Journal of Physics: Conference
Series

PAPER • OPEN ACCESS

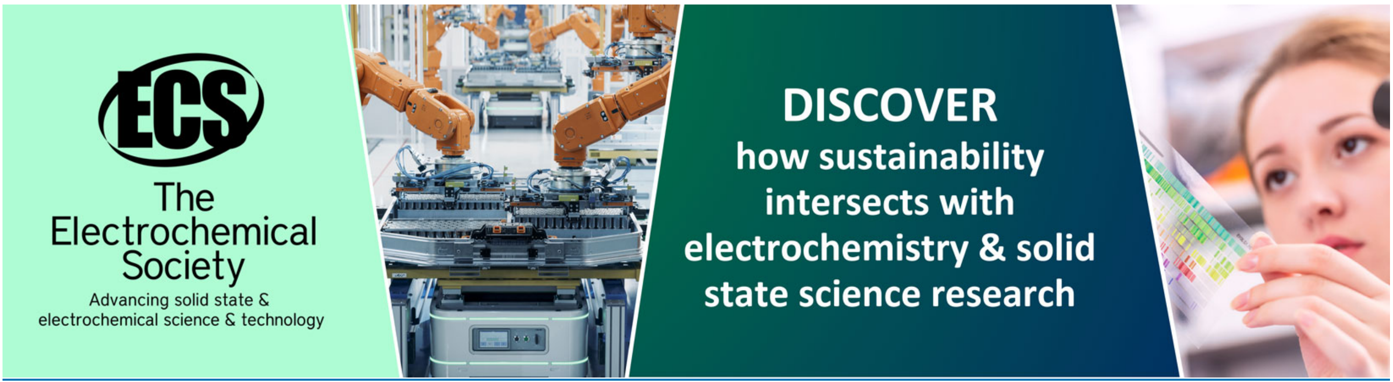
Implementation of Steganography Modified Least Significant Bit using the Columnar Transposition Cipher and Caesar Cipher Algorithm in Image Insertion

To cite this article: Handrizal *et al* 2021 *J. Phys.: Conf. Ser.* **1898** 012003

View the article online for updates and enhancements.

You may also like

- A Hybrid Encryption and Decryption Algorithm using Caesar and Vigenere Cipher
Camille Merlin S. Tan, Gerald P. Arada, Alexander C. Abad et al.
- An Implementation of RC4$^+$ Algorithm and Zig-zag Algorithm in a Super Encryption Scheme for Text Security
M A Budiman, Amalia and N I Chayanie
- Advanced hill cipher algorithm for security image data with the involutory key matrix
Supiyanto and S A Mandowen


ECS
The Electrochemical Society
Advancing solid state & electrochemical science & technology
DISCOVER
how sustainability intersects with electrochemistry & solid state science research

This content was downloaded from IP address 120.29.78.156 on 24/05/2024 at 16:45

Implementation of Steganography Modified Least Significant Bit using the Columnar Transposition Cipher and Caesar Cipher Algorithm in Image Insertion

Handrizal[1]*, Jos Timanta Tarigan[1], Doni Irwansyah Putra[1]

[1]Department of Computer Science, Faculty of Computer Science and Information Technology, Universitas Sumatera Utara, Jl. University No. 9-A, Medan 20155, Indonesia

*handrizal@usu.ac.id

Abstract. Steganography technique is a technique to hide data or information into other media such as digital images, text, sound, or video. One of the simplest methods of Steganography in the concept of Steganography is the Least Significant Bit. The Least Significant Bit (LSB) method hides the message by inserting the message at the lower or rightmost bits in the cover work file as a medium to hide the message. Caesar Cipher is one method that replaces each letter in the plaintext with letters that are at odds with certain numbers in the alphabet. Columnar transposition Cipher is one method in which messages are written in rows of a specified length, then are read column by column in the order of reading based on a keyword. The message is inserted into the cover image with the target pixel determination to be inserted based on the results of the Caesar Cipher process of the Columnar Transposition Cipher index to the random value of the Multiply With Carry Generator algorithm. The system implementation uses the C# programming language. The results of this study indicate that the implementation of a combination of Caesar Cipher, Columnar Transposition Cipher, and Multiply With Carry Generator can maintain the confidentiality, integrity, and security of data.

1. Introduction

Computer technology that is developing rapidly in the digital era now makes it easy for us to communicate and exchange data or information. The impact of these developments makes the dissemination of data or information very prone to abuse and manipulation by unauthorized parties. One of the data or information is carried out in the form of image files. Image (image) can be represented in a flat area that has two sizes (width and height). In the world of image, computation consists of pixels where the pixel value shows the color of the image (image). One technique to protect it with the Steganography Technique [1].

Steganography technique is a technique of hiding data or information into other media such as digital images, text, sound, or video. One of the simplest Steganography methods in the concept of Steganography is the Least Significant Bit [2].

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

The Least Significant Bit (LSB) method is a message hiding technique by inserting messages in the low or rightmost bit of the cover work file as a medium for hiding messages [3].

Caesar Cipher is a cryptographic method that replaces each letter in plain text (plaintext) with a letter that is different from a certain number in the alphabet [4]. The advantage of the Caesar Cipher is one of the most well-known encryption techniques and easy to learn.

Columnar transposition Cipher is a cryptographic method in which messages are written in a series of a specified length, then read back column by column in the order of reading based on a keyword. The length of the string is determined by the length of the keyword [4]. The advantage of the Columnar transposition Cipher is has a better mixing of letters than some ciphers and the main benefit that the transposition cipher has over substitution cipher is that transposition cipher can be applied more than once.

The Steganography Modified Least Significant Bit using the Columnar Transposition Cipher and Caesar Cipher Algorithm has been widely used to solve various problems such as, insert text to an image [5], png image security [6], secure the image file [7], image hiding [8], hiding and data safety [9]. There are also study in using another steganography method, such as Max-Plus Algebra, to implement an image based steganography as proposed in [10].

Therefore, with the above background, the writer wants to research with the title "Implementation of Steganography Modified Least Significant Bit using Columnar Transposition Cipher Cryptography Algorithm and Caesar Cipher in Image insertion". These algorithms need to be combined to cover the disadvantages of each algorithm, so it is hoped that file security can be improved.

2. Method

In this paper, we perform several stage as follow:

2.1. Least Significant Bit (LSB)

The least significant bit is often used for inserting data into digital media, where the message data bits that are inserted will be replaced with the lowest bit [3]. The lowest bit position is in the last bit, can be seen in figure 1:

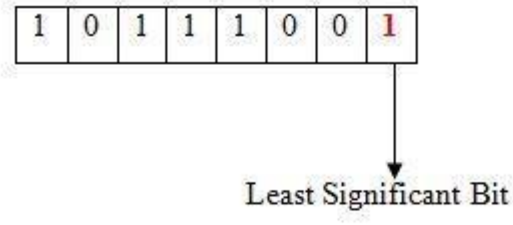


Figure 1. Least Significant Bit

2.2. Modified Least Significant Bit (MLSB)

The Modified Least Significant Bit method is a development of the Least Significant Bit method. This method is used to produce a method that is better than the existing LSB method. In this study, the author will use the MLSB Pseudo Random Number Generator with the Multiply with Carry Algorithm, because Multiply with Carry Algorithm has better performance and, random numbers are also produced at a higher speed. [3].

2.3. Caesar Cipher Algorithm

This algorithm uses a substitution technique where each letter on the plaintext is replaced by another letter with a certain position in the alphabet. This algorithm was invented and used by Julio Caesar and his soldiers, to encode messages to his governors [3].

2.4. Columnar Transposition Cipher Algorithm

The Columnar Transposition Cipher is one of the classic algorithms using the transposition technique. The way the Columnar Transposition Cipher works is to write plaintext characters with line orientation with the same character length and then the ciphertext is obtained by rewriting with column orientation [4].

2.5. Mean Squared Error (MSE)

MSE is the average error squared value to compare and measure the accuracy between the image before insertion and the image after insertion. The lower the MSE value the better, the MSE value can be calculated by the following equation:

$$MSE = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n}|I(i,j) - K(i,j)|^2 \qquad (1)$$

2.6. Peak Signal to Noise Ratio (PSNR)

PSNR is a parameter used for a comparison between the maximum value of the measured signal and the amount of noise that affects the signal. The greater the PSNR value, the better the compression quality. The PSNR value can be calculated by the following equation:

$$\text{PSNR} = 20^{Log_{10}} \frac{b}{\sqrt{MSE}} \qquad (2)$$

3. Results and Discussion

At this stage, the system will test an image that has a length and width of 20x20 pixels and a cover image measuring 1000x1000 pixels. The display message image and cover image to be tested can be seen in figure 2 and figure 3.

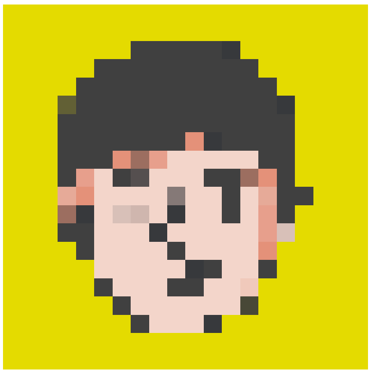


Figure 2. Image message of 20x20 pixels

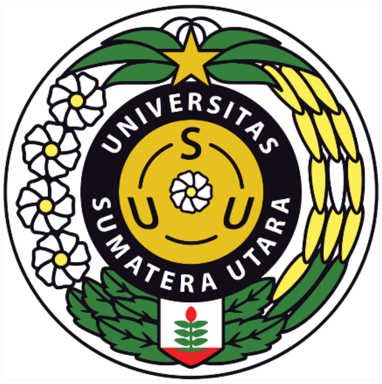
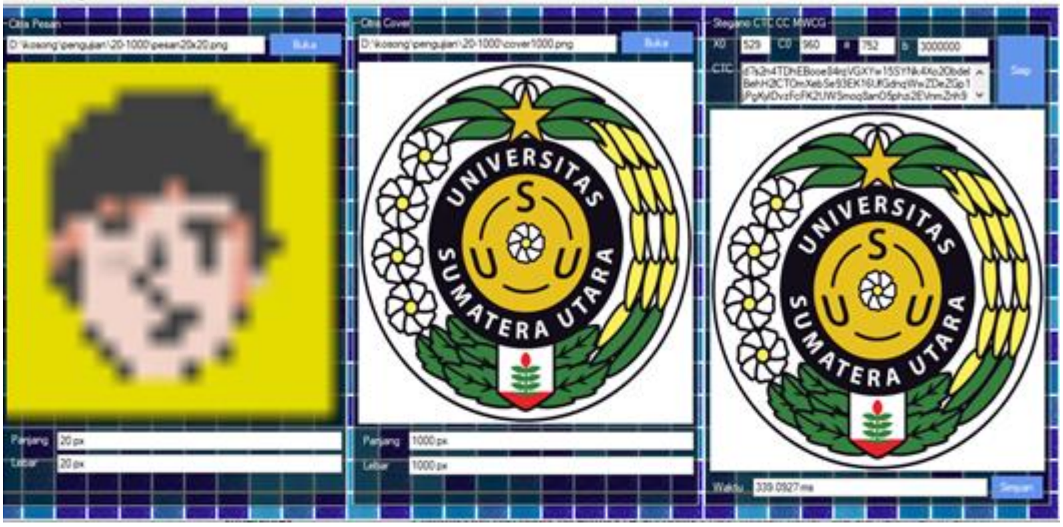


Figure 3. Cover image of 1000x1000 pixels

3.1. Embedding Process Testing

In the testing phase of the embedding process, the user first enters the message image file and the cover image where the message image size must be smaller than the cover image. Then press the insert button to carry out the process of inserting the message image into the cover image where before inserting the Multiply with Carry Generators and Columnar Transposition Cipher keys will be randomized first, which is then used to process the message image pixel randomization. After getting the stego image results, press the save button to save the stego image results and the keys obtained. The display of the embedding process results can be seen in figure 4.


Citra Pesan
D:\kosong\pengujian\20-1000\pesan20x20.png
Panjang 20 px
Lebar 20 px

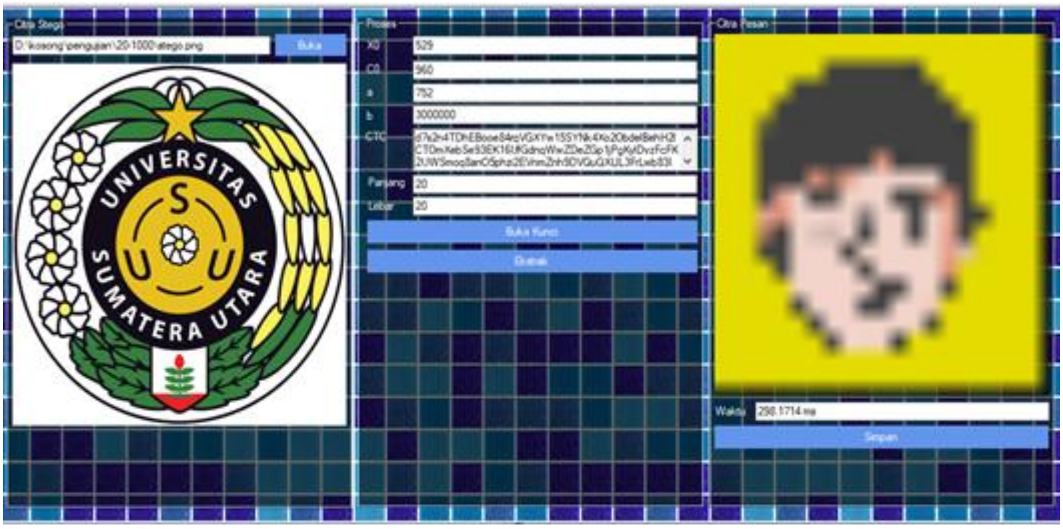
Citra Cover
D:\kosong\pengujian\20-1000\cover1000.png
Panjang 1000 px
Lebar 1000 px

Stegano CTC CC MWCG
X0 529 C0 960 a 752 b 3000000
CTC d7k2h4TDhEBooe84rqVGXYw15SYNk4Xo2Obdel BehH2lCTOmXebSe93EK16UfGdnqWw2DeZGp1 jPgKylDvzFcFK2tUWSmoqSan05phz2EVnm2hh9
Waktu 339.0927 ms

Figure 4. Embedding process

3.2. Extracting Process Testing

At the extracting stage, the first thing to do is to input the stored stego image file and input the previously stored key. Then press the extract button, and the system will perform the process of extracting the stego image to retrieve the message image that was inserted in the previous embedding process. After the message image is obtained, press the save button to save the message image. The extracting process display on the stego image can be seen in Figure 5



D:\kosong\pengujian\20-1000\stego.png

X0: 529

C0: 960

a: 752

b: 3000000

CTC: d7b2h4TDhEBooe84rzVGXYw15SYNk4Xo2ObdelBehH2l CTOmXeb5e93EK16tJGdnoWwZDeZGp1jPgKyIDvzFcFK 2UWSmoq8anO5phzi2EVnmZnh9DVQuGXUL3FrLwb83l

Panjang: 20

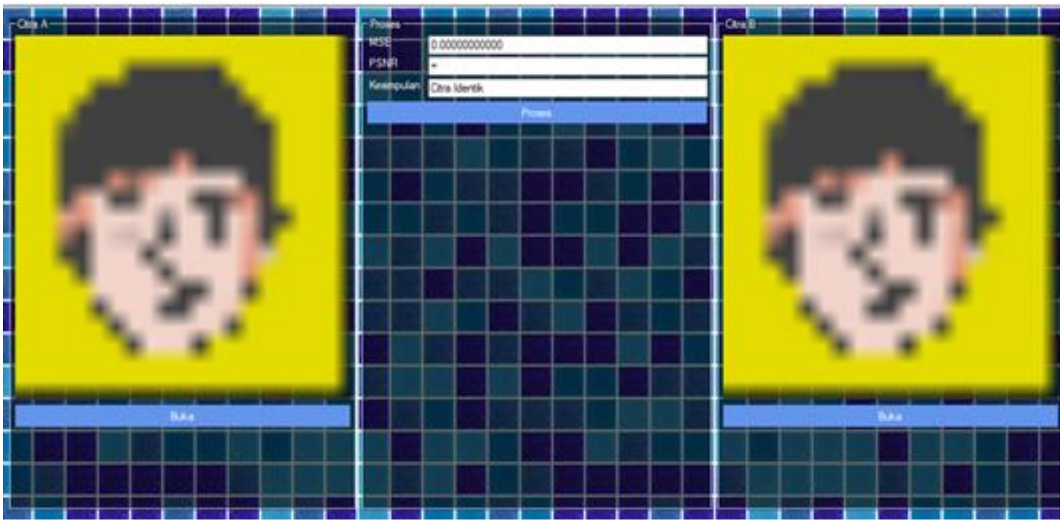
Lebar: 20

Waktu: 298.1714 ms

Figure 5. Extracting process

3.3. MSE-PSNR Process Testing

In the MSE-PSNR process, a comparison of the similarity of the original message image to the message image that has been processed and the cover image and the stego image will be carried out. The display of MSE-PSNR results on the message image with the original message image and the cover image with the stego image can be seen in Figure 6 and Figure 7

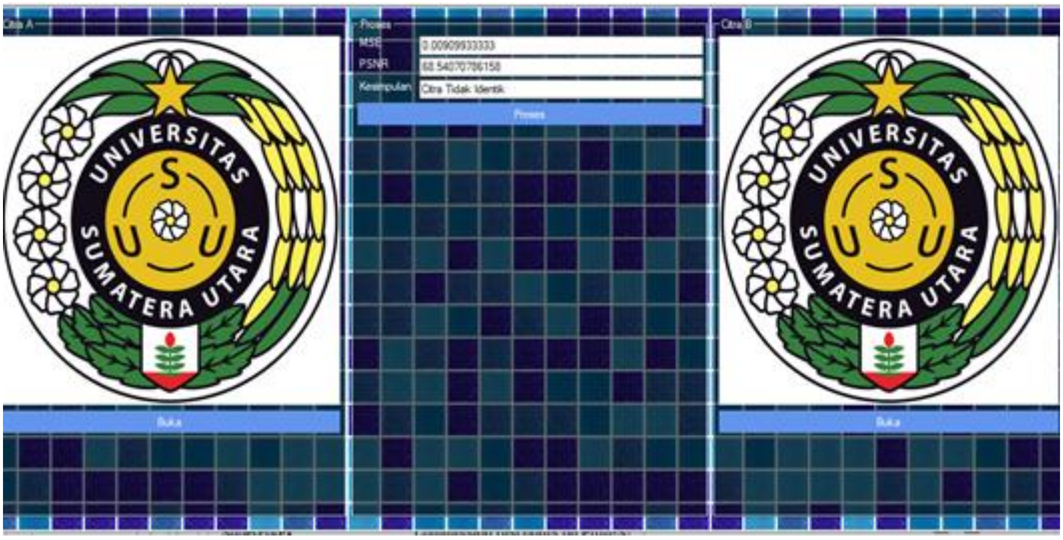


MSE: 0.000000000000

PSNR: ∞

Kesimpulan: Citra Identik

Figure 6. MSE-PSNR Results on Message Image with Original Message Image



MSE 0.00909933333
PSNR 68.54070786158
Kesimpulan Citra Tidak Identik

Figure 7. MSE-PSNR Results on Stego Image with Cover Image

3.4. Testing Running Time System and MSE-PSNR

In this system, a processing time testing process will be carried out with a pixel size comparison. This test will be carried out in 3 parts, namely the time of the embed, extract, and MSE-PSNR process. This test uses 4 sample image messages with a size of 10x10,20x20,30x30,40x40 and 3 sample cover images with a size of 1000x1000,2000x2000. The results of the system running time test and the MSE-PSNR value can be seen in Table 1.

Table 1. Results of Running Time and MSE-PSNR Value

Message	Cover	Running Time		MSE	PSNR
		Insert (ms)	Extract (ms)		
10 x 10	1000	30.9182	33.9084	0.00764933333	69.29456774377
20 x 20	1000	323.1693	301.2319	0.00909866667	68.54102606100
40 x 40	1000	4794.1905	4469.0559	0.01482000000	66.42232157225
80 x 80	1000	81956.3130	82861.0934	0.03822433333	62.30740441203
10 x 10	2000	39.9317	56.8417	0.00049225000	81.20894636058
20 x 20	2000	313.1642	317.6084	0.00085966667	78.78750273450
40 x 40	2000	5118.3233	487.7131	0.00232766667	74.46159573547
80 x 80	2000	87168.4805	87497.4085	0.00827200000	68.95469835118
10 x 10	3000	31.9547	92.7521	0.00715674074	69.58365076070
20 x 20	3000	315.0979	359.0742	0.00731696296	69.48749504143
40 x 40	3000	5486.3359	5466.4115	0.00796729630	69.11769392396
80 x 80	3000	85555.1237	87321.2564	0.01055685185	67.89545933883

4. Conclusion

After conducting research through literature studies, designing, implementing, analyzing, and testing applications on the implementation of Steganography Modified Least Significant Bit using the Columnar Transposition Cipher, Caesar Cipher, and Multiply With Carry Generator Algorithm on image insertion, it can be concluded:

1. Based on the tests that have been done. Testing the Implementation of Steganography Modified Least Significant Bit using the Columnar Transposition Cipher Algorithm, Caesar Cipher, and Multiply with Carry Generator on image insertion works well.
2. The factor that affects the time of the embedding process is the size of the message, the larger the message size, the more time it takes to carry out the embedding process. The embedding time for message size 10x10 cover 1000 is 30.9182 ms, while the embedding time for message size 80x80 cover 3000 is 85555.1237 ms.
3. The factor that affects the extracting process time is the size of the message, the bigger the message size, the more time it takes to do the extracting process. The extracting time for message size 10x10 cover 1000 is 33.9084 ms, while the extracting time for message size 80x80 cover 3000 is 87321.2564 ms.
4. Factors that affect the MSE and PSNR values are the size of the message inserted and the size of the cover object. The smaller the message that is inserted and the bigger the cover object, the better the MSE and PSNR values.

5. Acknowledgments

The authors gratefully thank all who have supported the completion of this research and Universitas Sumatera Utara that has allowed me to publish this paper.

References

[1] Champakamala B.S, Padmini. K, Radhika D.K 2014 Least Significant Bit Algorithm for Steganography *Int. J. of Advance Computer Technology* **3** 4

[2] Emam, Marwa M, Abdelmgeid A Aly, and Fatma A Omara. 2016 An Improved Image Steganography Method Based on LSB Technique with Random Pixel Selection." *Int.l J. of Advanced Computer Science and Applications* **7** 3 17-22.

[3] Naveen K Nishchal 2019, Digital techniques of data and image encryption. IOP Publishing Ltd.

[4] D Rachmawati, S M Hardi and R P Pasaribu 2019 Combination of columnar transposition cipher caesar cipher and lempel Ziv welch algorithm in image security and compression. *Journal of Physics: Conference Series* 1339 012007

[5] R R A Lubis, S M Hardi, M Zarlis, I Jaya and J T Tarigan, 2019, Analysis on Combination of Watermarking Algorithm: Modified Least Significant Bit Algorithm with Least Significant Bit+1, *Journal of Physics: Conference Series* 1235 012081

[6] S M Hardi, D Rachmawati, F Chairinnisa, I Jaya and J T Tarigan, 2019 Combination of myszkowski transposition algorithm and modified least significant bit (MLSB) green channel on png image security, *Journal of Physics: Conference Series* 1235 012080.

[7] D Rachmawati, M A Budiman and A Yusuf 2020 Combination of Rail Fence Cipher Algorithm and Least Significant Bit Technique to Secure the Image File *J. of Physics: Conference Series* 851 012069

[8] D Rachmawati, A Amalia and J Surya, 2017, Combination of Huffman Coding Compression Algorithm and Least Significant Bit Method for Image Hiding. *J. of Physics: Conference Series* 801 012059

[9] S M Hardi, M Masitha, M A Budiman and I Jaya, 2020, Hiding and Data Safety Techniques in Bmp Image with LSB and RPrime RSA Algorithm *J.of Physics: Conference Series* 1566 012084

[10] K.A. Santoso, Fatmawati, H. Suprajitno, 2018, On Max-Plus Algebra and its Application on Image Steganography *Scientific World Journal* 6718653