Lossless Compression Technique Using ILZW with DFRLC

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Abstract

The images with larger size and high resolution spread has led to an explosion in the volume of image to be stored on hard disks and sent over the Internet. This growth has led to a need for image compression. In this paper, a novel lossless image compression algorithm using a bit plane slicing and adaptive Huffman with a Lempel-Ziv-Welch (LZW) dictionary is used and the output received from the algorithm will be used as the inputs for the duplication free run-length coding (DFRLC). This idea is proposed to get a more compressed image. The result will come out by the combination of these two different algorithms and high image compression ratio will be achieved. The image size will be reduced so it is easy to store and transfer over the internet.

Keywords: *Compression, ILZW, DFRLC, Image, Bit-Plane Slicing.*

1. Introduction

Now days the images sizes increased day by day because of high resolution images. So storing images and transferring them over the internet is the biggest problem for that image compression is needed. There are two types of image compression: lossless and lossy compression. Lossless compression requires that original data be reconstructed without any distortion after inverse operation and the lossy compression does not guarantee that the original and recovered the image are identical, but it often provides better performance in terms of compression ratio than lossless methods[2].

Lossless image compression algorithms which are used in this paper include Improve Lempel Ziv Welch (ILZW) codes and duplication free run length coding (DFRLC) [1][2]. In the ILZW we use LZW and adaptive Huffman lossless compression and the output of this will introduce to the DFRLC. The ILZW and DFRLC compression algorithm is a powerful technique for lossless compression that gives high compression efficiency for image data.

1.1 ILZW Compression

ILZW is the improved form of LZW. LZW is named after Abraham Lempel, Jakob Ziv and Terry Welch [3]. ILZW can improve the LZW by using Bit slicing and then the dictionary has been made and it introduce to the adaptive Huffman coding which is also called dynamic Huffman coding[4]. In the ILZW firstly the bit-plane slicing has been done which convert the gray scale image into the eight binary images and if the image is colored it will be converted into the red, green and blue signals each of which is gray scale image will be sliced into eight binary images by using bit-plane slicing. The color will be reduced to the two colors black and white. Here 0 represents the black and 1 represents the white color [2].

In the second step of ILZW the dictionary will be initialized with the two colors 0 (black) and 1(white) that represent one value for white color in monochrome image instead of (256) characters of the underlying character set. Third, each output code in the dictionary associates a frequency counter to phase in binary codes progressively using Adaptive Huffman algorithm to decrease the number of bits. This way a continuous adaption will be achieved and local variations will be compensated at run time [2].

1.2 Bit-Plane Slicing

Highlighting the contribution made to the total image appearance by specific bits. Assuming that each pixel is represented by 8-bits, the image is composed of eight 1-bit planes. Plane (0) contains the least significant bit and plane (7) contains the most significant bit. Only the higher order bits (top four) contain the majority visually significant data. The other bit planes contribute the more subtle details. It is useful for analyzing the relative importance played by each bit of the image [8] [9] [2].

1.3. Adaptive Huffman Coding

The Huffman algorithm requires both the encoder and the decoder to know the frequency table of symbols related to the data being encoding, so it requires the statistical knowledge which is often not available. Even when it is available, it could be a heavy overhead especially when many tables had to be sent. To avoid building the frequency table in advance, an alternative method called the Adaptive Huffman algorithm [4] that was first conceived independently by Faller (1973) and Gallager (1978). It allows the encoder and the decoder to build the frequency table dynamically according to the data statistics up to the point of encoding and decoding [2].

1.4. Duplication Free Run Length Coding

Duplication free run length coding (DFRLC) solves the problem of run length coding (RLC) [5]. RLC is best when there are lot of redundant bits are there. Number of similar bits are called run. The longer the run the more will be the compression. Here the problem comes when there is redundant bit is very less at that time the size of file or the image will be increase instead of decrease the size of image or file. Let us take an example the sequence of pixels 9999995555555 is encoded by RLC as (9 6 5 7), where 6 and 7 are the runs for the intensity values 9 and 5, respectively [1]. But when a sequence of dissimilar pixels 1 2 3 4 5 will be encoded as (1 1 2 1 3 1 4 1 5 1) by RLC [1]. The size of the image or file will be increased. So this problem will be solved by the DFLRC. In DFLRC an entropy rule-based generative coding method is proposed to construct codewords that are capable of encoding both intensity level and different flag values into a single codeword. Hence, there is no need for adding extra byte, dedicating intensity value nor reserving a bit for flag. The proposed algorithm has no duplication problem, and the number of pixels that can be encoded by a single run is infinite [1].

2. The Problem Definition

Compression is one of the major issues in today's world, with the need for clarity; depth and quality of images growing day by day and the size of the images are also growing simultaneously. This creates a problem for storage and transfer of such images because of their size. Therefore, the need of new compression algorithm with high compression ratio are being developed so that the images can be compressed in a lossless manner and so stored and transferred easily. So, now there is need of new algorithms with better compression ratio.

3. Theoretical Foundation

The idea we propose is by combining of two compression algorithm in a manner that the output of the first compression algorithm acts as the input for the next compression algorithm and hence a better compression ratio can be achieved by this technique as a compressed output is further compressed, in other words a reduced output is further reduced.
The two lossless compression algorithm that are used are Improved LZW (ILZW) [2] and Duplication free run length coding (DFRLC) [1]. The image will be first compressed with ILZW and the output code generated will be used as the input for the DFRLC.

For Example: an image is introduced. Now firstly if the image is a grey scale image, it is sliced into eight binary images and if the image is a colored it will be converted into red, green and blue signals each of which is gray scale image will be then sliced into eight binary images by using bit-plane slicing. The image will be separated into red, green and blue by using color separation or through semantic sepration [6] [7]. By this the multiple colors will be reduced in 2 colors black (0) ad white (1). Hence we will get an output of code which is in the form of binary value 0 and 1. Then this will be added to the dictionary and each output code in the dictionary associates a frequency counter to phase in binary codes progressively using Adaptive Huffman algorithm to decrease the number of bits [2]. The output produced by the process will be used as the input for DFRLC. The code generated from the ILZW will have runs in its code; this code can be further compressed using DFRLC. In this the output will be taken as input to the DFRLC and codeswords will been assigned to the different intensity levels. The codeword assigned to the intensity level will be according to the Probability of Occurrence (PoO). Grater the PoO shorter will be the code word. Then the pixels are encoded by using End Bit Independent (EBI) codeword. In this the last bit y is independent no value is assigned to it. It is encoded as a flag to determine the status of next neighbour codeword [1]. There are three types of status S1, S2 and S3. If there is run of three or more pixels then it is assigned y as S3 to indicate that the next codeword encodes the count of pixels in the run. In this End Bit Dependent (EBD) codeword is used to count the runs of the pixels. S2 is used or assigned to y when encoder reads the run of two pixels and for these two pixels single codewod has been generated. Here S2 indicating that the encoded pixel intensity value is repeated twice and the next codeword encodes the intensity level of the next pixel(s) [1]. S1 is used where single pixel is read by the encoder and single codeword will be generated. Here S1 indicate the next codeword is the intensity level of the next pixel or pixels [1]. By these codeword the number of bits will be reduced and the compressed output generated might be better. The flow of the process is explained in fig 1 (refer appendix).

Decompression
Now, in decompression the final output will be firstly decompressed with DFRLC and a codeword be generated as the output which will be used as input for decompression process for ILZW and after the decompression we will get back the original image without loss the flow of the process is explained in fig 2 (refer appendix).

4. Conclusions

The idea puts down a method for compression of images using ILZW and DFRLC which tends to provide higher compression ratio. In literal sense in this technique the image data is compressed twice using two different compression algorithm one after another. As both the compression techniques that are being used are lossless compression techniques; hence the method can also be called lossless technique (considering no loss of image data in bits). Hence a new and better method for compression is proposed.

5. Scope

Coding for the algorithms ILZW and DFRLC is being worked on; these codes will be used as mentioned above in the paper accordingly. Then the results of this proposed compression technique will be compared with the results of other lossless compression techniques and hence further more clear conclusions can be put forward with statistical figures and other representation techniques.

Appendix

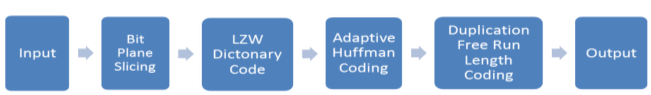

Figure 1: ILZW WITH DFRLC (Compression)

Figure 2: ILZW WITH DFRLC (Decompression)

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