ISSN (ONLINE): 2395-695X
ISSN (PRINT): 2395-695X

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Volume 2, Special Issue 19, October 2016

Efficient Image Compression through Data Folding with Arithmetic Coding

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Abstract **– Data Compression process is a major area of research in the field of Computer Science. The purpose of data compression is to reduce the size of data for saving the storage and reduce the transmission time. Image compression is one of the data compression method in which compression is carried on image using either lossless compression or lossy compression. A novel approach for lossless image compression in spatial domain using a new method of data folding with arithmetic coding for images is presented in this paper. In this approach, row folding is preceded by column folding which is applied iteratively on the image till the image size reduced as small as possible. The prediction is applied in proposed method with property of adjacent neighbor redundancy. After the folding process image is encoded with arithmetic coding to compress the image. The proposed method result is compared with existing method to find the efficiency. The result shows that proposed perform better than existing approach with less computational complexity.**

Keywords – Lossless Compression, Row folding, Column folding, Arithmetic Coding, Run Length Encoding

I. INTRODUCTION

In the modern era, various computer based application needs an image compression to handle the storage and transmission process considerably. With significant increase of data in the form of image which generated by various gadgets has made the research of Image Compression has vital. Apart the gadgets and other general image, there are few areas such as medical, satellite, etc which generates vital image data.

Basic Image compression process has been classified into two types. They are lossless compression and lossy compression. The lossy compression can be used for general images that can deal with few errors after decompression process. But with medical images and few other images, every piece of information is very important. To deal with this type of images, Lossless Image compression has to be considered.

In lossless coding method is divided as three stage process as transformation, data-to-symbol and lossless coding [1]. First convert an image into a form that compression process can be done efficiently with transformation process. Next step is data-to-symbol mapping process that converts the image into symbol which can be used for encoding in the final stage of the compression process. Final step is process lossless encoding after the previous two preprocessing steps.

Compression effectiveness and reduction of computational difficulty are major parameters considered image compression process. This is the main cause to work on the image compression process further. In the paper new method has been proposed to fast and efficient lossless compression scheme.

The rest of the paper deals with related study of existing approach in Section II, where Section III discusses methodology used for proposed work. Section IV explains the experimental results and Section V concludes the research work which is follows references.

II. RELATED WORKS

Suresh *et.al.,*[2] proposed an image compression based on data folding. The source image is applied with column folding and row folding process for odd rows and even columns. After the process, data is encoded with Huffman coding.

Amir *et.al.,*[3] proposed a novel image multi-resolution transform that is matched for both lossless and lossy compression. The new transformation is alike to the subband decomposition but can be calculated with merely integer calculation and bit shift process. During its computation the number of bits necessary to stand for the changed image is kept little from first to last watchful scaling and truncations. Results confirm that the entropy get hold of with the new transform is lesser than that gained with predictive coding of similar complexity.

Shaikh *et.al.,*[4] developed a method which converts an image into an array using Delphi image control tool. An algorithm is created in Delphi to apply Huffman coding method that take away redundant codes from the image and compresses a image file and it is successfully rebuild. This renovate image is an precise illustration of the original because it is lossless compression method.

Subarna *et.al.,*[5] proposed an algorithm by taking histogram based block optimization. In this paper, an proficient algorithm has been developed for lossy image compression/decompression scheme using histogram based block optimization and arithmetic coding.

III. METHODOLOGY

Image compression is an significant method in the contemporary digital world in tidy to decrease the memory storage and processing of the images. The superiority of the digital images is usually eminent which means that huge amount of data are required to symbolize the images and results in use of more memory space. Hence, the role of image compression is measured to be very important in each area that uses images particularly in the field of medical. Data Folding is one simple and faster method that incorporated in Image Compression.

A. Data folding using Huffman Coding (DFHC)

Suresh *et.al.,*[2] developed an image compression based on data folding with Huffman coding scheme. The main idea behind this work is based on spatial resolution for lossless image compression called data folding. The Data folding use pixel redundancy in 2-D images in either successive rows or columns. The idea is to subtract even pixels from odd pixels and store the difference data in a buffer. Odd pixels are stored in another buffer for further iterations. In data folding column folding followed by row folding is applied. In column folding, pixels used for subtraction are column adjacent whereas in row folding, the pixels are row adjacent.

The pixel redundancies are rearranged in a tile format and source encoding technique is applied at the end before transmitting the data. The difference matrix is encoded by using the Huffman Coding (HC) algorithm. The final results are obtained after encoding the data of each level would be compressed data for the input image.

Problem with this method is the high computational complexity while encoding data through Huffman coding scheme. It also has high encoding time due to Huffman tree construction process. Huffman coding produces rounding errors, because its code length is restricted to multiples of a bit.

B. Efficient Data folding using Arithmetic Coding (EDFAC)

To overcome the problems with DFHC method, a novel method EDFAC is proposed. Data folding is an iterative procedure, column folding followed by row folding, that is repeated at every image level.

Original image (i.e. input image) must be square. Define a buffer 'B' whose size is identical to original image. Original image is considered as input image for the first iteration initially, the buffer 'B' is empty. In the process of column folding, the input image odd columns are subtracted from its right neighboring even columns and stored in first half columns of the empty portion of the buffer 'B'. Odd columns are stored in a different buffer O' which is taken as input image to row folding. Following equations depicts column folding technique

$$B(X + a, Y + b) = S(a, 2b - 1) - S(a, 2b)$$

$$O'(a, b) = S(a, 2b - 1)$$

$$a \in [1, W] \text{ and } b \in \left[1, \frac{W}{2}\right]$$

Where S - input image, W - width of input image, O'- modified input image, X - starting x coordinate of empty portion of 'B', Y - starting y coordinate of empty portion of 'B'. Figure 3.1 shows the working of EDFAC method.

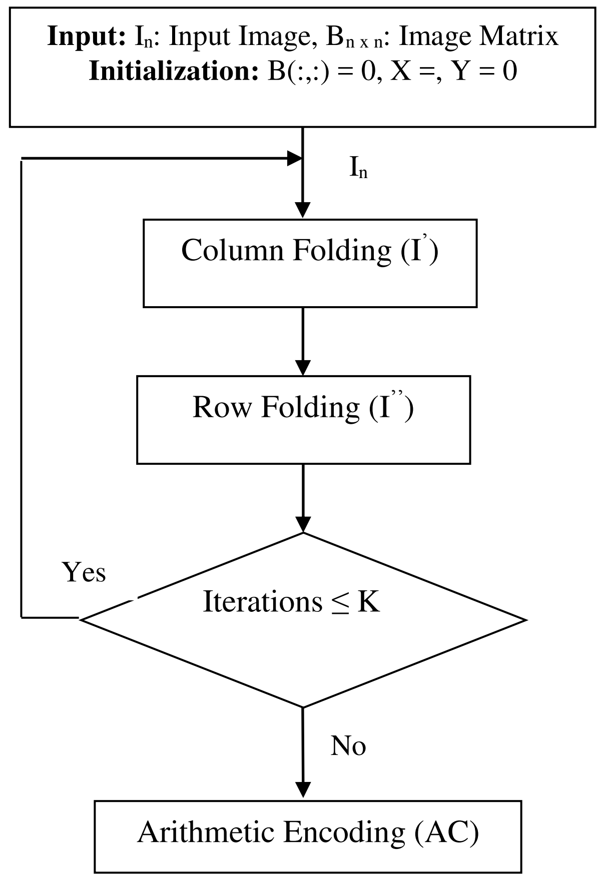

Figure 3.1 Flow of Data Folding with AC

Row folding is similar to column folding. In row folding, odd rows are subtracted from its adjacent even rows and stored in first half rows of empty portion of 'B'. Odd rows are stored in a different buffer S'' which is taken as input to next iteration. Observe that, input image to column folding is always square whereas it is rectangular to row folding. Difference data after all iterations is stored in the tile format is show in Figure 3.2

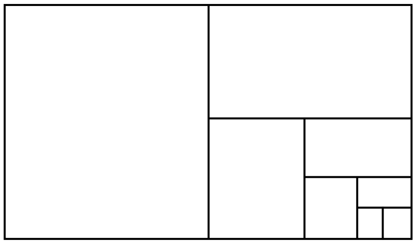

Figure 3.2 Data folding design

After all iterations, the magnitude of difference data ranges from -255 to +255. Add 255 to each element of image matrix in map the data to a positive range.

The aim of Arithmetic Coding (AC) is to define a method that provides code words with an ideal length. Like for every other entropy coder, it is required to know the probability for the appearance of the individual symbols. One method of AC is Run Length Encoding (RLE) [6] is used to encode data folding matrix 'B'.

RLE is used in image compression either as a standalone tool or as an element of a larger processing chain. The idea behind the RLE is that if a data item *d* occurs at *n* consecutive times in the input stream, compression can be achieved by replacing the *n* occurrences with the single pair *nd*. The *n* denotes the number of consecutive occurrences or the run length of data item d, thus the name run length encoding.

IV. RESULT AND DISCUSSION

After the maximum levels of folding on the images, arithmetic coding is used to encode the data. Various parameters used to analyze the performance of image are bits per pixel, compression ratio, PSNR, MSE, etc. To analyze the work Bits Per Pixels (BPP) and Compression Ratio (CR) are used.

Bits Per Pixel (BPP)

BPP is described as the numeral of bits per pixel in a specified image. The amount of diverse colors in an image is related to the depth of color or bits per pixel. The formula to find the Bits per Pixel is as follows:

$$Bits\ per\ pixel\ (bpp) = \left(\frac{Size\ of\ compressed\ color\ image\ in\ bits}{number\ of\ pixels}\right)$$

The comparison of BPP between EDFAG and DFHC is shown in Figure 4.1. Various standard images were tested for performance analyze.

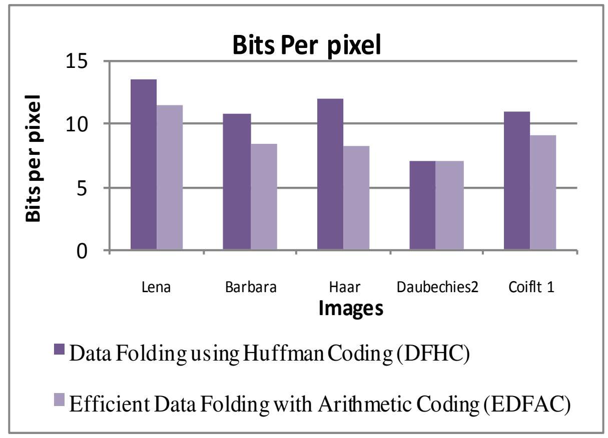

Figure 4.1 Bits Per Pixel (BPP)

Table 4.1 shows the BPP values for the existing and proposed methods. From the table values it is clear that the proposed EDFAG coding yields lower BPP values than the DFHC coding.

Table 7.1 Performance Comparison Ratio (%) of DFHC and EDFAG in terms of BPP values

Images	*DFHC scheme*	*EDFAC scheme*
Lena	13.63	11.57
Barbara	10.78	08.43
Haar	12.11	08.32
Daubechies2	07.08	07.02
Coiflt 1	11.07	09.11

From Figure 4.1 and Table 4.1, it can be concluded the EDFAG performance better than DFHC.

Compression Ratio

Compression ratio is described as the ratio of an original image and compressed image.

$$Compression\ Ratio = \frac{Original\ Image\ size}{Compressed\ Image\ Size}$$

Figure 4.2 shows the comparison of the proposed MHPCA scheme and the HPCA scheme in terms of compression ratio. In this graph, names of images are plotted in the x axis and the compression ratio values are plotted in the y axis.

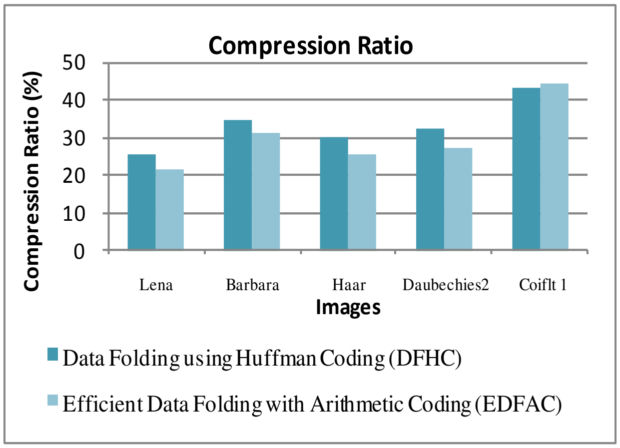

Figure 4.2 Compression Ratio (CR)

The compression ratio is low by using the DFHC coding while it is significantly increased by using proposed EDFAG coding. Table 43.2 shows the compression ratio values for DFHC and EDFAG coding schemes. From the table values it is clear that the EDFAG yields better compression ratio values than the DFHC coding.

Table 4.2 Performance Comparison of EDFAG scheme with DFHC scheme in terms of Compression ratio

Images	***DFHC scheme***	***EDFAC scheme***
Lena	25.37	21.59
Barbara	34.51	31.52
Haar	29.87	25.67
Daubechies2	32.65	27.19
Coiflt 1	42.98	44.37

V. CONCLUSION

Lossless image compression can be achieved in simple and faster manner with data folding method. After the data folding, Arithmetic coding with geometric transformation is applied. EDFAG has better performances than DFHC. The proposed method provides proficient lossless compression of image without degrading the quality of images. The difficult of calculating data difference in folding process for higher magnitude can be handle with efficient in future research.

REFERENCES

[1] Alan Conrad Bovik, *The Essential guide to Image Processing*, Vol.16, pp.385-419, 2009.

[2] Suresh Yerva, Smita Nair, Krishnan Kuttym, Lossless Image Compression based on Data Folding, *IEEE Xplore Digital Library,* August 2011, ISBN: 978-1-4577-0589-2, DOI:10.1109/ICRTIT.2011.5972472.

[3] Amir Said, Member, IEEE, and William A. Pearlman, Senior Member, IEEE, *"An Image Multiresolution Representation for Lossless and Lossy Compression"*, VOL. 5, NO. 9, SEPTEMBER 1996.

[4] A.A.Shaikh, P. P. Gadekar, *Huffman Coding Technique for Image Compression*, COMPUSOFT, An international journal of advanced computer technology, 4 (4), April-2015 , pp.1585 – 1587.

[5] Subarna Dutta, Aditya Abhinav, Partha Dutta, Purushottam Kumar, and Amiya Halder, *An Efficient Image Compression Algorithm Based on Histogram Based Block Optimization and Arithmetic Coding*, International Journal of Computer Theory and Engineering, Vol. 4, No. 6, December 2012, pp. 954 – 957.

[6] Med Karim Abdmouleh, Atef Masmoudi, Med Salim Bouhlel, *A New Method Which Combines Arithmetic Coding with RLE for Lossless Image Compression*, Journal of Software Engineering and Applications, 2012, Vol.5, pp. 41 – 44.