LSB Based Steganography Model for Medical Images

Sachin

Research Scholar, Department of CSE,

U.I.E.T, M.D.U, Rohak, Haryana, India

***Abstract*:-**This paper presents a steganographic model in medical system using LSB method. The LSB scheme takes the first LSB bit of the gray scale image and first message bit from the message matrix (Patient information) and embeds the message into the original image. After insertion of first message bit, pixel location of image and message is incremented by one. This process continuous itself till the message length is not equal to zero. Different medical images are taken for experimental result. Image is passed from one doctor to another after embedding their respective prescription in it. The experiment is performed on the seven medical images and the result is obtained.

Keywords: *LSB; PSNR; MSE; SSIM; MEDICAL IMAGING.*

*****

1. INTRODUCTION AND LITERATURE REVIEW

In modern era of communication security of message is a major concern. Achieving security leads anyone in two domains either steganography or cryptography. The prior technique is related to hiding of data while latter one uses scrambling of data [1,18,19]. Steganography uses some cover media like images to hide information (I) called Host image (H) and resultant image called Stego-image (S) i.e S= H+I. Present techniques in steganography are spatial domain and Transform domain wherein first one works over gray levels directly whereas other one transform host image from spatial domain to transform domain and information is concealed by changing image- coefficient. Popularly known technique in spatial domain such as PIT (pixel indicator technique) [2, 3], edges based embedding techniques [4, 5] while popularly known techniques in transform domain techniques such as discrete cosine transform technique [6, 7] and discrete wavelet transform technique [8]. Application domain of image steganography like medical imaging, watermarking, innocipher, GSI and so on; medical imaging is related to hiding information about patients in medical images such as CT scans, MRIs, Ultrasounds, X-Rays or in other modalities while watermarking for copyright reservation. In spatial domain, Joshi et al. [9,15,16,17] proposed a number of techniques based on LSB approach. W.Puech [10] proposed an algorithm that can be applied to images, videos and 3D objects for data hiding watermarking, encryption and compression. Al-Dmour and Al-Ani [11] proposed a technique that used Otsu's method in which host image is divided into two blocks namely ROI (Region of Interest) and RONI (Region of Non Interest). Based on Binary Pixel Intensity (BPI) ROI pixels are encased in rectangular shape and for enhancing security high frequency sub bands are used in which Electronic Patient Record (EPR) is embedded. Jain and lenka [12] provide an efficient method in image steganography in biomedical field. In this queue data structure is used for communication and message is first encrypted using Rabin Cryptosystem and results in many blocks and sub-blocks which are distributed equally. In this method, the receiver has four different values for plain text corresponding to one cipher text so that only authorized receiver can recognize the correct medical data. The diagonal queues are used for storing the different images of brain disease. J. Liu et al. [13] proposed a method in which confidentiality is maintained by steganography approach in medical images. In this, a host image is transformed into 1-D pixels sequence using Hilbert filling curve and further divided into non-overlapping groups of 3 pixels in each. Now embedding of data is based on APPM (adaptive pixel pair match) method. In which pixel value differences (PVD) of 3 pixels is taken out and data is embedded in those pixel ternaries causing minimal

ISSN: 2454-4248
446 – 451

distortion and results show better privacy protection than previous steganography methods. Rao and kumari [14] investigated; Medical image watermarking has been widely known for increasing data security, authenticity and content justification in e-health education where medical images are used over network. Figure 1 shows the block diagram of the proposed model.

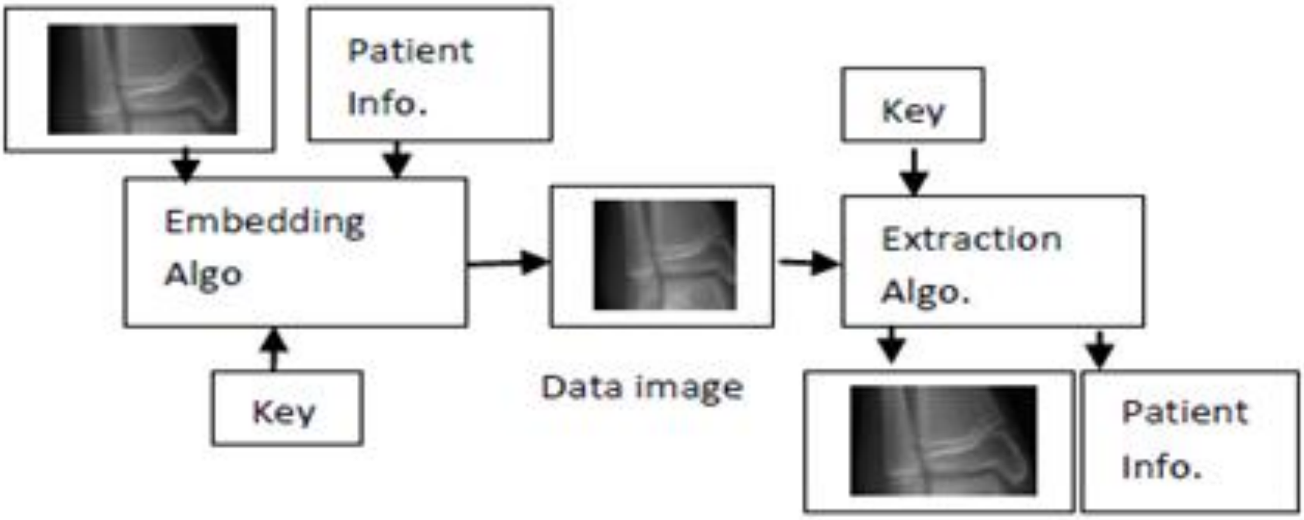


Figure 1; Block diagram of the proposed model

2. PROPOSED TECHNIQUE

Procedure starts from very first pixel (m_{oo}) of cover image i.e M = {m_{xy} | 0<=x<R, 0<=y<C} where m_{xy} represent a pixel of cover –image. Different pieces of information are added in Host image 'M' as prescriptions using Least Significant Bit (LSB) and each piece of information (D) can be represented as D = {d_Z | 0<=z< l , d_z □{0,1}}. From the very outset, insertion algorithm checks if length (L) of prescribed information i.e L < R*C where R is number of rows and C is number of column of cover media. If yes, then procedure continuous to embed information bits using LSB technique in cover media such that nxy = m_{xy}+d_z and f(x, y) = f(x,y) + 1 here pixel location can be represented by f(x,y), where x and y shows corresponding row number and column number of particular pixel in host image. On exhausting length 'L' prescription, if there exist anymore prescription of length (L_i) then procedure validates L_i < R*C- L. If yes, then insertion procedure is continued again just after next pixel location where last insertion is ended up. It continues until numbers of pixels in cover-media or doctor's prescriptions are over. At the end of this procedure we get resultant stego image (N) such that N = {n_{xy} | n_{xy} = m_{xy} + d_z, n_{xy} □ {0, 1} } as shown in following flow chart.

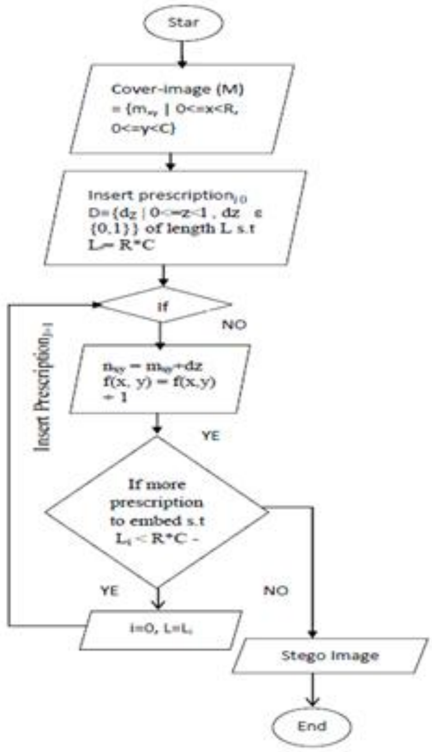


Figure 2; Flow Chart of Proposed Model

Figure 3 shows the original and the embedded information images having prescriptions from different doctors' .Table I, II and III showing the MSE, PSNR and SSIM of cover and Stego images using the GLM method.

3. IMAGE METRICS

PSNR (Peak Signal to Noise Ratio) and MSE (Mean Square Error) are taken for the performance measurement of the gray level modification method. Both are inversely proportional to each other. The value of PSNR increases when two images are close to each other whereas the value of MSE decreases when the two images are similar to each other. The PSNR is evaluated in decibels and is inversely proportional the MSE [20, 22, 23]. It is specified by the equation:

$$PSNR = 10\log_{10}\left[\frac{I^2}{MSE}\right] \quad (1)$$

$$MSE = \frac{1}{[R\times C]^2}\sum_{i=1}^{N}\sum_{j=1}^{M}\left(H_{ij} - S_{ij}\right)^2 \quad (2)$$

Where I denotes the dynamic range of pixel values, or the maximum value that a pixel can have for 8 bit image: I=255.

R and C are the dimensions of the cover and the image having information. H_{ij} and S_{ij} are the intensity of pixels in cover and the image embedding information. Structure SIMilarity Index (SSIM) is a method for measuring the similarity between two images. The SSIM index can be viewed as a quality measure of one of the images being compared provided the other image is regarded as of perfect quality. σ_x, σ_y, σ_{xy}, μ_y, and μ_x refer to some local parameters that are related to statistics.

$$SSIM(C,S) = \frac{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)}{(\mu_x^2 + \mu_y^2 + C_1)(\sigma_x^2 + \sigma_y^2 + C_2)} \quad (3)$$

4. RESULTS

Image name	PSNR	MSE	SSID
Image 1	65.36	0.006	0.9848
Image 2	66.89	0.005	0.9799
Image 3	64.29	0.007	0.9993
Image 4	66.54	0.006	0.9754
Image 5	65.23	0.007	0.9692
Image 6	64.28	0.005	0.9869
Image 7	64.27	0.006	0.9823

 ISSN: 2454-4248
446 – 451

Table I PSNR, MSE and SSID of Stego image 1 concealing data size 1Kb

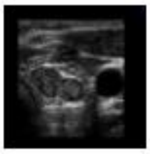
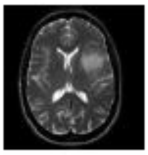
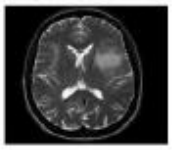
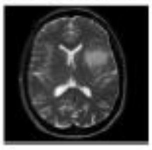
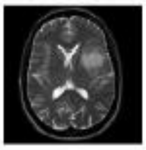
Name/Size	Host images	Doctor 1 prescription of data size 1Kb	Doctor 2 prescription of data size 2Kb	Doctor 3 prescription of data size 4Kb
		Stego image 1	Stego image 2	Stego image 3
1 (256*256)				
2 (256*256)				
3 (256*256)				
4 (225*224)				
5 (256*256)				
6 (256*256)				
7 (269*187)				

Figure 3; shows the (1) Different host images in first column (2) Doctor 1 prescription of data size 1Kb in second column (3) Doctor 2 prescription of data size 2Kb in third column (4) Doctor 3 prescription of data size 4Kb in fourth column.

Table II PSNR, MSE and SSID of Stego image 2 concealing data size 2Kb

Image name	PSNR	MSE	SSID
Image 1	63.45	0.011	0.9696
Image 2	61.78	0.013	0.9795
Image 3	62.96	0.012	0.9794
Image 4	62.24	0.014	0.9898
Image 5	61.57	0.013	0.9693
Image 6	63.24	0.011	0.9791
Image 7	61.88	0.014	0.9692

Table III PSNR, MSE and SSID of Stego image 3 concealing data size 4Kb

Image name	PSNR	MSE	SSID
Image 1	60.54	0.016	0.9581
Image 2	59.36	0.015	0.9595
Image 3	59.56	0.017	0.9693
Image 4	59.45	0.016	0.9794
Image 5	58.78	0.017	0.9496
Image 6	58.95	0.016	0.9497
Image 7	58.69	0.015	0.9398

CONCLUSION

In this paper, the proposed steganographic model was tested on seven different medical images. These medical images were shown to the different person for analyzing the change between original and the image having information. And the results show that when we use Least Significant Method, the imperceptibility of the medical images is not affected as the change in the image pixel is minute. This change does not identify by the normal HVS (Human Visualization System). These seven images were also tested on the PSNR and MSE and obtained good results as shown in the above tables. This model may decrease the paper work in medical system and may also be used in other areas like Geographical Information System in satellite imaging etc.

6. REFERENCES

[1] S. Allawadhi, S.Dhingra, “Steganography Techniques: A Survey” International Journal of Latest Trends in Engineering and Technology, pp 258-263, Vol. 8, 2017.

[2] [Gutub, A. A. A. (2010). Pixel indicator technique for RGB image steganography. Journal of Emerging Technologies in Web Intelligence, 2(1), 56–64. http://doi.org/10.4304/jetwi.2.1.56-64

[3] Liang, G. L., Wang, S. Z., & Zhang, X. P. (2007). Steganography in binary image by checking data-carrying eligibility of boundary pixels. Journal of Shanghai University, 11(3), 272–277. http://doi.org/10.1007/s11741-007-0317-2

[4] Pal, A., & Pramanik, T. (2013). Design of an Edge Detection Based Image Steganography with High Embedding Capacity. Quality, Reliability, Security and Robustness 794–800. Retrieved from http://link.springer.com/chapter/10.1007/978-3-642-37949-9_69

[5] Modi, M. R., Islam, S., & Gupta, P. (2013). Edge based steganography on colored images. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 7995 LNCS, 593–600. http://doi.org/10.1007/978-3-642-39479-9_69

[6] Jia-Fa, M., Xin-Xin, N., Gang, X., Wei-Guo, S., & Na-Na, Z. (2015). A steganalysis method in the DCT domain. Multimedia Tools and Applications, (180). http://doi.org/10.1007/s11042-015-2708-0

[7] M.M., S., G., S., & S.H., S. (2015). Detection of rapid eye movement behaviour disorder using short time frequency analysis of PSD approach applied on EEG signal (ROC-LOC). Biomedical Research (India), 26(3), 587–593.

[8] Chen, P., & Lin, H. (2006). A DWT Based Approach for Image Steganography, (4), 275–290.

[9] [9] K. Joshi and R.Yadav, "New Approach toward Data Hiding Using XOR for Image Steganography" in the proceedings of IEEE, International Conference on Contemporary Computing (IC3), Pages: 1 – 6, Dec 2016

[10] Puech, W. (2008). Image encryption and compression for medical image security. 2008 1st International Workshops on Image Processing Theory, Tools and Applications, IPTA 2008, 1–3. http://doi.org/10.1109/IPTA.2008.4743800

[11] [11] Al-Dmour(B) and Al-Ani, A Medical Image Steganography Method Based on Integer Wavelet Transform and Overlapping Edge Detection, ICONIP 2015, Part IV, LNCS 9492, pp. 436–444, 2015. DOI: 10.1007/978-3-319-26561-2 52

[12] [12] Jain, M., & Lenka, S. K. (2016). Diagonal queue medical image steganography with Rabin cryptosystem. Brain Informatics, 3(1), 39–51. http://doi.org/10.1007/s40708-016-0032-8

[13] [13] Liu, J., Tang, G., & Sun, Y. (2013). A secure steganography for privacy protection in healthcare system. Journal of Medical Systems, 37(2). http://doi.org/10.1007/s10916-012-9918-z

[14] Rao, N. V., & Kumari, V. M. (2011). Watermarking in Medical Imaging for Security and Authentication. Information Security Journal: A Global Perspective, 20(3), 148–155. http://doi.org/10.1080/19393555.2011.561154Bowman, M., Debray, S. K., and Peterson, L. L. 1993. Reasoning about naming systems.

[15] K. Joshi, R. Yadav, S.Allwadhi, "Exploration of Least Significant Bit Based Watermarking and its Robustness against Salt and Pepper Noise" in Journal of World Academy of Science Engineering and Technology (WASET), Vol 10, No 7, 2016.

[16] K. Joshi and S. Allwadhi, "Image Steganography Model for Medical Images Using GLM" in Journal of COMPUSOFT, An International journal of advanced computer technology, pp. 2120 – 2124 5(5), May – 2016 (Volume –V, Issue-V) ISSN:2320-0790

[17] K. Joshi, R. Yadav, S.Allwadhi, " PSNR and MSE based Investigation of LSB" in the proceedings of IEEE, International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT), pp. no. 178 -183 on March 11-13, 2016

[18] K. Joshi, R. Yadav, "A new LSB-S image steganography method blend with Cryptography for secret communication", 2015 Third International Conference on Image Information Processing (ICIIP), pp. 86-90, 2015.

[19] [19] K. Joshi, P Dhankhar, R. Yadav, "A new image steganography method in spatial domain using XOR", 2015 Annual IEEE India Conference (INDICON), pp1 – 6, 2015.

[20] Joshi, Kamaldeep, Rajkumar Yadav, and Gaurav Chawla. "An Enhanced Method for Data Hiding Using 2-Bit XOR in Image Steganography." International Journal of Engineering and Technology 8.6 (2016).

[21] Saini, Anamika, Kamaldeep Joshi, and Sachin Allawadhi. "A Review on Video Steganography Techniques." International Journal of Advanced Research in Computer Science 8.3 (2017).

[22] Joshi, Kamaldeep, Rajkumar Yadav, and Ashok Kumar Yadav. "An Additive Watermarking Technique in Gray Scale Images Using Discrete Wavelet Transformation and Its Analysis on Watermark Strength." World Academy of Science, Engineering and Technology, International Journal of Computer, Electrical, Automation, Control and Information Engineering 10.7 (2016): 1428-1433.

[23] Joshi, Kamaldeep, and Rajkumar Yadav. "A LL Sub Band Based Digital Watermarking in DWT." IJ Engineering and Manufacturing volume 7, Issue 2, pp 50-63 (2017).