

Implementation of Effective , Robust and BPCS Data Embedding using LSB innovative Steganography Method

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Abstract

Data hiding is most sensitive and secure process. LSB (Least significant Bit) is one of the more easy and secure tech for data hiding. Here Image, Text and audio are the medium used to hide . LSB method stores or embeds large amount of data .Using LSB for various formats of images , different text sizes and different .wav files data is hided successfully without any loss of information. Every time PSNR and MSE checks quality measure and indicate the image quality. RGB three bit planes contains hidden information which is more secure. Calculating Compression Factor is very much helpful for deciding similarity factor using quality factor. Hided information in each bit plane is fluently expressed in this paper.

Keywords:- Least Significant Bit(LSB), Peak Signal and Noise Ratio (PSNR), Mean Squared Error (MSE), BPCS (Bits Plane Complexity Segmentation).CR(Compression Ratio), SF (Similarity Factor), SNR (Signal Noise Ratio)

1.INTRODUCTION

The word steganography derived from two Greek words: steganos means covered and graphos means writing and often refers to secret writing or data hiding.[3] . Basically the Information which is used for data hiding is in the form of Text, B/W Image, Color Image, Audio or Video.

LSB (Least-Significant Bit) tech is one the very simple, popular and efficient tech for stegnography. [3]. LSB is the bit that when flipped from 0 to 1 or 1 to 0 , then no significant change will occur in the total value. It's the bit on the rightmost , that when flipped the value will be only affected by 1 to be 120 instead of 121 .

A color image is typically represented by a bit depth ranging from 8 to 24 or higher. With a 24-bit image, the bits are often divided into three groupings: 8 for red, 8 for green, and 8 for blue. Combinations of those bits are used to represent other colors. A 24-bit image offers 16.7 million (2^{24}) color values. Increasingly scanners are capturing 10 bit.

This process of selection of pixel is done as user's choice he may choose pixel continuous or alternate or at a fixed distance. Insert the data values in pixels eg. For example a grid for 3 pixels of a 24-bit image

10010101 00001101 11001001 10010110
00001111 11001011 10011111 00010000

The letter 'G' is the ASCII (American Standard Code for Information Interchange) standard recorded as a binary string 01000111. These 8 bits are written to the position of the least important bits in the original set of bytes:

10010100 00001101 11001000 10010110
00001110 11001011 10011111 00010001 [1]

Each RGB component is determined by a series of 8 bits, so the value of the intensity of each of the three colors can range from 0 to 255. Since the RGB system contains three components, this method of presentation, we get the 24-bit scheme which supports 16,777,216 unique colors[5]

Least Significant Bit is very popular ,simple and common approach for stegnography. To the human eye the stego image will look identical to the carrier image.. For hiding information inside the images, the LSB (Least Significant Byte) method is usually used. To a computer an image file is simply a file that shows different colors and intensities of light on different areas of an image. The best type of image file to hide information inside is a 24 Bit BMP (Bitmap) image. When an image is of high quality and resolution it is easier to hide information inside image. Although 24 Bit images are best for hiding information due to their size. Some people may choose 8 Bit BMP or possibly another image format such as GIF [2]. Here we are try to using small size images which can help to transfer through internet. The least significant bit i.e. the eighth bit is used to change to a bit of the secret message.[2]

Proposed algorithm of LSB for 8 bit as well as 24 bit color images is implemented. In this algorithm all types of Image format JPG, BMP, PNG and TIFF used for 8 bit as well as 24 bit. Improved results are got for 24 bit color images.

Proposed LSB Algorithm (1)

- 1.Divide cover Image into 3 planes RED,BLUE and GREEN
2. Modify Binary value of 255 (is 11111111)
- 3.For RED color make LSB value to 0 , Multiply RED plane by 254, that changes 8th bit of secret image to 0
- 4.For GREEN color make 2 LSB value to 0 , Multiply GREEN plane by 252, that changes 7th and 8th bit of secret image to 0

5. For BLUE color make 3 LSB value to 0, Multiply BLUE plane by 248, that changes 3rd, 4th and 5th bit of secret image to 0.

Fig 1 to 3 represents various formats of images which hides images.

Table : 1

Type of Cover and Stego Image	Histogram Difference	MSE	PSNR
8 bit color for red plane 254 and bit replacement=4	0.04699971	0.2183128	54.7740073
8 bit color for red plane 254 and bit replacement=1	0.38686590	0.3149319	53.1826328
8 bit color for Blue plane 248 and bit replacement=3	0.06543780	0.254467	54.1064406
24 bit color for red plane 254 and bit replacement=1	0.33396316	0.3793263	52.3746696
24 bit color for green plane 252 and bit replacement=2	0.14530233	0.2711442	53.8327954
24 bit color for red plane 254 and bit replacement=3	0.06607367	0.2218134	54.7049220
24 bit color for blue plane 248 and bit replacement=2	0.06623785	0.27114	53.8327897

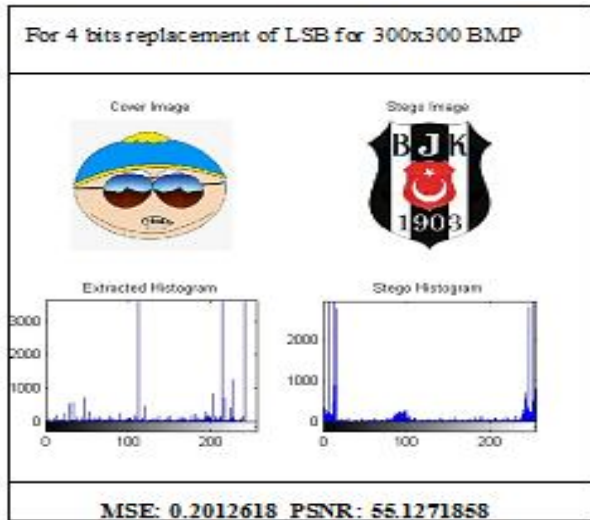


Figure : 1

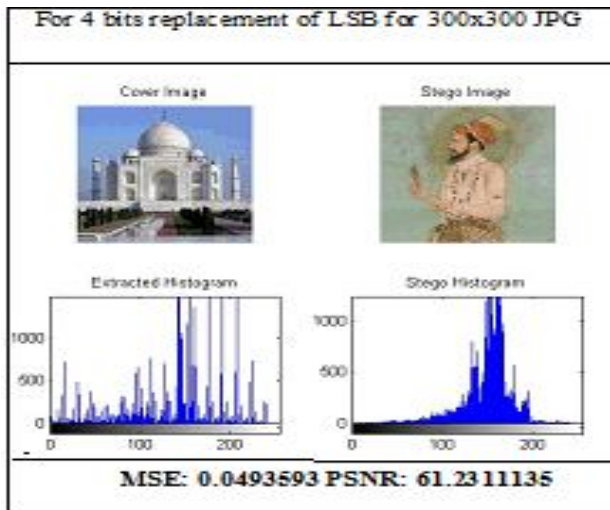


Figure : 2

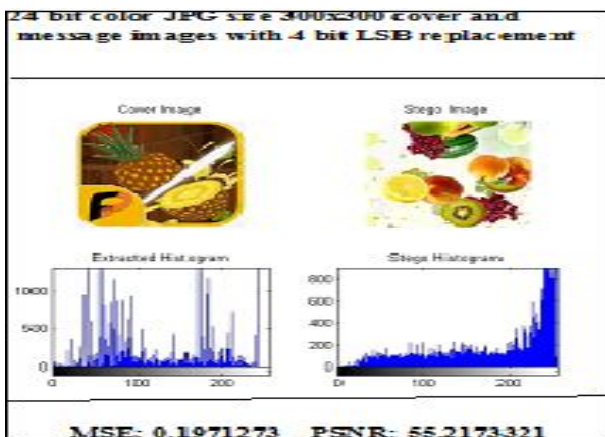


Figure : 3

As per the study of LSB tech for data hiding or to embed secret message (image) in cover image on an average half of the bits will need to be modified a secret image using maximum cover size. There are 256 possible combinations for each colors. The human eye cannot detect these changes, and secret message successfully embedded. [4]

Selection criteria of image in LSB replacement are to select 8 bit image because in this image the bit replacement is 1 only. While in 24 bit image there is three combinations of 8 bit pixels for RGB therefore for the replacement of LSB 3 bits are selected. So it requires large space. [6]

Stegnography this is one of the best solution for finding the pixels present in cover and stego images. As we see in the results above for 8 bit as well as 24 bit color images, the RED, GREEN and BLUE pixels are distributed in images as in each pixel. Following histograms shows list of pixels which are compulsory present as (RGB) in each histogram.

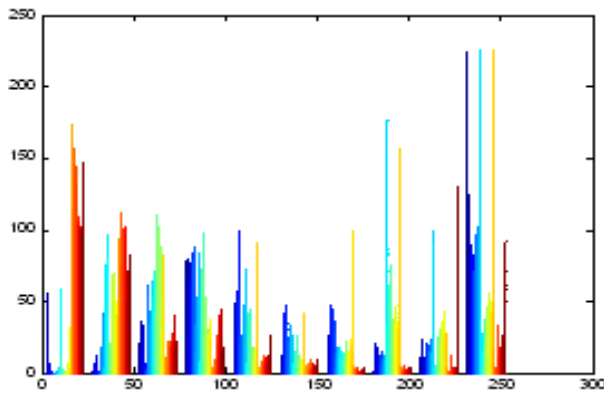


Fig. 4: Cover Image (24 bit)

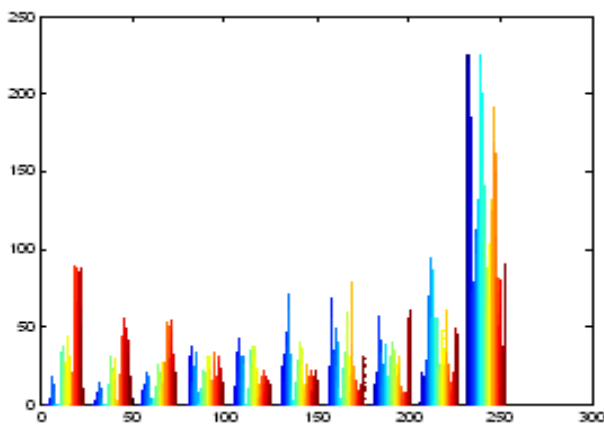


fig. 5 Stego Image (24 bit)

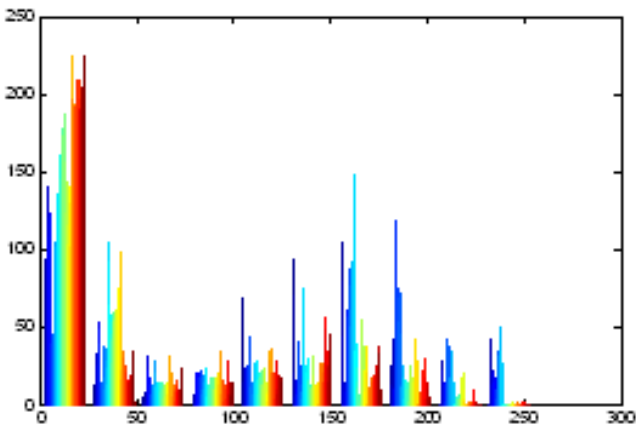


Fig. 6 Cover Image (8 bit)

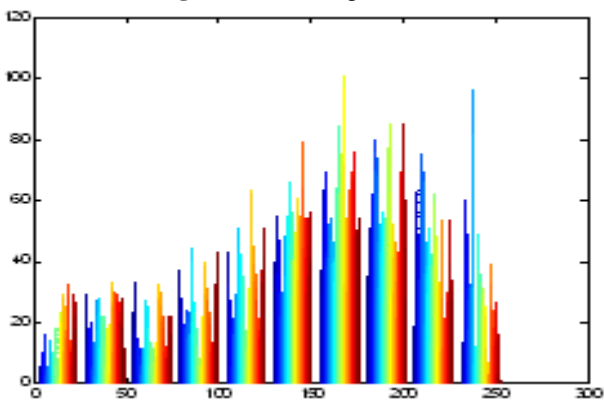


Fig. 7 Stego Image(8 bit)

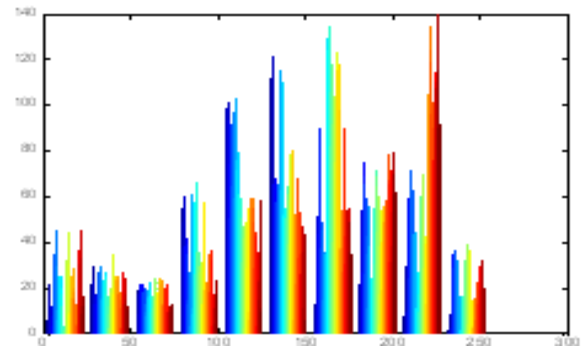


Fig. 8 Cover Image of Taj.jpg

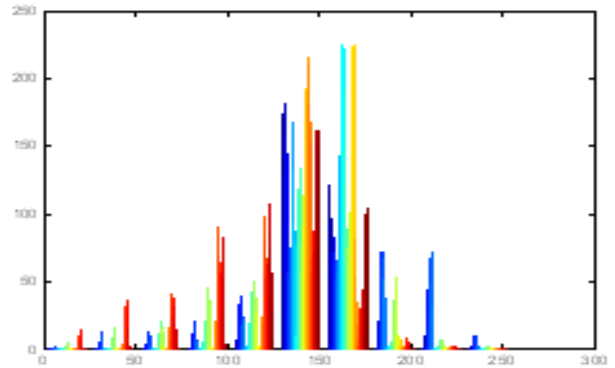


Fig. 9 Stego Image

This algorithm test LSB up to 7 th bit . If we test LSB value 1 to 7 for replacement of bits there are some changes occurs in the image pixel matrix. These changes are tested for all types of images for LSB 1 to 8 bit.

Table : 2

Type of Images	LSB	MSE	PSNR
JPG (for Taj.JPG and Shah.jpg)	1	0.8021	59.1219976
	2	0.05827	60.5099585
	3	0.05283	60.9336340
	4	0.05005	61.1702083
	5	0.04957	61.2117716
	6	0.04766	61.3827090
	7	0.04807	61.3457630
	8	0.0000074	99.4513166
JPG (Two 8 bit JPG)	1	0.3149	53.1826328
	2	0.2848	53.6184726
	3	0.2543	54.1064406
	4	0.2183	54.7740012
	5	0.1922	55.3231898
	6	0.1571	56.2024341
	7	0.11023	57.7416387
	8	0.0000068	99.8702494
JPG (Two 24 bit JPG)	1	0.3793	52.3746696
	2	0.2711	53.8327954
	3	0.2218	54.7049220
	4	0.1971	55.2173321
	5	0.17209	55.8070548
	6	0.1312	56.9843113
	7	0.06509	60.0292938
	8	0.0000083	98.9679336
JPG (Both are same images)	1	0.05754	60.5647150
	2	0.02228	64.6847971
	3	0.00469	71.4443801
	4	0.00123	77.2453173
	5	0.00129	77.0284120
	6	0.00331	72.9540405
	7	0.02539	64.1173782
	8	0.0000076	99.3452370
Average		0.12052077	66.18926648

The LSB have been used to conceal the data in the image. The LSB insertion varies according to the number of bits in an image. For 24-bit image the colors red, green and blue have been changed. For an 8-bit image, the eighth bit of the each image is changed to the bit of secret message.[8]

In the above case of LSB implementation each LSB bit is tested and result is generated with the help of quality measures MSE and PSNR. By using the same algorithm for dynamic bit replacement from 8 bit the following table 3 shows various result for the pair of any bit.

Table: 3

Bit pair	MSE	PSNR
(1,2)	0.2013	55.1259
(2,3)	0.8150	49.0528
(3,4)	3.1396	43.1964
(4,5)	8.4817	38.8799
(5,6)	11.9394	37.3849
(6,7)	12.0197	37.3658
(7,8)	12.9179	37.0528
Odd pair of Bits		
(1,3)	0.6038	50.3558
(3,5)	7.9391	39.1670
(5,7)	12.2826	37.2718
Even pair of Bits		
(2,4)	2.4043	44.3549
(4,6)	9.0639	38.5919
(6,8)	12.9070	36.0565
Three bits		
(1,3,5)	7.9637	39.1536
(2,4,6)	9.2607	38.4983

BPCS (Bit Plane Complexity Segmentation) steganography:

This traditional technique has limited data hiding capacity and they can hide up to 10 – 15% of the vessel data amount. BPCS steganography makes use of important characteristic that of human vision. In BPCS, the vessel image is divided into “informative region” and “noise-like region” and the secret data is hidden in noise blocks of vessel image without degrading image quality . In LSB technique, data is hidden in last four bits i.e. only in the 4 LSB bits. But in BPCS technique, data is hidden in MSB planes along with the LSB planes provided secret data is hidden in complex region.

The 8-bit image is composed of eight 1-bit plane regions from bit plane ‘0’ (LSB) to bit-plane ‘7’ (MSB). Plane ‘0’ contains all lowest order bits of all pixels in the image while plane ‘7’ contains all higher order bits. Bit plane Slicing is useful for image compression. Complexity of each bit–plane pattern increases monotonically from MSB to LSB [9]

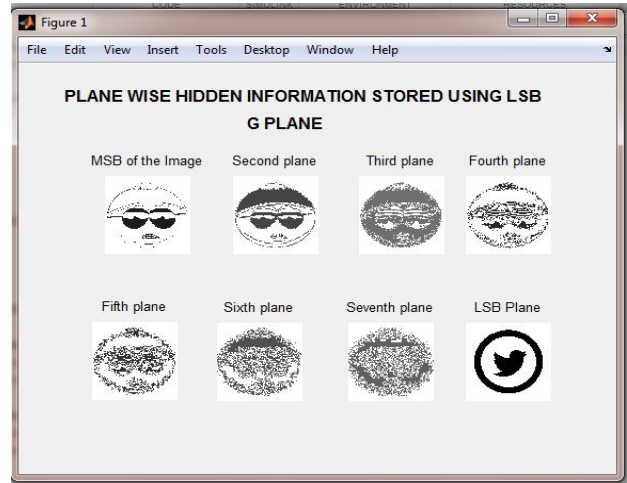


Figure 10 : Extracted Images from RGB plan

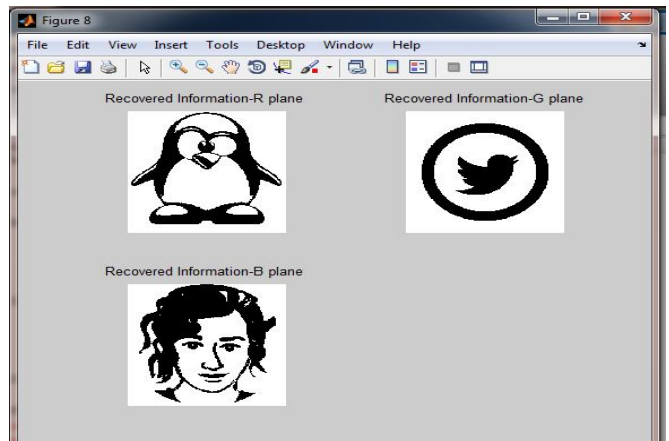


Figure 11: Embedded data in G plane

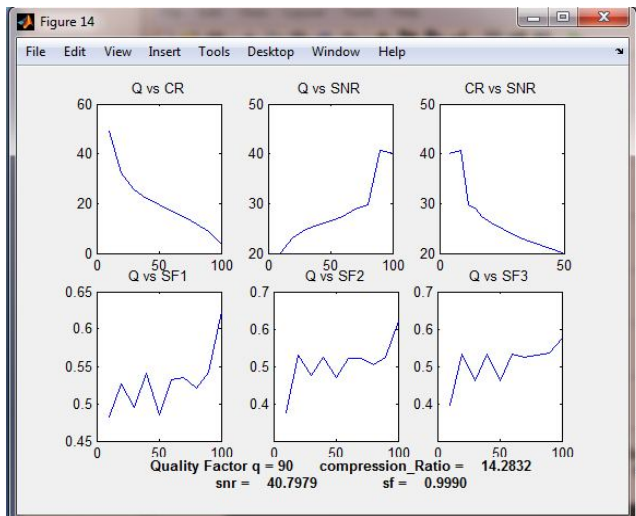
Fig 10 and fig 11 are the results of BCPS implemented algorithm in MATLAB. This algorithm is implemented for 8 bit grayscale images. Three .BMP images having 256X256 dimensions embedded in R,G and B planes using LSB algorithm. In my work with grayscale images the number of bits is eight. A bit-plane refers to all the bits at a single bit position across an image. In LSB Steganography, the least significant bit-planes are manipulated.

Effect of Compression Ratio:

Following table: 3 shows graphical representation based on Quality Factor on Compression Ratio(CR), Signal Noise Ratio(SNR) and Similarity Factor (SF) .

Table : 3

Quality Factor(QF)	Compression Ratio(CR)	Signal Noise Ratio(SNR)	Similarity Factor(SF)
90	14.2832	40.7979	0.9990
80	18.8160	40.1057	0.9988
70	20.8581	38.3750	0.9985
60	25.2178	33.0303	0.9977
10	55.4920	25.1184	0.9935



Graph 1 Shows the effect of QF on CR ,SF and SNR

From above Table : 3 and Graph: 1 as per testing of Quality factor using BCPS as QF increases CR ratio decreases, SNR decreases and SF increases.

2. Conclusion

LSB is the most suitable technique for hiding information in the image. In above implemented algorithms based on LSB indicates the information stored is very secure using the hiding concept of RED,BLUE and GREEN planes for 8 bit and 24 bit color planes. This technique is also used in hiding text in audio file (.wav) without disturbing sound quality. Comparison of quality measurements MSE and PSNR clearly indicates differences in cover and stego images and sound every time.

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PROGRAMMING LANGUAGE MATLAB AS A FUNCTION OF DIGITAL STEGANOGRAPHY TECHNOLOGY pg-1-6

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