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Comparative Analysis of Efficient Image Steganographic Technique with the 2-bit LSB Algorithm for Color Images

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Abstract: Steganography is the process of embedding data bits on carrier or cover file. If the carrier file is an image file, then it is called as image steganography. In this proposed method, an image steganographic technique is applied on only red and green planes of 2-bit LSB and also the experimental results are compared with the general two bit LSB (i.e., red, green, blue planes) algorithm. We observed our proposed algorithm is giving best results in terms of quality of the stego image.

Keywords: LSB algorithm, red-green-blue planes, Image Steganography, Spatial Domain.

I. INTRODUCTION

Steganography is a process of sending information on a carrier or cover image. Image steganography refers to sending data bits on an image as carrier file. Image steganography is basically divided into two categories. After stuffing data bits on a carrier/cover image, it is called as stego image. The efficiency of any steganographic algorithm is depending on the level of distortion between carrier image and stego image and also the data stuffing capacity. The best image steganographic algorithm exhibits less distortion and more bit stuffing capacity. Spatial domain image steganography: The data bits will be stuffed in the carrier image file directly.

Transform domain image steganography: The data bits will be stuffed into transform coefficients of the bits in the carrier image file. After stuffing the bits, it will be converted back to the spatial domain.

II. PROPOSED METHOD

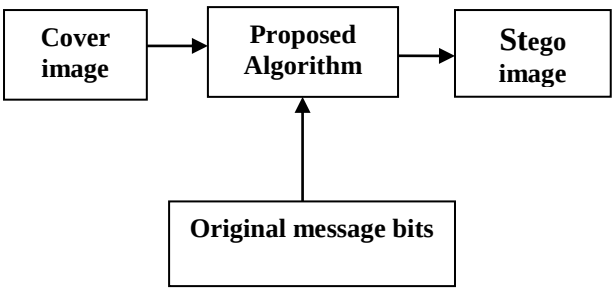

Fig. 1. Proposed image steganographic algorithm

We proposed an algorithm for embedding the original message bits in the spatial domain of the carrier color image without much distortion in the quality of the color image. Hence this technique is called "efficient color image steganographic technique in spatial domain". Here in this proposed method, original data bits are stuffed into the red and blue planes of LSB pixel position excluding green plane.

If we exclude the green plane, we can find remarkable quality in the stego image, the algorithm works as follows:

- Read a cover image which is a color image.
- Resize that color image using resize() as two dimension matrix with the size [500,500].
- Display the cover image.
- Read the three planes RGB into three different variables, these will be converted into matrices by using double ().
- Read the original message bits from any input data file.
- Read the red and blue plane pixel values into variables.
- These values will be converted into binary.
- Stuff 2-bits of original data bits into 2 LSB positions of pixels of red and blue planes, hence we can embed 4bits/ pixel data.
- Now whole matrix is converted back to an image using uint8() function.
- Find the PSNR value and mean square error rate (MSE) for stego image with following formulae to evaluate quality of the image.

$$PSNR = 10 \log_{10} \frac{\text{max possible pixel values of an image}}{MSE}$$

- Display the cover image and stego image along with the PSNR value, MSE.

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III. EXPERIMENTAL RESULTS

We considered 10 images from standard database with URL:sipi.usc.edu/database/. For all 10 images we applied 2-bit LSB algorithm for with green plane and without green plane (for comparison study) and also calculated the PSNR and MSE values for all the images.

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.7671
MSE=1.723338

Stego image with green plane

PSNR=22.8834
MSE=334.7652

Fig. 2 img1

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9129
MSE=1.666443

Stego image with green plane

PSNR=17.6936
MSE=1105.911

Fig. 3 img2

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9159
MSE=1.665292

Stego image with green plane

PSNR=14.3305
MSE=2399.001

Fig. 4 img3

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9058
MSE=1.669169

Stego image with green plane

PSNR=27.6763
MSE=111.0326

Fig. 5 img 4

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9642
MSE=1.646874

Stego image with green plane

PSNR=20.071
MSE=639.7059

Fig. 6 img5

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9136
MSE=1.666174

Stego image with green plane

PSNR=21.8301
MSE=426.6486

Fig. 7 img6

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.8982
MSE=1.672093

Stego image with green plane

PSNR=14.5837
MSE=2263.134

Fig. 8 img7

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9019
MSE=1.670669

Stego image with green plane

PSNR=21.7688
MSE=432.7134

Fig. 9 Img8

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Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9276
MSE=1.660812

Stego image with green plane

PSNR=23.1083
MSE=317.8706

Fig. 10 Img9

Cover image

(Proposed method)
Stego image without green plane

PSNR=45.9017
MSE=1.670746

Stego image with green plane

PSNR=20.4248
MSE=589.6582

Fig. 11 Img10

TABLE I
COMPARATIVE ANALYSIS OF PROPOSED METHOD WITH 2-BIT LSB-RGB

Image Name	Proposed method (2-bit LSB-RED and BLUE only)			2-bit LSB-RGB (all planes)		
	PSNR	CAPACITY	MSE	PSNR	CAPACITY	MSE
img1	45.7671	1000000	1.723338	22.8834	1500000	334.7652
img2	45.9129	1000000	1.666443	17.6936	1500000	1105.911
img3	45.9159	1000000	1.665292	14.3305	1500000	2399.001
img4	45.9058	1000000	1.669169	27.6763	1500000	111.0326
img5	45.9642	1000000	1.646874	20.071	1500000	639.7059
img6	45.9136	1000000	1.666174	21.8301	1500000	426.6486
img7	45.8982	1000000	1.672093	14.5837	1500000	2263.134
img8	45.9019	1000000	1.670669	21.7688	1500000	432.7134
img9	45.9017	1000000	1.670746	20.4248	1500000	589.6582
img10	45.9276	1000000	1.660812	23.1083	1500000	317.8706

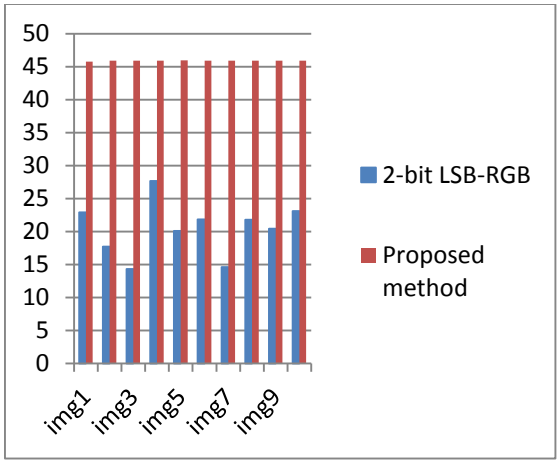

Fig. 12 PSNR Values Comparison chart

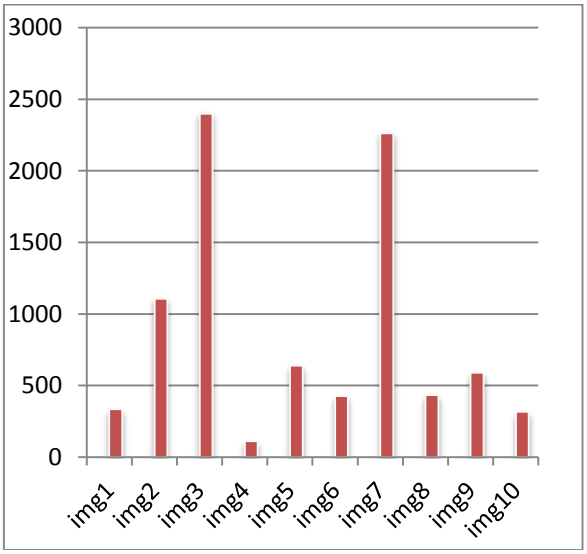

Fig. 13 MSE Values Comparison chart

IV. CONCLUSION

As per the experimental results, it is observed that the proposed algorithm will be providing high embedding capacity with very low distortion. The following demonstration will be providing the efficiency of the proposed algorithm in terms of quality of an image and embedding capacity.

A. Quality of Image:
In 2-bit LSB (RGB), the image quality is not good, because the PSNR values for various images are ranging from 14.3305, which is not at all acceptable (PSNR value must be at least greater than 20). In our proposed method (2-bit LSB with Red and blue planes only), the PSNR values for various stego images are >45, which gives high quality of images.

B. Embedding capacity of bits:
In 2-bit LSB (RGB):-
6-bits/pixel*500*500=15, 00,000 bits
In proposed method:-
Bits/plane*2 planes*500*500 =10, 00,000 bits

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With RGB, 15, 00,000 bits can be stuffed in stego image, but quality of the stego image is completely distorted, hence our proposed method will be stuffing 10, 00,000 with high quality of stego image.

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