International Journal of Current Engineering and Technology
ISSN 2277 - 4106

Available at http://inpressco.com/category/ijcet

Research Article

A Novel Approach of Digital Image Compression Technique using Bit Plane Size Reduction

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Accepted 10 October 2013, Available online 21 October 2013, **Vol.3, No.4 (October 2013)**

Abstract

This paper presents a novel method for the compression and decompression of digital color images .Image compression is essential for applications such as storage in data base and transmits an image. Compression becomes very easy techniques to apply without much technical requirement. In this paper we proposed an algorithm by which we can compress a color image or a photo frame. A novel algorithm has been developed by which we can decompress a color image which is compressed using the compression algorithm. The results show that the coding performance and the estimated time require compressing an image and decompressing an image is significantly increases.

Keywords*: Image Compression, Image decompression, coding performance.*

1. Introduction

1. Image

An image is essentially a 2 Dimensional signal processed by any human visual system. The signals can represent images are usually in analog form. However, for processing, storage and transmission by any computer system the signal should be converted into digital form. A digital image is basically a 2-Dimensional matrix of pixels.

Image form the significant part of data, particularly in remote sensing, biomedical and video conferencing applications . The use of and dependence on information and computers continue to grow, so too does our need for efficient ways of storing, transmitting and processing large amount of data.

1.2 Image Compression

Image compressionis the technique of reducing the amount of data required to represent a digital image. it is a process intended to yield a compact representation of an image, thereby reducing the image storage, transmission or processing requirements. Image compression is achieved by the removal of one or more of the three basic data redundancies:

1. Coding Redundancy.
2. Spatial Redundancy.
3. Irrelevant Redundancy.

Coding redundancy is exists when less than optimal code words are used.
Spatial redundancy is from the correlations between pixels of an image.
Irrelevant redundancy is due to data that is ignored by a human visual system.

Image compression techniques reduce the number of bits required to represent an image by taking advantage of this redundancy, an inverse process called decompression is applied to the compressed data to get the reconstructed image. The objective of compression is to reduce the number of bits as much as possible, while keeping the resolution and the visual quality of the reconstructed image as close to the original one as possible. Image compression systems are composed of two distinct structural blocks: an encoding block another one decoding block.

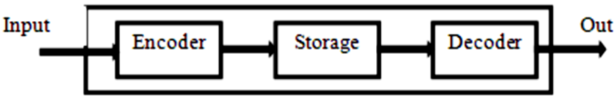

Figure 1: Simple image.

Basically two types of compression are available. (i) Lossy Compression and (ii) Lossless Compression.

In the equation (1) we consider that f(x,y) is an original image and f^(x,y) is a decompress image which is constructed by an encrypted image. And we calculate F(x,y), depending upon the value of F(x,y) we should take the decision whether an algorithm is Lossy or lossless.

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$$F(x,y) = f(x,y) - f^\wedge(x,y) \quad (1)$$

(i) Lossy Compression: In this compression there is loss of information and the original image is not recovered exactly. This is irreversible because F(x,y) is not zero. Most lossy data compression formats suffer from generation loss: repeatedly compressing and decompressing the file cause it to progressively loss quality.

(ii) Lossless Compression: The goal of lossless image compression is to represent an image signed with the smallest possible number of bits without loss of any information as because F(x,y) is zero, thereby speeding up transmission and minimizing storage requirement. This reproduces the original image without any quality loss.

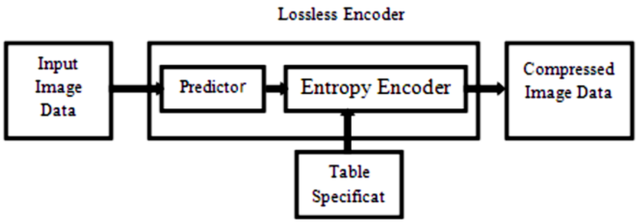

Figure 2: Lossless Decomposition.

This paper is divided into various sections. Where 1st section describes the introductory part of the research work. Section 2 gives a clear idea over the technique that is proposed in this research work. Section 3 describes the algorithm analysis of the proposed technique. IN section 4 experimental results are illustrated and discussed. And finally we finish this research article with concluding remarks.

2. Proposed Technique

The proposed technique in this paper comes from the ability to construct a novel format to reduce the size of byte field of an image in any format, here we use JPEG, BMP, and TIFF image as a source images for the algorithm. The ability to restore the original files in the proposed method is near is high but not 100%. The proposed method is suitable for any image where human visual system is necessary. The proposed technique starts with converting the original R, G, and B arrays into less size. For a color image there are three fields for each pixel of size 8 bits to represent the image, in this technique we decrease the size of these three fields by which image size is also decrease. The novel image format has greater compression ratio and this has been obtained by the proposed compression method. We can compress an image by two method first one to decrease the size of an image another one to decrease the intensity of each pixels. In this method we only consider the intensity value for each pixel and decrease the intensity value which can be represented by a less bit number than original one. For each pixel in a color image there are three intensity values. In equation (2) we decrease the size of these intensity values, each intensity value is divided by 2^n where n is the encoding quantization factor.

$$A[i,j,k] = im[i,j,k]/2^n \quad (2)$$

Where im is the original image and the intensity values are represented in 8 bit format and A is the compress image and the intensity value is in (8-n) bit format. We also explain in equation (3) how to decompress an compress image

$$im2[i,j,k] = A[i,j,k] * 2^n \quad (3)$$

Here A is the compress image and im2 is the decompress image where intensity field is of 8 bits and n is the decoding quantization factor.

3. Proposed Algorithms Steps

In proposed encoding and decoding method to compress the image, the foremost step is to load the image and for the compression of image, firstly the RGB values of each pixel should be separated. For each pixel the RGB should be reduced by the equation 3 and store the values in another one matrix whose RGB fields are 8-n and then to decompose the image we represent each RGB field as 8 bit by equation 4 and we get the output which is actually look like the original image. The flow diagram of the proposed algorithm is shown below.

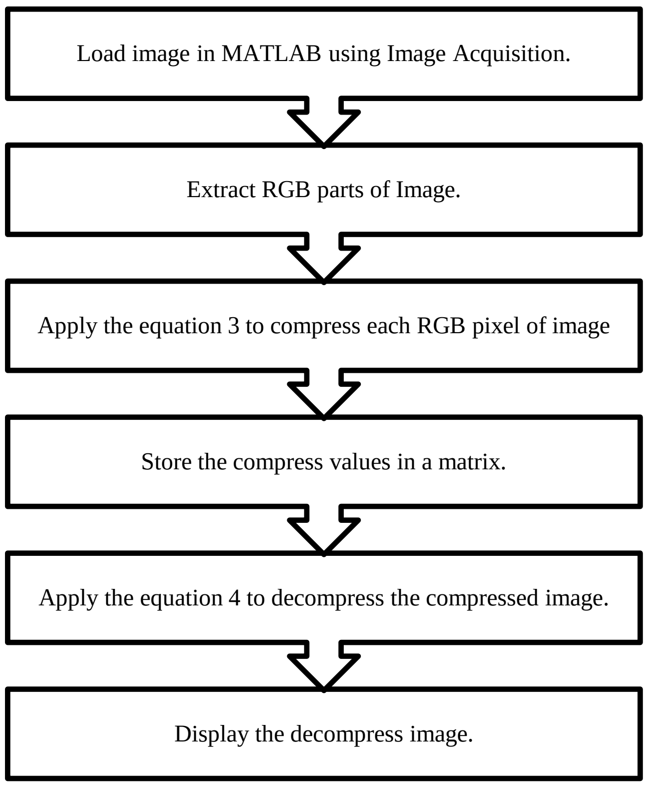

Figure 3: Flow diagram of the proposed technique.

4. Experimental Results

Figure 4: Real life images.

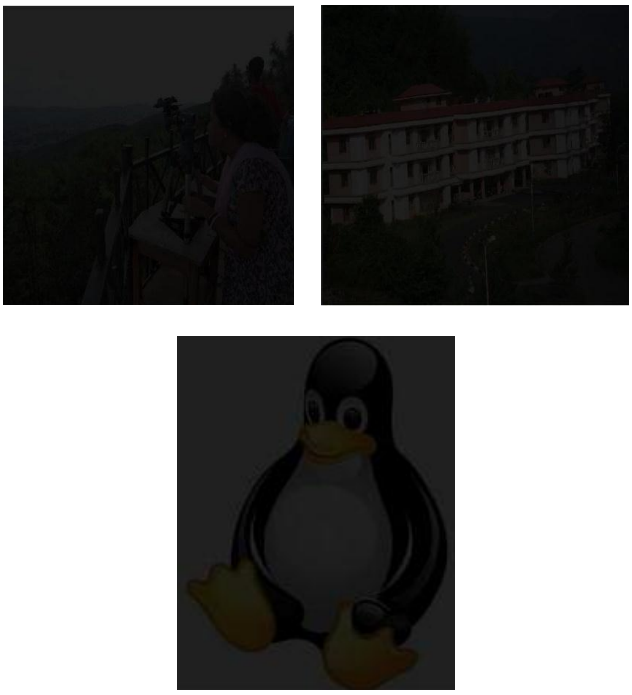

Figure 5: compressed images.

Figure 6: decompressed images.

In order to support the proposed contribution in this paper, three test images have been used; figure (4). The decomposed images have absolutely undistinguishable ocular differences by the human eye. But this is not enough, therefore; a mathematical performance measures have been applied. The first and the simplest evaluation measure is the size of each pixel. The test is performed on three real life images of size 512 x 512 each. If we assume that the n value is 4 then using the equation 4 we get the compression ratio 50% for the test image. To store the compress image we use a matrix of same size of the original image but the bit plane size is of 8-n bits which can reduce the size of these three images, and the images are shown in figure 5. Using our decompress algorithm if we decompress the compressed images we see that no changes is occur in the human visual format and the result is displayed in figure 6.

The statistical analysis is also done in this experimental work. We have calculated the image entropy for figure 5 and 6. Image entropy is a quantity which is used to describe the `business' of an image, i.e. the amount of information which must be coded for by a compression algorithm. PSNR which is Peak Signal- to-noise ratio is the ratio between the maximum possible power of a signal to the power of corrupting noise that affects the fidelity of its representation and MSE which is mean squared error is also calculated for the figure 5 and figure 6. we calculate the entropy of the images of figure 5 and 6 using the following equation.

$$Entropy = \sum_i p_i log_2 p_i \quad (5)$$

We calculate the MSE and PSNR of the images of figure 5 and figure 6 using the following equation.

$$\text{PSNR} = 10.\log10(MAX_1^2/\text{MSE}) \quad (6)$$

Table 1: Statistical analysis

IMAGE	ENTROPY	MSE	PSNR
Figure 5 (1st image)	4.4165	2.0388e+004	5.0370
Figure 5 (2nd image)	4.6910	1.0423e+004	7.9510
Figure 5 (3rd image)	3.4533	3.7374e+004	2.4052
Figure 6 (1st image)	6.6970	1.0905e+003	17.7547
Figure 6 (2nd image)	7.5856	2.8123e+003	13.6401
Figure 6 (3rd image)	4.0000	8.8400e+003	8.6663

Conclusion

In this paper a new compression and decompression scheme for digital color images is proposed using the size reduction of bit plane of a pixel. This technique is tested against different real life images using different values of quantization factor. The experimental results confirms the effectiveness of the proposed technique.

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