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A Review on Various Techniques of Image Compression

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Abstract— Images are an important form of data and are used in almost every application. Some applications cannot use images directly due to the large amount of memory space needed to store these images. Image compression is to reduce irrelevance and redundancy of the image data in order to be able to store or transmit data in an efficient form. Compression of images plays an important role in storing the images .in this paper. In this paper we analyze different types of existing method of image compression. Now there is question may be arise that how to image compress and which types of technique is used. Basically lossy and lossless image compression technique are used for compress the images.

Keywords- Image compression, lossy and lossless, Quantization, Optimization.

1. INTRODUCTION

Images are important documents today; to work with them in some applications there is need to be compressed. Compression is a very essential tool for archiving image data, image data transfer on the network etc. Originally image compression was started at 1970; basically it is obtained by mathematical transformations and quantization with encoding techniques. The main aim of image compression is to represent an image in the fewest number of bits without losing the essential information content within an original image The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages.. There are some techniques that perform this compression in different ways: some are lossy and lossless. Lossless keep the same information as the original image and in lossy some information loss when compressing the image. There are several different ways in which image files can be compressed. For Internet use, the two most common compressed graphic image formats are the JPEG format and the GIF format. The JPEG method is more often used for photographs, while the GIF method is commonly used for line art and other images in which geometric shapes are relatively simple. Image compression Systems are composed of two distinct structural blocks: an Encoder and Decoder.

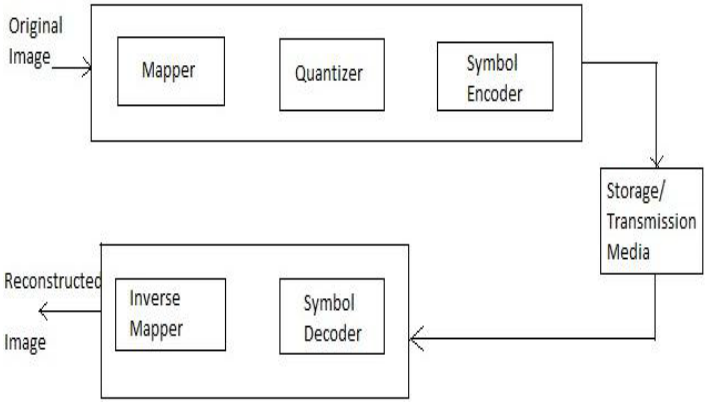

Fig. 1 Image Compression System

2. RELATED WORK

There are number of papers which described the problem of redundancy in images. In order to build the base we analyze number of such papers. Some of the papers which we have studied will be described in this section. Redundancy will make certain portion of the image much brighter than the other portion of the images. This paper considers the compression technique for images. The transferred images will be compressed so that image should not take much space over the transmitted medium. The transmission media will charge expenses if the data transferred are large. So compression is required. If image is compressed properly than less bits per image is required to represent the image. Hence the mechanism of image compression will help in decreasing the cost associated with the image storage. Compression technique which is suggested in this paper includes lossless and lossy compression. Image compression is required so that the space requirements can be reduced. The image compression will be required to reduce the redundancy. The main area of concern is Huffman coding, LZW coding etc. The compression techniques which are specified are lossy or lossless in nature. All the suggested techniques use complex mechanisms in order to reduce the redundancies.

3. IMAGE COMPRESSION TECHNIQUES

On the bases of our requirements image compression techniques are broadly bifurcated in following two major categories.

a) Lossless image compression
b) Lossy image compression

LOSSLESS IMAGE COMPERSION

Lossless compression is a class of data compression algorithm that allows the original data to be perfectly reconstructed from the compressed data. There are various lossless image compression techniques listed below:

1) Run length encoding
2) Huffman encoding
3) Arithmetic Coding

4) Area coding
5) Data folding

1. Run length Encoding: Run Length Encoding (RLE) is an entropy encoding compression technique that works on inter pixel redundancy. This compression algorithm is suitable for line drawings, logos and small animation files. The sequence of same consecutive pixel values are replaced by a
token whose first part consists of the pixel value and the second part consists of the number of consecutive same values. For example 112222233345667 can be replaced as (1,2)(2,5)(3,3)45(6,2)(7,1).

2. Huffman encoding: Huffman coding is based on frequency of occurrence of a data item.[4] This technique maintains a table according to frequency of occurrence of data symbols. Then a variable-length bit code is assigned to each data symbol. Huffman Coding is suitable rather than Run Length Encoding. For symbols that occur more frequently, smaller number of bits are assigned and others are assigned with relatively larger number of bits. For example, in a text file we consider five symbols: A, E, I, O, U with their probability of occurrence and number of bits allotted for each of them:

Bit allocation for various symbols Symbols	Frequency of occurrence	Number of bits allotted to encode
A	12	6
E	30	2
I	6	7
O	17	5
U	22	3

Table1

3. Arithmetic coding:
Arithmetic coding is another coding method widely used in image and video compression and its performance is better then Huffman coding. We treat the whole input data as a single symbol and find the corresponding codeword for it. The main idea behind Arithmetic coding is to assign each symbol an interval. Starting with the interval [0...1), each interval is divided in several subinterval, which its sizes are proportional to the current probability of the corresponding symbols. The subinterval from the coded symbol is then taken as the interval for the next symbol. The output is the interval of the last symbol.

4. Data Folding:
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.

5. LZW Coding:
Lempel–Ziv–Welch (LZW) is a universal lossless data compression algorithm created by Abraham Lempel, Jacob Ziv, and Terry Welch.LZW is a dictionary based coding. Dictionary based coding can be static or dynamic. In static dictionary coding, dictionary is fixed when the encoding and decoding processes. In dynamic dictionary coding, dictionary is updated on fly. The algorithm is simple to implement, and has the potential for very high throughput in hardware implementations. It was the algorithm of the widely used UNIX file compression utility compress, and is used in the GIF image format. LZW compression became the first widely used universal image compression method on computers. A large English text file can typically be compressed via LZW to about half its original size.

LOSSY COMPRESSION TECHNIQUE

Lossy compression as the name implies leads to loss of some information. The compressed image is similar to the original uncompressed image but not just like the previous as in the process of compression some information concerning the image has been lost. They are typically suited to images. The most common example of lossy compression is JPEG. Various lossy compression techniques are listed below:

1) Transformation coding
2) Vector quantization
3) Fractal coding
4) Block Truncation Coding
5) subband coding

1 Transformation Coding

In this coding scheme, transforms such as DFT (Discrete Fourier Transform) and DCT (Discrete Cosine Transform) are used to change the pixels in the original image into frequency domain coefficients (called transform coefficients) These coefficients have certain useful properties. For example: it has the energy compaction property due to which maximum amount of energy in the original data gets concentrated in few of the transform coefficients. These coefficients alone are selected, the remaining are deleted to achieve compression. To the selected coefficients, further processing is applied.DCT coding has been the most common approach to perform transform coding. It is also adopted in the JPEG image compression standard.

2 Vector Quantization

This source encoding technique is otherwise known as block quantization or pattern matching quantization. The input image which contains various amplitude levels is divided into various blocks. The basic idea in this technique is to develop a dictionary of fixed-size vectors, called code vectors. A vector is usually a block of pixel values. A given image is then partitioned into non-overlapping blocks (vectors) called image vectors.

3 Fractal Coding

Fractal coding works on the principle that real world input data contains many fractals. The similar patterns in the images getting repeated itself are known as fractals. The essential idea here is to decompose the image into segments by using standard image processing techniques such as color separation, edge detection, and spectrum and texture analysis. Then each segment is looked up in a library of fractals. The library actually contains codes called iterated function system (IFS) codes, which are compact sets of numbers. This gives a good quality of compression even in higher compression ratios when compared with other lossy compression techniques because other techniques aim in discarding the redundant data while fractal encoding does not aim in discarding data. Fractal coding is an asymmetric technique which needs more time for compression then decompression because the process of

compression needs to find the various fractals in the image using millions of iterations and the process of decompression simply needs to translate back the fractals into bitmaps.

4. Block Truncation Coding

In this scheme, the image is divided into non overlapping blocks of pixels. For each block, threshold and reconstruction values are determined. The threshold is usually the mean of the pixel values in the block. Then a bitmap of the block is derived by replacing all pixels whose values are greater than or equal (less than) to the threshold by a 1 (0). Then for each segment (group of 1s and 0s) in the bitmap, the reconstruction value is determined.

5. Sub band Coding

In this source encoding technique, the input frequency band is divided into different sub-bands using digital filter bank. This digital filtration is based on the separation of low and high frequencies. Thus these filters act as the low pass and high pass filters. For further separation, each of the sub-bands is applied with low pass and high pass filters. This compression technique works to remove the psycho visually redundant information and hence some of the high frequency data is removed. Then each of the sub-bands is quantized separately.

OPTIMIZATION TECHNIQUES: The optimization techniques can effectively reduce the encoding time while retaining the quality of the retrieved. Various optimization techniques are explained below:

a) **Genetic Algorithm*:***

Genetic algorithms (GA's) are mathematically motivated search techniques that try to emulate biological evolutional processes to solve optimization problems. Instead of searching one point at a time, GA's use multiple search points. GA's attempt to find near-optimal solutions without going through an exhaustive search mechanism.

b) Ant Colony Optimization (ACO):

Ant Colony Optimization (ACO) is a paradigm for designing meta-heuristic algorithms for combinatorial optimization problems. The essential trait of ACO algorithms is the combination of a priori information about the structure of a promising solution with a posteriori information about the structure of previously obtained good solutions.

c) Particle Swarm Optimization (PSO):

PSO is a general-purpose optimization algorithm which also uses the concept of fitness. It provides a mechanism such that individuals in the swarm communicate and exchange information, which is similar to the social behavior of insects and human beings. Because of the mimicking of the social sharing of information, PSO directs particles to search the solution more efficiently.

4. CONCLUSION

We have considered various techniques of image compression such as lossy and lossless image compression. Each technique follows its own way of compression and so they have specific application area. All the suggested techniques use complex mechanisms in order to reduce the redundancies. In the proposed work we will use relatively simple mechanism to reduce the redundancy from the given image. After study of all techniques it is found that lossless image compression techniques are most effective over the lossy compression techniques. Lossy provides a higher compression ratio than lossless.

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