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A SURVEY ON LOSSLESS AND LOSSY IMAGE COMPRESSION TECHNIQUES

Caran Hepsiba.B, Jeevitha.V,
Master of computer science,
University of Madras,
Shri Shankarlal Sundarbai Shasun Jain College for Women,
Tnagar, Chennai , Tamilnadu, India
caranbalraj888@gmail.com, jeevithav95@gmail.com

ABSTRACT

With the growth of multimedia technology over the past decades the demand for digital information increases dramatically. This Paper gives review of two different compression techniques. Digital images are compressed of an enormous amount of data. reduction in the size of the image data for both storing and transmission of digital images are becoming increasingly important as they find more applications. Image compression is an mapping from an higher dimension space to lower dimension space. The basic goal of image compression is to represent an image with minimum number of bits of an acceptable image quality.
In lossless compression, the image after compression and decompression is identical to the original image and every bit of information is preserved during decomposition process. In lossy compression the reconstructed image contains degradation with respect to the original image.

Keywords: Image compression, lossy compression and lossless compression, image compression standards.

I. INTRODUCTION

Image compression is a process of reducing the size in bytes of the image to an undesirable level. It plays an important role in many multimedia applications, such as image storage and transmission. It is different than compression of digital data. To lower the irrelevance and the redundancy of image data is the major target of the image compression is to enable them to get saved or transmit the data in the better form. Lossy compression methods can achieve and they reduce the accuracy of the reconstructed images by producing some distortions. It is generally used for video and sound, where a certain amount of information loss will not be detected by most users.
Lossless compression or error free compression is the data reduction method since there is no loss of data. It is used for medical imaging, technical drawings, clipart, or comics.

II. NEED FOR COMPRESSION

With the advancement in internet ,teleconferencing, multimedia and high –definition television technologies, the amount of information is handled by computers has been grown over the past decades hence storage of the digital image component of multimedia system is a major problem .the possible solution is to compress the information so that storage space can be reduced. Image compression is a way to represent an image in a more compact way, so that images can be stored in a compact manner and can be transmitted faster.

III. TYPES OF REDUNDANCY:

To reduce some data which is not relevant or provide no information is called as Redundancy. There are 3 types of data redundancy.

A. Coding Redundancy:

A code is a system of symbol used for representing and information. Each piece of information or event assigned a sequence of code symbols called code word[7]. The code length is defined as number of symbols in each code word.

A resulting image is said to have a coding redundancy if its gray levels are coded using more code symbols than actually needed to represent each gray level. The Huffman codes and the arithmetic coding technique are examples of image coding schemes that explore coding redundancy.

B. Inter pixel Redundancy:

In image neighboring pixels are not statistically independent. It is due to the correlation between the neighboring pixels of an image. This type of redundancy is called Inter-pixel redundancy. Inter pixel correlation are the structural and geometric relationships between objects in the image.

Other names:

- Spatial Redundancy
- Geometric Redundancy
- Interframe Redundancy

C. Psycho visual Redundancy:

The human eye does not respond to all information with equal sensitivity. Because, some information, may be given less importance when comparing to another information in normal visual processing. Such information is said to be psycho visually redundant.

Properties:

It has the following properties:
It is basically different from other redundancies.
It is related with real or quantifiable visual information.
Removal of this redundancy will not affect the perceived image quality, since the data is not essential for normal visual processing.

IV. CLASSIFICATION OF IMAGE COMPRESSION

Image compression can be classified into 2 types.
They are :

- lossless compression
- lossy compression

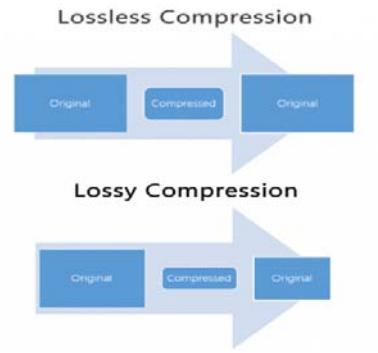

Fig:1

a. Lossless compression:

Lossless compression is the acceptable data reduction method since there is no loss of data. For both binary and grey-scale images lossless method can be applied.lossless compression retains raster values during compression and file size is also reduced. It is also known as entropy coding as it uses decomposition techniques to minimize loopholes. The original image can be perfectly recovered from the compressed image, in lossless compression techniques. These do not add noise to the signal. It is also known as entropy coding as it uses decomposition techniques to minimize redundancy.

Following techniques used in lossless compression are:

1. Run length encoding
2. LZW coding
3. Huffman coding
4. Arithmetic coding

i. Run Length Encoding:

The simplest data compression technique is run length encoding. It is effective when long sequences of the same symbol occur. Run-length coding exploits the spatial redundancy by coding the number of symbols in a run. The term run is used to indicate the repetition of a symbol, while the term run-length is used to represent the number of repeated symbols. This compression technique is useful in case of repetitive data. When we have sequence of same intensity pixel or symbols then this sequence is replaced by shorter symbols and it is represented by a sequence (Vi,Ri),where Vi is represented as the intensity of pixel and Ri is the no of consecutive pixel with same intensity.[2]

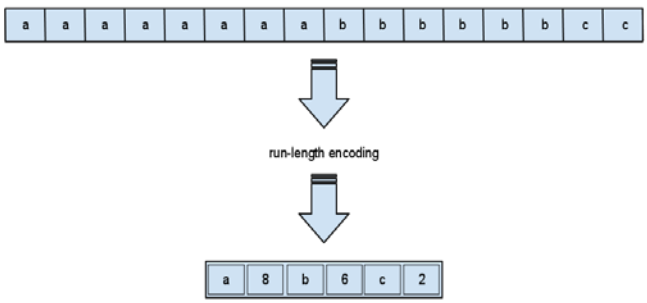

Fig2

ii. LZW Coding:

LZW (Lempel-ziv-welch) coding is an error free compression technique. It is dictionary based coding, which is used in computer industries[2].It replaces string of characters with single codes. LZW compression creates a table of strings commonly occurring in the data being compressed, and replaces the actual data with references into the table. The table is formed during compression at the same time at which the data is encoded and during decompression at the same time as the data is decoded[3].

iii. Huffman coding:

The Huffman coding algorithm is named after its inventor, David Huffman. Huffman coding today is often used as a "back-end" to some other compression methods[7]. The pixels in the given image are assigned some specific numbers. The pixel having lesser occurrences will be given higher number of bits and the pixel with higher frequency occurrences will get relatively lesser number of bits. It is a prefix code. No two symbols in an image can have exactly same binary set of numbers[8]. The pixels in the image are treated as symbols.

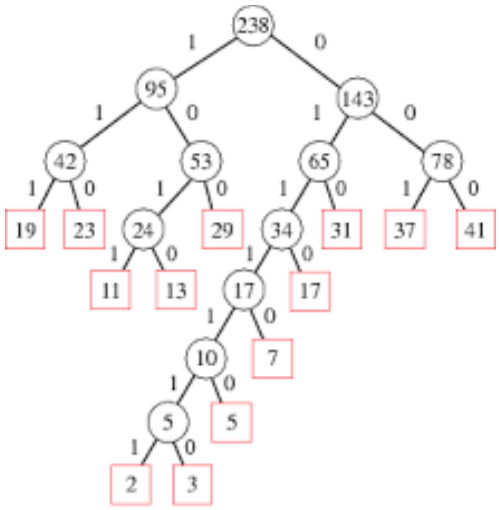

Fig3

iv. Arithmetic coding

Arithmetic Coding is the compression technique for lossless encoding that represents a message as some finite intervals between 0 and 1 on the real number line[7].AC does not generate individual codes for each character but performs arithmetic operations on a block of data, based on the probabilities of the next character. Using arithmetic coding it is possible to encode characters with the fractional number of bits. Arithmetic coding performs very well for sequences with low entropy.

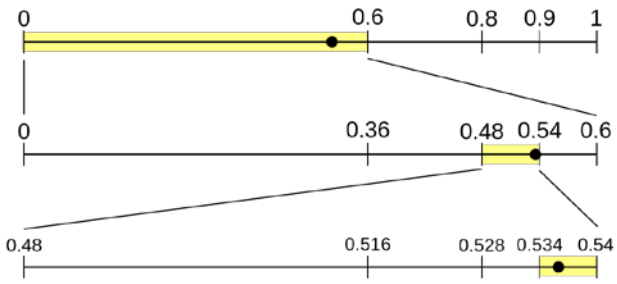

Fig 4

b. Lossy image compression:

In Lossy compression techniques reconstructed image contains loss of information which in turn produces distortion in the image. .It is a irreversible process. Image compression ratio can be very high.

Following techniques used in lossy compression are:

1. Transform coding.
2. Block truncation coding.
3. CodeVector quantization.
4. Wavelet Coding

i. Transform coding:

It is a common method for lossy image compression. It employs a reversible and linear. The linear transform is to decorrelate the actual image into a set of coefficients in transform domain. In transform domain the coefficients are then quantized and coded successively [5].

ii. Block Truncation Coding

Block truncation coding is well known technique for image compression, It (BTC) divides the original image into small sub blocks of size n x n pixels and after the division of image, it reduces the number of gray levels within each block. reduction of gray level is performed by a quantizer[2]. The threshold is normally the mean value of the pixel values in the vector. Then a bitmap of that vector is generated by replacing all pixels having values are greater than or equal to the threshold by a 1. Then for each segment in the bitmap, a value is determined which is the average of the values of the corresponding pixels in the original code vector[8].

iii. Code Vector Quantization

The basic idea in Vector Quantization is to create a dictionary of vectors of constant size, called code vectors. Code vector is the Values of pixels composed the blocks.A image is then parted into non-recurring vectors called image vectors. Dictionary is made out this information and it is indexed. Further, it is used for encoding the original image. Thus, every image is then entropy coded with the help of these indices[8].

iv. Wavelet Coding:

Wavelet coding technique is based on the discrete wavelet transform.

Discrete wavelet transform ,which transforms a discrete time signal to a discrete wavelet representation.

Digitize the source image to a signal s,which is a string of numbers. Decompose the signal into a sequence of wavelet coefficients. Use the Thresholding to modify the wavelet compression to w, to another sequence w. Use quantization to convert w to a sequence q. Apply entropy coding to compress q into sequence of e.

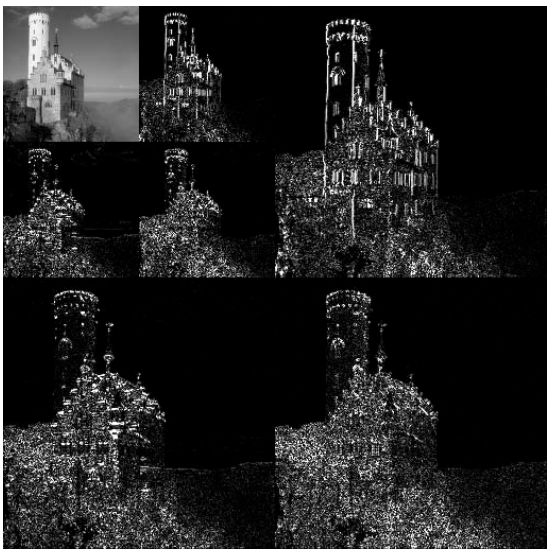

Fig5

V. CONCLUSION

In this paper we have concluded that two types of techniques can be used for compression. Lossy and Lossless techniques, the usability and efficiency of respective techniques are different. This review paper also gives the idea about various image types and performance parameter of image compression.

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