A Steganography Technique on Edges

Jaspreet Kaur
M.Tech Scholar
Deptt. of CSE
A.I.E.T,Faridkot,Punjab,India

Gurbinder Singh Brar
Assistant Professor
Deptt. of CSE A.I.E.T,
Faridkot, Punjab, India

Dr. Rahul Malhotra
Campus Directors,
CT Group of Institutions,
Maqsudan, Jalandhar

Abstract—**Steganography is the art and science of hiding secret data information in other media like digital images. The secret message is hidden in such a way that no one can apart from the sender or the intended recipient view the information. Therefore, different techniques have been proposed so far for. This paper introduces a Block based Steganography Technique which hides the message bits into the colour images using the edges of the cover image. In the proposed algorithm, to preserve the quality of the stego image it is preferred to hide the data at the edges because by doing so the visual quality of the image is affected less as compared to the other areas in the image. The present algorithm offers high steganographic quality in terms of PSNR and provides high embedding capacity without compromising with the quality. The experimental results show that the proposed scheme not only achieves high embedding capacity but also enhances the quality of the stego image from the HVS by an edge detection technique.**

Keywords—Steganography, Least Significant Bit (LSB), Bit Level Block (BLB), Embedding, Peak Signal-to-Noise Ratio (PSNR), Human Visual System (HVS), Edges.

I. INTRODUCTION (*Heading 1*)

Today is the age of science and technology where nothing is considered impossible and everything is vulnerable to attacks. So a numbers of secret communication techniques are used to communicate confidential information. Steganography is one of technique which is used to transmit a secret message under the cover of digital media such as images. Steganography derived from two Greek words [13] i.e. 'Steganos' and 'Graphie' where Steganos means covered and Graphie means writing. On the whole Greek translation of the term is concealed writing [9]. Steganography aims to hide the existence of message by embedding secret message to be communicated in any cover message which can be text, audio, video or image. For image steganography, cover message can be any randomly chosen image.

Out of the five pillars of information assurance, namely confidentiality, authentication, identification, integrity and non-repudiation, steganography offers confidentiality by ensuring the privacy of sensitive information. Authentication and identification is only offered if keys are used. However, integrity of information can never be offered by standalone steganography. Non-repudiation is also not possible, because the person can later deny embedding the message as there is no proof of ownership is provided during steganography [8].

The general model of steganography is shown in Fig.1.In this process secret message is embedded into cover file using steganographic algorithm to form stego-file. Then stego-file is communicated over any channel and then receiver extracts message from stego-file using extraction algorithm which is reverse of the steganographic algorithm. Secret key is optional. If it is used during embedding, it is necessary to provide secret key during extraction [11].
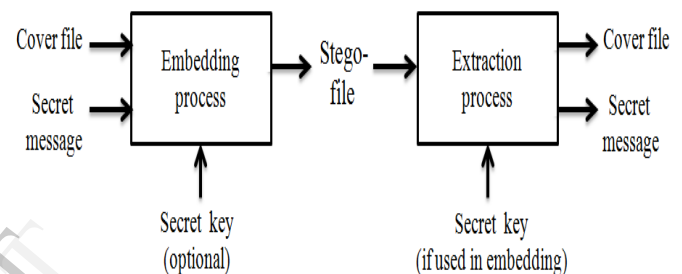

Fig:-1 General model of steganography

LSB (Least Significant Bit) is the traditional approach of steganography which acts as the base for many other techniques. In this technique, message bits are directly hidden into the LSB's of every pixel. It does not affect the visual quality of image, because human eyes are insensitive to gradual changes in shade [7]. There are many extensions introduced for this approach that focus on improving the quality and increasing the steganographic capacity. Few of these techniques are discussed in the following section.

The rest of the paper is organized as follows: In Section II related work is presented. The implementation of the system and proposed algorithm is discussed in section III. Discussion of various results obtained from testing the system based on the proposed algorithm, with various sizes of data is explained in section IV and section V we conclude the paper along with future scope.

II. RELATED WORK

S. Arora et al [1] in this paper, author proposed a technique that hide the text data into the color images using edge detection method. The alteration in edges cannot be distinguished well so edges can hide more data without losing quality of an image. In this technique, Edges of an image are detected by scanning using 3x3 window and then text message is concealed in edges using first component alteration technique.

N. Jain et al [2] in this paper, the edges of the images are being used to hiding text message in Steganography for gray image has been presented. In this method tried to find binary value of each character of text message and then in the next stage, tried to find dark places of gray image by converting the

original image to binary image for labelling each object of image by considering on 8 pixel connectivity. Then these images have been converted to RGB image in order to find dark places. In the final stage each 8 pixels of dark places has been considered as a byte and binary value of each character has been put in low bit of each byte that was created manually by dark places pixels for increasing security of the main way of least Significant bit steganography.

S. Kaur et al [3] in this paper, image steganography technique based on first component alteration technique using hybrid edge detector is proposed. There are lots of algorithms to hide data but they are also decreasing the quality of the image. In this work, edges of an RGB image has been detected by hybrid edge detector which is the combination of 3x3 matrix scanning and sobel edge detector, and then text will be embedded in to the first component of edges of the color image.

W.J. Chenet al [4] in this paper, author used least significant bit (LSB) substitution mechanism, based steganographic technique for embedding a secret message in an image with high capacity, while the human visual system (HVS) would be unable to notice the hidden message in the cover image. In this paper, besides employing the LSB substitution technique as a fundamental stage, advantage of edge detection technique is utilized.

V.S. Jain et al [5] in this paper, author proposed a new steganographic algorithm that is used to hide text file inside an image. In order to increase/ maximize the storage capacity a compression algorithm that compresses the data to be embedded. The compression algorithm we have used works in a range of 1bit to 8 bits per pixel ratio.

III. PRESENT WORK

Before In present work, a Block based Steganography Technique is proposed which hides the message bits at the edges of the cover image. The presented algorithm can be applied to the RGB images and does not hide the data to the gray scale images. In the proposed algorithm, to preserve the quality of the stego image it is preferred to hide the data at the edges because by doing so the visual quality of the image is affected less as compared to the other areas in the image. And to make the algorithm high data capacity embedding system, the edge pixels from every layer are calculated using canny edge detector. Then the whole image is divided into the blocks of 4 pixels. The last 3 pixels of each block are used to hide the secret data. All these 3 pixels are analyzed for its status as edge or non edge pixel and if pixel is found edge pixel then 3 bits of data is replaced with the 3 LSBs of the blue layer of that pixel. But if the pixel is found non edge then 3 bits of data is scattered into 3 layers of that pixel by replacing the one bit of data with the 1 LSB of each layer. And also 1st pixel of every block is used to hide the status of the rest 3 pixels in the group. If the pixel is edge pixel then store its status as 1 into the 1st pixel and if the pixel is non edge then store its status as 0 into the 1st pixel. After hiding the whole data into the image blocks stego blocks are re arranged and stego image is obtained. The block diagram showing the basic layout of present approach of message hiding is shown in figure 2.

To retrieve the hidden message from the stego image the stego image is divided into blocks of 4 pixels and from the 1st pixel of every block the status of the rest 3 pixels in the group is retrieved as edge or non edge. out the rest 3 pixels in the group, if the pixel is found edge pixel then retrieve the 3 bits from the blue layer of this pixel otherwise retrieve one bit from every layer of the pixel. After retrieving these data bits from whole blocks arrange them in a proper manner to retrieve the hidden message. The block diagram for retrieval of message from stego image is shown in figure 3.

A. Message Hiding Algorithm Steps:

1. Read RGB image.

2. Divide the image into blocks of four pixels.

3. Read the status of last three pixels of the group as edge and non edge pixel.

4. Hide their status in first pixel of the group.

   Hide 1 for edge pixel and 0 for non edge pixel.

5. If pixel is edge pixel then hide 3 bits of secret message into three bits of blue component.

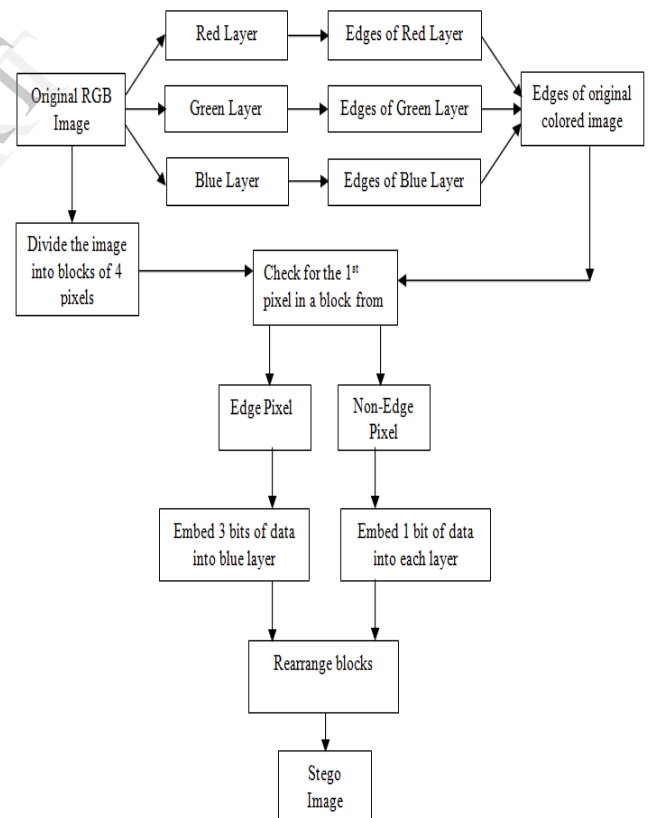6. Hide one bit at LSB of each layer if pixel is non edge.
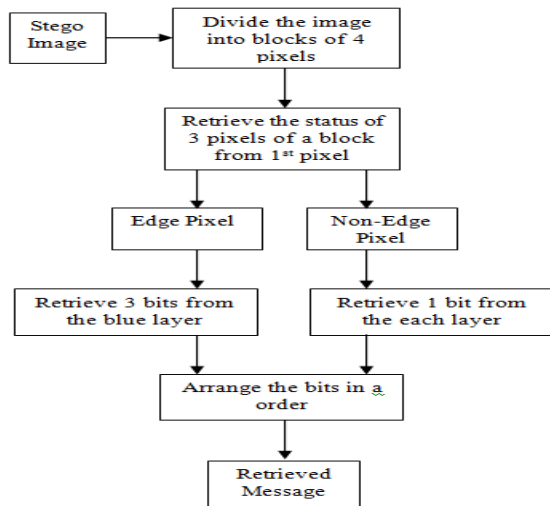

Fig: - 2 Message hiding process

Fig: - 3 Message retrieval process

B. Message Retrieval Algorithm Steps:

1. Read the Image

2. Divide the Image into blocks of four pixels.

3. Read the first pixel of the group and check the status of each pixel.

4. Retrieve three bits from blue component of pixel if it is found edge pixel.

5. Otherwise retrieve one bit from each component of the pixel if it is found non edge pixel.
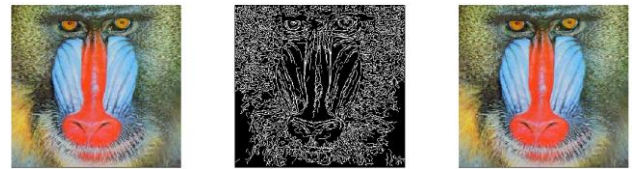
IV. RESULTS

Experimental results using the proposed method are presented in this section. To test the system, images of different sizes to calculate the steganographic capacity and performance. Moreover, to check the steganographic quality, MSE and PSNR are calculated using equation1 and 2. For this purpose different message of different length of characters is embedded in each image as follows:

A1 (Original Image)   A2 (Edges of Image)   A3(Stego Image)

B1 (Original Image)   B2 (Edges of Image)   B3 (Stego Image)

C1 (Original Image)   C2 (Edges of Image)   C3 (Stego Image)

Fig:-3 Message hiding process (Data Length: 792Bytes)

Results for proposed method are shown in table 1.

Table:-1 Proposed method results

Image	Data Length (in bytes)	MSE	PSNR
Lena (512 X 512 X 3)	792	0.0006	79.812
	1702	0.0016	76.181
	2547	0.0031	73.164
Pepper (512 X 512 X 3)	792	0.0015	76.388
	1702	0.0034	72.806
	2547	0.0045	71.567
Baboon (331 X 345 X 3)	792	0.0053	70.870
	1702	0.0135	66.838
	2547	0.0197	65.196

A. Data Payload for proposed Algorithm:

Steganographic capacity is calculated using the following formula:

Max msg length= (No. of rows * No. of columns)/4

For example, we have an image of size 512 X 512 then the msg length can be calculated as:

Max msg length = (512*512)/4 =65536

Capacity= Max msg length* no of bits hide in a block

Capacity=65536*9= 589824bits or 72 kb

Present steganographic algorithm embeds 3 bits in one pixel i.e. one character can be stored per 3 pixels because each character consists of 8 bits.

$$MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} \left[I(i,j) - K(i,j) \right]^2 \quad (1)$$

$$PSNR = 10.Log_{10} \left(\frac{MAX^2}{MSE} \right) \quad (2)$$

Table:-2 Comparisons between proposed method and previous work

Image	Data Length (in bytes)	Previous Work [3]		Proposed method	
		MSE	PSNR	MSE	PSNR
Lena (512 X 512 X 3)	792	1.9044	45.3672	0.0006	79.812
	1702	4.4395	41.6915	0.0016	76.181
	2547	6.4501	40.0692	0.0031	73.164
Pepper (512 X 512 X 3)	792	3.7463	42.4288	0.0015	76.388
	1702	8.0184	39.1239	0.0034	72.806
	2547	12.4848	37.2010	0.0045	71.567
Baboon (331 X 345 X 3)	792	3.3397	42.9277	0.0053	70.870
	1702	6.7508	39.8712	0.0135	66.838
	2547	9.4621	38.4049	0.0197	65.196

V. CONCLUSION

This paper introduced a Block based Steganography Technique which hides the message bits at the edges of the cover image is implemented and analyzed for color images. We have performed test on standard images with different sizes of message data to be hidden. To make the algorithm high data capacity embedding system, the edge pixels from every layer are calculated using canny edge detector. In this technique the image is divided into a block of four pixels, the 1st pixel store the status of the other three pixels and remaining three pixels store the information bits. In the proposed algorithm, to preserve the quality of the stego image it is preferred to hide the data at the edges because by doing so the visual quality of the image is affected less as compared to the other areas in the image. Along with this high steganographic capacity, it offers very good quality in terms of PSNR.

The results of proposed method and First Component Alteration Technique are compared in the Table 2.The proposed method results show that the proposed scheme not only achieves high embedding capacity but also enhances the quality of the stego-image from the HVS by an edge detection technique.

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