Fractal Image Compression Based on Multi-Objective Genetic Algorithm

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Abstract - The use of social media, handheld devices like smart phones etc and other areas of computer world are generating huge and further increasing amount of information which results in increased storage requirement. Providing good quality of digital image compression techniques and its optimization is in a great demand even though different image compression schemes are available. So that, new and advanced Image compression techniques are required to develop. Digital image compression algorithms also utilize the redundancy in an image so that it can be represented using lesser number of bits while still maintaining acceptable image quality. The compression technique gives the verity of algorithm such as lossless compression and lossy compression. Different algorithms and compression techniques are used to get better compression rate. Multi-objective genetic algorithm (MOGA) technique for the fractal image compression is presented here in this research paper. The MOGA gives the two fitness constraints function one is selection of symmetry block and another is removal of redundant block of information.

Keywords – Image Compression, Multi-objective genetic algorithm, fitness function.

1. INTRODUCTION

Fractal image compression (FIC) is great coding technique according to its features. It gives high compression ratio. It is resolution independence. Decompression process in FIC in faster. It gives good quality retrieved image. It takes advantage of similarities within an image [1]. It has most important characteristics and that is unsymmetrical property of FIC encoding/decoding. FIC technique takes longer time because it needs a large amount of computations to search the best-matched domain block at encoding process. While decoding process is simple and fast. Many researchers have studied and improved FIC in recent years to reduce storage requirements, computational time, and bandwidth [6][7].

Genetic algorithm (GA): It is a search and optimization method to solve nonlinear different problems. GA mimics the evolutionary principles and chromosomal processing in natural genetics to solve optimization problems. GA uses multiple search points to discover good building blocks of solutions in a parallel fashion [7][8].

2. SYSTEM MODEL

The fractal wavelet transform function provides the facility of block symmetry property for the selection of block coefficient. The improved genetic algorithm provide the searching process for block coefficient for finding similar and dissimilar block coefficient for the processing of searching technique. The similar block passes through HCC code matrix and HCC code matrix compressed the image. The compressed image measures the performance of image compression. Results indicate wavelet fractal transforms can décor- relate gray data efficiently. Simple coefficients shuffling makes data to satisfy zero tree features. Classical encoding algorithm fractal in wavelet field is used to generate embedded data flow. Wavelet, a new thing developed from scalar wavelet has good characteristics. In this work, two algorithms, Particle Swarm Optimization and wavelet transform, were applied to solve a structural optimization problem which deals with the design of the wavelet packets. Both the DWT and genetic algorithms produced reasonable results in terms of PSNR and the compression scores.

3. PREVIOUS WORK

This work has been inspired by a number of previous works available in the literature which uses fractal image compression and genetic algorithm. Many literature researches used GA for FIC to find the optimal solution and speed up the FIC encoding time. Many of these researches lead to bad peak signal to noise ratio (PSNR) and lower compression ratio (CR) or need large computation time. Whereas, few of literature researches are related to solve the problems based on GA and implemented using parallel programming to increase the speed of computations. Other literature researches where solved the problem of FIC by adopting parallel processing. Whereas, very few literature researches are related to FIC based GA and implemented using parallel programming [1]. To obtain higher compression ratios by preserving quality, a fractal method which uses adaptive portioned iterated function system

(PIFS) based on variants of affine transformations and lossless compression methods was developed by Murray H. Loew, et al in which Polynomials of various orders were used to represent adaptively the similarity of grayscale based on the original details of the image [2].

4. PROPOSED METHODOLOGY

The proposed algorithm is composition of fractal wavelet transform function, genetic algorithm and HCC matrix. The fractal wavelet transform generates the symmetrical block coefficient, the symmetrical wavelet coefficient decomposed into number of layers. The decomposed layers computes in fashion of horizontal vertical and diagonal transform. The values of transform combined and make block matrix. The block matrix process for motion estimation process of structure reference process. The structure reference process set the block value of similar and dissimilar. For the finding the position the value of equal coefficient used improved genetic algorithm. The improved genetic algorithm searches the block coefficient for passes of code matrix HCC. The proposed algorithm discuss in three sections. Section first discuss the process of fractal transform function and in second section discuss structure reference section for allocation of block coefficient. And finally discuss the process of code matrix.

➢ SECTION FIRST

1. Input the image.
2. Apply 2D fractal transform function and decomposed the image into number of layer in terms of details and approximate.
3. The processes of property of symmetry of fractal transform function.
4. Compute the value of symmetry in the form of transform value.
5. The block coefficient value of transform form a series of coefficients a1……an.
6. These coefficient passes through genetic algorithm and find optimal set of structure.

➢ SECTION TWO

1. In this phase initialized the population set N=512;
2. Define the fitness constrains selection for similar structure and dissimilar structure.

$$fitness = V(r1,r2)/M(ri)$$

3. Load the selected coefficient block for the process of encoding.
4. Define the correlation coefficient parameter is r1-r2=x.
5. for every coefficient Ri in V
   x=0;
6. for every coefficient in Ri in V
   xij=x(ri,rj)
7. if(x=1) then coefficient is non- redundant
8. else coefficient is redundant
9. Two block code are generate one is redundant and another is non redundant.

➢ SECTION THREE

1. The sorted coefficient of redundant and non-redundant input the HCC matrix.
2. Image compressed.
3. Find C.R value.

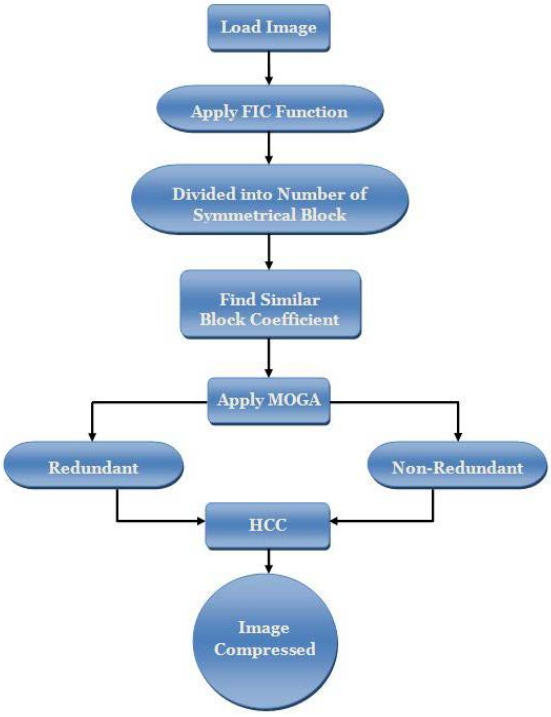

Fig.1: Flowchart of proposed framework.

5. SIMULATION/EXPERIMENTAL RESULTS

The proposed compression algorithm is implemented using MATLAB software. For the performance of the proposed algorithm used sequence of Cameraman, Leena and Barbara image. The sequence used is gray-scale. The images in these sequences are of dimension 512*512. For the validation of proposed FICIGA algorithm compared with JPEG algorithm and FICGA algorithm.

Table-1: Shows that the PSNR, Compression Rate in bits/pixel and Compression Ratio using JPEG, FICGA and FICIGA method for Cameraman.jpeg image.

Image	Method Name	PSNR	Compression Rate	Compression Ratio
Cameraman	JPEG	22.4304	0.5456	8.3805 : 1
	FICGA	26.1212	0.48461	12.0715 : 1
	FICIGA	27.9669	0.43588	15.7626 : 1

Table-2: Shows that the PSNR, Compression Rate in bits/pixel and Compression Ration using JPEG, FICGA and FICIGA method for Leena.bmp image.

Image	Method Name	PSNR	Compression Rate	Compression Ratio
Leena	JPEG	71.660	0.17078	26.7738 : 1
	FICGA	83.4521	0.15169	38.5658 : 1
	FICIGA	89.3481	0.13644	50.3578 : 1

Table-3: Shows that the PSNR, Compression Rate in bits/pixel and Compression Ration using JPEG, FICGA and FICIGA method for Barara.png image.

Image	Method Name	PSNR	Compression Rate	Compression Ratio
Barbara	JPEG	17.199	0.71153	6.4262 : 1
	FICGA	20.0302	0.63198	9.2566 : 1
	FICIGA	21.4453	0.56843	12.0869 : 1

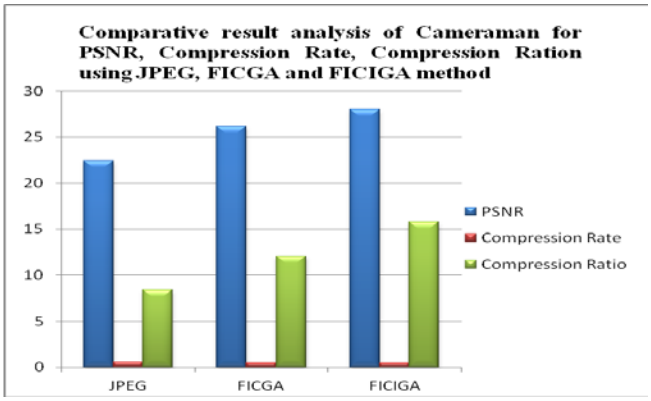

Fig.2: Shows comparative result analysis of Cameraman for PSNR, Compression Rate and Compression Ratio using JPEG, FICGA and FICIGA method and it is found that proposed FICIGA method gives better PSNR and Compression Ratio values than existing methods.

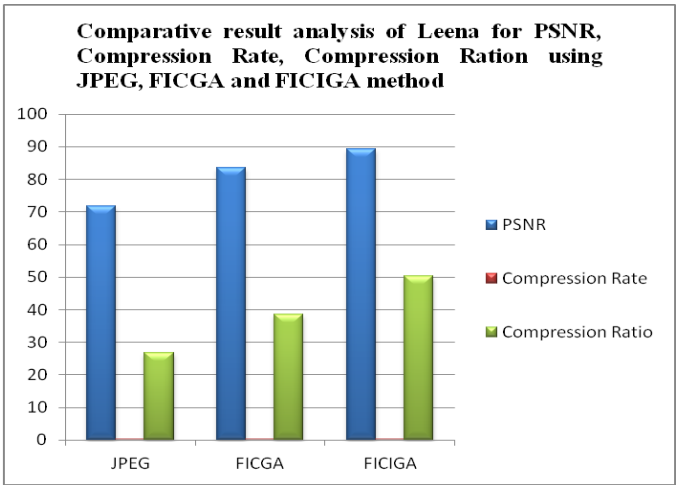

Fig.3: Shows comparative result analysis of Leena for PSNR, Compression Rate and Compression Ratio using JPEG, FICGA and FICIGA method and it is found that proposed FICIGA method gives better PSNR and Compression Ratio values than existing methods.

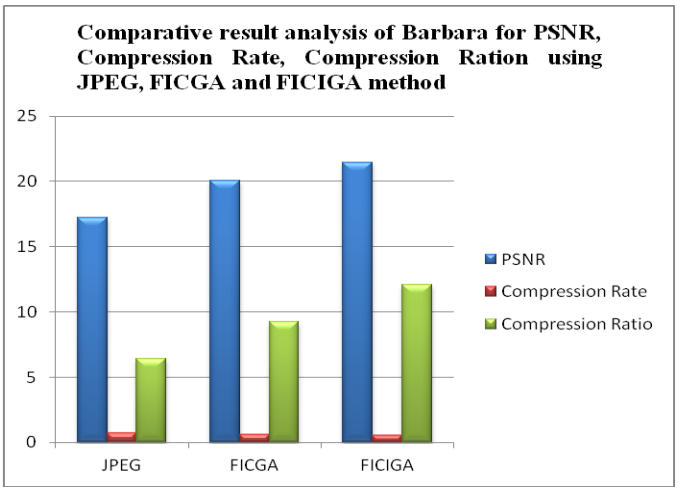

Fig.4: Shows comparative result analysis of Barbara for PSNR, Compression Rate and Compression Ratio using JPEG, FICGA and FICIGA method and it is found that proposed FICIGA method gives better PSNR and Compression Ratio values than existing methods.

6. CONCLUSION

In this paper a hybrid method of image compression is proposed. The hybrid method is a combination of fractal wavelet transform, genetic algorithm and HCC code matrix. The proposed algorithm improved the compression ratio and PSNR value. The increased PSNR value shows that the proposed algorithm is efficient in compression than JPEG and FICGA algorithm. Both the DWT and genetic algorithms produced reasonable results in terms of PSNR and the

compression scores. For the problems of which the feasible region was not narrow, that is when the lower bound of PSNR was low, genetic algorithm was successful. However, when the feasible region was shrieked, the performance of the genetic algorithm was not as good as in the former case.

7. FUTURE SCOPES

In this paper genetic algorithm for adaptive block coding is used for proposed image compression. But genetic algorithm is iterative process so that the computational time of method is increased and also some visual effect of image is degraded. Now in future, work can be done to minimize computational time and for more improvement in visual quality of image. Also, use of another structure optimizations algorithm such as ACO ABC (Ant Colony Optimization Algorithm Based Compression) and another biological inspired function for compression of image for reduction of packet tree.

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