A Lossless Recovery of Data Embedded in Color Image Based On Block Division Method

Samriti Sharma
MAEER'S MIT College Of Engineering
Kothrud, Pune

Snehal Shendkar
MAEER'S MIT College Of Engineering
Kothrud, Pune

Rekha Udabale
MAEER'S MIT College Of Engineering
Kothrud, Pune

Prof. Sukhada Bhingarkar
MAEER'S MIT College Of Engineering
Kothrud, Pune

***Abstract*— Today, digital media are getting more and more popular. Not only multilevel images, video and audio are in digital form, but gray scale images are also digitized in many applications. Data transmitted over the internet can be hacked, so the data encryption becomes important. One of the encryption techniques is reversible data hiding. The major characteristic of this method is that it allows reconstruction of the original image from the stego image after extraction of data. Ni (NSAS) proposed the reversible data hiding based on histogram shifting. However the method had no provision of sending the peak point information required to extract the secret data. Later, Hwang (HKC) proposed a scheme based on histogram shifting to overcome this shortcoming. But this method decreases the data hiding capacity. In order to enhance data hiding capacity block division method is used. In this paper an algorithm for embedding data into color image is proposed. According to the proposed method , the reversible data hiding scheme for color images not only improves the original data hiding capacity but also attains the goal of lossless data recovery.**

Keywords: Reversible data hiding, RGB planes, Block division.

I.INTRODUCTION

As the communication technology is growing rapidly, more and more digitalized data are distributed and transmitted over the Internet. For these exposed data, security becomes one of the most important issues for the public channel. One of the ways to protect the transmission of secret data is to encrypt the secret message using traditional crypto graphical methods. In this method sender obtains cipher text from plain text by using some encryption algorithm and sends it to destination. Receiver, with the help of a key has to use same algorithm but in reverse way to get correct plain text from cipher text. Depending upon the key cryptography is classified as symmetric key cryptography and asymmetric key cryptography. However, the disordered encrypted codes may attract the suspicion of illegal users and incur attacks on this basis. For this reason, many methods have been proposed to provide a way of data hiding called steganography that embeds the secret data into a cover
carrier confidentially so that only the intended receiver can detect and reveal the secret message. In steganography, using an image as a carrier, the *cover image* is used to contain the secret data and the *stego image* refers to the cover image in which the secret data have been embedded.

Until now, many data hiding techniques have been proposed but most of them are irreversible [1, 2], which means that the original cover image cannot be recovered without loss from the stego-image. However, in some applications such as military, medical, and high-energy particle physical experimental investigation, because of the required high-precision nature it is also desired that the original cover media should be recovered. In 2001, the first reversible embedding method was carried out in the spatial domain by Honsinger, *et al.* [3]. Since then, many reversible data hiding schemes have been reported.

In 2006, Ni, *et al.* [4] (NSAS) utilized the peak and zero points of the histogram of a cover image and then modify the pixel grayscale values to allow secret data to be appended. After experimental results they guarantee that the computational complexity is low and the execution time is short in their scheme. However, the peak point will be changed after embedding secret data in NSAS. The embedded secret data cannot be recovered when the knowledge of peak and zero point of histogram are not transmitted to the receiver. However, NSAS does not discuss how to transmit the additional information, peak point and zero point of histogram, from sender to receiver. To overcome the above disadvantage, Hwang (HKC), *et al.*[5] proposed a robust reversible data hiding scheme based on histogram shifting method. The method proposed the location map to store the reversible data. However, this solution will waste the storage quantity and decrease the original data hiding capacity. In order to enhance the data hiding capacity, the block division method is used.

The rest of the paper is organized as follows. The NSAS and block division schemes for gray scale images will be reviewed briefly in Section II. Then, an efficient reversible data hiding scheme for color images is described in Section III and conclusions are drawn in Sections IV.

II. RELATED WORK

In this section, we will roughly review a high capacity method for reversible data embedding was proposed by Ni *et al*.[4] in 2006 .An image is used along with its histogram as an example to illustrate NSAS algorithm as shown in Fig. 1.1.According to the NSAS scheme, there are three steps during the data embedding process.

Step 1. Find out the peak point and the zero point in
Fig.1.1 (b). Where the peak point corresponds to the maximum number of pixels and zero point refers to no number of pixels in the given image.

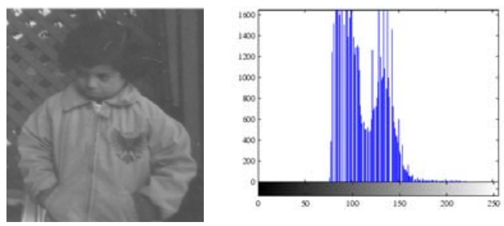


Figure 1.1 (a) Image Figure 1.1(b) Histogram

Step 2. Scan the whole image in a sequential order, such as row-by-row, from top to bottom. Consider the zero point in the given image is "x" and peak point is "y".The grayscale value of pixels between x (including x) and y(including y) is incremented by "1", i.e., shifting the range of the histogram, [x,y] to the right-hand side by 1 unit and leaving the grayscale value x empty.

Step 3. Embed the secret data "0" and "1" into the
grayscale value of [x-1] and [x], respectively.

After the above data embedding process the stego image is obtained and then it can be transmitted to the receiver. Obviously, the data embedding capacity of NSAS scheme is equal to the grayscale value of the peak point. However, the peak point in cover-image is not the same as the peak point in stego-image. In order to achieve the reversible property, the grayscale value of peak point and zero point in the original cover-image must be transmitted to receiver. Unfortunately, this major problem how to transmit the additional information, the grayscale value of peak point and zero point, from sender to receiver is not discussed in NSAS.In order to improve this shortcoming, Hwang, *et al*.[5] (HKC) proposed a robust reversible data hiding scheme based on histogram shifting method which embedded the location map along with the secret data. The information hiding capacity is finite when one pair in original image is selected. Therefore, several pairs in location map are used to improve the capacity of embedding information into the cover image. As the HKC scheme does not tell how to increase several pairs in location map, the block division method can be utilized to improve the capacity of embedding information into the cover image effectively. Here, we regard the Tiffany's picture as the example and the histogram shown in Fig. 2.1(a) and (b), respectively.

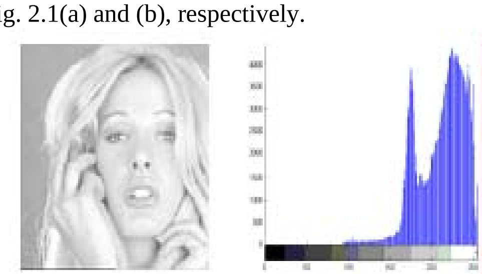


Figure.2.1 (a).Tiffany (b). The histogram picture

The following four steps complete the data embedding process in block division-

Step 1. Divide the cover image to several equal blocks such as four blocks shown as Fig.2.2.

Step 2. Take the histogram of each block and the result shown as Fig.2.3. Then, find out the maximum point and the two minimum points in this block histogram. Simultaneously, generate the embedding space by shifting the both side of maximum point to right and left one point, respectively.

Step 3. A location map is used to store location information of the pixels (such as maximum point, left minimum point, and right minimum point in each block).

Step 4. Embed the secret data into cover image.

Figure 2.2 Blocking the image

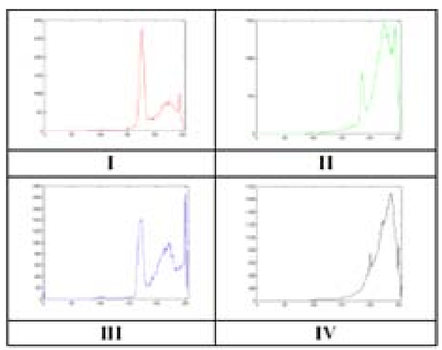


Figure 2.3. Histogram of each block

The block division method can be utilized to improve the
materials amount of displacement effectively and can increase the hidden materials amount.
The structure of location map used is explained below-

MIN1**:** The minimum point corresponds to the grayscale value which the minimum number of pixels in the left side of peak point in the histogram.

MIN2**:** The minimum point corresponds to the grayscale value which the minimum number of pixels in the right side of peak point in the histogram.

Value1**:** It is used to remember how many points must be recovered in left side and the length is $N = [\log_2 \ MAX]$.

Value2**:** It is used to remember how many points must be recovered in right side and the length is $N = [\log_2 MAX]$

Length1**:** It is used to note these points relationship in left side.

Length2**:** It is used to note these points relationship in right side.

MIN1	MIN2	VALUE1	VALUE2	LEN1	LEN2

Figure.2.4. Structure of location map

Thus block division method [6] uses location map to record the selected min point, max point and other details to achieve not only higher data hiding capacity but also the reversible effect. Also the cover image is divided into blocks which improve the fact embedding capacity to great extent. However this method was used for grayscale images. This paper proposes the same method for color images.

III. PROPOSED SCHEME FOR COLOR IMAGE BASED ON BLOCK DIVISION

Each image is composed by three fundamental colors: red, green and blue. The RGB color model is an additive model in which red, green and blue are combined in various ways to reproduce other colors. The original color image and histograms of all the three planes are shown in Figure3.1.

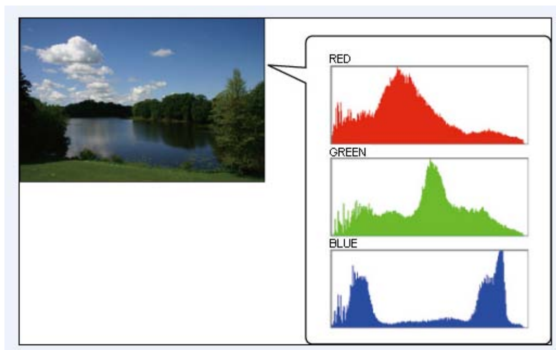
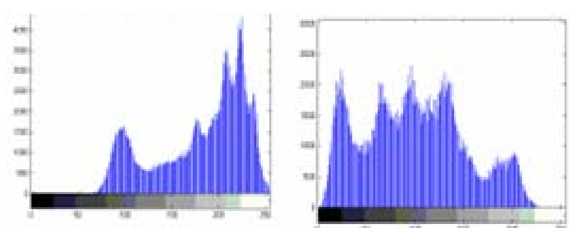
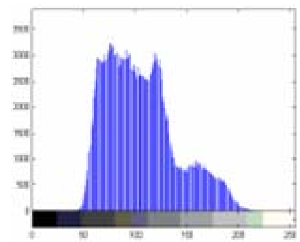


Figure 3.1. Decomposition of color image into RGB planes

Figure 3.1. Lena original (a) and its decomposition red (b), green (c) and blue (d)



(a) Red Plane (fr) (b) Green Plane (fg)



(c) Blue Plane (fb)

Figure 3.2 Histogram of all three planes

A. Data Embedding Process-

***Step*1.** Divide the color image to several equal blocks.

***Step2*.** Each block is decomposed into three planes.

***Step3*.**Histogram of each block for all three planes is prepared.

***Step4*.** The color image is scanned pixel by pixel to find peak value. If the scanned pixel value is the peak value, then it is increased by '1' if the embedded bit of the secret data is '1'. If the embedded bit of the secret data is '0' it remains
same. This step is repeated for all the planes until all the bits of the secret data are embedded.

Step5. The location map is embedded into fr plane and finally all the three planes are concatenated to obtain the stego image which is then sent to the receiver.

B. Data Extraction Process-

***Step*1.** The stego image is divided into several equal blocks.

***Step2*.** Each block is decomposed into three planes.

***Step3*.**Histogram of each block for all three planes is prepared and location map is retrieved from fr plane.

***Step4*.** For data extraction all the three RGB planes are scanned for peak value and the incremented peak value in the same sequence of embedding. If the scanned value is the incremented peak value, then the extracted bit is '1'otherwise the extracted bit is '0'.

Step5. All the three planes are concatenated to form the
color image.

Figure. 3.3 Blocking the color image

IV. CONCLUSION

In this paper, a reversible data hiding scheme for color image based on block division is proposed. According to the proposed method , the reversible data hiding scheme for color images not only improves the original data hiding capacity but also attains the goal of lossless data recovery.

V. REFERENCE

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