Lossy and Lossless Compression using various Algorithms

M.Sundaresan, PhD
Associate Professor
Department of Information Technology
Bharathiar University
India, Tamilnadu, Coimbatore – 641 046

E.Devika
Research Scholar
Department of Information Technology
Bharathiar University
India, Tamilnadu, Coimbatore - 641 046

ABSTRACT

An images is an array, or a matrix, of square pixels arranged in columns and rows. A color image has primary colors of red, green and blue. Compound image is combination of text, graphics and pictures. Here, Compression is the process of reducing the amount of data required to represent information. It also reduces the time required for the data to be sent over the Internet or Web pages. Image compression is done on the basis of various lossy and lossless compression algorithms. This research work contains with the preprocessing, macroblock divisions, transformations, quantization and lossy and lossless algorithms are used to compress an image to produce a high compression ratio, less compression time and decompression time and high PSNR value. The performance of these techniques has been compared.

Keywords: Preprocessing, Macroblocks, Transformation, Quantization, Lossy and Lossless Compression

1. INTRODUCTION

Digital image processing is the use of computer algorithms to perform image processing on digital images. It is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it [1]. It is a type of signal exemption in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. It is composed of finite number of elements, each of which has a particular location and value. These elements are referred to as picture elements, digital elements, pels and the pixels. The pixel is the term most widely used to denote the elements of a digital image. Digital image processing is used to improve the appearance of an image to a human observer to extract from image quantitative information that is not readily apparent to a human perception [2]. Example for a compound image is shown in the below Figure 1.

Figure 1: Example for an Compound Image.

At this point Pre-processing methods used, it is a small neighborhood of a pixel in an input image to get a new brightness value in the output image [3]. Such pre-processing operations are also called filtration. If the images are too noisy or blurred, the images should be filtered and sharpened. In image processing, filters are mainly used to suppress either the high frequencies in the image [4]. The various types of linear and non-linear filters are used to reduce the noise. There are two types of compression techniques are used to reduce file size of an image they are lossy and lossless compression. Both lossy and lossless compression various algorithms are used to compress a compound image. After compression, the decompression process has to be made to get the original compound image.

The paper is structured as follows. In section 2 Existing systems are discussed. Section 3 Proposed systems. In section 4 Methodology. Section 5 deals with the conclusions Section 6 deals with the Feature enhancement.

2. EXISTING SYSTEM

In United Coding (UC) Method used several lossless coding techniques such as Run-Length Encoding (RLE), Portable Network Graphics (PNG) and gzip are combined into H.264 hybrid coding, and macroblock is the basic coding unit. Preprocessing is implemented to remove noise which helps to improve the compression ratio of an image. In this UC method, various types of compound images are used. Using these algorithms compression ratio and PSNR value is calculated [5].

3. PROPOSED SYSTEM

In this work before compressing a compound image, pre-processing is implemented for compound images to reduce the noise. For pre-processing median filter is used. Preprocessed image are segmented using macroblock based technique which segments the image as 16X16 non overlapping blocks [6]. H.264 algorithm is used for lossy compression and Deflate algorithm is used to lossless compression. In the existing method PNG, gzip and run-length encoding algorithms are used for compressing the compound images. So while comparing both existing and proposed method, the proposed method gives the high compression ratio, less compression time and decompression time and high PSNR value than the existing method. The proposed method provides better result.

4. METHODOLOGY

In this work, various types of images like normal, desktop, word, ppt and compound images for image compression. Before compressing these images, the image should be segmented as 16 X 16 macroblock divisions. Then the compression is done through lossy and lossless methods. This greatly enhanced the proposed algorithm in terms of compression time and decompression time. The above processes are depicted in the below Figure 2.

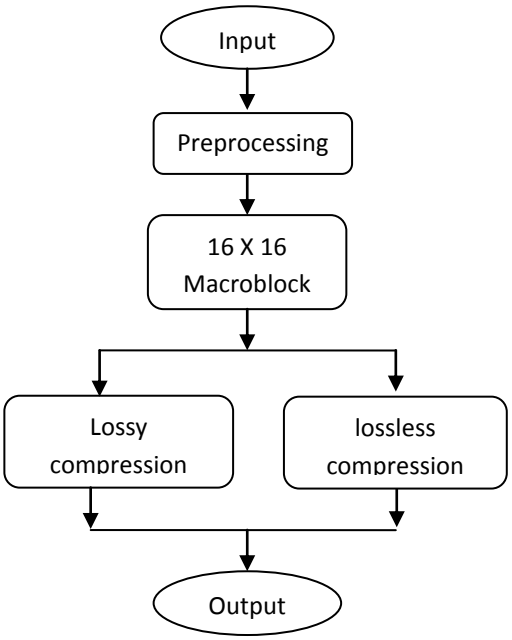


Figure 2: Flowchart

4.1 Preprocessing

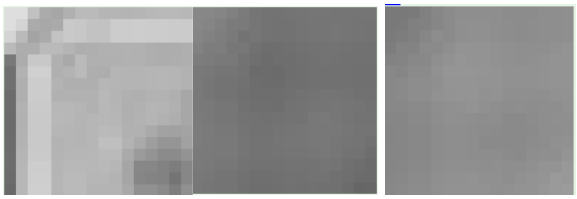
Preprocessing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Image preprocessing is the technique of enhancing data images prior to computational processing. The preprocessing methods are used to reduce image data size by reducing noise in images. It improves the quality of images. If the images are too noisy or blurred it should be filtered and sharpened. In image processing, filters are mainly used to suppress either the high frequencies in the image, smoothing the images or the low frequencies, i.e. enhancing or detecting edges in the image [7]. In this proposed Integrated Coding method Median Filter is used for preprocessing. The success of the median filters in the image processing is based on two intrinsic properties edge preservation and efficient reduction of the impulsive noise. The median filter calculates the middle value by first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel value. If the neighborhood under consideration contains an even number of pixels, the average of the two middle pixel values is used.

4.2 Quantization

Quantization process initially starts with; the source image is divided into macroblocks. Discrete Cosine Transform (DCT) is applied to macroblocks for color transformation [8]. This step transforms the input image to a set of values or color components. Color components are converted as RGB and from RGB again it converts into YCbCr color components.

It works on the principle that as human eye perceives changes in brightness better than changes in color; focus more on brightness than the actual brightness level. YCbCr stores more relevant data at a lower accuracy than RGB. Moreover, it is well known that the RGB components of color images are highly correlated [9].

Integrated Coding method used YCbCr as it represents the human perception of color more closely than the standard RGB model used in computer graphics hardware and stores more relevant data at a lower accuracy. The output of the YCbCr is shown in the Figure 3 respectively.



Y Component ***Cb Component*** ***Cr Component***

Figure 3

A magnitude of the sampled image is expressed as a digital image in image processing and the transition between continuous values of the image function and its digital equivalent is called quantization. The number of quantization level should be high enough for human perspective of fine shading details in the image. The Figure 4 shows the effect of quantizing a compound image.

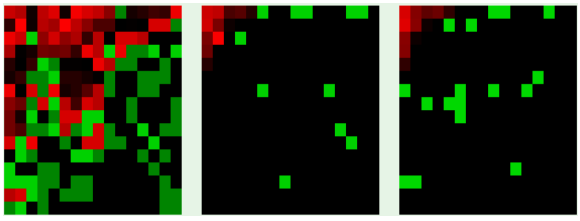


Figure 4: Quantization

4.3 Lossy Compression

The lossy compression is applied to compound image using H.264 algorithm. Using this algorithm images are compressed. The steps involved during the compression are Image Transformation and Quantization. Transformation is done through Discrete Cosine Transform (DCT). DCT is used to translate the image information from spatial domain to frequency domain to be represented in a more compact form. Quantization is used to represent the information within the image by reducing the amount of data. Here every image is encoded by dividing it into blocks and assigning to each block the index of the closest codeword. After the Quantization process the compression is done for the compound image and the compression ratio level is obtained for compound image.

4.4 Lossless Compression

Lossless compression is applied to compound image using Deflate compression algorithm. Deflate compression is a lossless data compression algorithm that uses a combination of the LZ77 algorithm and Huffman coding. [10] The LZ77 Compression Algorithm is used to analyze input data and determine how to reduce the size of that input data by replacing redundant information with data. The Huffman encoding algorithm is an optimal compression algorithm when only the frequencies of individual pixels are used to compress the data. [11]

Compression is achieved through two steps:

1. The matching and replacement of duplicate strings with pointers.

2. Replacing symbols with new, weighted symbols based on frequency of use.

So the deflate compression is done and the compression ratio is produced for compound image.

4.5 Performance Analysis

The performance of Integrated Coding with the concept of preprocessing the image by Median Filter has been tested in various types of compound images such as normal, word, PPT, desktop and web image. An experiment was conducted for the image size 512 X 512 and for different file formats namely jpeg, TIFF, BMP, PNG and JP2. The Compression time for the image is compared between existing and proposed for the various compound images are tabulated in the Table 1.

Table 1: Comparison of Lossy and Lossless Images

Images	Lossy		Lossless	
	CR	CT(Secs)	CR	CT(Secs)
Normal	5.71	1.31	3.32	2.78
Compound	1.58	2.01	1.53	2.78
Word	2.38	1.61	2.34	3.42
Desktop	4.32	2.01	3.03	3.05
PPT	5.01	1.59	4.21	2.73

The decompression time for the compound images are compared between existing and proposed and the average compression time are tabulated in the Table 1. From the table, it is observed that decompression time is less in Integrated coding than United Coding

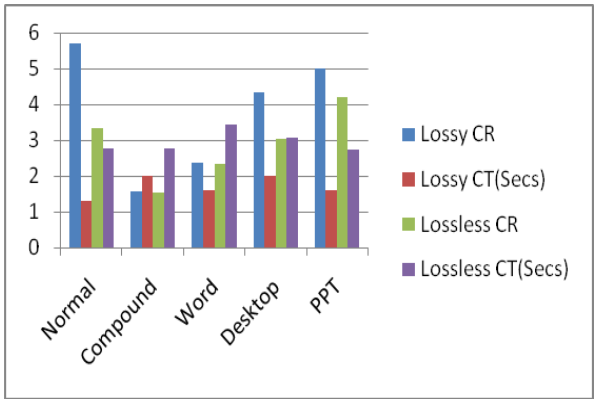


Figure 5: Lossy and lossless Value for Compound Images

Figure 5 shows the graphical representation of Compression Time and Decompression Time for various compound images.

The Quality of the image is compared for both existing and proposed method and it showed the proposed method Integrated Coding provides better result than the existing method United coding. The average PSNR value for various compound images is shown in Table 2. By adopting the proposed method the PSNR achieved is 35.83 db for Compound Images.

Table 2: PSNR in db for various Images

Images	H.264	Deflate
Normal	20.3	17.32
Compound	34.83	31.61
Word	27.32	26.01
Desktop	22.29	20.01
PPT	24.13	22.32

Figure 6 shows the graphical representation of PSNR value for various compound images.

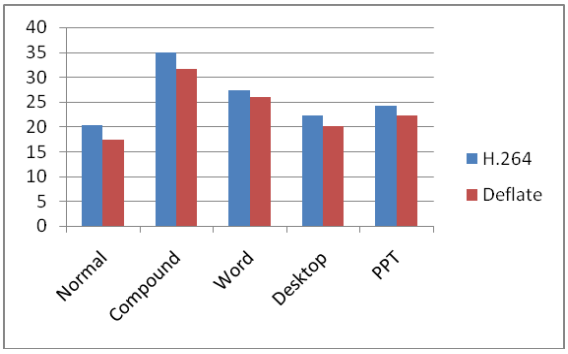


Figure 6: PSNR Value for various Compound Images

5. CONCLUSION

In this paper, five different types of images like normal, compound, word, desktop and ppt images are compressed. All these images are compressed using both lossy and lossless. H.264 algorithm is used for lossy compression and Deflate algorithm is used to compress lossless compression. In the united coding method PNG, gzip and run-length encoding algorithms are used for compressing the various compound images.

So while comparing both existing and proposed method, the proposed method gives the high compression ratio, less compression time and decompression time and high PSNR value than the existing method. The proposed Integrated Coding method provides better result than existing method.

6. FUTURE ENHANCEMENT

In Future, different lossy and lossless algorithms can be used to improve the performance of the compression ratio and quality of the image.

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8. AUTHOR'S PROFILE

Dr.M.Sundaresan did his B.Sc (Applied sciences) Degree at Madurai Kamaraj University. MCA at Bharathidasan University, M.Phil and Ph.D at Bharathiar University. He has presented more than 20 research papers in International and National Conferences. He has published in Journals also. He is Senior Life member of Professional bodies like CSI, ISCA and ISTE. Currently, he is working as an Associate Professor and Head i/c of the Department of Information Technology at Bharathiar University. His areas of interest are Image Processing and Data Compression.

E.Devika working as Assistant Professor. She did her B.Sc (Computer Science) Degree from Bharathiar University, M.sc (Computer Science) from Bharathiar University and M.phil (Information Technology) from Bharathiar University. Her area of interest is Digital Image Processing. She has presented her research paper in International Conference and National Conference.