Volume-7,Issue-4, (Apr-17)
ISSN (O) :- 2349-3585

Matlab Based Image Compression Using Various Algorithms

Avishek Kumar[1], Shashank Shekhar[2], Ankit Kumar Ranjan[3], Ajit Kumar Patro[4]
[1,2,3]B.Tech,[4]Professor Electronics & Communication Engineering, Gandhi Institute of Engineering & Technology, Gunupur, Rayagada, India

Abstract:Image Compression is very interesting as it deals with the real world problems. It plays significant role in the transfer of data, like an image, from one user to other. This paper presents the use MATLAB software to implement a code which will take an image from the user and returns the compressed form as an output. WCOMPRESS function is used which includes wavelet transform and entropy coding concepts. This paper presents the work done on various types of images including JPEG (Joint Photographic Expert Group), PNG etc. and analyzed their output. Various compression techniques like EZW, WDR, ASWDR, and SPIHIT which are very common in image processing are used.

Keywords— RLE, WRD, STW, SPIHT, Image Compression

1. Introduction

MATLAB is a powerful tool for analysing images and signals for developing applications. One of the applications of image compression with MATLAB using a graphical user interface is described in this article.Cameras are nowadays being provided with more and more megapixels to improve the quality of captured images. With improvement in image quality, size of the image file also increases.Due to speed limitation of the Internet, it takes more time to upload good-quality images that are of bigger sizes. A user needs to compress the image without degrading its quality. Mobile manufacturers need algorithms in their cameras that enable storing the images in reduced sizes without degrading their quality.There are two types of compression algorithms, namely, loss-less and lossy-image compression. This article proposes a technique to compress the captured image to reduce its size while maintaining its quality. A number of images were considered to check the veracity of the proposed algorithm.In this article, discrete cosine transform algorithm is used, which compresses the image with a good compression ratio.Image compression has been the key technology for transmitting massive amount of real-time image data via limited bandwidth channels. The data are in the form of graphics, audio, video and image. These types of data have to be compressed during the transmission process. Digital image is basically an array of various pixel values. In the digital image Pixels of neighbourhood are correlated so that these pixels contain redundant bits. By using the compression algorithms redundant bits are removed from the image so that size image size is reduced and the image is compressed. Image compression has two main components: redundancy reduction and irrelevant data reduction. Redundancy reduction is achieved by removing extra bits or repeated bits. While in irrelevant reduction the smallest or less important information is omitted, which will not received by receiver. The three types of redundancies i.e. coding redundancy is used when less number of code words is required instead of larger symbol. Inter pixel redundancy results in correlation of pixels of an image and in psycho visual redundancy data is ignored by the normal visual system. Image compression is applied to reduce the number of bits which represent the image.

II.TYPES OF IMAGES

Table 1 Various types of images

Image Type	Interpretation
Binary	Logical array containing only 0s and 1s, interpreted as black and white.
Indexed	Array of class logical unit8, unit16, single, or double whose pixel values are direct indices into color map. The color map is an m-by-3 array of class double.
Grayscale	Array of class unit8, unit16, int16, single, or double whose pixel values specify intensity values. For single or double arrays, value ranges from (0, 1). For unit8 value ranges from (0, 255). For unit16, values range from (0, 65535). For int16, values from (-32768, 32767).
Truecolor	m-by-n-by-3 array of class unit8, unit16, single, or double whose pixel values specify intensity values. For single or double arrays, value ranges from (0, 1). For unit8 value ranges from (0, 255). For unit16, values range from (0, 65535).

3. Compression Algorithm

intensity of the next pixel is coded using different encoding methods The two types of compression algorithms are Lossless and Lossy. The compressed image is totally replica of the original input image in the loss less compression, so there is not any amount of loss present in the image. But in Lossy compression the compressed image is not same as the input image, some amount of loss is present in the image.

Histogram Processing Technique

It is the process used for equalization of images. Most of time images are not in good quality and the frequency bandwidth of that image not capture the whole time slot that's why the image is not clear so increase the bandwidth of image and increase the quality of image we are used the histogram technique in the MATLAB.

Lossless compression Techniques

In lossless compression scheme reconstructed image is same to the input image. Lossless image compression techniques first convert the images in to the image pixels. Then processing is done on each single pixel. The First step includes prediction of next image pixel value from the neighbourhood pixels. In the second stage the difference between the predicted value and the actual.

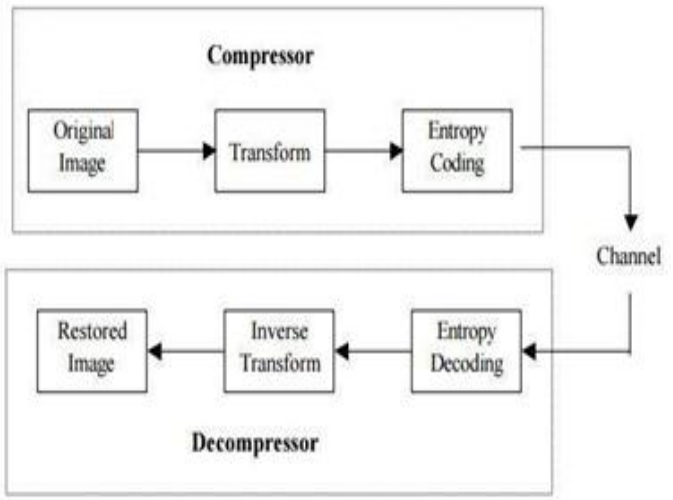

Fig.1 Block diagram of Lossless compression method

Lossy Compression Techniques

Lossy compression technique provides higher compression ratio compare to lossless compression. In this method, the compressed image is not same as the original image; there is some amount of information loss in the image. Lossy compression scheme is shown in fig.

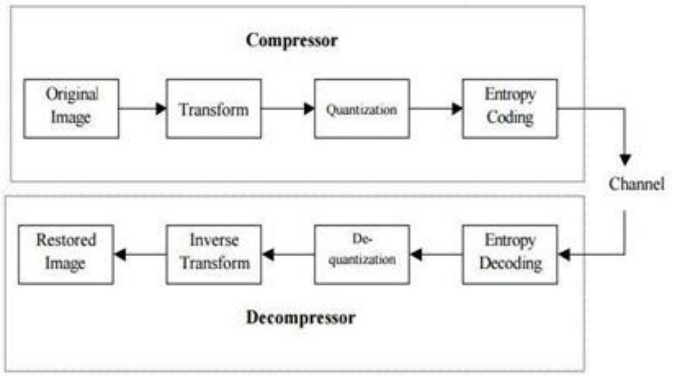

Fig.2 Block diagram of Lossy compression method

4. PURPOSE OF IMAGE COMPRESSION

Size of image can be minimized using Image compression technique in bytes of a graphics without degrading the quality of the image to an unacceptable level. The reduction in file size helps to store more images in a given amount of disk or memory space. The reduction in file size also reduces the time required for images to be sent over the internet or downloaded from Web pages. There are several different ways in which image files can be compressed. The two most common compressed graphic image formats are the JPEG format and the GIF format. The JPEG method is used for photographs, while the GIF method is commonly used for line art and other images in which geometric shapes are relatively simple. Other techniques for image compression include the use of fractals and wavelets technologies. Both these two technologies offer higher compression ratios as compared to the JPEG or GIF methods. Another new method is the PNG format. A text file or program can be compressed without the introduction of errors, but only up to a certain extent or up to good level.

5.METHODS USED IN IMAGE COMPRESSION

Embedded Zerotree Wavelet (EZW)

EZW is a lossy image compression algorithm. At low bit rates, i.e. high compression ratios, most of the coefficients produced by a sub band transform will be zero, or very close to zero [6]. This occurs because "real world" images tend to contain mostly low frequency information. However where high frequency information does occur high quality coding scheme is used. In zerotree based image compression scheme such as EZW and SPIHT, emphasis on the use of statistical properties of the trees in order to code the locations of the significant coefficients efficiently [1]. Since most of the coefficients will be zero or close to zero, the spatial locations of the significant

ISSN:-2349-3585 |www.ijrdt.org

coefficients make up a large portion of the total size of a typical compressed image. A coefficient is considered significant if its magnitude is above a particular threshold. By starting with a threshold which is close to the maximum coefficient magnitudes and iteratively decreasing the threshold, it is possible to create a compressed representation of an image which progressively adds finer detail. Due to the structure of the trees, it is very likely that if a coefficient in a particular frequency band is insignificant, then all its descendants will also be insignificant.

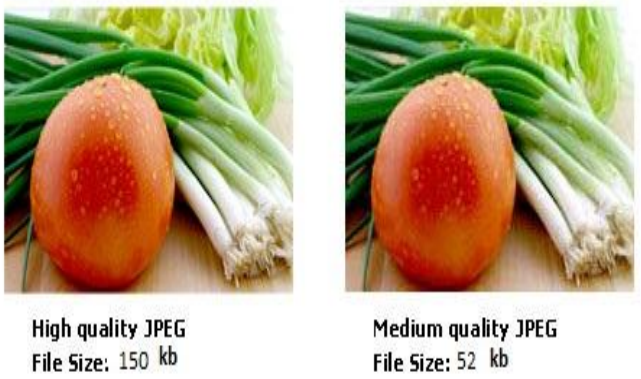

Fig.3 Image compression using EZW

Wavelet Difference Reduction (WDR)

The WDR combines run-length coding of the significance map with an efficient representation of the run length symbols to produce an embedded image coder. In both SPIHT and WDR techniques, the zerotree data structure is precluded, but the embedding principles of lossless bit plane coding and set partitioning are preserved. In the WDR algorithm, instead of employing the zerotrees, each coefficient in a decomposed wavelet pyramid is assigned a linear position index. The output of the WDR encoding can be arithmetically compressed. The method that they describe is based on the elementary arithmetic coding algorithm de. The WDR algorithm is a very simple procedure. A wavelet transform is first applied to the image, and then the bit-plane based WDR encoding algorithm for the wavelet coefficients is carried out.

Adaptively Scanned Wavelet Difference Reduction (ASWDR)

One of the most recent image compression algorithms is the Adaptively Scanned Wavelet Difference Reduction (ASWDR) algorithm of Walker. The adjective adaptively scanned refers to the fact that this algorithm modifies the scanning order used by WDR in order to achieve better performance.

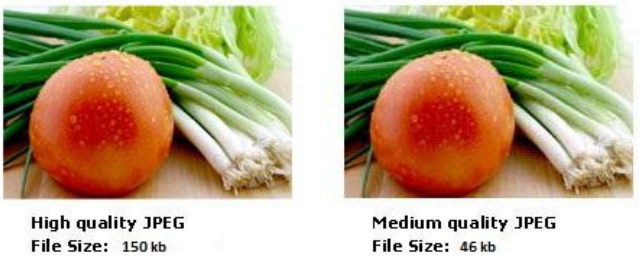

Fig.4 Image compression using ASWDR

Set Partitioning In Hierarchical Trees 3D for True color Images (SPIHT_3D)

The proposed algorithm presents an application of 3D-SPIHT algorithm to color volumetric dicom medical images using 3D wavelet decomposition and a 3D spatial dependence tree [3]. The wavelet decomposition is accomplished with bi-orthogonal 9/7 filters [2]. 3D-SPIHT is the modern-day benchmark for three dimensional image compressions. The three-dimensional coding is based on the observation that the sequences of images are contiguous in the temporal axis and there is no motion between slices. Therefore, the 3D discrete wavelet transform can fully exploit the inter-slices correlations [11]. The set partitioning techniques involve a progressive coding of the wavelet coefficients. The 3D-SPIHT is implemented and the Rate-distortion (Peak Signal-to-Noise Ratio (PSNR) vs. bit rate) performances are presented for volumetric medical datasets by using bi orthogonal 9/7. The results are compared with the previous results of JPEG 2000 standards. Results show that 3D-SPIHT method exploits the colour space relationships as well as maintaining the full embeddedness required by colour image sequences compression and gives better performance in terms of the PSNR and compression ratio than the JPEG 2000. The results suggest an effective practical implementation for PACS applications.

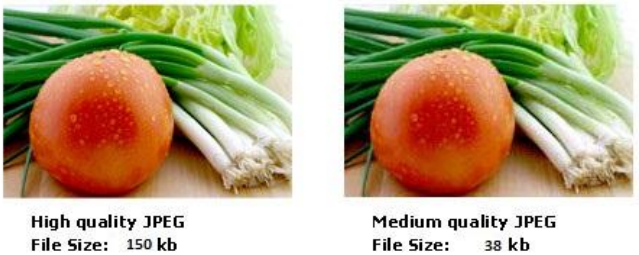

Fig.5 Image compression using SPIHT (True colour)

Set Partitioning In Hierarchical Trees (SPIHT)

The images obtained with wavelet-based methods yield very good visual quality. Even simple coding methods produced

good results when combined with wavelets. SPIHT belongs to the next generation of wave sophisticated coding. SPIHT exploits the properties of the wavelet-transformed images to increase its efficiency SPIHT wins in the test of finding the minimum rate required to obtain a reproduction indistinguishable from the original. The SPIHT advantage is even more pronounced in encoding color images, because the bits are allocated automatically for local optimality among the color components, unlike other algorithms that encode the color components separately based on global statistics of the individual components

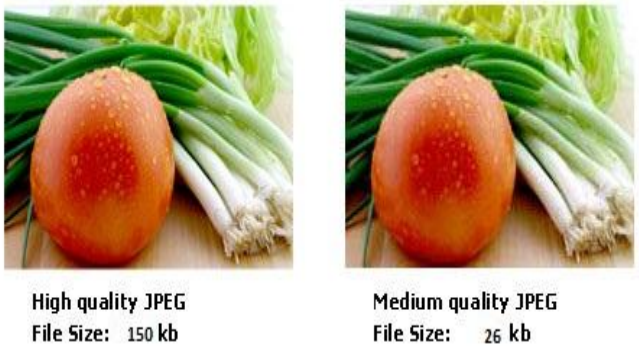

Fig.6 Image compression using SPIHT (Gray colour)

Spatial-orientation Tree Wavelet (STW)

Spatial orientation trees, are groups of wavelet transform coefficients organized into trees with lowest frequency sub band is the root and higher frequency sub bands are with the offspring in the lowest frequency or coarsest scale sub band is with the offspring. 3D-SPIHT: The extended version of 2D SPIHT is the 3-D SPIHT scheme possessing the same three characteristics. 1) By arranging partially with the magnitude of the 3-D wavelet transformed video using a 3-D set partitioning algorithm; 2) transmission of refinement bits in an ordered bit plane; and 3) utilization of self-similarity across spatial-temporal orientation trees

Fig.7 Image compression using STW

Table 2 Comparison chart of these algorithms are given below:

Algorithm	Original Size in Kb	Compressed Size in Kb
EZW	150	52
ASWDR	150	46
SPIHIT (True Color image)	150	38
SPIHIT (Gray Scale)	150	26
STW	150	23.4

VI. ADVANTAGES & DISADVANTAGES OF IMAGE COMPRESSION

5.1Advantages

• Format of image has been in use since long time and is extremely portable.

• Format of image is compatible with almost every image processing application.

• Format of image is compatible with most of the hardware devices e.g printers etc; therefore it is very easy to print the images in JPEG format.

• JPEG format can be used to store high resolution fast moving images which would be blur in other image formats because owing to their small size, JPEG images can be stored quickly from a camera to storage device.

• Size of JPEG images can be reduced and compressed which makes this file format suitable for transferring images over the internet because it consumes less bandwidth. A JPEG image can be compressed down to 5% of its original size.

5.2Disadvantages

• Compression technique is a lossy compression. Lossy compression means that after image is compressed in JPEG format, it loses certain actual contents of the image.

• Quality of Image is reduced after compression owing to the loss of actual content of the image.

• Image compression is not suitable for images with sharp edges and lines. JPEG image format is not capable of handling animated graphic images.

• JPEG images do not support layered images. Graphic designer need to work on layered images in order to manipulate and edit graphic images which is not possible with JPEG Image

Only 8 bit images are supported by JPEG format. On the other

hand, modern high resolution digital cameras support 10, 12, 14 or 16 bit images. If these images are stored in JPEG format, extra information is discarded, resulting in decreased image quality

6. Conclusion

The objective of this work was to compress an image. As in many of the devices where the full size images cannot be viewed or are not supported so the compressed images are used. The image compression also helps to save memory, as the size of the compressed image is less than the actual size of the image. In this project we have taken several images, in which original images were converted into compressed images using the various compressing methods. Comparison of various algorithms has been done and it is found that the original image 'wpeppers.jpg' of size (150kb) is compressed into a compressed image of size (23.4kb) using the STW compression method.

References

[1]Christophe, E., C. Mailhes, P. Duhamel (2006), Adaptation of zerotrees using signed binary digit representations for 3 dimensional image coding," EURASIP Journal on Image and Video Processing, 2007, to appear in the special issue on Wavelets in Source Coding, Communications, and Networks, Paper ID 54679.

[2]Misiti, M., Y. Misiti, G. Oppenheim, J.-M. Poggi (2007) Wavelets and their applications, ISTE DSP Series.

[3]Two Dimensional True Compression /Wavelet Toolbox / http : // in.mathworks.com / help

[4]Digital Image Processing using matlab (Gonzalez)/Chapter 6/Color Image Representation in MATLAB

[5]IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 17, NO. 12, DECEMBER 2008 Hyper spectral Image Compression: Adapting SPIHT and EZW to Anisotropic 3-D Wavelet Coding Emmanuel Christophe, Member, IEEE, Corinne Mailhes, Member, IEEE, and Pierre Duhamel, Fellow, IEEE

[6]Emmanuel Christophe, Pierre Duhamel, and Corinne Mailhes, Adaptation of Zerotrees Using Signed Binary Digit Representations for 3 Dimensional Image Coding, INTERNATIONAL JOURNAL OF IMAGE AND VIDEO PROCESSING 1

[7]Q. Du and J. E. Fowler, Hyperspectral image compression using JPEG2000 and principal component analysis, IEEE Geosci. Remote Sens. Lett., vol. 4, no. 4, pp. 201–205, Apr. 2007.

[8]Q. Du and J. E. Fowler, Low-complexity principal component analysis for hyperspectral image compression, Int. J. High Performance Comput. Appl.,to be published.

[9]D. Van Buren, A high-rate JPEG2000 compression system for space, in Proc. IEEE Aerospace Conf., Mar. 2005, pp. 1–7.

[10]P.-S. Yeh, P. Armbruster, A. Kiely, B. Masschelein, G. Moury, C. Schaefer, and C. Thiebaut, The new CCSDS image compression recommendation, presented at the IEEE Aerospace Conf., Mar. 2005.

[11]X. Tang, W. A. Pearlman, and J. W. Modestino, Hyperspectral image compression using three-dimensional wavelet coding, in Proc. SPIE Image and Video Communications and Processing, 2003, vol. 5022, pp. 1037–1047.