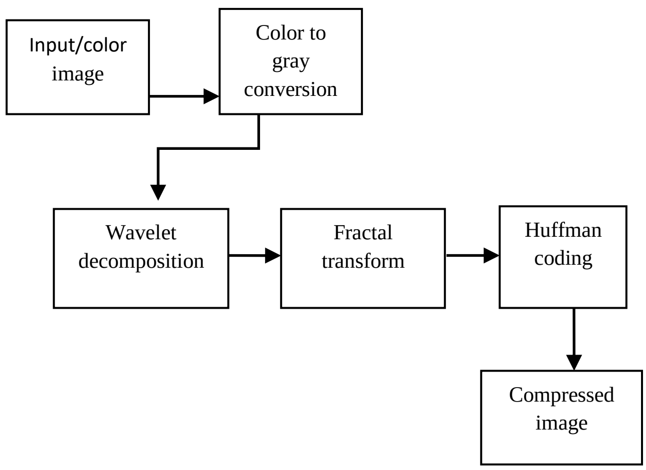


Fig 4.Wavelet based fractal compression

The Block Diagram of wavelet based fractal image compression is shown in above figure. This is responsible for reducing or eliminating any redundancies in the input image and also responsible for reducing the encoding time.

COLOUR TO GRAY CONVERSION:

Here the colour image can be converted into grayscale image by using average method which is most simple one. Colour increases the difficulty of the modal. Hence here the image compression is done by using gray level image as opposed to colour, not because of the format of gray level images, but because the inherent complexity of gray level images is lower than that of colour images.

WAVELET TRANSFORM DECOMPOSITION AND CONSTRUCTION OF SUBTREES:

Here the wavelet decomposition is ddecomposing the gray scale image into its smooth variations and details can be obtained simply by using a Discrete Wavelet Transform (DWT) [12]. The decomposition process is divided into several levels. Every level will construct a two-dimensional array of coefficients contains four bands of data. These bands are labeled as LL (low- low), HL (high-low), LH (low-high) and HH (high-high) respectively. The next level will crumble the LL band once more in the similar manner, by this means producing still more sub bands. This procedure can be frequent to any level, thereby ensuing in a pyramidal decomposition [1].

The wavelet transform coefficients are composed of three kinds of wavelet sub trees horizontal, vertical and diagonal direction sub tree as shown in below figure

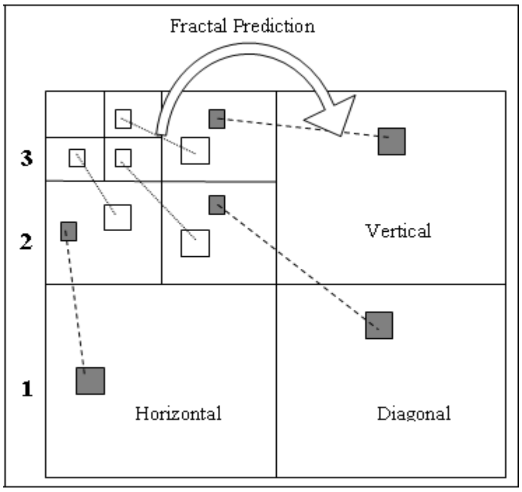


Fig5. Construction of wavelet sub trees with a three-level wavelet decomposition.

The matched domain and range sub trees consist of the blank and filled blocks situated in identical spatial location but with dissimilar resolutions in that order.

The LL band at the upper level of decomposition is classified as the uppermost energy band with smooth visitations, and the other 'detail' bands are classified as lower energy bands with sharp variations [1]. As it is noticeable from the Figure. The amount of energy compaction is reducing from the top of the pyramid to the bands at the underneath. Furthermore, decomposition will not disclose further information concerning the image. After decomposing the image into sublevels, a Stream of coefficients will appear. A small number of those contain the most energy of the image whereas others appear as insignificant details. Hence, the intent is to take out the significant coefficients, which contain the majority of energy, and ignore the others. In spite of the adopted compression scheme in the wavelet domain, if used as is, the low-resolution sub band which contains most of the energy of the image and characterized by its smooth variation will consume most of the bit quota.

Therefore, to efficiently exploit the properties of the fractal image compression this part is coded separately using fractal image coding. Other parts of the image that contain more coefficients but at low amplitude levels will be coded efficiently using the wavelet domain only. To attain this, after decomposing the image signal into sublevels an appropriate threshold is required to control the compression rate and the quality of the detailed sub images. Thresholding is a course that compares some given values to a reference value. A hard thresholding concept is used in compressing the details of the image which is described as setting the values that are less than the reference value to zero, and keeping the other values, which are greater than this value, to their original value.

FRACTAL TRANSFORM:

After the wavelet decomposition the approximation coefficients are subjected to the fractal transform. Here the Fractal transform generates the fractal codes as like the existing system.

HUFFMAN ENCODING:

Huffman encoding is a lossless data compression algorithm .this idea is to assign variable length codes to fractal codes, length of the assigned codes are based on the frequencies of corresponding fractal code. The most frequent fractal code gets the smallest code and the least frequent fractal code gets the largest code. Finally generates the compressed image with high compression ratio, low bit rate and proper PSNR.

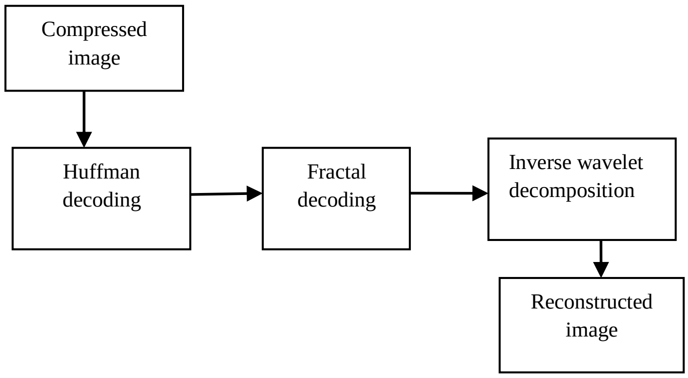


Fig6. Wavelet based fractal decompression

HUFFMAN DECODER:

Huffman decoder decodes the received data of compressed image by iterating the encoded data. To find the fractal code corresponding to the current bits.
We start first root and do following until a leaf is found.
1. We start from root and do following until a leaf is found.
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FRACTAL DECODER:

Fractal image compression is an efficient method for compactly coding images. in which an image is encoded by a contractive transformation whose fixed point is close to original image and then is decoded by using iteration theorem with a control parameter is presented which provides a novel iteration procedure that progressively approaches the fixed point of a contractive transformation and particularly reverts back to the conventional iteration procedure, a progressive decoding which does not need any specific fractal encoder and is useful for low bandwidth transmission. Hence it can convert fractal codes which are generated from Huffman decoder into approximation coefficients and gives it as input to the inverse digital wavelet transform.

INVERSE WAVELET DECOMPOSITION:

In inverse wavelet decomposition IDWT technique is used in order reconstruct original image. This inverse wavelet transform reconstruction the original gray level image by using approximation coefficients generated from the fractal decoder. which then passed through the low pass filter.

Here the decompressed image is not exactly same as original image because DWT is used to remove the blocking artifacts at low bit rates and the fractal coding is a lossy image compression so it almost removes the redundancy bits for the sake high compression ratio.

The resultant image gives better resolution for observing the main details of the image. Hence this kind of jpeg images is more preferable rather than zooming the image whenever there is a need of clear observation in an industrial application.

IV. ADVNTAGES AND APPLICATIONS

ADVANTAGES

- It gives high PSNR for performance of reproduced image.
- Quality of Image reconstructed is good, even at very low bit rates.
- The distortion characteristics of fractal coders are reduced: blocking artifacts are less annoying, images are less blurred.
- For the implemented technique, the encoding time is reduced.
- It gives better compression ratio to reduce memory requirements.

APPLICATIONS

- Fingerprint compression and matching
- Face identification
- Medical applications
- Industrial applications
- Data storage

V.EXPERIMENTAL RESULTS

TABLE 1 SIMULATION RESULTS IN TERMS OF COMPRESSION RATIO, PSNR AND TIME FOR LENA AND BABY IMAGE

As the decomposition level increases the compression ratio also increases with less difference in time but the peak signal to noise ratio is decreases because of lossy compression method.

The proposed technique generates the compressed image with high compression ratio, PSNR and less encoding time.

LENA			
Decomposition level	**Compression ratio(dB)**	**Time (sec)**	**PSNR (dB)**
1	51.13	4.39	48.12
2	84.53	4.46	38.12
3	95.61	4.43	34.12

BABY			
Decomposition level	**Compression ratio(dB)**	**Time (sec)**	**PSNR (dB)**
1	51.16	3.406	46.48
2	84.62	3.375	39.91
3	95.61	3.312	35.80

From the below figure we can notice that the compressed image has high compression ratio than that of original image .It takes less time for encoding and its PSNR is high enough.

Fig6. Stimulated Output

TABLE II COMPAISION OF RESULT IN TERMS OF CR, ENCODINING TIME AND PSNR FOR BABY IMAGE

PARAMETER	EXISTING METHOD	PROPOSED METHOD
Compression Ratio (dB)	48.09	51.16
Time(sec)	5.233	3.406
PSNR(dB)	42.32	46.48

From the above table we can observe that the proposed method got high compression ratio with less encoding time at fruitful PSNR.

VI.CONCLUSION

The novelty of the design is based on the concept of using wavelet decomposition with fractal coding, which improves the efficiency of image compression and decompression in terms of compression ratio, coding time and peak signal to noise ratio.

In this project, all the low frequency sub bands i.e. approximation coefficients are formed by subjecting the original image to wavelet decomposition, theses sub bands are converted into fractal codes by using fractal transform separately. Finally these fractal codes are encoded by using the Huffman coder. Experimental results shows that proposed method helps to improve the visual quality without blocking artifacts at low bit rates than JPEG. Extension with HAAR shows excellent and improved results for low band width utilization.

VII.FUTURE SCOPE

To optimize the proposed system design in terms of coding efficiency, we can use the advance techniques of Huffman coding like secondary and tertiary Huffman coding techniques.

REFERENCES

[1] R.E.Chaudhari, B.Dhok, "Wavelet transformed based fast fractal image compression", *International Conference on Circuits, Systems, Communication and Information Technology Applications (CSCITA)*, IEEE Xplore 2014.

[2] B. Wohlberg and G. de Jager, "A Review of the Fractal Image Coding Literature," *IEEE Transactions on Image Processing*, vol. 8, no. 12, pp. 1716-1729, December 1999.

[3] R. Rinaldo, G. Calvagno, "Image coding by block prediction of multiresolution subimages", IEEE Transaction on Image Processing, vol. 4, no. 7, pp. 909–920, July 1995.

[4] G. M. Davis, "A wavelet based analysis of fractal image compression", IEEE Transaction on Image Processing, vol. 7, no. 2, pp. 141–154, Feb. 1998.

[5] Taekon Kim, Robert E. Van Dyck, David J. Miller, "Hybrid fractal zerotree wavelet image coding", Elsevier signal Processing: Image Communication, vol. 17, pp. 347-360, 2002.

[6] Jin Li and C.-C. Jay Kuo, "Image Compression with a Hybrid Wavelet-Fractal Coder", IEEE Transaction on Image Processing, vol. 8, no. 6, pp. 868-874, June 1999.

[7] Al-Fahoum A, Harb B, "A Combined Fractal and Wavelet Angiography Image Compression Approach", The Open Medical Imaging Journal, vol. 7, pp. 9-18, 2013.

[8] Yuzo Iano, Fernando Silvestre da Silva, Ana Lucia Mendes Cruz, "A Fast and Efficient Hybrid Fractal-Wavelet", IEEE Transaction on Image Processing, vol. 15, no. 1, pp. 98–105, Jan. 2006.

[9] B. Sankaragomathi, L. Ganesan, S. Arumugam, "Use of Wavelets in Fractal Compression Algorithm for Enhanced Performance", International Journal of Information Systems for Logistics and Management, vol. 6, no. 1, pp. 73-80, 2010.

[10] S. B. Dhok, , R. B. Deshmukh, A. G. Keskar, s transform", International Journal on computing Vol.1, Issue 2, Feb. 2011.

[11] K. M. S. Soyjaudah, I. Jahmeerbacus, " Fractal Image Compression using Quadtree Partitioning", International Journal of Electrical Engineering Education 38/4, October-2001.

[12] Rafel C. Gonzalez, Richard E. Woods, "Digital Image Processing", Second Edition, Pearson Education Asia, 2005.

[13] M. F. Barnsley, L.P. Hurd, Fractal Image Compression, AK Peters, Wellesley, MA, 1993.

[14] M.Antonini, M.Barlaud, P.Mathieu, I.Daubechies. Image coding using wavelet transform", IEEE Transaction on Image Processing, vol. 1, no.26, pp. 205-220, June 1992.

[15] A. pande, Joseph Zambreno," Design and Analysis of Efficient Reconfigurable Wavelet Filters", IEEE International Conference on Electro/Information Technology, pp. 327-332, 2008.