A Novel Approach for Lossless Image Compression for Cloud Computing Using Adaptive LZW Dictionary

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Abstract: Cloud computing is a powerful, cost efficient platform for providing heterogeneous services to the consumers over the Internet. Moreover storing data in the cloud storage is a one of the key challenging issues now a day. In cloud environment universal data is available from different vendors. To avoid capital expenditure for hardware and software the image data must be reduced in size and they should have a better quality. Image compression is the one of the prominent techniques for data storage in cloud. The main aim of image compression is to reduce the size and also it provide better quality image with better compression ratio. This paper proposes improving compression method which uses a SPIHT, bit plane slicing and adaptive LZW dictionary. The limitations is decreased by using SPIHT and bit plane slicing for colored and also gray scale images. The compression ratio of the proposed method is better than the standard method for both colored and gray scaled images. An experimental result for the proposed methods is better than existing methods for different types of image.

Keywords: Image Compression, SPIHIT, LZW, Bit Slicing, PSN.

I. INTRODUCTION

In cloud computing environment data is available in different formats like text, images, audio and videos. Storing data is also one of the prominent parameters. For that we have different approaches and techniques are available. Image compression is also one of the prominent techniques if the data is in the form of images. Image compression deals with reducing the amount of data required to represent a digital image by removing of redundant data. The main aim of image compression is which makes storage and transmission of images more practical. The basic requirement of maintaining image quality is easily translated into two basic quantitative parameters:

1) Rate of digital image data transfer or data rate (Megabit per second or Mb/s)

2) Total amount of digital storage required or data. With image compression both data rate and data capacity are reduced to great extent. So less space, less time and less bandwidth are required for storage and transmission of digital images.

Two categories of data compression algorithm can be distinguished: lossless and 'lossy'. Lossy techniques [4] cause image quality degradation in each compression/ decompression step. Careful consideration of the human visual perception ensures that the degradation is often unrecognizable, though this depends on the selected compression ratio. In general, lossy techniques provide far greater compression ratios than lossless techniques. However, in this paper, we will focus on the topic of SPIHT, Bit plane slicing and adaptive LZW Huffman lossless compression [5]. The SPIHT and LZW compression algorithms are the powerful and useful techniques for lossless data compression and it gives high compression ratio for textual data as well as image data. In this paper we consider SPHIT, variant of the Huffman code called adaptive Huffman code or the dynamic code, which does not need to know the probability of the input symbols in prior or in advance.

1.1 SPIHT Compression

SPIHT was designed for optimal progressive transmission, as well as for compression. One of the important features of SPIHT (perhaps a unique feature) is that at any point during the decoding of an image, the quality of the displayed image is the best that can be achieved for the number of bits input by the decoder up to that moment. Another important SPIHT feature is its use of embedded coding. This feature is defined as follows: If an (embedded coding) encoder produces two files, a large one of size M and a small one of size m, then the smaller file is identical to the first m bits of the larger file.

Suppose that three users wait for you to send them a certain compressed image, but they need different image qualities. The first one needs the quality contained in a 10 Kb file. The image qualities required by the second and third users are contained in files of sizes 20 Kb and 50 Kb, respectively. Most lossy image compression methods would have to compress the same image three times, at different qualities, to generate three files with the right sizes. SPIHT, on the other hand, produces one file, and then three chunks—of lengths 10 Kb, 20 Kb, and 50 Kb, all starting at the beginning of the file—can be sent to the three users, thereby satisfying their needs.

Another principle is based on the observation that the most significant bits of a binary integer whose value is close to maximum tend to be ones. This suggests that the most significant bits contain the most important image information, and that they should be sent to the decoder first (or written first on the compressed stream).

1.2 LZW Compression

A popular lossless universal coding scheme is a dictionary-based coding method developed by Ziv and Lempel and known as Lempel-Ziv (LZ) coding. Dictionary-based coders dynamically build a coding table (called dictionary) of variable-length symbol strings as they occur in the input data. As the coding table is constructed, fixed length binary code words are assigned to the variable-length input symbol strings by indexing into the coding table. In LZ coding, the decoder can also dynamically reconstruct the coding table and the input sequence as the code bits are received without any significant decoding delays. Although LZ codes do not explicitly make use of the source probability distribution, they asymptotically approach the source entropy rate for very long sequences. Because of their adaptive nature, dictionary-based codes are ineffective for short input sequences since these codes initially result in a lot of bits being output. So, short input sequences can result in data expansion instead of compression.LZW is the foremost technique for general purpose data compression due to its simplicity and versatility.

Word-based LZW is a modification of the character-based LZW method. The number of words in the input stream is not known beforehand and may also be very large. As a result, the LZW dictionary cannot be initialized to all the possible words, as is done in the character-based original LZW method. The main idea is to start with an empty dictionary (actually two dictionaries, an A-dictionary and a P-dictionary) and use escape codes.

The LZW algorithm reads the data and tries to match a sequence of data bytes as large as possible with an encoded string from the dictionary. The matched data sequence and its succeeding character are grouped together and then added to the dictionary for encoding later data sequences. For an image with n-bit pixels, the compressed code of each pixel occupies n + 1 bits or larger. While a smaller compressed code results in higher compression rate, it also limits the size of the dictionary. For example, a common arrangement uses a 12-bit compressed code for each 8-bit data element. A 12-bit code size allows 4096 entries in the dictionary. If the encoder runs out of space in the dictionary, the traditional LZW encoder must be aborted and a larger compression code size is tried again. The initial dictionary is a collection of roots containing all possible values of an n-bit pixel.

1.3. Bit-Plane Slicing

In Bit –Plane slicing each pixel is represented by 8 bits; the image is composed of eight 1- bit planes. Plane 0 consists of least significant bit and plane 7 consists most significant bits.

II. INTRODUCTION

Akimov, Kolesnikov and Fränti[1] has proposed an new compression algorithm based on color map images by context tree modeling . It works with n-ary context tree model with incomplete tree structure of color map images. It is suitable for only the images which have few colors and it works up to 67 colors only.

Horspool [2] have selected improving in LZC (unix compression command). They proposed a new method of loading the dictionary at a faster rate with the help of C language code. This algorithm suits only for english text it does not applicable for images and the C source code file have high redundancy.

Cui [3] proposed a new algorithm it increases throughput and compression ratio simultaneously. In this mainly focus on the designing adaptive preprocessor which reduces correlation between data blocks. In this have a new VLSI architecture for the compression processor is proposed. Moreover this algorithm has high redundancy and the compression ratio is more than when compared to LZW.

III. PROPOSED WORK

The image is transformed by SPIHT encoding. A SPIHT is a wavelet-based image compression coder. It first converts the image into its wavelet transform and then transmits the wavelet coefficients in bit stream information. The LZW algorithm is introduced for the better comparison which is lossless reads the data information from the bit stream of SPIHT encoding part and tried to match a sequence of data symbols (pixels) as large as possible with an encoded string form the dictionary.

The post processing by LZW on SPIHT encoded data. The data sequence and its succeeding data present in the array are grouped together and then added to the dictionary for encoding. The decoder uses the received signal and LZW decoding is performed to reconstruct and followed by SPHIT decoding in which inverse wavelet is implemented to recover the image. We introduce proposed SPIHT algorithm it produces better bitrate in lossless compression.

In LZW compression First, the gray scale image is converted into eight binary (monochrome) image using bit plane slicing. The colored images are have three colors red, green and blue signals each of which is gray scale image will be converted into monochrome images. This process can be done by the color separation. The separation images contain redundant bits. Because the colors are reduced to two colors black (the value is 0) and white (the value is 1).

We initialize LZW dictionary with two values "0" that represent black color and "1" that represent white color instead of 256 colors. Each output code in the dictionary associates a frequency counter to phase in binary codes to decrease number of bits. This way a continuous adaption will be done. Figure 1 presents the complete block diagram of the proposed algorithm.

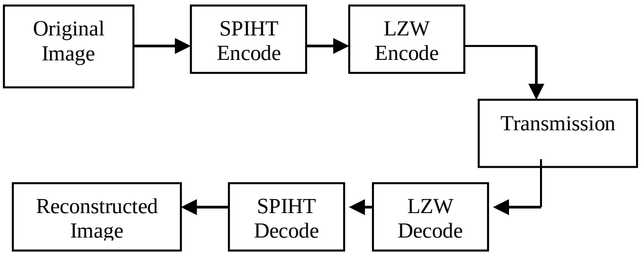


Figure 1: Block Diagram for Proposed Algorithm

IV. Prepare Your Paper Before Styling

Experiment is performed on 256x256 gray-scale for different images, using a wavelet decomposition based on the Daubechies filters [6] in SPIHT and LZW is used before encoding and decoding. Compression ratio for medical images is tested and which show the better bits per pixel (bbp) for proposed algorithm compared with JPEG2000. The same is performed for Lena image and the result are satisfactory and good. The results are based on the performance measured of PSNR. Form equation (3) PSNR is computed from the mean square error, obtained from the difference of source and compressed image, and defined in dB. Unless otherwise noted, all tests are performed using the well known "Lena" image with dimensions 256×256 pixels. Comparison between proposed method with the JPEG in criteria: PSNR values of the reconstructed image and reduces complexity.

The performance is evaluated by PSNR (peak signal to noise ratio).PSNR is mathematically evaluated as

PSNR= 10 log10 2552/ 1/T∑n-1 i=0∑n-1 j=0 (1)

PSNR has been accepted as a widely used measure of quality in the field of image compression. From Tables I-III, at a give bit rate, all of the proposed algorithms PSNR values are higher than these of the SPIHT and JPEG2000.

Table I: PSNR the JPEG2000 and SPIHT-LZW algorithm at various bit rates in X-ray test images.

Bitrate (bpp)	PSNR JPEG2000 LZW	PSNR SPIHT	PSNR Proposed SPIHT -LZW
0.12	36.4	37.72	39.65
0.80	37.9	39.4	41.32
1.40	40.6	41.2	43.45

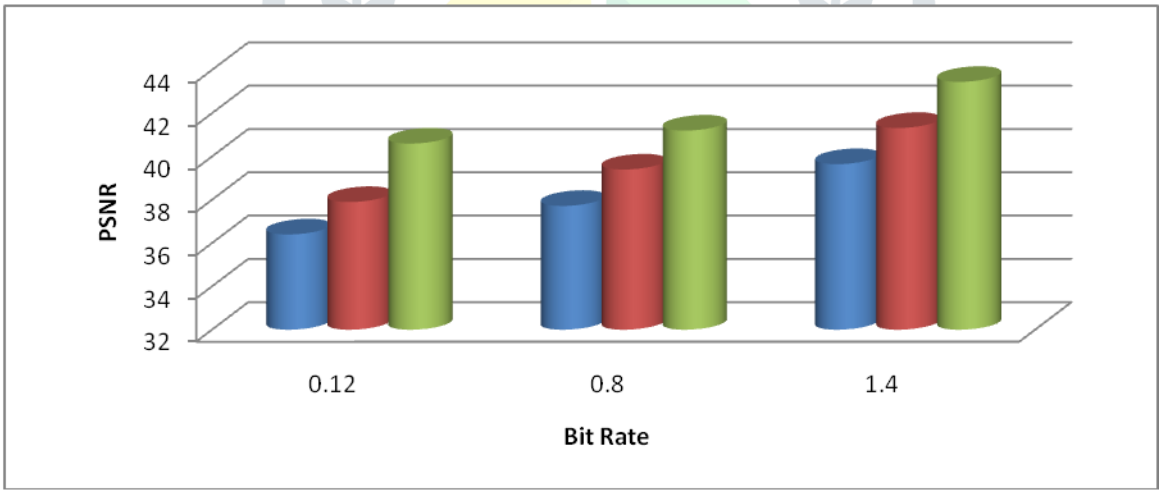


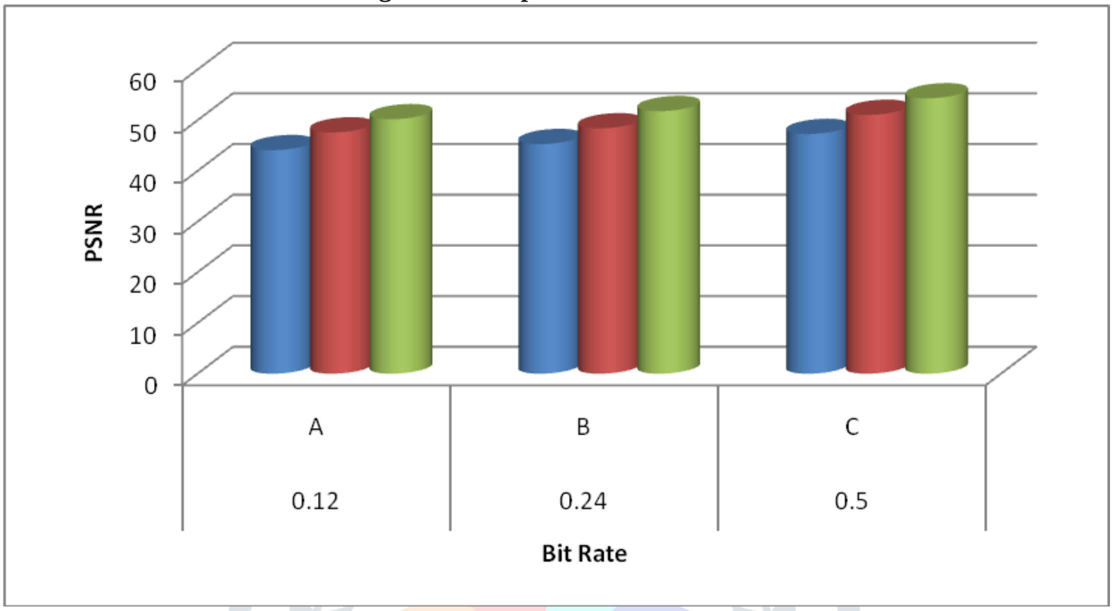
Figure 2: Comparison values of bit rates

Results show that the image compression reduced the computational complexity to only a half of the wavelet based sub-band decomposition and improved the quality of the reconstructed medical image in terms of both the peak signal-to-noise ratio (PSNR) and the perceptual results close to JPEG2000 and SPHIT at the same bit rate. The graph is plot between bitrate and PSNR, as bitrate increase, PSNR increases as shown. For same bit rate PSNR values of proposed algorithm is having high values. The scheme was studied with different medical images such as X-ray, Sonogram, and Angiogram etc., from these X-ray produces high PSNR. Theoretical analysis and experimental results, it clearly shown that both memory requirement and coding time are reduced, and the reconstructed images PSNR is increased in various bit rates in our proposed SPIHT algorithm.

Table II: PSNR for the JPEG2000 and proposed algorithm at various bit rates in Angiogram test images.

Bitrate (bpp)	PSNR LZW JPEG2000	PSNR SPIHT	PSNR Proposed SPIHT-LZW
0.12	44.1	45.3	47.29
0.24	47.6	48.4	51.06
0.50	50.2	51.8	54.32

Figure 3: Comparison values of bit rates



V. CONCLUSION

This technique employee SPIHT followed by LZW coding for image compression and storing image in cloud environment with less storage space. The main goal of this paper is to reduce bitrate to achieve maximum compression ratio without loss in information by which to save the store usage distance diagnosis in the future. The SPIHT compression algorithm for image coding has been presented in bit stream and is applied to LZW coding algorithm which gives high compression ratio. Furthermore, these compression performance is competitive virtually with all know techniques. The results indicate that the proposed technique can produce a better reconstructed image. The PSNR with values of the proposed method are better than the PSNR values of SPIHT-LZW and JPEG2000 at a given bit rate. High image quality of decoded images prevents misdiagnosis because of image distortion. The good compression ratio makes the storing of images in cloud environment more effective because of reduced bandwidth and storage requirements.

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