A Lossless Image Compression using Modified Entropy Coding

Dr. R. Mala, MCA., M.Phil., PhD.,
Assistant Professor
Murugan.dcdrf@gmail.com

S. Sarathadevi, MCA.,
Student
Maruthupandiyar College of Arts and Science
Thanjavur, India
Sarathadv3@gmail.com

Abstract— Due to size limitation and complexity of the hardware in transmission applications, multimedia systems and computer communications, compression techniques are much necessary. The reasons for multimedia systems to compress the data, large storage is required to save the compressed data, the storage devices are relatively slow which in real-time, has constrain to play multimedia data, and the network bandwidth, that has limitations to real-time data transmission.

This paper presents an enhanced approach of run length coding. First the DCT applied, and the quantization done on the image to be compressed, then the modified run length coding technique has been used to compress the image losslessly. This scheme represents the occurrence of repeated zeros by RUN, and a non-zero coefficient by LEVEL. It removes the value of RUN, as for the sequence of non-zero coefficients it is zero for most of the time and for a zero present between non-zero coefficients is replaced by '0' which results in larger compression than RUN, LEVEL (1, 0) pair is used.

Keywords---*Run length encoding; Lossless compression; zigzag coding; Image Compression*

*****

I. INTRODUCTION

An Image can be represented as a two dimensional function I(x, y), here x and y are spatial coordinates, and the intensity of any point(x,y) is the amplitude of I at that point.

*Grayscale Image***:** Each picture element in an 8 bit grayscale image, has 0 to 255 value as intensity.

Coloured Image : Colours in images is motivated by the factor that humans can distinguish thousands of colours and intensities.

Digital Image Processing: Two major tasks in digital image processing. They are (i) Enhancing image for human perception (ii) Image data processing of image for autonomous machine perception.

Figure 1 shows the Fundamental steps of digital image processing.

II IMAGE COMPRESSION

The purpose of image compression is to reduce redundant data in the image to make it store or transmit data efficiently. Image Compression techniques reduces the storage needed to store an image an d reduces the transmission bandwidth, particularly in the uses of internet. Some of the compression techniques are Huffman coding, Arithmetic coding, LZW coding, Run length coding, Predictive coding , Block Transformation coding.

In 1940s with the emergence of data theory data compression begun. And with the block probability a way for code word was developed systematically in 1949 by Claude Shannon and Robert Fano. Huffman discovered words opinion relying on the data used and compression methods related to all adaptive Huffman coding in 1970s. In 1977, Abraham Lempel and Jacob suggested a pointer coding.

By the further study of Teri Welch the LZW algorithm has been created in 1980s.

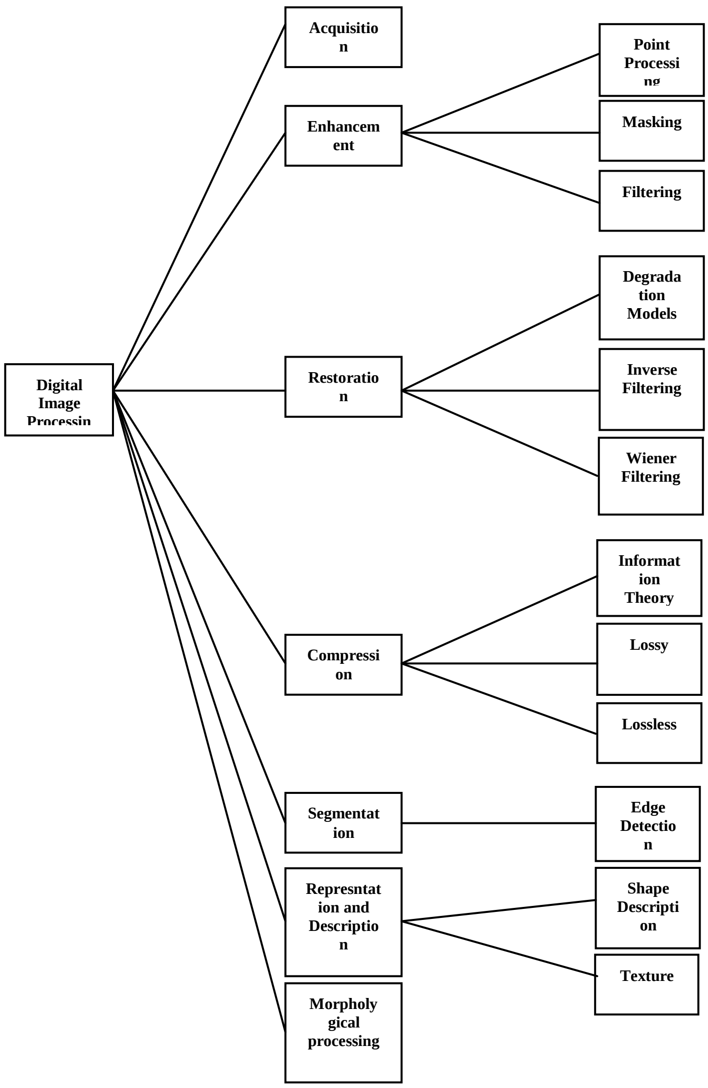

Figure 1

Broad Category of Image Compression

In general, there are two main categories of compression.

Lossless compression

The original image can be retrieved by decompressing compressed image by lossless compression. It uses decomposition techniques to eliminate or minimize redundancy it is known as Entropy coding. The methods that fall under lossless compression are Huffman encoding, Run length coding, and LZW coding.

Lossy compression

Lossy compression technique provides higher compression ratio than lossless compression but the decompressed image from the compressed is not exactly identical to the original image. The methods are Fractal coding, Block truncation coding.,Vector Quantization, etc.

III CONVENTIONAL RUN LENGTH CODING

One of the standard coding technique is Run Length coding for the block transformation compression. Here the number of redundant zeros are counted as R variable and the Non-Zeros are represented by LVL.

The run length in JPEG compression algorithm counts the zeros between two non-zeros and update the coefficient except zero following the number of zeros. For continuous non-zeros it adds redundancy in the encoded data.

The Figure 2 is the flow diagram of Conventional Run Length Coding.

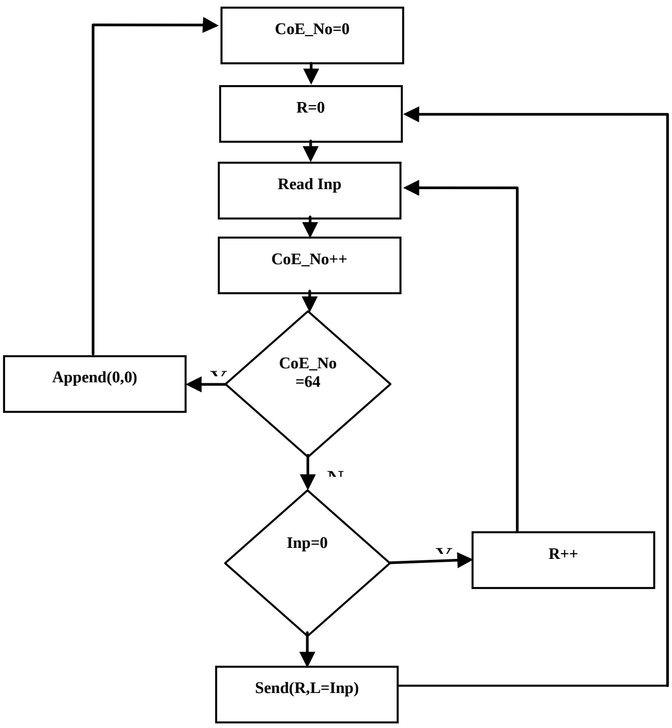

Figure 2

IV OPTIMIZED RUN LENGTH CODING

The drawbacks of conventional Run Length Coding are overcame by a more optimized scheme. while continuous zeros occur at the input it uses (RUN, LEVELS) .

The parameter RUN will be eliminated for the non-zero digits in the final encoded message .

To identify a zero or consecutively zeros present in the data stream a FLAG bit is used. It represents the single zero between non-zero characters with a 2-digit sequence of (1, 0).

V PROPOSED MODIFIED RUN LENGTH CODING

In this when a consecutive zeros present at the input, a pair of (R, LVLs) have been used. LVLs parameter holds encoded non-zero digits. A zero or consecutive zeros in the stream of data identified using FLG bit. The single zero between non-zero characters represented with 2 digit sequence (1,0) and at final encoded data are added with extra digit for further optimization of the algorithm. In JPEG compression consequent zeros, Non-zero digits with same value is very rare, this observation is used for this modified coding.

The presence of consecutive zeros in the data stream flips the FLG bit once. The FLG bit reinitialized when the continuous zero digits encountered at the end.

To increment the value of R variable for consecutive zeros at the end of block, the process will be bypassed to the process of appending (0, 0). If R count is equal to "1" then there is no consequent zeros but there is single zero between non zero coefficients, so it has been encoded as "0" instead of (1,0) R, LVL pair.

The Figure 3 illustrates the optimized Run Length Coding

VI COMPARISON OF ALGORITHMS

To compare and prove the optimization of above algorithms consider 8 X 8 block in figure 4 which is obtained after the quantization.

88	-22	-5	-4	-1	-2	0	0
12	-1	-3	0	-1	0	0	0
-5	0	1	0	0	0	0	0
3	0	0	0	0	0	0	0
2	0	0	1	0	0	0	0
-1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Figure 4

Conventional Run Length Coding

The encoded data of the conventional Run Length Coding algorithm uses 33 digit sequence for 8x8 image block in Figure.4. The output will be

[(0,-22) (0,12) (0,-5) (0,-1) (0,-5) (0,-4) (0,-3) (1,3) (0,2) (1,1) (1,-1) (0,-2) (0,-1) (3,-1) (11,1) (0,0)].

Optimized Run Length Coding

ISSN: 2321-8169
2148 – 2150

Here the optimized algorithm uses 29 digit sequence to represent the data the output would be:
[-22 12 -5 -1 -5 -4 -3 (1, 0) 3 2 (1, 0) 1 (1, 0) -1 -2 -1 (3, 0) -1 (11, 0) 1 (31, 0) (0, 0)].

Proposed Run Length Coding

The output of Proposed run length algorithm is:
[-22 12 -5 -1 -5 -4 -3 0 3 2 0 1 0 -1 -2 -1 (3, 0) -1 (11, 0) 1 (31, 0) (0, 0)].

It uses 26 digit sequence

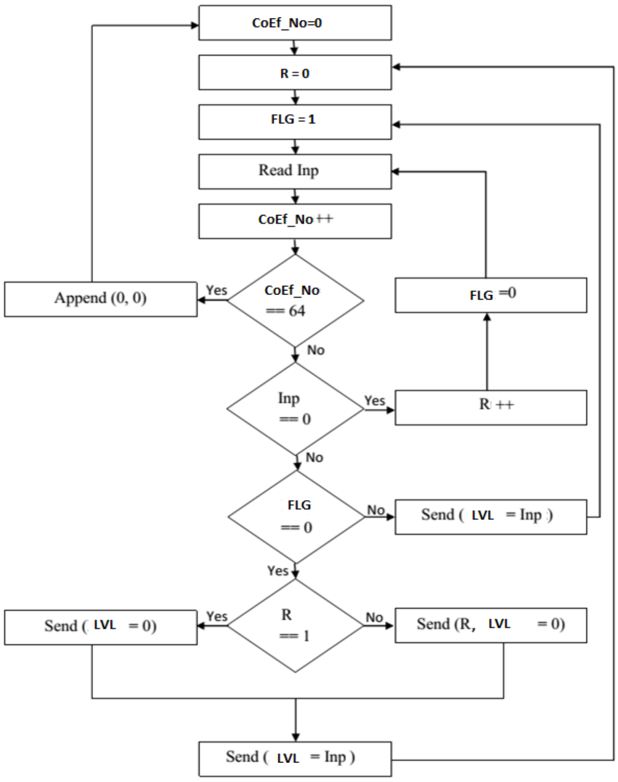

Figure 3

Algorithm	Used digits
Conventional Run Length Encoding	33
Optimized Run Length Encoding	29
Proposed Modified Run Length Encoding	26

Table 1: The algorithms' results

With this, the efficiency of proposed algorithm is clearly stated. The results of one 8 X 8 block I shown and still more 8 X 8 blocks will present in an image after the image is divided at the DCT phase, and single zeros present between two non-zero can occur 1 or 2 times.

V CONCLUSION

The proposed technique is based on DCT as it is very efficient among other techniques. The proposed algorithm gives a good rate of compression without much loss of data. The algorithm compresses the images upto 75% without much loss of picture information. Moreover still it has to be enhanced to use this technique in motion pictures, as MPEG1, MPEG2 and MPEG4 standards uses run length coding it has to implement the proposed algorithm the videos.

REFERENCES

[1] Chengjie Tu, and Trac D. Tran, , "Context-Based Entropy Coding of Block Transform Coefficients for Image Compression", IEEE
[2] R Sanderson, "Introduction to remote sensing", New mexico space grant consortium, Aug 2010.
[3] Rice University, [online] http://www.owlnet.rice.edu/~elec539/Projects99/BACH/proj2/intro.html
[4] T. Cebrail, S.K. Sarikoz, "An overview of Image Compression Approaches", The 3rd International conference on Digital Telecommunications, IEEE 2008.
[5] I.H. Witten, R. M. Neal, J. G. Cleary, Arithmetic Coding For Data Compression, Communications of the ACM, Volume 30 Number 6, pp 520-540, 1987.
[6] Paul G. Howard, Jeffrey Scott Vitter, Arithmetic Coding for Data Compression, Proceedings of the IEEE. Vol. 82, No. 6, June 1994.
[7] V. E. 1. Neagoe, "Predictive ordering technique and feedback transform coding for data compression of still pictures," IEEE Trans. Commm., vol. 40, pp. 385-396, Feb. 1992.
[8] Hossein Mobahi, Shankar Rao, Allen Yang, Shankar Sastry and Yi Ma, Segmentation of Natural Images by Texture and Boundary Compression, International Journal of Computer Vision (IJCV), 95 (1), pg. 86-98, Oct. 2011.
[9] Myung-Sin Song , "Entropy Encoding in Wavelet Image Compression", Department of Mathematics and Statistics, Southern Illinois University Edwardsville, Edwardsville.
[10] A. Deever and S. S. Hemami, "What's your sign?: Efficient sign coding for embedded wavelet image coding," inProc. 2000 Data Compression Conf., Mar. 2000, pp. 273–282.
[11] W. B. Pennebaker, J. L. Mitchell, G. G. Langdon, and R. B. Arps, "An overview of the basic principles of theQ-coder adaptive binary arithmetic coder,"IBM J. Res. Develop., vol. 6, no. 3, pp. 243–249, Nov. 1988.
[12] J. Liang and T. D. Tran, "Fast multiplierless approximations of the DCT with the lifting scheme,"IEEE Trans. Signal Processing, vol. 49, pp. 3032–3044, Dec. 2001.