Image Compression using DWT And Optimization using Evolutionary Algorithm

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***Abstract*— The proposed system is based on image compression using Discrete Wavelet Transform (DWT) technique and optimization using Evolutionary Algorithms like Artificial Bee Colony and Particle Swarm Optimization. The optimization provides the good quality of the image in order to provide better results. As the image quality and its size are constantly increasing. Many products in the market use images for control and display with advanced technology. The Image compression is a technique in different types of multi-media services. In this project coding techniques called Discrete Wavelet Transform (DWT) is applied for image compression. These techniques utilize less memory. In order to find the best possible quality of image we will use Evolutionary Algorithms for optimization. Evolutionary algorithms are the evolution of the species and it focuses on the mechanism. Since after the compression of the image using DWT the image quality has deteriorated hence we make use of Evolutionary Algorithms to optimize the compressed image. Here two types of Evolutionary algorithms are used: Artificial bee colony and Particle Swarm Optimization And they are compared in terms of parameters like PSNR, CR, MSE and Entropy.**

Keywords-image, compression, optimization

I. INTRODUCTION

In order to reduce the cost for storage and transmission image compression is applied to digital images. Generally, an image can be compressed in two different ways which are Lossy and Lossless. Lossy compression is those in which there is a loss of fidelity for natural images like photographs. There are various lossy compression methods like Transform coding, Discrete cosine transform, Discrete Wavelet transforms, Chroma subsampling, Fractals Lossless compression is generally used for medical imaging, drawings, comics. There are various methods for lossless compression like run-length coding, predictive coding, entropy coding, Huffman coding, LZW. So Discrete wavelet transform technique is applied for image compression. It supports all types of images like jpeg and png. DWT is effective and robust in its set of images. It is best suited to time-limited data. After the image is compressed using DWT it is important to optimize it for better quality purposes. It is done using Evolutionary algorithms which are evolution of species. It focuses on the subset of the mechanism. There are many types of Evolutionary algorithms but most popular and useful among them are Artificial bee colony(ABC), Particle Swarm Optimization(PSO) and Ant Colony Optimization(ACO)[7]. So the given image will be compressed in the initial stage using DWT and it will be optimized using Evolutionary algorithms. The best solution will be determined by the implementation of these algorithms in terms of parameters. The parameters that are used to differentiate are PSNR, CR, MSE and Entropy.

II. RELATED WORK

In [1] Martino, Ferdinando Di aSessa, Salvatore have supplied a today's multi-degree photo thresholding technique all through which a Chaotic Darwinian Particle Swarm Optimization set of rules is applied on photos compressed by the use of Fuzzy Transforms. The strategy calls for a partition of the pixels of the photograph below several thresholds which might be obtained with the aid of maximizing a fuzzy entropy. In the pre-processing phase, the simplest compression charge is determined by comparing the grey stage histograms of the source and compressed snap shots. Comparisons with the classical Darwinian Particle Swarm Optimization multi-level photograph thresholding algorithm and other

meta-heuristic algorithms are provided in terms of the fine of the segmented picture through PSNR and SSIM.

In [2] Amer Draa have Image Enhancement can be an essential advent to almost each image processing system. The paper aims to improve each visible and informational great of distorted photos. The method for the Image Enhancement is performed using Histogram Equalization (HE). Histogram Equalization (HE) preserves its image processing main characteristics. Generally, maximum of the time using exhaustive techniques for histogram equalisation seems to be an algorithmically complicated task. These HE techniques also fail in imparting good enhancement if parameters aren't chosen properly. So, new intelligent techniques, the use of computer science strategies, are proposed for photo enhancement. In the course of this context, this paper proposes a substitute Artificial Bee Colony (ABC) algorithm for image assessment enhancement. A gray-stage mapping approach and an alternative image quality measure are used.

In [3] Krivenko, Sergey, Lukin, Vladimir, Vozel, Benoit have addressed the controversy of predicting parameters of distortion added by way of lossy compression. Such a prediction is needed to deliver the desired excellent of compressed pics quickly. It is proven that mean rectangular blunders and top S/N may be anticipated with high accuracy if pictures subject to compression are almost noise-free and with appropriate accuracy if photos situation to compression are noisy. Approaches to reinforce the accuracy of parameter prediction in compressing noisy pix are proposed and compared. Practical tips are given.

In [4] Akay, B., Karaboga, D. Have incremented inside the sizes of the photos through the technological advances accompanying high call for for large capacities, high-overall performance devices, high bandwidths etc., Therefore, compression techniques are essential to scale back the computational or transmittal costs. Wavelet transform is one in each of the compression strategies specially used for pix and multimedia files. The distinct coefficients are re-decomposed up to a few levels to increase frequency resolution. Once the coefficients are generated, the optimized threshold values are determined to get the most effective reconstructed photograph. During this, have a look at the Artificial Bee Colony set of rules which can be a latest and successful optimization tool employed to train session the thresholds to offer the maximum efficient way of the compressed picture in terms of compression ratio(CR) and high-quality[4].

In [5] Delport, V. And Koschorreck, M.Has a unique method for fractal photo compression . It is proposed using a Genetic algorithm (GA) . The methodology carried out in this paper utilizes the Genetic Algorithm (GA) which determines the fitness characteristic and mutation . It decreases the search area for finding the self similarities inside the given picture. This paper has supplied a theory, implementation, and study of the proposed technique with a straightforward classification protocol. An evaluation with different fractal-based compression strategies is moreover reported.

III. PROPOSED SYSTEM

A type of image compression scheme based on discrete wavelet transform is proposed which provides sufficient compression ratios with very less degradation of image quality [1]. The real images set of images has been justified with robustness and effectiveness using this approach. The compressed image has been optimized using Evolutionary Algorithms which are: Artificial Bee Colony, Particle Swarm Optimization as the level of evidence. This Optimization technique gives better performance compared to other traditional techniques.

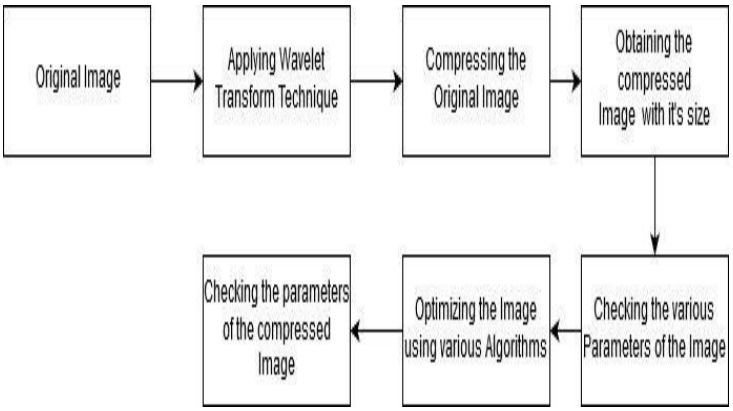

Fig 1: Block diagram of Image Compression and Optimization

Fig 1 describes the block diagram of the proposed system which includes various blocks like dwt, compressed image parameters and optimized parameters. Initially, the original image will be given to the system to which the DWT technique will be applied so that the original image is compressed and its size will be displayed.The image can be of any size like in MB,KB etc...hence here the image size will be converted to KB so original image and compressed image will be shown in terms of KBs. Then it will optimize the compressed image by Artificial Bee Colony (ABC) and Particle Swarm Optimization (PSO) algorithm and the parameters will be displayed [13]. The parameters used in these techniques are PSNR, Compression Ratio, MSE and Entropy. Hence with the help of parameters, we will be able to decide that out of two algorithm which gives better-optimized results.

IV. IMPLEMENTATION DETAILS

A. Technology Details

1) Discrete Wavelet Transform

DWT is a Discrete Wavelet Transform in which wavelets are discretely sampled. The advantage of having DWT is that it has Fourier Transforms which provides temporal resolution [1]. It is used to capture frequency and location (in time)information. Hence wavelets are the signals that are local in scale and time. It has an irregular shape, Wavelet is nothing but a waveform that has an average value of zero. It integrates to zero and waves up and down across the axis. Many wavelets display a property ideal for compact signal presentation which resides to orthogonality. It ensures that data is not over-represented. The signal is decomposed into shifted and scaled representations of the original wavelets. So a wavelet transform is used for decomposition of signals into component wavelets[1]. Once the decomposition is done the coefficients of the wavelets are decimated in order to remove a few details. Using DWT provides a great advantage of being able to separate out the fine details in a signal[1]. So small wavelets can be used to separate very minute details in a signal, while large wavelets can be identified by coarse details. There are many different wavelets that can be used and are also liable to choose, they are HAAR, DAUBECHIES, etc...Hence DWT is most suited to image compression and it generates a more sparse representation of a signal than other types of compression techniques[4].

2) Artificial Bee Colony

The artificial bee colony was introduced by Karaboga in the year 2005[10]. It was described by the foraging behavior of honey bees. For honey bee colonies it was proposed by Tereshko and Loengarov in the year 2005. It is classified into three types of honey bees: employed, scouts and onlooker bees. In order to apply ABC the optimization problem is converted to a problem of finding the best parameter vector which has minimized objective function. ThenThen the bees randomly find out a populace of first answer vectors. The bees improve the employing strategies by finding better solutions and leaving behind poor solutions. Employed bees search for the rich food source (a great solution for the given trouble). Employed bees will be accountable for investigating the food resources and sharing the statistics with onlooker bees[10]. This in turn will make a decision on selecting food resources with the aid of such facts. A food supply that has higher great offers a larger hazard to be selected by way of onlooker bees than the ones displaying a lower first-rate. An employed bee, whose food source is rejected as low quality with the aid of on-looker bees gets changed to a scout bee and randomly searches for brand new food resources. Hence the exploration is maintained through scout bees. ABC algorithm is an iterative procedure and it starts with a population of randomly generated answers or food resources[12].

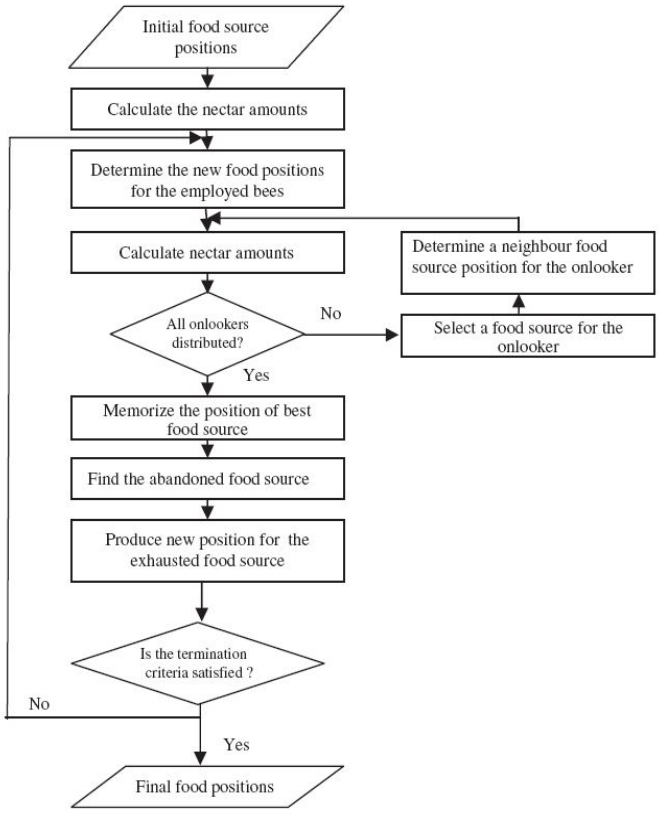

Fig 2: Block diagram of ABC

- **Initialization:** The algorithm begins by initializing Np food sources. Each food source is a vector that contains the parameter values that are to be optimized. These are randomly and uniformly distributed between the lower initial parameter bound low and the upper initial parameter bound high.
- **Send employed Bees:** The total number of food sources is equal to the number of employed bees. After achieving this stage every hired bee generates a new food source within the neighbor-hood of its present position.
- **Selection of the food sources by Onlooker Bees:** Each and every onlooker bee (the number of onlooker bees corresponds to the food source number) selects one of the

proposed food sources, depending on their fitness value, which has been recently defined by the employed bees.

3) *Particle Swarm Optimization*

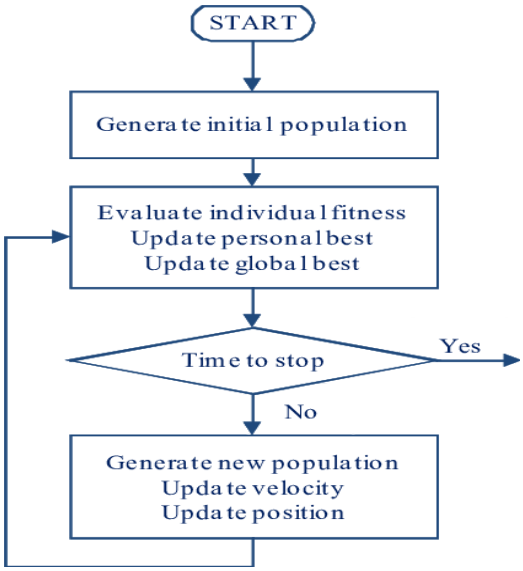

Fig 3: Block diagram of PSO

Particle swarm optimization (PSO) is introduced by manner of Kennedy, Eberhart, and Shi[11]. PSO became first intended for simulating social appearance, as an illustration of movement in a bird flock. PSO can remedy a problem by way of having a populace of solutions. PSO algorithm works via having a population (called a swarm) of candidate answers (called particles). These particles can pass around within the search area with a mathematical system over the particle function and velocity[11]. Particle motion can be influenced by using the great-known position but it's also guided to the nice-known role in the search area. These are updated as higher positions and are located over other particles. It is predicted that it will swarm to the best solutions. The Particle Swarm Optimization algorithm is easy and it becomes discovered acting optimization to a given problem. The Particle Swarm Optimization set of rules is a metaheuristic as this algorithm makes few assumptions or no assumptions approximately the trouble that is being optimized. It can search for large spaces for candidate solutions. PSO algorithm does not guarantee that optimized answers will be found for a given hassle . The use of the gradient of the problem being optimized is also now not used by PSO[16].

B. Results

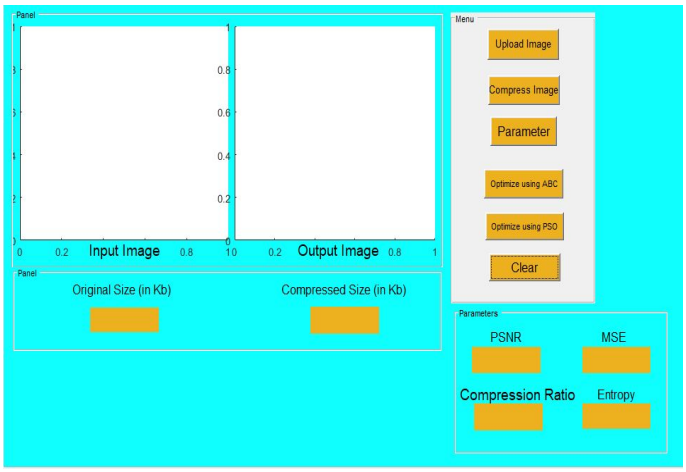

Fig 4: Graphical User Interface of the Proposed System

Fig 4 shows the Graphical User Interface of the system. The user can upload an image to which image will be displayed in the Input Image block and its size will be displayed in the Original Size block. The imaging unit will be converted to kb.

Fig 5: Image Compression with their size(in kb)

Fig 5 shows that the image is compressed using DWT technique. The compressed image is displayed in the Output Image block and its compressed size is also displayed. The parameters like PSNR, MSE and Compression Ratio of the image are calculated and displayed.

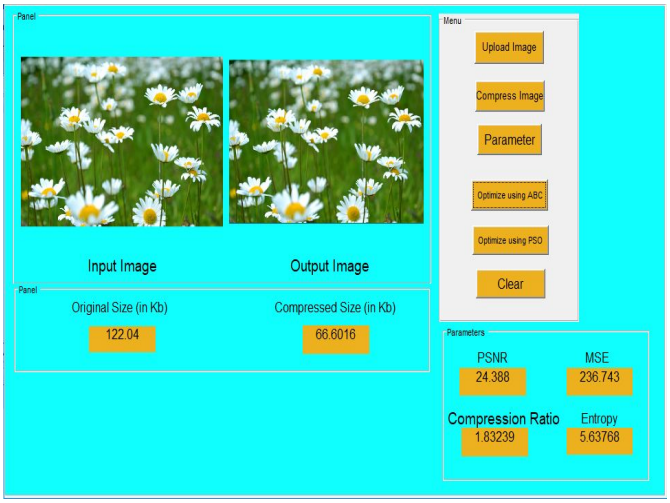

Fig 6: Optimized Image using Artificial Bee Colony

Fig 6. shows that the compressed image is optimized using Artificial Bee Colony and the change in the parameters is observed.

Fig 7: Optimized Image using Particle Swarm Algorithm

Fig 7 shows that the compressed image is optimized using Particle Swarm Optimization and the changes in the parameters are observed.

Table 1 shows that the image is compressed using DWT. The original size and compressed size is shown for the respective image. And we can observe that by using DWT the size of the original image is compressed. The below tables 2,3,4 shows the results obtained of three different images which show parameters(PSNR(in dB), Mean Square Error and Compression Ratio) of the image before and after applying Evolutionary Algorithm

Image	Original Image (in kb)	Compressed Image(in kb)
Image 1	2857.75	518.89
Lenna Image	592.93	26.51
Image 3	378.95	198.64

Table 1. Image Compression using DWT

Image	PSNR(dB)	Mean Square Error	Compression Ratio
Image 1	8.83	8505.2	5.50
Lenna Image	8.81	8559.9	22.36
Image 3	9.11	7974.5	1.91

Table 2. Without using Evolutionary Algorithm

Image	PSNR(dB)	Mean Square Error	Compression Ratio	Entropy
Image 1	32.84	33.78	5.50	4.51
Lenna Image	24.09	253.17	22.36	1.98
Image 3	28.41	93.81	1.91	5.22

Table 3. Using ABC Algorithm

Image	PSNR(dB)	Mean Square Error	Compression Ratio	Entropy
Image 1	41.19	32.92	5.50	5.37
Lenna Image	31.39	200.10	22.36	2.48
Image 3	31.29	203.79	1.91	6.40

Table 4. Using PSO Algorithm

As we can observe in Table 2. that without applying evolutionary algorithms the value of PSNR is very less and the value of MSE is very high for the given image. So, after applying the ABC algorithm the results are improved and it is shown in Table 3. We can observe that the value of PSNR is increased and the value of MSE is decreased and provides better results as compared to the results obtained without applying the ABC Algorithm. The evaluation of the PSO algorithm is shown in Table 4. which shows that PSNR value is improved as compared to ABC and the value of MSE is decreased to some extent but still holds better results as compared to the results obtained without applying the PSO Algorithm. The value of CR will remain the same as it is constant. So by applying Evolutionary Algorithms like ABC and PSO it is observed that parameters are improved and provides better performance than the results obtained after just compressing the original image.

V. CONCLUSION AND FUTURE SCOPE

The Image Compression based on Discrete Wavelet Transform (DWT) is performed. It provides high compression ratios with no appreciable degradation of image quality. So the compression of the image is done and so to improve quality of the image Evolutionary Algorithm is applied for image optimization. The effectiveness and robustness of the DWT is sustained by using a set of real images. Wavelets are better as compared to other compression techniques. It maintains better image quality by reducing errors, hence this is an advantage of using Discrete Wavelet Transform(DWT) for image compression. The evolutionary algorithm shows better optimization results. The types of Evolutionary Algorithms like Artificial bee colony (ABC) and Particle Swarm Optimization (PSO) are implemented. ABC and PSO shows that the compressed image is optimized and based on parameters it is concluded that PSO takes lesser time as compared to ABC for image optimization.From the results and tables it is seen that the defined optimization techniques gives better performance as compared to traditional techniques. The parameters used like PSNR , MSE , CR and Entropy helps to determine which provides better results in terms of optimization.

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