Comparision of different Image Compression Techniques : A Review

[1]Suraj A. Shete, [2]Girish G. Bhide, [3]Mahesh A. Jadhav, [4]Ashish B. Vartak

[1,2,3,4]Assistant Professor, Dept. of Electronics Engg. FAMT, Ratnagiri, India.

[1]suraj.shete@famt.ac.in, [2]girish.bhide@famt.ac.in, [3]mahesh.jadhav@famt.ac.in, [4]ashish.vartak@famt.ac.in

Abstract **2 Dimensional representation of 3 Dimensional world is called as Image. For quality enhancement or for feature extraction purpose, we analyze and change some features of original digitized image is called Digital Image Processing. In our day to day life more information obtained on internet is in the form of image. Also more times we comes contact with multimedia services. So to store such images more memory is required. As rapid growth in internet technology and multimedia services, there is need of image compression. So Image compression plays a vital role in memory management as well as recent internet technologies. Encoding or converting original image file in a way that resultant image consumes less memory is considered as Image Compression. For Image transmission and storage purpose, Compression is essential. There are several image compression techniques are exist. Technique to technique compression ratio and quality of resultant image changes. In this paper comparative image compression techniques and their performance is discussed.**

***Keywords — Lossy, Lossless, DCT, DWT, Compression ratio*.**

I. INTRODUCTION

Image is a 2 Dimensional signal. Digital Image is represented by 2 dimensional array i.e. matrix. Each element of matrix is called as ‘Image element’ or ‘Pixel’. So each digital image is stored as 2 Dimensional matrix. In digital image, each pixel has some numeric value & this numeric value decides intensity of corresponding pixel. Total number of Pixels present in image is calculated as multiplication of number of rows and number of columns present in that image. Also each pixel requires bits to represent corresponding numeric value. To store such image total number of bits required is equal to multiplication of number of rows, number of columns and bits required to represent each pixel. Suppose one image consists of A rows, B columns and C bits required to present each pixel, then memory required to store such image is A×B×C bits. For binary image, one bit is sufficient to represent each pixel whereas for gray scale image 8 bits (1 byte) are required to represent each pixel. In color image each pixel is represented by using 24 bits (3 bytes).

As image size increases, it requires more memory for storage purpose and transmission cost also increase. Also big image size reduces transmission speed. Any image consists of some surrounding data i.e. some irrelevant data is present within image. So due to irrelevant contain there is scope to remove that irrelevant contain to reduce size of image.

A. Definition of Image compression

Reducing number of pixels i.e. image quantity without excessively reducing quality of that image is called as ‘Image Compression.’ When we perform image compression then compression ration comes into picture. Compression ratio is ratio of file size of image after compression to the file size of image before compression.

$$\text{Compression ratio} = \frac{\text{Size of image after compression}}{\text{Size of image before compression}} \quad (1)$$

Practical image compression system consist of encoder i.e. compressor and decoder i.e. de-compressor as shown in fig 1.

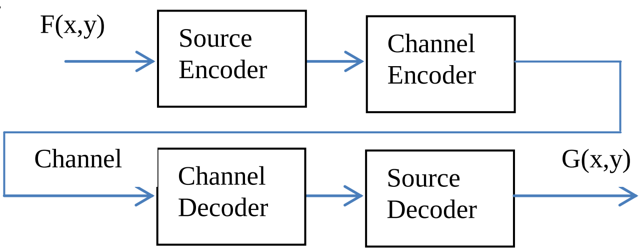

Fig 1. Basic Image compression system

Input image F(x,y) is taken from image database and fed to encoder which encodes input image so that it is suitable for transmission purpose. Encoder makes set of blocks of input image. Encoder has two parts as- Source encoder and channel encoder. Source encoder removes input redundancies. After removing redundancies in image, image is fed to channel decoder. Channel decoder increases noise immunity of image so that in transmission easily noise should not add. After channel encoder image is ready for transmission purpose. The decoder receive transmitted image and pass through channel decoder and source decoder. Exactly reverse process is obtained in decoder session as that of encoder.

Image compression techniques are divided into two type's viz. lossy compression and lossless compression. In lossy type some amount of original image lost during compression

process whereas in lossless compression no information is lost. We will discuss both techniques in detail.

B. Need of Image compression

Memory required for storage purpose is less. Decrease transmission time so speed of transmission increases. Due to small size it also effects on cost.

Remaining session of paper is organized as –

Session II describes lossy compression and it's types. Session III involves lossless compression and it's types. Session IV is dedicated for comparative study between lossy and lossless compression techniques. Paper is concluded in Session V

II. Lossy compression

An image file consists of redundant as well as irrelevant data. In lossy image compression algorithms some amount of redundant and maximum amount of irrelevant data is eliminate. Thus compression ratio is high in lossy compression methods. In compression first we compress input image (F(x,y)) using algorithms and decompression means reconstruct image (G(x,y)). In lossy compression size of reconstructed image is very small as compared to input image. Thus in lossy compression $F(x,y) \neq G(x,y)$.

Here we will discuss different lossy compression techniques.

A. Improved Grey Scale (IGS) Quantization

In this technique Psychovisual Redundancies are removed. Psychovisual Redundancies means image content which is not visually important. In IGS coding lower 4 LSB bits of modified pixel are added to recent pixel and new 4 MSB bits of recent image is considered as IGS code.

In IGS quantization visual information is lost.

B. Transform Coding

In transform coding input image is transform into other domain and after transformation discard those pixels whose value is near to zero or exact zero. In this only those pixels are quantized whose value consist of more information. When any image is passed through any transform then its low and high frequency components are separated. High frequency components might consider noise or sharp edges. So in this method some high frequency pixels are removed.

Discrete Fourier Transform (DFT) and Discrete Cosine Transform (DCT) are shows better result in lossy compression. But DCT achieves better compactness as compared to DFT. For JGEG images DCT is used.

C. Fractal Algorithm

In this technique image is segmented into fractals by using standard techniques like edge partition, color partition etc. Each fractal have less bit requires for storage purpose. Obtained each fractal is looked up into library of fractals. Afterwards each fractal is matched with standard fractal codes.

III. Lossless Compression

In lossless compression compact representation of original image is done without losing information. Thus compression ratio is less as compared to lossy compression. But In lossless compression size of reconstructed image is nearly same as compared to input image. Thus in lossless compression $F(x,y) = G(x,y)$.

Here we will discuss different lossless compression techniques.

A. Huffman coding

Basic principle behind Huffman coding is shorter code-words are assigned to symbols which are frequently used in image as compared to less frequently symbols. Generated code-words have different size also they decrease average length of code which results into compression of image.

Huffman coding is one of the popular technique.

B. Entropy coding

Entropy coding assigns unique prefix code to each symbol and these symbols are called entropy encoder. Size of Entropy encoder is less as compared to original symbol.

C. Run length Encoding

In this method, repeated same symbols encoded as number of symbols and name of that particular symbols. That means series of same symbol is replaced by count and the symbol.

For example, The string 'AAAAAAAABBBCCCCCCC' is encoded as 8A3B7C. In this example instead of 18 bytes only 6 bytes are sufficient to represent this symbol using Run Length Encoding.

D. Lempel-Ziv-Welch coding (LZW Coding)

This is dictionary dependent coding. LZW is classified into two types, static and dynamic. In static LZW, dictionary is constant and in dynamic dictionary is updated.

E. Discrete Wavelet transform (DWT)

In DWT, discrete image is represented into discrete wavelets. Wavelet is a small part of wave. DWT provides Multi-resolution. Wavelet transform is more effective to remove noise and blur contain so this technique is so much popular in today's scenario. DWT separates low frequency, detailed part of image called as 'wave functions' and high frequency regions of image. JPEG 2000 Image compression is done by using DWT.

F. Discrete Cosine transform (DCT)

In DCT using cosine transform image is split into its frequency components. Using quantization less significant frequencies are cancelled and more significant frequencies are preserving during process of decomposition. DCT method is used in JPEG compression.

IV. Comparative Study Between Lossy and Lossless Compression

In lossy image compression more information is lost as compared to lossless compression. But compression ratio is more in lossy compression as compared to lossless compression. Quality od lossless image is better.

V. Conclusion

This review paper describes different image compression techniques. From previous work, it is observed that each compression technique is important in their related regions. In this paper we review both lossy and lossless Image compression techniques.

References

[1] Dr. K. Kuppusamy, R.Ilackiya "Fractal Image Compression & Algorithmic Techniques" International Journal of Computer & Organization Trends –Volume3 Issue 4 , May 2013

[2] Anil kumar Katharotiya, Swati Patel Mahesh Goyani, "Comparative Analysis between DCT & DWT Techniques of Image Compression" Journal of Information Engineering and Applications Vol 1, No.2, 2011

[3] S. Kumar, T. U. Paul, A. Raychoudhury, "Image Compression using Approximate Matching and Run Length", International Journal of Advanced Computer Science and Applications, Vol. 2, No. 6, 2011.

[4] A. K. Jain,Image data compression:A review", in Proc. IEE, vo169, pp. 349-389, 1981

[5] Yu-Ting Pai, Fan-Chieh Cheng, Shu-Ping Lu, and ShanqJang Ruan, "Sub-Trees Modification of Huffman Coding for Stuffing Bits Reduction and Efficient NRZI Data Transmission" IEEE Transactions On Broadcasting, Vol.58,No.2, June 2012.

