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Digital Image Compression Using Improved Genetic Algorithm

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Abstract: *Improved genetic algorithm increase the compression ratio and rate of digital image. The improved genetic algorithm process the parallel selection of transform block in multiple sequence. For the transformation of image data used the fractal transform function. The fractal transform function gives the non-overlapping blocks of given image. The dimension and transform of image mapped in second dimension. The improved genetic algorithm process of data based on reference direction of image. The direction of image divide into three section horizontal, vertical and diagonal.The proposed algorithm is simulated in MATLAB software and used standard image dataset such as Leena, Barbra and cameraman. For the evaluation of the performance measure the value of PSNR and compression ratio.*

Keywords: ***Digital Image, Compression, Fractal Transform, Genetic Algorithm.***

I. Introduction

The digital multimedia is famous because of their highly perceptual effects. However, it often requires a large amount of data to save these multimedia data due to the complex information detail they may encounter [8][10]. Now, the resolution's need is much higher than stating, such that the data size of the image is surprisingly too large. So, image compression has presented to be an important technique as one solution. Currently, terms of digital image information details in large amount is provided. The result solution for the storage of this detail information and transmission of this information is compression of image. There are several applications of image transmission such as long distance communication, TV broadcasting, remote sensing using satellite etc [13]. The increasing rate of multi-media data required more storage and more bandwidth for the transmission of data. Now the current system and communication system required compression technique of digital data. The compression technique reduces the size of data and increases the efficiency of bandwidth and transmission. In current scenario of image compression various authors used various compression techniques some are based on transform function and some one based on the concept of neural network and swarm intelligence. In this paper proposed an improved genetic algorithm along with fractal transform function for the processing of image compression. The proposed algorithm is also called extension of JEPG compression technique and fractal transform compression technique. in the process of proposed work discuss the property and working principle of fractal transform, parallel genetic algorithm and proposed algorithm and model. The transform function plays an important role in digital image compression. In family of transform function gives one member is called fractal transform function. Basically, the fractal transform function is loosy image compression technique. But in this work fractal transform function work as lossless image compression [4]. The fractal transform function used the property of similarity. The property of similarity index combined the data in from of processing in terms of compression. overall, the FACTRAL algorithm makes full use of the characteristics of wavelet coefficients involving the energy clustering and the energy attenuation along with the increase of scalability. Furthermore, buying combining the quad tree partition with the bit-plane encoding, this method can nearly achieve the same compressing performance with the SPIHT. The rest of paper discuss in section II Related work. In section III discuss improved genetic algorithm, in section IV proposed algorithm, in section V discuss experimental result and finally discuss conclusion & future work.

II. Related Work

In this section discuss the related work in the field of image compression. The process of image compression used various transform function and heuristic based function. Here some work discusses in tabular form.

Et al.	Authors	Method	Description
[1]	Omaima N. Ahmad Al-Allaf	Experiments based on these two approaches (ParFor and Co-distributor) were conducted with comparisons	The research results showed that the compression computation time can be reduced when decreasing the GA population size and increasing number of workers in parallel computing. Best results obtained from implementing Co-distributor approach with 6 workers and 150 population size. The execution speed for Co-distributor reached 3s with PSNR equal 34.89db and CR equal 90.65%. . The experimental results showed that, the Co-Distributor parallel approach requires less computation time. At the same time, when

			adopting Co-Distributor, best quality of the CR and decompressed image (PSNR) can be increased.
[2]	Mai Xu, Shengxi Li, Jianhua Lu and Wenwu Zhu	A CCSR approach to low bit-rate image compression using a learnt over-complete dictionary of texture patches.	CCSR approach, given learnt over-complete dictionary, an image patch can be well represented with linear combination of elements selected from this dictionary, based on the coefficients constrained by the proposed CCSR formulation. Then, a recursive algorithm was proposed to solve linear optimization problem of CCSR formulation, to obtain the sparse and compressible coefficients. Finally, the CCSR approach is capable of compressing images through the quantization and entropy encoding of compressible coefficients. Besides, the over-complete-dictionary can be learnt off-line from a set of training image patches, using a gradient descent algorithm. The experimental results demonstrated that the proposed CCSR approach greatly out performs the conventional JPEG2000, RLS-DLA, and MP approaches in compressing images at low bit-rates.
[3]	Wei-Yi Wei	On the evaluation and analysis basis they have shown the PCA technique which applied to an image compression.	It is difficult to find, calculate, determine and compare the performance of compression method, if equivalent data sets and performance parameter are not used in all techniques. For certain applications some of these compression methods are good. For certain class of data many methods provide good solution results and prove poor solution results for other. They defined, PAC technique. This approach got its applications in image compression.
[4]	Seyun Kim and Nam Ik Cho	An RGB image lossless compression, implementation is first decorrelated by a reversible color transform and then *Y* component is encoded by a conventional lossless grayscale image compression technique.	They discussed the first transformed into *YCuCv*color space using an RCT, for RGB image compression. After the color transformation, the luminance channel *Y* is compressed by a conventional lossless image coder. Pixels in chrominance channels are predicted by the directional prediction and hierarchical decomposition. In the implementation final result, an appropriate context modeling of prediction residuals is defined and arithmetic coding is applied.
[5]	Sujoy Paul and BitanBandyopadhyay	The discussed compression technique applied to encrypted images is slightly worse, in terms of compression efficiency, than the state-of-the-art lossy image or lossless image coders.	Within the Discussed framework, the image encryption has been achieved via prediction error clustering and random permutation. Highly efficient compression of the encrypted data has then been realized by a context-adaptive arithmetic coding approach. As inputs coding efficiency of described compression method on encrypted images is very close to that of the state of-the-art lossy or lossless image codecs, which receive real, without encrypted images.
[6]	Sujoy Paul and BitanBandyopadhyay	They described about histogram based image related method, a histogram based image compression technique is discussed based on several stages image thresholding.	Important image quality metrics- PSNR, WPSNR and storage size of the compressed image file are used for comparison and testing. Comparison of Shannon's entropy with Tsallis Entropy is also provided. Shannon's Entropy is maximized to obtain the best thresholds. an image thresholding based algorithm is proposed for image compression. Shannon's Entropy is maximized to obtain the best thresholds. Differential Evolution is used to reduce the computational by great extent.
[7]	Vikrant Singh Thakur and Kavita Thakur	a novel data compression method for gray images using fuzzy logic based fusion of available JPEG and JPEG2K Standards to get higher compression ratio as compared to JPEG2K and stand-alone JPEG standards	It is concluded that the discussed method fuzzy based soft hybrid JPEG, not only provide much higher compression ratio but also capable of keeping MSE smaller than JPEG and JPEG2K methods so fuzzy based soft hybrid JPEG method gives efficient gray image compression. In this implementation, fuzzy based soft hybrid JPEG also deducts blocking artifacts generated by discrete cosine transform and DWT. The Fuzzy logic's fusion with the hybrid transform leads to efficient result solution for image imprecise conditions
[8]	Jianji Wang and Nanning Zheng	It is based on the fact that the affine similarly between two blocks in FIC is equivalent to the APCC between them	This research finally got the result that the defined scheme can greatly deduct the encoding time with preserving the reconstructed image quality good.
[9]	TiloStrutz	A whole family of multi-plierless reversible color transforms and investigates their performance in lossless image compression.	The subsequent spatial decorrelation step would implement's result in a signal with higher entropy, leading to worse compression. The used prediction step took these dependencies into account. So that, the color space was not selected according to the best color decorrelation, but according to the presumably minimum bitrate. The results presented that this approach was successful, not only for prediction-based compression, but also for wavelet-based compression schemes.
[10]	Chiyuan Zhang and Xiaofei He	The compression includes storing only the grayscale image and a few carefully chosen color pixel seeds. Rregression models are learned with the stored data to	The key advantage over previous methods comes from the maximum exploitation of the full label set (i.e., the colors for all the pixels) at the encoding stage. TEM-C used the label set to generate and store a difference image for correcting the prediction error and improved the colorization quality significantly. Experimental results demonstrated the outstanding performance of the proposed methods

		predict the missing colors for decompression.	
[11]	K. Srinivasan, Justin Dauwels and M. Ramasubba Reddy	The author has shown image compression algorithms based on image and volumetric coding for multichannel EEG (electro-encephalo-gram) signals which near-lossless and lossless.	Researchers have used a 2-stage coding philosophy: the electroencephalogram data are first coded at an optimal rate using a wavelet-based scheme, and next the residuals are further encoded by an entropy encoding scheme. Such approach guarantees a specifiable maximum error between original and reconstructed signals. The compression algorithms are applied to three different electroencephalogram datasets, every with different sampling rate and resolution. The discussed multichannel compression algorithms achieve attractive compression ratios for low error values compared to algorithms that compress individual channels separately
[12]	Miguel Hernández-Cabronero, Victor Sanchez, Michael W. MarcellinandJoan Serra-Sagristà	The suitability of lossy compression for DNA microarray images and highlights the necessity for a distortion metric to assess the loss of relevant information	The analysis pipeline of DNA microarrays has been discussed, and three key image features have been identified that are the foundation of most current analysis techniques, and very likely for future techniques as well. The identified features are the mean intensity of each spot, of each local background, and the overall the image's intensity.

III. Proposed Methods

Parallel Genetic Algorithm

Genetic algorithm well knows method of searching and optimization algorithm. The process of genetic algorithm based on the dynamic population in the form of chromosome and genes selection. The selection of chromosome and genes based on fitness constraints algorithm. in genetic algorithm used three types of fitness selection algorithm such as wheel technique, rank based technique and parity based technique. the process of genetic algorithm defines in three phase. The phase of genetic algorithm defines in flow chart.

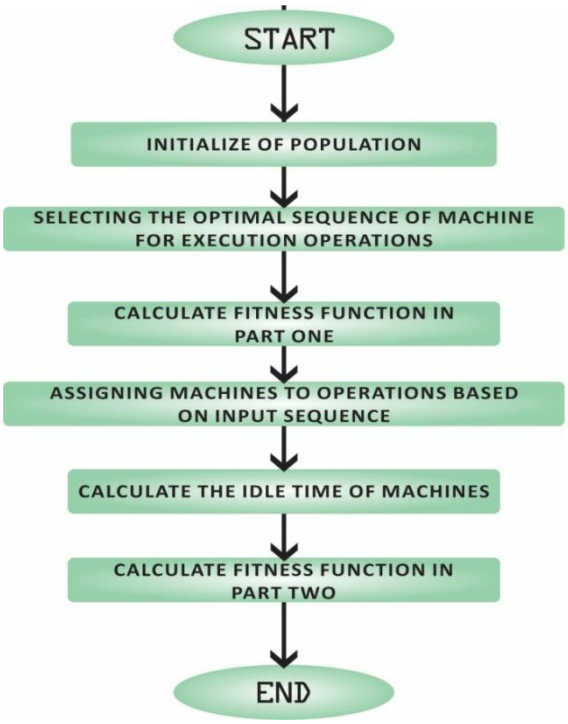

Figure 1: shows that working process of genetic algorithm.

HCC Matrix

The utilization of head code matrix is basically creation of index of image data in terms of redundant and non-redundant. The mapping of redundant and non-redundant data in terms of bit formation index value such as 0 and 1. The formation of index converted into the standard template of JPEG image compression. The JPEG image compression process execute the mapping of transform function. The Mapped data according to the formation of index for the compression purpose. The head coder follows the principle of run length encoding technique. the run length encoding technique proceed the data index in terms of repeated value of bits for the compression.

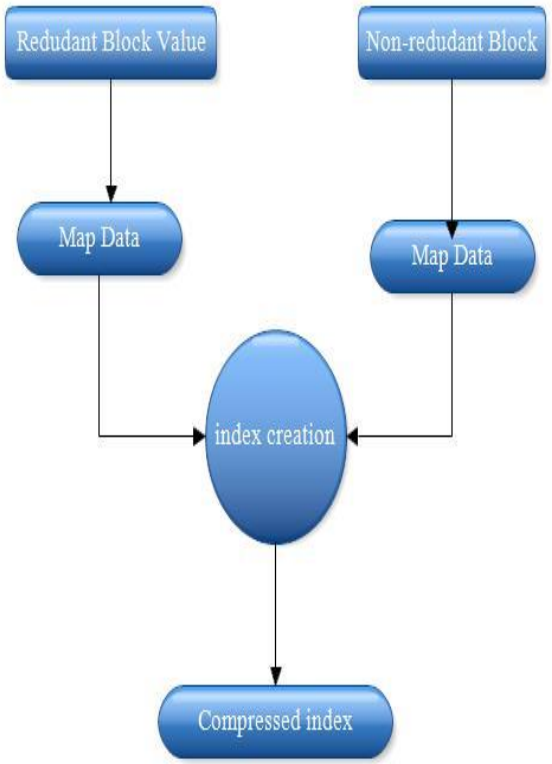

Figure 2: The processing block diagram of HCC matrix.

Proposed Algorithm

The proposed algorithm is combination of transform function and parallel genetic algorithm. For the decomposition of data used fractal transform function, the used transform function decomposed data in different layers the different layer proceed the data for the input of parallel genetic algorithm. The parallel genetic algorithm precedes the data for searching of best set of pixel or transform value for the purpose of input of HCC matrix.

Procedure of FIC (2)
Begin
The process of transform gives non-overlapping blocks
The total number of block according to the size of matrix
Do
PGA (Iij)
Estimate reference overlap block
While (redundant block ()>Reference block)
Block matrix=total block of redudant
End
If (redundant =overlap block)
{Non- redundant block estimated}
Else
New direction of FIC is estimated
If (redundant!=0)
{call PGA()}
Else
Estimate redundant and non-redundant block set
The index of both passes in HCC matrix
Finally image is compressed
Measure PSNR value

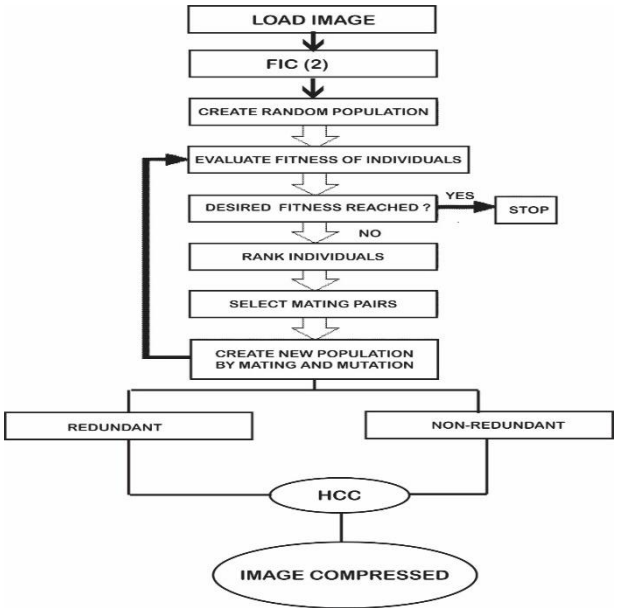

Figure 3: Shows the proposed model of image compression.

IV. Experimental Result

In this chapter discuss the simulation and result analysis of image compression method. Here discuss three image compression algorithm one is jpeg and two other is FIC and proposed algorithm. all three algorithm implemented in MATLAB software. The MATLAB software is well known recognition tools for image processing. It gives the basic and fundamental image processing tools.

Description of Dataset

For the validation of proposed algorithm of image compression used some standard image such as Leena, Barbara, cameraman and some other image. This image resolution size is 512* 512. These entire images obtained from Google image database.

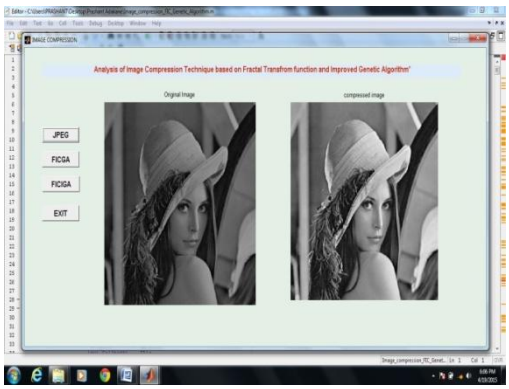

Figure 4: Shows Leena image in original and compressed form using JPEG image compression method.

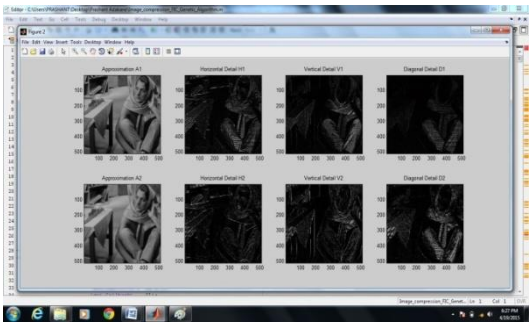

Figure 5: Shows Barbara image details for Approximation A1 and Approximation A2 using FICGA image compression method.

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

FICGA	30.8956	0.6598	10.0715 : 1
FICIGA	31.2654	0.5632	14.7626 : 1

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

FICGA	19.1998	0.61153	8.4262 : 1
FICIGA	22.0302	0.43198	11.2566 : 1

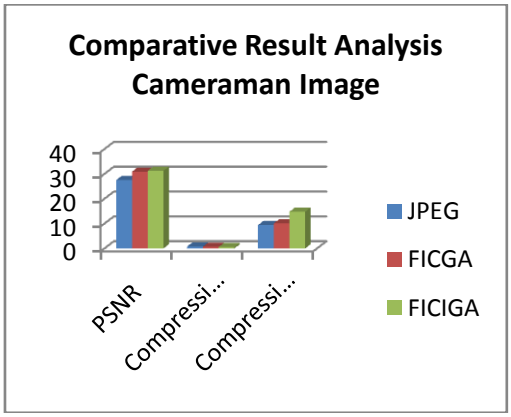

Figure 6: The above figure Show the result analysis on the basis of comparative result analysis study of using Cameraman image with include the performance parameter is PSNR, Compression Rate and Compression Ratio value with applied the method such as JPEG, FICGA and FICIGA.

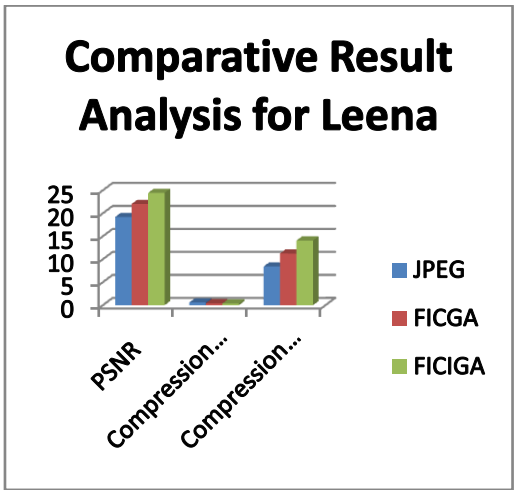

Figure 7: The above figure Show the result analysis on the basis of comparative result analysis study of using Barbara image with include the performance parameter is PSNR, Compression Rate and Compression Ratio value with applied the method such as JPEG, FICGA and FICIGA.

V. Conclusion and Future Work

In this paper modified the FIC image compression technique using genetic algorithm. the modified image compression algorithm is very efficient in terms of compression ratio and compression rate. the proposed algorithm also retains the quality of image in terms of better PSNR value. The better PSNR value indicates that proposed algorithm is better than pervious algorithm such as FIC and JPEG compression technique. the proposed algorithm gives the advantage of loosy image compression towards lossless image compression. The modified algorithm is combination of FIC and genetic algorithm. for the validation and empirical evaluation of proposed algorithm used MATLAB software and some standard image dataset. The increased value of PSNR and C.R value shows that our process is better. The proposed algorithm is better in terms of image quality in terms of PSNR value and some other parameter. The proposed algorithm compressed gray scale image and medical image. In future used color image compression process and enhanced the compression method in three component process. Now also improved the coefficient searching technique process for image compression.

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