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Lossless Compression of Colour Image

Preethi Peerashetti[1] & Vishwanath Kamatar[2]
[1,2]Computer Engineering, K.L.E. Institute of Technology, Hubballi

Abstract: *The need of an efficient technique for image compression is ever increasing just because the raw images need more disk space to be stored and also require more bandwidth during transmission. There are so many compression technique which present a better technique for faster transmission of images through the network, and memory efficient that suits the user requirements. Here we proposed the Lossless method of compressing the image and decompressing the image using a simple coding technique called Huffman coding. This technique is simple to implement and uses less memory. Algorithm has been developed and implemented for compression and decompression of the given image using Huffman coding techniques in Java platform.*
Keywords — **Lossless compression, Compression ratio, Encoding, Decoding, Huffman codes.**

Introduction

Image data is used in different applications such as medical, media, military etc, with improvement in image analysis techniques and visual intelligence. The images generated by the some of the critical applications that are of high resolution require larger storage space and good processing time. In order to process the different types of images various compression methods are to defined to meet the deadlines without changing the quality of the image becomes important. The past few years, researchers have introduced number of mathematical transforms to compress and analyse the different images, hence providing good compression schemes. But the high resolution images should be handled so that the quality of image is not lost. Various approaches to handle such high quality of images have been proposed. Image compression technique can be classified in two types lossless image compression and lossy image compression method. Lossless image compression is a method where the quality of image is not effected, such compression technique can be used in medical images, military signature applications etc. Lossy image compression is a method where the quality of image is affected and it can be used in applications related to multimedia.

Property lossy image compression provides good compression ratio as human eyes are not able to identify the small changes in the quality of image.

A digital image requires an enormous storage space obtained by sampling and quantizing a continuous tone picture. For instance, a 24 bit colour image with 512x512 pixels will occupy 768 Kbyte storage space on a disk, and a picture double of this size will not fit in a single floppy disk. To transmit such an image over network require will take almost large amount of time.

The main objective of this paper is to compress Images to decrease the transmission time for transmission and reducing number of bits per pixel required to represent it. Then reconstructing back by decoding the Huffman codes.

II. NEED FOR COMPRESSION

The following example explains the need for compression of images.

a. To store a colour image of size, 512×512 pixels, requires 0.75 MB of disk space.

b. A digital slide of size 35mm and with a resolution of 12μm requires 18 MB.

c. Digital PAL (Phase Alternation Line) of one second video requires 27 MB.

To make these images available over the network, and to store them with less usage of space, compression techniques are needed. Image compression helps to reduce the amount of data required to represent a image.

III. HUFFMAN CODING

The Huffman encoding algorithm is an optimal solution for compressing the images. The Huffman algorithm is used when only the frequency of individual numbers is used to compress the data. The idea behind the Huffman algorithm is that it makes use of fewer bits to encode the numbers which are more frequent than the numbers that less frequent.

The polyamine compressed image format is lossless: this means that it can be used to compress and decompress an image any number of times without lowering the image's quality. Typically images are saved in lossy formats, as discarding the less significative information we can obtain file several times smaller, and in many cases this little loss does not affect the visual quality of the image.

Even if through higher-quality compression we could achieve (almost) imperceptible changes, there are still cases that require lossless compression:

A. *Bad lossy compression result*

In some cases lossy compression behaves very badly. Jpeg gives worst results for high-edged images, where for example a lossless compression algorithm (PNG) obtains a file of size less than the half of the jpeg worst-quality file (9.5 KB against 22.5 KB!).

B. *Multiple encoding loss*

Sometimes there is a need to compress and decompress an image more than one time, for example while working on it and according to various changes, and it may be deserved to store the image in a compressed format among the various changes. Encoding the image in a lossy format as jpeg every time will slowly degenerate image quality.

C. *High importance of an image*

Some images are so important were there should be no loss of information is allowed. For example medical images that may be used to determine the right therapy for a patient and images that can be used in a legal process like fingerprints.

D. *Compression*

At the beginning of the phase for each layer a compression method is selected. This allows the application of different compression techniques for various types of data, as the compression through polyamines is more effective on the layers with few one while the compression with Huffman codes has better results with layers with higher value of entropy.

This can be dispose of the percentage *d* of zeros in a layer, as the algorithm counts the number of zero values during the previous decomposition phase. We also consider the index of the layer *b*, as 0 for layers relative to the least significative bit up to 7 for the most significance. This is because we expect that, having equal density of zeros, layers that refer to higher bits have more grouped one values, and this reduces the entropy of the matrix. The function that determines the compression method is the following:

- If $d + b > 90$ then compress the layer using polyamines.
- If $52 < d + b <= 90$ then compress the layer with RLE and Huffman coding.
- If $d + b <= 52$ then store the layer 'as is'.

The values above have been chosen empirically always keeping in mind the efficiency goal. The limit 90 in the above two rule gives quite similar results if lowered up to 85, but in these cases the Huffman compression method has been chosen as it allows a faster elaboration.

Further information about the two different compression techniques can be found at the compression through polyamines section and in the compression through RLE and Huffman codes section.

In the table below, it shows the different size of the variety of compressed components of the Lena image. For every layer the used compression method and its compressed size are shown. The infestation of the image contains mainly the more information about the filters applied to the image in the different zones, and also includes the remapping array and various image information

TABLE I

Images	Original image size	Compressed image size	Compression Ratio
Airplane.bmp	768KB	363KB	2.11
Lena.bmp	768KB	414KB	1.85
Baboon.bmp	706KB	512KB	1.37
Pepper.bmp	768KB	453KB	1.69

E. *Decompression*

At this point the image is decomposed in 24 matrixes containing only zeros and ones. Each of these matrixes is refer to one among the 8 bits of the bit representation of one of the 3 primary colours representing the image.

What we expect after this phase is some very chaotically layers relatively to the least significative bits and some matrixes with lots of zeros corresponding to the most significative bits. Another important property that we can find is that the ordered layers are often grouped together, offering highly compressible data to the techniques that will follow the above phase.

During the algorithm of decomposition it also counts the number of zeros and ones in each layer; this will be useful to estimate the chaos in each matrix and determine with which technique this will be compressed or to determine, if the layer is too disordered, that the algorithm can save time storing it as it is as there would be a very low gain obtained through its compression.

After the decomposition phase, layers are sufficiently uncorrelated from one to another for allowing the following compression phase to operate on them separately without losing compression efficiency.

The figure represents how the famous Lena image is decomposed into layers by the algorithm after the various filtering phases as shown in Fig. 2.

Fig. 1 Original image

Fig.2 Decompressed image.

CONCLUSIONS

The experiment shows that more compression of the image is achieved with the higher data redundancy. Here a new compression and decompression technique based on Huffman coding and decoding to reduce test data volume, test application time is represented. Experimental results show that up to a 1.8456 compression ratio for bitmap colour images, hence we conclude that Huffman coding is efficient technique used for image compression and decompression. As the future work on compression of grey images for transmitting images and storing can be done by discovering new lossless methods of image compression. We have concluded that the decompressed image same as that of the input image so that indicates that there is no loss of information during transmission of image over the network.

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