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A study on Image Compression and Encryption Algorithm based on Chaotic System and Compressive Sensing

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Abstract: *Wavelet transform popularly used signal processing method in image processing and pattern recognition, currently it became an important feature to be used in texture classification. In this proposed work, an attempt has been made to propose an efficient and less complex image code compression algorithm that would be suitable for the various application and low bit rate image transmission purposes using various devices. Proposed algorithm is supposed to produce a good quality image for a given bit rate and will accomplish this task in an embedded fashion i.e., in such a way that all encoding of same image at lower bit rates are embedded in the beginning of the bit stream for the target bit rate. It will be helpful in many applications, such the medical science and real-life applications. The input images considered are subjected to mentioned transform coding techniques which are simulated on MATLAB R2013a, running on an Intel core i3 processor, for lossy image compression algorithms, comparison metrics are calculated and tabulated according to the considered input images. The algorithms considered for analysis include Particle Swarm Optimization methods, with using all the input images we getting some performance parameter value such as Compression Rate, PSNR and Elapsed time for each input image.*

Keywords: Image Encryption and Compression, Image Encryption, Chaotic system, Compressive sensing.

Introduction

The image is actually a kind of redundant data i.e. it contains the same information from certain perspective of view. By using data compression techniques, it is possible to remove some of the redundant information contained in images. Image compression minimizes the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a certain amount of disk or memory space. It also reduces the time necessary for images to be sent over the Internet or downloaded from web pages. Two elementary components of compression are redundancy and irrelevancy reduction.[1][2] Redundancy reduction aims at removing duplication from the signal source image. Irrelevancy reduction omits parts of the signal that is not noticed by the signal receiver, namely the Human Visual System (HVS). Image compression is an application of data compression that encodes the original image with few bits. The objective of image compression is to reduce the redundancy of the image and to store or transmit data in an efficient form.

There are many ways to calculate the effectiveness of the compression. The most often used factor for this purpose is compression ratio (CR), which expresses the ability of the compression method to reduce the amount

of disk space needed to store the data. CR is defined as number of bits of the original image (Borg) per one bit of the compressed image (Bcomp):[3]

$$CR = \frac{B_{org}}{B_{comp}}$$

The compression percentage (CP) serves the same purpose:

$$CR = \left(1 - \frac{1}{CR}\right).100\ \%$$

Another measure of the compression effectiveness is bit rate (BR), which is equal to the average number of bits in compressed representation of the data per element (symbol) in the original set of data. High effectiveness of a compression method manifests itself in high CR and CP, but in low BR. When time needed for compression is important must be used different factor product of time and bit rate. Here were mentioned only the most commonly used factors but there are many more ways to estimate the effectiveness [4].

Image Compression

Transform coding on the other hand uses frequency domain, in which the encoding system initially converting the pixels in space domain into frequency domain via transformation function. Thus, producing a set of spectral coefficients which are then suitably coded and transmitted. The background research of this chapter will focus on the transform coding since the Bin DCT algorithm by itself is also transforms the row image in space domain into spatial frequency domain. The decoder on the other side must perform an inverse transform before the reconstructed image can be displayed. The coding technique implemented in this project is the transform coding using multiplier-less approximation of the DCT algorithms [5].

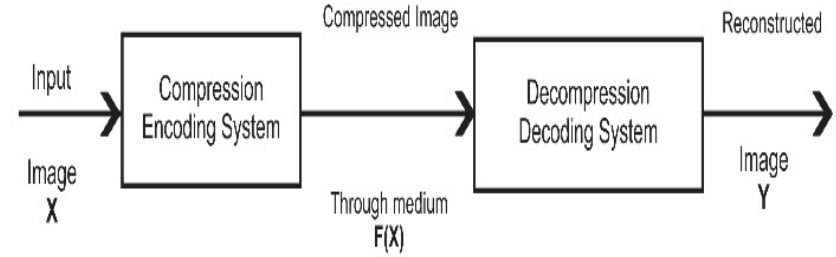

Figure 1: Basic Data Compression System.

II. Research Methodology

Huffman Coding

A simple and ingenious tree-based algorithm was devised by Huffman in to develop an efficient binary representation. It builds a binary tree from the bottom up, and works as follows. A simple example can quickly illustrate the basic concepts involved in Huffman Coding. Suppose given a message composed of only four symbols, {A,B,C.D}, which occur with probabilities {0.3,0.4,0.2,0.1}, respectively. It builds a binary tree from the bottom up, and works as follows:

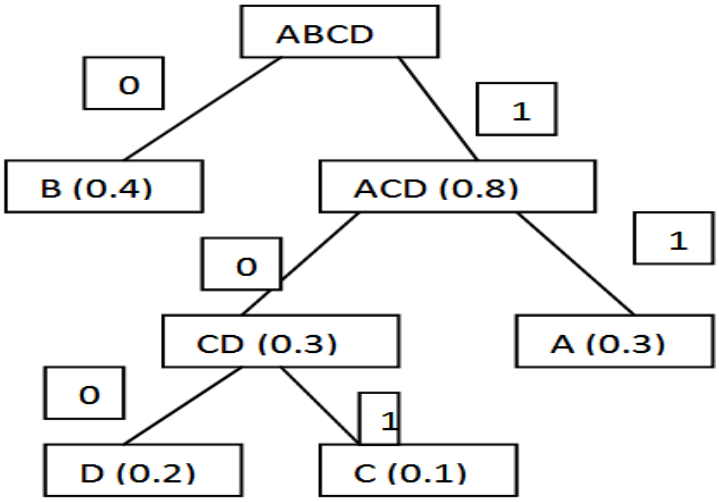

Figure 2: Example of Huffman Tree.

Particle Swarm Optimization

Particle Swarm Optimization (PSO) was proposed by Eberhart and Kennedy [18]. The PSO is a population-based search algorithm based on the simulation of the social behavior of birds, bees or a school of fishes. PSO initially intends to graphically simulate the graceful and unpredictable choreography of a bird folk. Each individual within the swarm is represented by a vector in multidimensional search space. This vector has also one assigned vector which determines the next movement of the particle and is called the velocity vector.[6]

Particle swarm optimization used for removal of redundant structure of packet in common similar block and create separate block and then both block forwarded for to decomposition of an image then we apply the image compression techniques and finally images are compressed and we getting the performance parameters measurement values. For the searching of redundant structure block and non-redundant structure block used fitness constrains function, those structure satisfied the given constraints are called non redundant structure else redundant structure. The proposed algorithm is a combination of wavelet packet transform function and particle swarm optimization, for the grouping of packet used cluster algorithm.[7]

III. Result & Discussions

In this section, experimental process of image compression is performed. This process of image compression is done by using previous method and proposed method. For the performance evaluation of image compression technique with different number of images MATLAB software package is used. MATLAB is a software package for high- performance numerical computation and visualization. It provides an interactive environment with hundreds of built-in function for technical computation, graphics and animation. Best of all, it also provides easy extensibility with its own high- level programming language. The MATLAB stands for matrix laboratory. There are also several optional "toolboxes" available from the developers of MATLAB. Here we are using four different images, they are having different sizes [8, 9].

Comparative Result Analysis

Table 1: Shows that the PSNR, Compression Rate and Elapsed time using pervious and proposed method for Cameraman image.

Image	Method Name	Compression Rate	PSNR	Elapsed Time
Cameraman Image	Previous	1.48	49.56	4.59
	Proposed	1.86	58.42	3.25

Table 2: Shows that the PSNR, Compression Rate and Elapsed time using pervious and proposed method for Lena image.

Image	Method Name	Compression Rate	PSNR	Elapsed Time
Lena Image	Previous	1.32	68.15	1.63
	Proposed	1.65	75.32	1.62

Table 3: Shows that the PSNR, Compression Rate and Elapsed time using pervious and proposed method for Baballon image.

Image	Method Name	Compression Rate	PSNR	Elapsed Time
Baballon Image	Previous	1.77	43.65	4.77
	Proposed	2.17	54.28	4.71

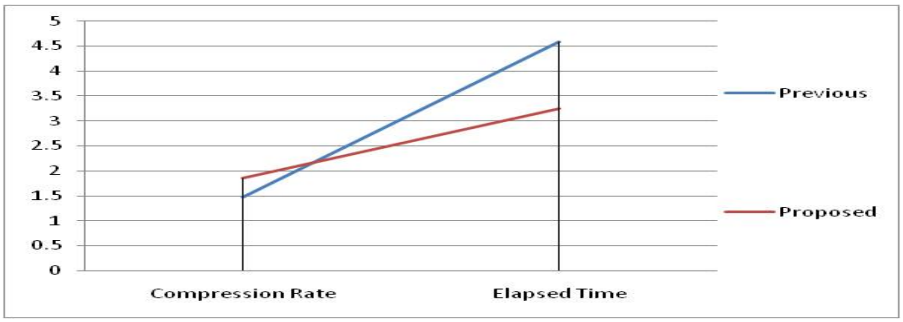

Figure 3: The above figure Show the comparative result analysis using cameraman image for the image compression techniques, with include the performance parameter is Compression Rate and Elapsed Time value with applied the previous and proposed method.

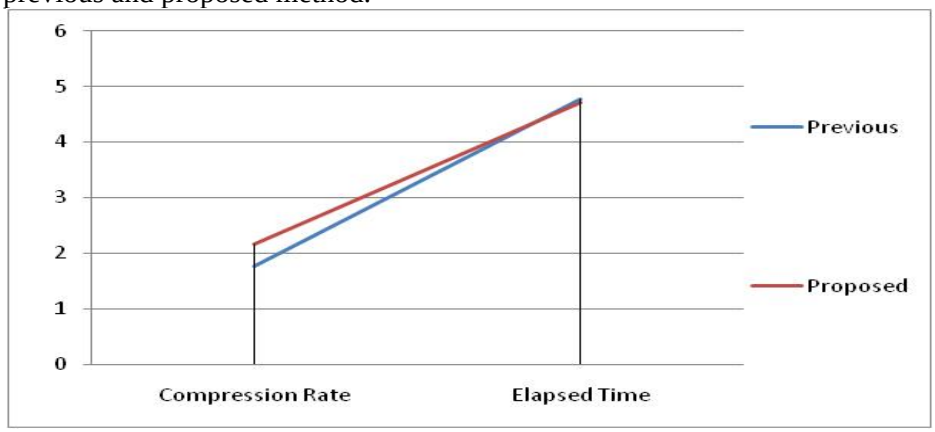

Figure 4: The above figure Show the comparative result analysis using Baballon image for the image compression techniques, with include the performance parameter is Compression Rate and Elapsed Time value with applied the previous and proposed method.

Figure 5: The above figure Show the comparative result analysis using cameraman image for the image compression techniques, with include the performance parameter is PSNR value with applied the previous and proposed method.

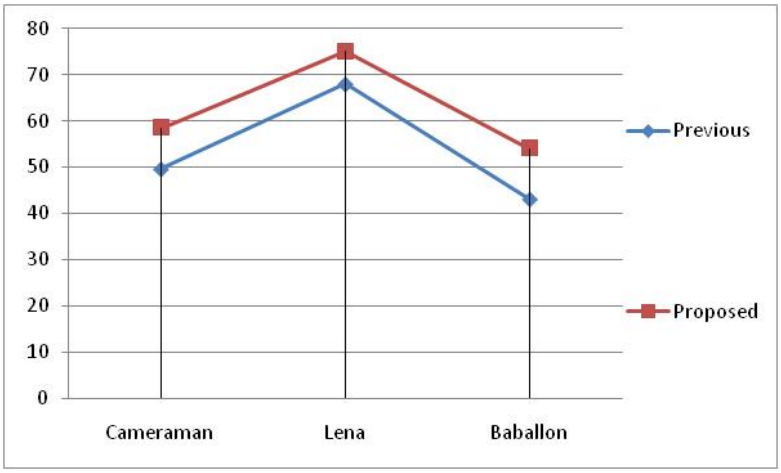

Figure 6: The above figure Show the comparative result analysis using cameraman image, Lena image and Baballon image for the image compression techniques, with include the performance parameter is PSNR value with applied the previous and proposed method.

IV. Conclusion

Multimedia data compression is a challenging job for compression technique, due to the possibility of loss of data and required large amount of storage place. The minimization of storage place and proper transmission of these data needed compression. Now in this day various image compression techniques are used, some compression technique is lossless and some compression technique is lossy. The types of image involve some standard images, digital images, bio-medical images etc. for the image format .png, .jpeg, .bmp, etc. during the literature survey we found the some issues and challenges with image compression techniques such as PSNR value of image, Compression rate, Compression ratio, Computed time etc. The digital image compression is vital research field in the area of communication and storage. In this dissertation our proposed methods which is a presents the new model for the image compression using wavelet transform and particle swarm optimization methods, which gives better results in the terms of performance parameter evaluation comparative study or analysis. The input images considered are subjected to mentioned transform coding techniques which are simulated on MATLAB R2013a, running on an Intel core i3 processor, for lossy image compression algorithms, comparison metrics are calculated and tabulated according to the considered input images. The algorithms considered for analysis include Particle Swarm Optimization methods, with using all the input images we getting some performance parameter value such as Compression Rate, PSNR and Elapsed time for each input image.

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