International Research Journal of Computer Science (IRJCS)
Issue 03, Volume 5 (March 2018)
ISSN: 2393-9842
www.irjcs.com

A NEW PIXEL SELECTION TECHNIQUE OF LSB BASED STEGANOGRAPHY FOR DATA HIDING

Atanu Sarkar*, Sunil Karforma
Dept. of Computer Science, University of Burdwan, West Bengal, India
atanu.sk@gmail.com; sunilkarforma@yahoo.com

Manuscript History
Number: **IRJCS/RS/Vol.05/Issue03/MRCS10084**
https://doi:/10.26562/IRJCS.2018.MRCS10084
Received: 20, February 2018
Final Correction: 03, March 2018
Final Accepted: 17, March 2018
Published: March 2018
Citation: Atanu & Sunil (2018). A NEW PIXEL SELECTION TECHNIQUE OF LSB BASED STEGANOGRAPHY FOR DATA HIDING. IRJCS:: International Research Journal of Computer Science, Volume V, 120-125. **doi://10.26562/IRJCS.2018.MRCS10084**
Editor: Dr.A.Arul L.S, Chief Editor, IRJCS, AM Publications, India

Abstract - In modern era it is very challenging job that how to secure the data during transaction through internet. The redundancies of digital media as well as the characteristics of human visual system make hiding technology a significant one. Steganography is the art and the science of valuable information in such way that no one, apart from sender and the intended recipients suspect the existence of the messages. Image steganography is the most popular method for message concealment. LSB steganography is one of the methods by which we can hide the valuable data into least significant bit position of cover image pixels. In traditional LSB steganography method pixels are selected from the beginning (upper left corner) of images and successive pixels are selected row wise or column wise. In this paper we have selected middle region as the beginning pixel during embedding processes of secret bit into cover image and embedded the secret bit into the middle region. Then four diagonal pixels of middle region are selected as successive pixels and embed the data into four edges (collection of pixels) of quadrilateral which is created by four diagonal pixels of cover image and finally reach towards the four corners of images. Experimental analysis shows that the proposed algorithm outperforms the existing methods in terms of capacity and security of stego image.
Keywords: Steganography; Image steganography; LSB steganography; middle region; capacity;

I. INTRODUCTION

We need to secure the information which is transacted between sender and receiver through internet from attacks caused by hackers. To maintain confidentiality, integrity and availability of information from unauthorised access, steganographic algorithms may be used. Steganography [1, 2] is one of the popular methods to hide valuable information into the image; text; audio and video.Image Steganography can be achieved in two ways - spatial domain and frequency domain. In spatial domain the valuable information is embedded into the cover image to produce stego image. LSB steganography [3, 4] is a method where one bit of valuable information is directly embedded into least significant bit position of a cover image pixel. In this paper a LSB based technique is proposed in spatial domain. Section 2 deals with brief Literature review. The proposed technique is outlined in Section 3.In subsequent steps result and analysis is shown in section 4 .Conclusions has drawn in section 5.

II. LITRATURE REVIEW

D.C. Wu and W.H. Tsai [5] have proposed a method for hiding the data into images by pixel value differencing (PVD) method. J.K.Mondal et al. [6] has proposed a method for colour image steganography based on pixel value differencing (PVD) in spatial domain. The above two paper [5, 6] embed the information depend on pixel value difference.

So, capacity of stego image depends on pixel value difference of cover image. P. Bhari et al. [8] have proposed a new technique to hide the data using the cryptography and LSB steganography. G.R Manjula and A. Danti [9] have proposed hash based steganography method. Their method embeds total 8 bit (2-3-3) per pixel into the RGB cover images. Last two bit LSB based image steganography has proposed in paper [10].Capacity of embedded data into the cover images can be increased by k bit rightmost LSB method. The paper [11] proposes k bit of secret data is embedded into cover image pixel using LSB technique and then genetic algorithm is applied for pixel value optimization for better visibility of images.The paper [12] has proposed a simple LSB based steganography and optimal pixel adjustment method for better visual quality of image. Fuzzy Neural Network based on pixel optimization is proposed in the paper [13]. All of the optimization based steganography [11, 12] time complexity has increased considerably. Edge based image steganography has been proposed in the paper [14, 15].The secret data is embedded into edges of the cover image. But Edge based steganography reduces the capacity of information into the cover image. All of the papers [5, 6, 7, 8, 10, and 11] have used the left most corner pixel of an image as the beginning pixel for embedding the secret bit of the data into cover images. So, hackers can easily guess the bit position of valuable information from stego image. But our method selects middle region of an image as the beginning pixels for embedding the secret bit. Our proposed method increases the security as well as the capacity of valuable information into the stego image.

III. PROPOSED TECHNIQUE

Every pixels in a colour image composed of three colours i.e. red, green, and blue. So, every pixel contains 24 bit (for 8 bit representation) where 8 bit for red component, 8 bit for green and 8 bit for blue component. Here we embed three bit (one bit each red, green and blue pixel) per pixel.We first select middle region. It is a collection of pixels. We proposed a method for selection of middle region. We consider the four cases depending upon height (row) and width (column) of an image. Height (row) and width (column) may be odd-odd, even-even, odd-even and even -odd. Each case can be further divided into two sub cases depending upon height (row) greater than width (column) orwidth (column) greater than height (row). We select red colour as middle region which is depicted in fig. 2-3

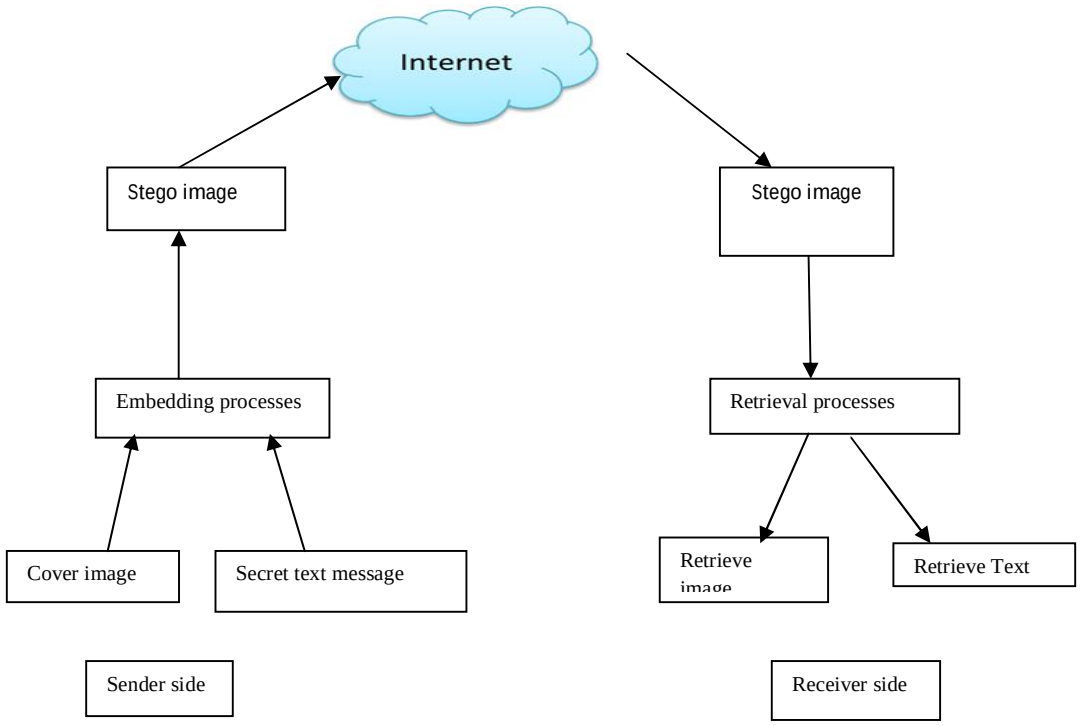

Fig.1 Proposed Model

If height (row) or width (column) is odd then we select single column or single row as a middle region respectively. If height (row) or width (column) is even then we select two columns or two rows as middle region. After selection of middle region we embed the data bit into the middle region. Next we select four diagonal pixel of red region .Here (x1, y1), (x2, y2), (x3, y3) and (x4, y4) are four diagonal pixels. We embed the data bit from (x1, y1) to (x2, y2), (x2, y2) to (x3, y3), (x3, y3) to (x4, y4) and(x4, y4) to (x1, y1).Again we select four diagonal pixels and embed the data bit into the pixels same way. Green and blue region depicts the successive region.

A. Embedding Algorithm

STEP 1: if row > column
N=column
P=row-column
Else
N=row
P=column-row
STEP 2: If N is odd then goto case I otherwise (even) goto case II

Case I:

Start pixel x1=ceil (N/2), y1=ceil (N/2)
If row >= column
End pixel x2=ceil (N/2) +p, y2=N/2
Else
End pixel x2=N/2, y2=ceil (N/2) +p
(Here single row or column will be selected as a middle region)
Embed the secret data into the image using LSB technique from start to end pixel.
Select next four diagonal pixels for start and end pixel (either single row or column).

Case II:

If row >=column
(Here two consecutive column are selected as middle region)
Start pixel x1=N/2, y1=N/2.
Another start pixel x2=N/2, y2=N/2+1
End pixel corresponding to (x1, y1) is x4=N/2+p+1, y4=N/2
End pixel corresponding to (x2, y2) is x3=N/2+p+1, y3=N/2+1
Else
(Here two consecutive rows are selected as middle region)
Start pixel x1=N/2, y1=N/2
Another Start pixel x4=N/2+1, y4=N/2
End pixel corresponding to (x1, y1) is x2=N/2, y2=N/2+p+1
End pixel corresponding to (x4, y4) is x3=N/2+1, y3=N/2+p+1
Embed the secret data into the image using LSB technique from start to end pixel (either consecutive two rows or two columns).
Select next four diagonal pixels for two starts and two end pixel.
STEP 3: Select the pixel that covers four edge of quadrilateral through corners (x1, y1), (x2, y2), (x3, y3) and (x4, y4) clockwise and use LSB technique for embed the data.
STEP 4: increment each four pixel diagonally and goto step 3 until end of row or column is reached or end of secret bits is reached.

B. Retrieval algorithm

Step1: first we select middle region as encryption algorithm and retrieve the secret bits from it.
Step 2: select four diagonal pixels and retrieve the secret bits.
Step 3: process continue until the all the secret bits are retrieve.

C. Examples

Here we consider two examples among eight cases.
From fig. 2 row=5, column=11 and column > row. Single row is selected as middle region. Here pixel counting starts from upper left corner as (1, 1).For red region the start pixel x1=ceil (N/2), y1=ceil (N/2) .N=row i.e. N=5 and x1=3, y1=3.The end pixel is End pixel x2=N/2, y2=ceil (N/2) +p.

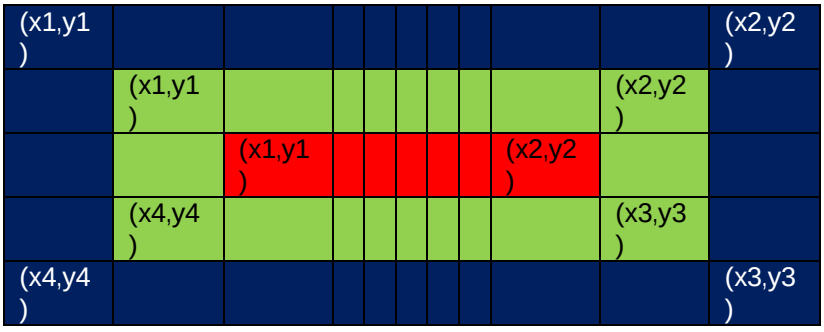

Fig. 2: row=5, column=11 and column > row

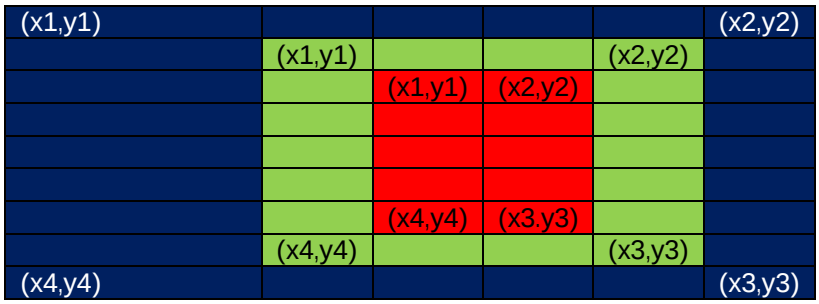

Fig. 3: row=9, column=6 and row>column.

Here p=column-row i.e. p=6 and x2=3, y2=9.Next diagonal pixels are (x1,y1)=(2,2),(x2,y2)=(2,4),(x3,y3)=(3,3) and (x4,y4)=(4,3). From fig 3 row =9 and column=6 and row > column. Here pixel counting starts from upper left corner as (1, 1). Two columns are selected as middle region. Here N=6 and p=3.For red region starts pixels are x1=3, y1=3 and x2=3, y2=4. End pixel corresponding to (x1, y1) is x4=7, y4=3. End pixel corresponding to (x1, y1) is x3=7, y3=4.Next diagonal pixels are (x1,y1)=(2,2),(x2,y2)=(2,4),(x3,y3)=(8,5) and (x4,y4)=(8,2).

IV. RESULT AND ANALYSIS

Extensive analysis has been made on various images using our LSB method. This section represents the results, discussion in terms of visual interpretation, peak signal to noise ratio and histogram analysis. Here we use four bmp images of different size namely Leena, Baboon, Pepper and Tank. Fig 4 shows the host images and corresponding stego images.

$$PSNR=10 \log (\max (I_{m,n}^2)/MSE) \quad \ldots\ldots 1$$

$$MSE=1/M*N\sum (I_{1m,n}- I_{2m,n})^2 \quad \ldots\ldots 2$$

Fig. 4: Cover images and corresponding stego images.

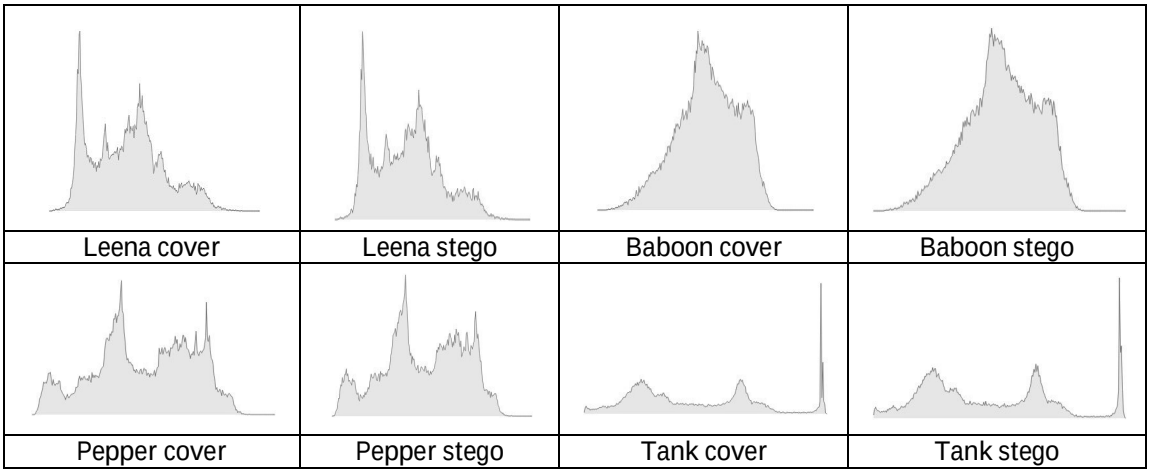

Fig. 5: Luminosity analysis of cover images with stego images.

Fig 5 shows Luminosity histogram of four images. Here we use text as input data to embed into cover images. Table I shows capacity of cover image in byte and PSNR values of various size image. Table II shows capacity (byte) comparison analysis of proposed method with PVD [5] and PVD [6]. From results it is seen that a high capacity of embedding has been achieved in terms of good PSNR.It is also observed that the capacity of stego image is variable from one image to other image of same size in case of PVD [5] and PVD [6] whereas in our proposed method the capacity remains unchanged from one image to other image of same size. Fig 6 shows the 2-D Line curve analysis of PSNR values of PVD [5] and PVD [6] with proposed method.
The equation-1 and equation -2 is used to calculate PSNR and MSE.

TABLE I: CAPACITY, SIZE, AND PSNR VALUES OF IMAGES.

Image Name	Capacity(byte)	Size	PSNR(db)
Leena	100467	185×185	48.13
Baboon	177012	300×200	53.68
Pepper	192027	255×255	48.35
Tank	167400	281×202	48.85

TABLE II: CAPACITY (BYTE) COMPARISION OF PROPOSED METHOD WITH PVD [5] & PVD [6]

Cover image Size 512 × 512	Maximum Capacity (byte) of PVD [5] Method	Maximum Capacity (byte) of PVD [6] Method	Maximum Capacity byte) of Proposed Method
Leena	50960	145787	784432
Baboon	56291	144916	784432
Pepper	50685	145995	784432

TABLE III: PSNR COMPARISION OF PROPOSED METHOD WITH PVD [5] & PVD [6]

Cover image Size 512 × 512	PSNR(dB) values of PVD [5] Method	PSNR(dB) values of PVD [6] Method	PSNR (dB)values of Proposed Method
Leena	41.70	42.26	48.13
Baboon	36.86	38.44	53.68
Pepper	40.55	42.28	48.35

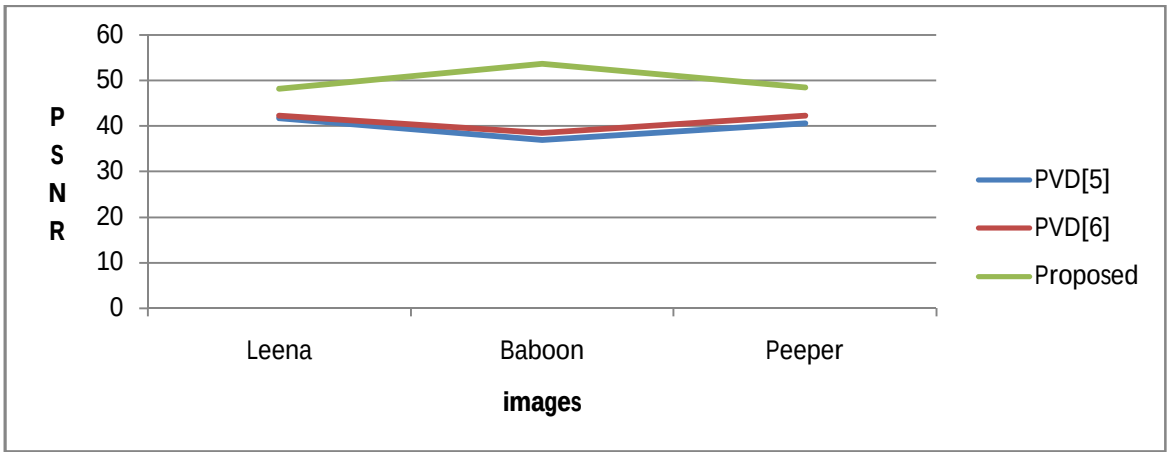

Fig. 6: 2-D Line Curve analysis of PSNR (dB) values of PVD [5] and PVD [6] with proposed method.

V. CONCLUSIONS

This paper proposes a novel and robust embedding technique based on LSB based steganography for colour images. From experimental analysis it is clear that proposed method achieved high PSNR along with good image fidelity for various images. In future the visibility and capacity of images may be further increased by improvement of our proposed method. Our proposed method can be applied on document associated with e-governance, e-commerce, e-learning etc where valuable information is transacted through internet.

REFERENCES:

1. N.Provos, P.Honeyman, “Hide and Seek: An Introduction to Steganography”, IEEE Security and Privacy, Vol. 1, No. 3, 2003, pp. 32–44 .
2. ArvindKumar ,K. M. Pooja , “Steganography a Data Hiding Technique” , International Journal of Computer Applications, Vol-9,No-7,Nov 2010.
3. W. bender, D. gruhl, N. Morimoto, A.Lu, “Techniques for data hiding”, IBM Systems Journal Vol. 35(3-4),pp. 313-336, 1996.

4. Eric Cole, Ronald D. Krutz, Consulting Editor (2003)," Hiding in Plain Sight, Steganography and the Art of Covert Communication", Wiley Publishing, Inc.
5. D.C. Wu, and W.H. Tsai, "A Steganographic method for images by pixel-value differencing", Pattern Recognition Letters, Vol. 24, pp. 1613-1626, 2003.
6. J. K. Mandal ,Debashis Das, "Colour Image Steganography Based on Pixel Value Differencing in Spatial Domain", International Journal of Information Sciences and Techniques (IJIST) Vol.2, No.4, July 2012.
7. H.C. Wu, N.I. Wu, C.S. Tsai , M.S. Hwang, "Image Steganographic Scheme Based on Pixel Value Differencing and LSB Replacement Method", IEEE Proceedings on Vision, Image and Signal processing, Vol. 152, No. 5,pp. 611-615, 2005.
8. P.Bharti,R.Soni,"A new approach of data hiding in images using cryptography and Steganography", IJOCA (0975-8887),vol. 58,no. 8,Nov 2012.
9. G.R. Manjula , AjitDanti"A novel hash based LSB (2-3-3) image steganography in spatial domain", International Journal of Security, Privacy and Trust Management (IJSPTM) Vol. 4, No 1, February 2015 .
10. Ali Akbar Nikoukar, "An Image Steganography Method with High Hiding Capacity Based on RGB Image", International Journal of Signal and Image Processing, Vol. 1,Iss.4, pp. 238-241,2010.
11. Ran Zan Wang, Chi Fang Lib, Ja Chen Lin, "Image hiding by optimal LSB substitution and Genetic algorithm", Pattern Recognition Society. Published by Elsevier Science Ltd., pp.671-683, 2001.
12. Chi-Kwong Chan et al "Hiding data in images by simple LSB Substitution", pattern recognition, ELSEVIER, Vol. 37, Iss. 3, pp. 469-474 , Mar 2014.
13. A.Saleema, Dr.T.Amarunnishad , " A New Steganography Algorithm Using Hybrid Fuzzy Neural Networks" , International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST- 2015), ELSEVIER,Procedia Technology(24),pp.1566-1574,2016.
14. Mrs.Sivaranjani ,Ms. Semi Sara mani, "Edge Adaptive Image Steganography BasedOn LSB Matching Revisited",Journal of Computer Applications (JCA),ISSN: 0974-1925, Vol 4, Iss.1, 2011.
15. Nitin Jain, Sachin Meshram, ShikhaDubey," Image Steganography Using LSB and Edge Detection Technique", International Journal of Soft Computing and Engineering (IJSCE),ISSN: 2231-2307, Vol.2, Iss.3, July 2012

