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Lossless Image Compression using Remove Redundancy Technique

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Abstract: Image compression is process to remove the redundant information from the image so that only essential information can be stored to reduce the storage size, transmission bandwidth and transmission time. The essential information is extracted by various transforms techniques such that it can be reconstructed without losing quality and information of the image. The development of transmission and digital imaging has junction rectifier to high amount of knowledge needed to represent fashionable im-agery. This needs giant space for storage, and durable for transmission over Computer networks, and these are comparatively high-ticket. These factors prove the necessity for pictures compression. compression addresses the problem of reducing the quantity of house needed to represent a digital image yielding a compact illustration of a picture, and thereby reducing the image storage/transmission time necessities. The key plan here is to get rid of redundancy data bestowed among a picture to scale back its size while not moving the essential information of it.

Keywords: Image Processing, compression.

I. INTRODUCTION

The redundancy in data may appear in different forms. For example, the neighbouring pixels in a typical image are very much spatially correlated to each other. By correlation it means that the pixel values are very similar in the non-edge smooth regions in the image. The composition of the words or sentences in a natural text follows same context model based on the grammar being used. Similarly, the records in a typical numeric database may have some sort of relationship among the atomic entities that comprise each record in the database. There are rhythms and pauses on regular intervals in any natural audio or speech data. These redundancies in data representation can be reduced in order to achieve potential compression.

Factors related to the need for image compression include:

- The large storage requirements for multimedia data
- Low power devices such as handheld phones have small storage capacity
- Network bandwidths currently available for transmission
- The effect of computational complexity on practical implementation.

In the array each number represents an intensity value at a particular location in the image and is called as a picture element or pixel. Pixel values are usually positive integers and can range between 0 to 255. This means that each pixel of a BW image occupies 1byte in a computer memory. In other words , we say that the image has a grayscale resolution of 8 bits per pixel (bpp) . On the other hand , a colour image has a triplet of values for each pixel one each for the red, green and blue primary colors. Hence, it will need 3 bytes of storage space for each pixel. The captured images are rectangular in shape. The ratio of width to height of an image is called the aspect ratio. In standard definition television (SDTV) the aspect ratio is 4:3, while it is 16:9 in a high-definition television (HDTV).

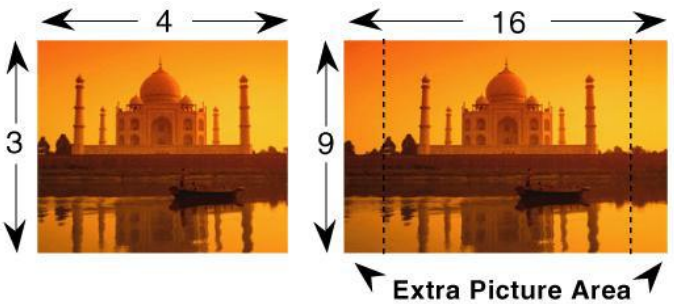

Figure 1: aspect ratio (a) 4:3 (b) 16:9Advantages of Data Compression

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i) It reduces the data storage requirements
ii) The audience can experience rich-quality signals for audio-visual data representation
iii) Data security can also be greatly enhanced by encrypting the decoding parameters and transmitting them separately from the compressed database files to restrict access of proprietary information
iv) The rate of input-output operations in a computing device can be greatly increased due to shorter representation of data
v) Data Compression obviously reduces the cost of backup and recovery of data in computer systems by storing the backup of large database files in compressed form.

Disadvantages of Data Compression

i) The extra overhead incurred by encoding and decoding process is one of the most serious drawbacks of data compression, which discourages its use in some areas.
ii) Data compression generally reduces the reliability of the records.
iii) Transmission of very sensitive compressed data through a noisy communication channel is risky because the burst errors introduced by the noisy channel can destroy the transmitted data.
iv) Disruption of data properties of a compressed data, will result in compressed data different from the original data.
v) In many hardware and systems implementations, the extra complexity added by data compression can increase the system‟s cost and reduce the system's efficiency, especially in the areas of applications that require very low-power VLSI implementation.

Redundancy different amount of data might be used. If the same information can be represented using different amounts of data, and the representations that require more data than actual information, is referred as data redundancy. In other words, Number of bits required to represent the information in an image can be minimized by removing the redundancy present in it. Data redundancy is of central issue in digital image compression. If n1 and n2 denote the number of information carrying units in original and compressed image respectively, then the compression ratio CR can be defined as

$$CR=n1/n2;$$

The main advantage of compression is that it reduces the data storage requirements. It also offers an attractive approach to reduce the communication cost in transmitting high volumes of data over long-haul links via higher effective utilization of the available bandwidth in the data links. This significantly aids in reducing the cost of communication due to the data rate reduction. Due to the data rate reduction, data compression also increases the quality of multimedia presentation through limited-bandwidth communication channels, Because of the reduced data rate. Offered by the compression techniques, computer network and Internet usage is becoming more and more image and graphic friendly, rather than being just data and text-centric phenomena. In short, high-performance compression has created new opportunities of creative applications such as digital library, digital archiving, video teleconferencing, telemedicine and digital entertainment to name a few. There are many other secondary advantages in data compression. For Example it has great implications in database access. Data compression may enhance the database performance because more compressed records can be packed in a given buffer space in a traditional computer implementation. This potentially increases the probability that a record being searched will be found in the main memory. Data security can also be greatly enhanced by encrypting the decoding parameters and transmitting them separately from the compressed

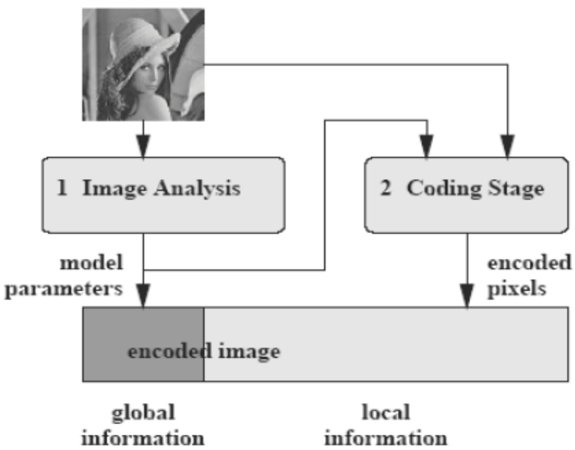

Figure 2: TMW block diagram.

database files to restrict access of proprietary information. An extra level of security can be achieved by making the compression and decompression processes totally transparent to unauthorized users. The rate of input-output operations in a computing device can be greatly increased due to shorter representation of data. Data compression obviously reduces the cost of backup and recovery of data in computer systems by storing the backup of large database files in compressed form. The advantages of data compression will enable more multimedia applications with reduced cost.

II. LITERATURE REVIEW

Author did analysis of various Image compression techniques for different images is done based on parameters, compression ratio(CR), mean square error (MSE), peak signal to noise ratio (PSNR). Our simulation results from chapter 4 shows that we can achieve higher compression ratio using Hybrid technique but loss of information is more. DWT gives better compression ratio without losing more information of image. Pitfall of DWT is, it requires more processing power. DCT overcomes this disadvantage since it needs less processing power, but it gives less compression ratio. DCT based standard JPEG uses blocks of image, but there are still correlation exits across blocks. Block boundaries are noticeable in some cases. Blocking artifacts can be seen at low bit rates. In wavelet, there is no need to divide the image. More robust under transmission errors. It facilitates progressive transmission of the image (scalability). Hybrid transform gives higher compression ratio but for getting that clarity of the image is partially trade off. It is more suitable for regular applications as it is having a good compression ratio along with preserving most of the information.

On the other hand Fractal Image Compression gives a great improvement on the encoding and decoding time. A weakness of the proposed design is the use of fixed size blocks for the range and domain images. There are regions in images that are more difficult to code than others .Therefore; there should be a mechanism to adapt the block size (R, D) depending on the mean and variance calculated when coding the block. This type of compression can be applied in Medical Imaging, where doctors need to focus on image details, and in Surveillance Systems, when trying to get a clear picture of the intruder or the cause of the alarm. This is a clear advantage over the Discrete Cosine Transform Algorithms such as that used in JPEG [1].

In this thesis, an efficient lossless image compression algorithm for both the bi-nary images and gray-scale images is developed. Lossless image compression has extensive application in medical imaging, space photographing and film industry to archive and transmit images. To efficiently compress images, we first decompose images into a set of binary images to reduce encoding symbols. The benefits lie in four aspects. First, the progressive image transmission is achieved by image decomposition. Second, the encoding alphabet is reduced to the binary alphabet which is suitable for context quantization and adaptive arithmetic coding. Third, decomposition provides an opportunity to use those partial future" information of non-causal pixels to help encoding. Finally, the decomposition provides a straight-forward way to encode bi-level images, considering that current gray-scale image compression algorithms usually have bad performance on bi-level images. To deal with the well-know context dilution problem, we propose a Lloyd-like context quantization algorithm which refines the context mapping to minimize the compression rate. By combining image decomposition and context quantization, we design an efficient lossless image compression scheme for both bi-level images and gray-scale images. Experimental results show that our scheme has competitive compression performance on both bi-level images and gray-scale images compared to JBIG and CALIC, respectively. Our scheme provides an interesting progressive transmission feature for gray-scale image compression as well [2].

With the development of information technology, the rapid development of microelectronics technology, image information acquisition and use is also increasing, sensor technology also unceasingly to reform. A single sensor information obtained is limited, often can not meet the actual needs, in addition, different sensors have the advantage of the imaging principle and its unique, as in color, shape characteristics, band access, spatial resolution from the aspects of all have their own characteristics. Registration algorithm is proposed in this paper has better robustness to image noise, and can achieve sub-pixel accuracy; the registration time has also been greatly improved. In terms of image fusion, the images to be fused through wavelet transform of different resolution sub image, using a new image fusion method based on energy and correlation coefficient. The high frequency image decomposed using new energy pixels of the window to window energy contribution rate of fusion rules, the low frequency part by using the correlation coefficient of the fusion strategy, finally has carried on the registration of simulation experiments in the Matlab environment, through the simulation experiments of fusion method in this paper can get the image fusion speed and high quality fast fusion image.

This paper based on the introduction of the principle of wavelet analysis and its application in image compression coding on the proposed an improved SPIHT algorithm. The fundamental of standard SPIHT algorithm is the quantization of the wavelet coefficients, the standard SPIHT algorithm adopted quantitative two into interval fixed, without considering the features of energy distribution of the wavelet coefficients, sometimes this is not necessarily the best method. This paper puts forward a new method based on this. The SPIHT algorithm the algorithm than the standard encoding and decoding times greatly reduced time consumption and PSNR and the standard SPIHT algorithm

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is quite. Finally, using MATLAB to achieve reasonable procedures show that the improved algorithm. In this paper, we propose a new adaptive multiplicative noise removal algorithm based on variation method. By analysis the shortcoming of Euler-Lagrange equation, we find that these traditional variation models are not fitted for multiplicative noise very well. The amount of multiplicative noise is relative with the pixel value. [3].
Common image compression standards are usually based on frequency transform such as Discrete Cosine Transform or Wavelets. We present a different approach for lossless image compression, it is based on combinatorial transform. The main transform is Burrows Wheeler Transform (BWT) which tends to reorder symbols according to their following context. It becomes a promising compression approach based on context modelling. BWT was initially applied for text compression software such as BZIP2; nevertheless it has been recently applied to the image compression field. Compression scheme based on Burrows Wheeler Transform is usually lossless; therefore we implement this algorithm in medical imaging in order to reconstruct every bit. Many variants of the three stages which form the original BWT-based compression scheme can be found in the literature. We propose an analysis of the more recent methods and the impact of their association. Then, we present several compression schemes based on this transform which significantly improve the current standards such as JPEG2000 and JPEG-LS. In the final part, we present some open problems which are also further research directions. [4].

III. OBJECTIVES

Our objective is to design an efficient and effective progressive lossless image compression scheme.

- Study of existing image compression techniques.
- Understand and design efficient "Remove the Redundant Data" Technique.
- Implement the proposed algorithm in MATLAB Tool for Redundant data removal and image compression.
- To Achieve a higher PSNR value, decomposes an image wavelet to level N=2
- Evaluate results.

Problem Statement

Uncompressed images normally require a large amount of storage capacity and transmission bandwidth. For example, a 24-bit true color high-definition television (HDTV) image with size 1920£1080 needs approximately 6 megabytes (6M bytes) of storage space. On the other hand, various types of redundancy exist in images, such as temporal redundancy, spatial redundancy (or interpixel redundancy), coding redundancy, spectral redundancy and psychovisual redundancy. The primary goal of image compression is to minimize the number of bits required to represent the original images by reducing the redundancy in images, while still meeting the user-defined quality requirements. The core issue in image compression is to design efficient and effective compression schemes. In terms of reconstruction ability, image compression schemes can be broadly classified into two major categories: lossless image compression and lossy image compression. Lossless image compression refers to the compression in which the original image can be fully reconstructed from the compressed image, i. e., no loss of any information during the compressing. Lossy image compression, on the contrary, allows some kind of difference or distortion between the reconstructed image and the original image, and the original image can not be fully recovered.
Lossless image compression has many applications such as medical imaging, space photograph, and film industry. In practice, medical images must be represented flawlessly for medical professionals to make clinical diagnosis with accuracy. Any minor distortion or errors introduced by lossy compression may lead to serious consequences to patients. In space exploration, astronomical images obtained by the satellites are often compressed and transmitted back to the earth for later processing such as object identification and feature extraction. These processing procedures may "amplify" the distortion caused by lossy compression and thus produce false results due to the distortion. In such cases, lossy compression is not appropriate because original astronomical images are very difficult and expensive to be obtained again. Finally, in film industry, lossless compression also has a huge market in archiving the films in order to save storage and meanwhile maintain the original high quality for future editing and re-compressing.

IV. PROPOSED ALGORITHM

Image compression is process to remove the redundant information from the image so that only essential information can be stored to reduce the storage size, transmission bandwidth and transmission time. The essential information is extracted by various transforms techniques such that it can be reconstructed without losing quality and information of the image.

V. CONCLUSION AND FUTURE WORK

Here as a dataset some classic image like Lena image and is used. The size of the each image is 128x128 or 80x80.

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The following 5 experiment shows the compression of images. For comparing the results of proposed method, PSNR (in dB) value is chosen. Time taken for compression also compared.

Experiment 1
Size: 17KB, Dimensions: 128x128 Pixel

Figure 3: Input Image 1

Output file of Experiment 1: Output.Hdwt
Size: 9.32Kb, **Decompress:** Output.Hdwt

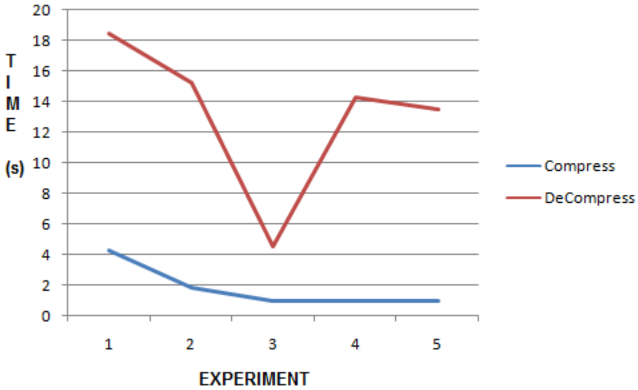
Figure 4: Output Image after Decompress

Elapsed time is 4.315881 seconds.
PSNR = 39.5412
MSE = 7.2271

Compression Time for All Experiments

Experiment	Compression Time(s)	Decompress Time(s)
1	4.315881	18.42
2	1.873331	15.18
3	1.013132	4.51
4	1.002406	14.21
5	0.976667	13.44

Time taken by Experiments to Compress/De-Compress Image



Size Comparison of Original vs Compressed.

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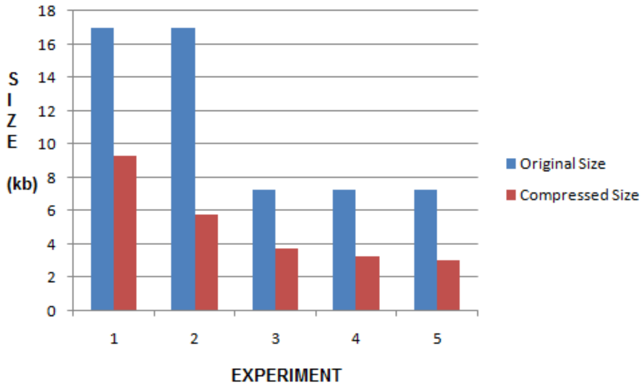

CONCLUSION

Currently, our method uses an Modified Redundant data removal technique to decrease file Size. Our main objective is to achieve a higher PSNR and compression ratio. In the future work, our techniques can be applied on other algorithms to decrease execution time.
An image compression algorithm was simulated using Matlab to comprehend the process of image compression. Modifications on the padding style showed reduction in the error, because it offers a better reproduction of image at its edges. It also supports faithful reproduction of the image, keeping the size of the transform coefficient matrix equal to the image size.

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