

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 9, Issue 3, March 2020

Analysis of Adaptive Lossless Compression Using Genetic Based Approach Algorithm

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ABSTRACT: Data compression techniques have become emerging areas in the field of computer science, In the modern era of multimedia and the internet. Compression of data is important for a large and active field as well as many organizations. Nowadays on the internet that any digital image has required a large amount of network bandwidth for transmission of packets or to storage that image. With this problem statement the research area for image or data compression to develop techniques that compress images to lower size and data rates with sustained or better quality. Multiple types of computer data and file integration has raised due to the popularity of Multimedia, which has different types of data like audio or video files, text, images, graphics, animations, etc. The lossless image compression has very good scope in the various fields like medical, commercial and in banking field. In this thesis work, GENETIC compression algorithm has also show the good performance for the lossless compression. By keeping in view, the wide range of applications in this field, improvement in the lossless image compression algorithm is the demand of today's scenario. In the future approach, the lossless compression can also be done by using the neuro-fuzzy or machine learning techniques.

KEYWORDS: Compression, Loseless, neuro-fuzzy

I. INTRODUCTION

In these days Image compression, most talked and trending topic. Because now large numbers of applications have data of multimedia nature is generated. This multimedia data includes images, videos, audios etc. As these types of data files have large sizes due to high quality devices are available that provides more quality and display. To store these multimedia files, require large amount of storage space and also transmission bandwidth. To solve these issues, we have various compression methods and techniques are available. These compression techniques chosen based on the requirement that we need because each technique has its pros and cons. So, we have to select choice amongst these techniques.

We can define these techniques in two categories. One is Lossy image compression technique and second is Lossless image compression technique. Either we need Lossy image compression technique, or we need lossless image compression technique for specific requirement.

Data compression techniques have become emerging areas in the field of computer science, In the modern era of multimedia and the internet. Compression of data is important for a large and active field as well as many organizations. Nowadays on the internet that any digital image has required a large amount of network bandwidth for transmission of packets or to storage that image. With this problem statement the research area for image or data compression to develop techniques that compress images to lower size and data rates with sustained or better quality. Multiple types of computer data and file integration has raised due to the popularity of Multimedia, which has different types of data like audio or video files, text, images, graphics, animations, etc. The prime aim of image compression is

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to decrease the bit rate of image for data transfer or storage while keeping image or quality or an acceptable fidelity. Digital images have the number of pixels associated with it. Every pixel of an image defines the intensity of the image at that point. In Image compression process an Image is re-presenting with lesser number bits with maintains image quality. Which will save the cost of data transmission and the requirement for data storage.

Lossless Image Compression

The fundamental goal of image compression technique is compress image size in less number of bits per pixel without compromising with image quality. So that compressed image can be used for storage and transmission with less cost. Nowadays usually produced digital files have large size most of the time they are in Megabytes. For example, image produced with digital Camera ranges from 1 MB to 25MBs. But using lossless compression techniques we can significantly reduce the image size. Using lossless compression techniques ass density is increased and this way file size is reduced from 10 to 20 percentage. Lossless compression is commonly used to compress digital images, text files, spread sheets, geolocation information like maps and other form of media used over internet.

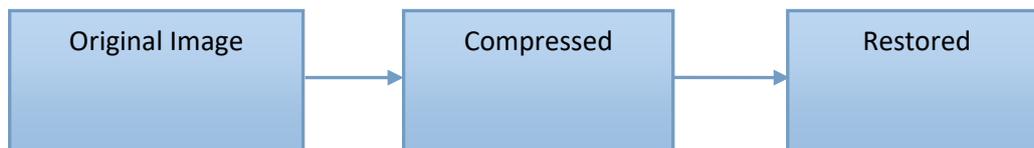


Fig.1 Block diagram of image compression process

II. LITERATURE SURVEY

C. Kamargaonkar et al.(2016) Digital form of human body pictures are produces by CT or MRI medical imaging. Compression schemes that are available now days provide a intense level of compression with acceptable loss of information. In this document with the support of lossless compression the ROI part can be compressed. Thresholding method of segmentation extracts in this paper and compressed with the support of SPIHT method and construct a acceptable grade image. Haar wavelet transform method is used to compressed other NROI part. Our technique produces better Peek Signal to Noise Ration (PNSR) values for medical images.

K.H. Voet al. (2015)In this document a new grade analysis method for 3D image with compression bend is available. The lodged metric is series on LIVE 3D image database with JPEG and JPEG2000 (JP2K) errors This technique is constructed on combination of 2D image grade metrics and 3D depth map information. As outcome, this metric has presented an enhanced implementation in analyzing discern grade for stereoscopic images. Even though many other metrics have been advocated to check out the perceptual grade of dimensional images, no same attempts were made for grade evaluation of stereoscopic images.

Besides, in the method of defining an objective metric devised for Dimensional images, we calculate whether 2-D image quality objective parameters are also acceptable for grade evaluation of stereo images Consequently, this document suggest a strategy for subjective evaluation of Dimensional images[2].

Y.Kwonet al. (2015)Many other approaches have manifested that a general approach is achieved by experiencing application-specific prototype from cases; however, learning prototypes educated enough to produce high-grade images by computation is very expensive, and that are also specific to the and the data. To resolve this concern, we have devised an coherent and cost effective mid-local estimation process to large-scale Gaussian exercise. With that productive training of job-specific image improvement from case images or data without compromising withgrade. Our method could be customized easily for applications to applications depending upon the requirement and available data

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sets, and we proven thecoherence and correctness of our technique over different domains: human face detection single-image super-resolution for scene, and pictures having text, and tracepurging in JPEG2000 and JPEG encoded images [3].

III. ALGORITHM

The basic idea behind the PSO based-adaptive quantization table for the standard JPEG digital image compression can be Simply stated as:

1. Read the uncompressed RGB color digital image to be compressed.
2. Converts the 24 bits RGB color space to the YCbCr color space, where (Y) is the luminance and (Cb, Cr) are the chrominance. This color model conversion allows better compression without an important influence on the perceptual digital image quality [18].
3. Divides each of Y, Cb, and Cr color space components into a number of non-overlapping (8x8) sub matrices blocks.
4. Normalize all pixel values in all blocks of all Y, Cb and Cr color space components in the range between [-128, 127].
5. Applies the two-dimensional DCT to each (8x8) block of the Y, Cb& Cr components to converts the digital image from the spatial domain to the numeric domain (frequency domain) so that the quantitative form of the image's information can be manipulated for better compression.
6. Generally, in the standard JPEG color image compression, the default standard JPEG quantization matrix is used to perform the quantization step. In this work, the standard PSO algorithm has been used to produce the optimum (8x8) block of quantization matrix as follows:

Step 1: Generate an initial random population of quantization matrixes.

Step 2:Stop, if the pre-specified number of iterations is carried out.

Step 3:Compute the fitness value of each quantization matrix (particle).

Step 4:For each iteration, find the local better quantization matrix (particle).

Step 5: Find the global better quantization matrix (particle).

Step 6: Implement the velocity updating for each particle using equation (4).

Step 7: Implement the position updating for each particle using equation (5).

Step 8: Go back to Step 2.

The fitness function has been used in this paper is the Mean Square Error (MSE) between the original uncompressed color image and the reconstructed color image which it is defined as:

$$MSE = \left[\frac{1}{MN} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} [f^{i,j} - f(i,j)]^2 \right] \frac{1}{2} \dots \dots \dots (3.1)$$

Where y and z are the corresponding color image sizes, m(i,j) and n(i,j) are the pixels in the original and compressed color images respectively.

The quantization step is performed by dividing each of the (8x8) DCT coefficients block by the quantization matrix that has been produced using the standard PSO algorithm.

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7. Uses the "zigzag" sequence to reorders all of the (8x8) quantized DCT coefficients blocks and convert them into a one dimension vectors.
8. Uses the Huffman entropy encoded to compress the zigzagged quantized DCT coefficients vectors. Three Huffman modules are used for the JPEG color image compression, one for each of the Y, Cb and Cr components. The output stream of the JPEG algorithm incorporates all Y, Cb, and Cr Huffman codes together, where it starts with the Y Huffman codes, followed by the Cb Huffman codes, and finally the Cr Huffman codes for each (8x8) block of the image and so on for the next block.
9. Finally, the compressed color image is reconstructed through a reverse process using the Inverse Discrete Cosine Transform (IDCT).

IV. FLOWCHART

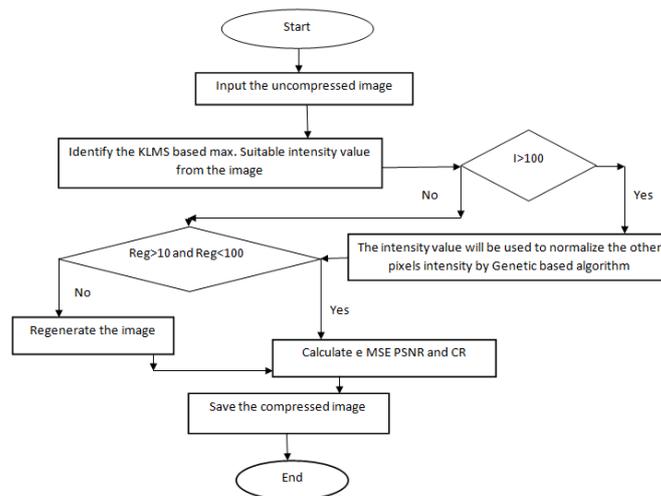


Fig. 2 Flowchart for image compression using GENETIC

The flowchart for the approach for the GENETIC has been applied for the inputted image. The suitable intensity value using DCT-BASED based approach has been identified. This average intensity will be compared to the other pixel of the image using genetic based path. The normalized image pixel will be retained to the original position. In result optimum pixels will generate the compressed image. Various factors will be evaluated like MSE, PSNR are being evaluated.

V. RESULTS AND DISCUSSIONS

5.1 Comparative analysis of compression algorithms in terms of image size

When the original images compressed by DCT-BASED and GENETIC algorithm, there is a change in image size after compression. The sizes of original and compressed images by using both compression algorithms are shown in table 5.1. The percentage reduction in the size of original image after compression also represented in the table. It is clear from the table that the percentage reduction in the size of image is not same for all images. For small size images, image3.jpg, image5.jpg and image9.jpg, the percentage reduction in size is less, i.e. they have less size reduction that is

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17%, 13% and 19% respectively. For images, image4.jpg and image8.jpg, the percentage reduction in size is 22% and 28% respectively. For the large size images, reduction in size after compression is large as compared to above mentioned small size images.

Table 1 Comparative analysis of DCT-BASED and GENETIC algorithm in terms of image size

Image name	Size of original Image (Kb)	Size after compression (Kb)		Percentage reduction (%)	
		DCT-BASED	GENETIC	DCT-BASED	GENETIC
Image1.jpg	117	116	110	17%	21%
Image2.jpg	268	179	168	16%	19%
Image3.jpg	46	45	32	11%	17%
Image4.jpg	667	665	627	19%	22%
Image5.jpg	42.1	42	41	11%	13%
Image6.jpg	337	336	327	13%	15%
Image7.jpg	419	418	400	14%	18%
Image8.jpg	488	487	418	18%	28%
Image9.jpg	58	54	44	14%	19%
Image10.jpg	509	502	478	13%	21%

The image1.jpg and image10.jpg, the percentage reduction in size is 21%. Both images have small difference in percentage reduction of image size, but they have large difference in the size of original images. For the image2.jpg and image9.jpg, the percentage reduction in size is 19%. They also have same percentage reduction of image size, but there is large difference in the size of original images. The image6.jpg and image7.jpg have percentage reduction in size is 15% and 18% respectively. Both images have small percentage reduction, but they have large size. So, it is clear from the above discussion that both algorithms compress the images without the reduction of image information. The information is safe while using the both DCT-BASED and GENETIC compression algorithm. For the different size of images, the percentage reduction of size depends on the information stored in that image not on the size of original image. It is clear from the table 5.1 that the GENETIC compression algorithm performs better as compared to the DCT-BASED algorithm.

5.2 Performance analysis of DCT-BASED and GENETIC compression algorithms

Compression of different images by using DCT-BASED and GENETIC algorithms have been done, the performance analysis on the basis of different parameters i.e. Compression ratio (CR), Peak signal to noise ratio (PSNR), mean square error (MSE) and bit per pixel (BPP) is shown in the table 5.2.

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Table 2 Comparative analysis of DCT-BASED and GENETIC algorithm in terms of BPP

Image	CR		PSNR (dB)		MSE		BPP	
	DCT-BASED	GENETIC	DCT-BASED	GENETIC	DCT-BASED	GENETIC	DCT-BASED	GENETIC
Image1.jpg	1.26	1.78	47.18	29.27	1.30	0.78	0.30	0.43
Image2.jpg	2.24	3.08	47.52	29.55	1.16	0.73	0.54	0.74
Image3.jpg	2.33	3.88	47.14	29.46	1.29	0.76	0.56	0.93
Image4.jpg	1.33	1.93	47.66	29.73	0.99	0.64	0.32	0.46
Image5.jpg	2.80	3.98	47.22	29.62	1.26	0.72	0.67	0.95
Image6.jpg	2.18	2.78	47.32	29.44	1.23	0.75	0.52	0.67
Image7.jpg	2.15	3.07	47.91	29.82	1.12	0.63	0.52	0.74
Image8.jpg	2.20	3.08	47.81	29.66	1.19	0.63	0.53	0.74
Image9.jpg	2.29	3.14	47.38	29.53	1.25	0.73	0.55	0.75
Image10.jpg	2.52	3.08	47.32	29.54	1.24	0.73	0.60	0.74
Average	2.13	2.98	47.44	29.56	1.20	0.71	0.51	0.72

In case of DCT-BASED algorithm, for small size images, i.e. image3.jpg, image5.jpg and image9.jpg, the value of CR is 2.33, 2.80 and 2.29 respectively. When GENETIC algorithm used, then the value of CR is 3.88, 2.78, 3.14 respectively. Large size images, i.e. image4.jpg and image8.jpg, the value of CR in case of GENETIC algorithm is 1.93 and 3.08 respectively, which is also greater than the CR value in case of DCT-BASED algorithm. For all images, the average value for CR is 2.13 when image has been compressed with DCT-BASED algorithm, It increases to 2.98, if image compressed using GENETIC algorithm.

From table 2, it is clear that all images have different image sizes and after compression, the image size is reduced. A lossless compression algorithm should have produced the lossless information after compression that is indicated by the PSNR value. If PSNR value of image is high, then information is lost after compression. If PSNR value of compressed image is low, then the image has lossless compression and very less information is lost during compression. For all images, when DCT-BASED algorithm was used for compression, the average value of the PSNR is 47.44, it reduces to 29.56 while doing the compression through GENETIC algorithm. So, GENETIC algorithm performs well as compared to DCT-BASED algorithm.

For all images, the average value of the MSE is 1.20, if DCT-BASED algorithm is used, it reduces to 0.71 while doing the compression through GENETIC algorithm. GENETIC algorithm produces less error as compared to DCT-BASED algorithm and almost same image quality is produced by the GENETIC algorithm after compression. By using DCT-BASED algorithm, the average value of BPP is 0.51. The average value of BPP is 0.72 while the compression using GENETIC algorithm. The greater BPP value shows that the GENETIC algorithm performs better as compared to DCT-BASED algorithm.

The proposed GENETIC compression algorithm has shown better performance on all performance parameters i.e. Compression ratio (CR), Peak signal to noise ratio (PSNR), mean square error (MSE) and bit per pixel (BPP). For the

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lossless compression, GENETIC algorithm performs better because it gives the good quality image as well as lossless information.

VI. CONCLUSION

This thesis work presented PSO compression algorithm for the improvement of different parameters for the image compression. The combined approach using two algorithms namely, particle swarm optimization (PSO) and artificial bee colony(ABC) algorithm are used for compression of different size images. Using each algorithm, some qualitative parameters such as Peak Signal to Noise Ratio, Mean Squared Error, Bits per Pixel, Compression ratio (CR) are calculated. It is concluded that GENETIC algorithm has shown high BPP values as compared to the DCT-BASED algorithm. The histogram plot is also more flattened in case of GENETIC algorithm. It represents that the quality of the image is higher in case of proposed algorithm. Similarly, the CR for the GENETIC is even on higher side. The amount of compression done using GENETIC compression algorithm is higher as compared to DCT-BASED compression algorithm. Similarly, the PSNR and MSE for GENETIC is lower as compared to DCT-BASED algorithm, this represents the lossless compressed image is produced after compression using GENETIC algorithm.

VII. FUTURE SCOPE

The lossless image compression has very good scope in the various fields like medical, commercial and in banking field. In this thesis work, GENETIC compression algorithm has also show the good performance for the lossless compression. By keeping in view, the wide range of applications in this field, improvement in the lossless image compression algorithm is the demand of today's scenario. In the future approach, the lossless compression can also be done by using the neuro-fuzzy or machine learning techniques.

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