

# Security on GIF Images Using Steganography with LSB Method, Spread Spectrum and the Vigenere Cipher

**Andika Amirulhaqi**

*College Student, Faculty of Electrical Engineering,  
Telkom University, Bandung, Indonesia.*

*Orcid: 0000-0001-7518-7437*

**Tito Waluyo Purboyo**

*Lecturer, Faculty of Electrical Engineering,  
Telkom University, Bandung, Indonesia.*

*Orcid: 0000-0001-9817-3185*

**Ratna Astuti Nugrahaeni**

*Lecturer, Faculty of Electrical Engineering,  
Telkom University, Bandung, Indonesia.*

*Orcid: 0000-0002-5471-9593*

## Abstract

Graphics Interchange Format (GIF) is a graphics format, that is most often used for the purposes of website design. GIF has a bit more color combinations than JPEG, but able to store graphics with background transparent or in the form of a simple animation. Because of the ability possessed by the GIF that is could make as an animated GIF from any number of images, it is sometimes still considered to be good to use when want to download loads of sources in large sizes, then the GIF image can be shown in advance so that users don't feel strange when the load occurs. GIF image has a specific format that is has the colormap containing as many as 255 entries and entry consists of a number of images in the GIF animations or one image if not an animation. Spread Spectrum method of treating the cover-image as both a noise (noise) or as an effort to add artificial noise (pseudonoise) into the cover-image. On a method of steganography with Least Significant Bit (LSB) of the image to GIF images, basically consist of a part of the image so that it can be applied with LSB method inserts a message in the LSB of each byte of image from the image. Both of these methods certainly has advantages and disadvantages of each. One of the advantages of each method of spread spectrum is on better security compared with the method of least significant bit (LSB). While the algorithm of Least Significant Bit was to allow the message size in the embed dynamic depending on the size of the GIF image. In addition, in terms of the calculation of the Peak Signal-to-Noise Ratio and speed of embed course will also differ on the use of both methods.

**Keywords:** GIF, steganography, spread spectrum method, pseudonoise, least significant bit method.

## INTRODUCTION

Now hide the message not only can be done by disguising the message. But it can also insert those messages in other media. So people would not be suspicious of the message we send, because the message is not visible, the look is simply a media holding our messages.

For example, we want to send a message to someone who is far away by email. Fearing our message known to others then we insert the message in a media that is larger. For example in the media image file. So that other people will not suspect will be the image that we send. This is certainly going to be more practical than we are sending the message in the form of a file that is encrypted. This is certainly going to make others suspicious and started doing the attack to find out the contents of the message that we send. [1]

The technique of insertion messages in other media larger named Steganography. A storage medium that can be used in steganography can be files of songs, images, or other files that are large and can put the message that we want to hide. [1]

By using steganography then people will not become suspicious if it turns out we are sending a secret message. But there is a price to be paid in steganography i.e. magnitude file size stuffed secret messages. We need to transfer large amounts of data but important data required only small sized.

## STEGANOGRAPHY

Steganography is a technique to hide information that is personal with something that the result will look like other normal information. The medium used is generally a different

media with media bearer of confidential information, where this is a function of technique of steganography using disguises techniques as other media are different so that confidential information in the the initial media is not clearly visible. [1]

## GIF FORMAT

Graphics Interchange Format or often abbreviated GIF is an image file format that was introduced by CompuServe in 1987 to replace the format of RLE which is only capable of displaying images with black and white only. [5]

The GIF file format is one of the most frequently encountered images in the digital world. This happens because this format size is relatively small. For example for the same image, a file with a GIF format can be smaller if compared to the JPG format. [5]

This is because the GIF files using only 256 color palette. So obviously the file size will be smaller. However the 256 color palette of 256 colors just not absolutely certain. But the color can be chosen from the 24-bit RGB color palette. So in short it can be concluded that the files with GIF format will get rid of the color palette is not required and take only 256 color palette as needed. [5]

The size of a palette of 256 colors is a standard GIF ' 89 and 87. Some versions of the gif is now able to display colors with more than 256 colors. The GIF format is GIF and GIF ' 89 ' 87 can be distinguished through the header files. [5]

According to one source this now 3 preferred file formats are JPG, GIF and PNG as well. PNG format is indeed now the format is valued more favorite than other formats but GIF format still is one of the commonly used formats. Because one of the advantages of this format is the support for motion picture appearance. [5]

GIF uses a different type of data compression with JPG. GIF uses a type of compression that is often called "lossless". This means that the image did not experience a loss of quality when compressed. While in the JPG compression type used is "lossy" image so that experienced a reduction of quality when compressed. [5]

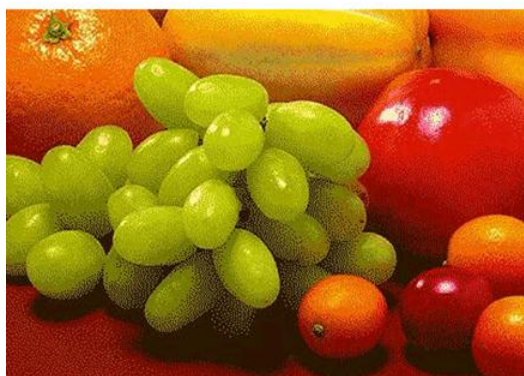


Figure 1: Image with GIF format [5]



Figure 2: Image with JPG format [5]

Clearly visible in the above two images that image with the GIF format has a bad outcome when compared to the JPG format in figure 1 and figure 2.

## VIGENERE CIPHER CRYPTOGRAPHY

Vigènere code including alphabetic code-multiple (polyalphabetic substitution ciphers). Published by the diplomat (at once a kriptologis) Blaise de Vigènere in the 16th century, the year 1586. Actually Giovan Batista Belaso have described it for the first time in 1533 as written in the book La Cifra del Sig. this new Algorithm known for 200 years later and named vigènere code. Vigènere is a trigger for the civil war in America and the vigènere code used by the Confederate States Army (Confederate Army) in the American civil war (American Civil War). Code vigènere was successfully solved by Babbage and Kasiski in mid-19th century. [14]

This type of encryption algorithm is very known for its easily understood and implemented. Techniques to produce the ciphertext can be done using the substitution digits or rectilinear vigènere.

Techniques using the numbers done by Exchange of letters with numbers, almost the same as the slide code.

## LEAST BIT SIGNIFICANT (LSB)

Method of a least significant bit is the standard method that is widely used to perform steganography especially on digital image media changes one bit at least significant bit will not result in a color change that is large enough so as not too visible are visible by others. [3]

This method uses the least significant bit of the byte-byte on a digital media substitution with one bit – one-bit message is inserted so that the size of files that can be stored is likely to be much smaller than the original size of a digital image. The extraction process of this method can be done by arranging bits-bits of the image foisted on forming a message that has

been inserted. [3]

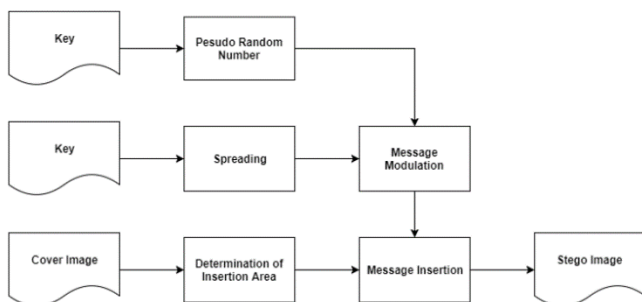
However, if the insertion is done on a byte-by-byte data sequentially, it will be easy for others to extract messages inserted because the person simply crafts a bit-bit byte and the end of all chances of getting the text the easier it is. The steps of the method of a least significant bit are:

- a. Read GIF files
- b. Do some checking to find the position of the image block.
- c. Generate a random value between {1,5} so the next position is between 1 to 5 bytes from the byte positions now.
- d. Insert the bit at the least significant bit in the byte.
- e. Repeat steps 3 and 4 until all of the bits of the message pasted already inserted at random.
- f. Save back into the new file.

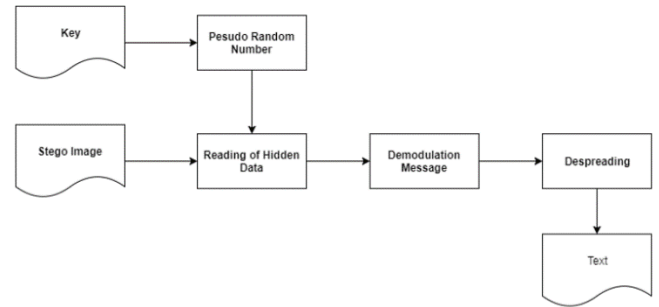
### SPREAD SPECTRUM

Spread Spectrum method is a technique of transmission using pseudonoise code, that are independent of the data information, as the modulator wave form to spread the energy signal in a communications line (bandwidth) that greater lines of communication signal information. By the receiver, the signal is collected again using pseudonoise code synchronized replica. Based on the definition, it can be that steganography using Spread Spectrum method of treating the cover-image as both a noise (noise) or as an effort to add artificial noise (pseudonoise) into the cover-image. [2][8]

The process of insertion of messages using the spread spectrum Method consists of three processes, namely the spreading, modulation, and insertion of a GIF image to the message. While the extraction process the message using the spread spectrum Method consists of three processes, i.e., the retrieval of messages from the matrix of frequencies, demodulation, and de-spreading. [2][8]



**Figure 3:** The scheme of insertion of text



**Figure 4:** Message extraction process scheme

### MEASUREMENT ERROR

The measurement of the quality of the image has been inserted the message done subjectively and objectively. Subjective measurement done by visually see the difference the shape and color of the image has been inserted with that yet. Measuring objectively the human rate visualizations are used by calculating the value of PSNR (Peak Signal to Noise Ratio). PSNR values in units of decibels (dB) are counted according the equation:

$$PSNR = 10 \cdot \log_{10} \left( \frac{MAX^2}{MSE} \right)$$

Where MSE values (Mean Square Error) obtained from the equation:

$$MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} \|I(i, j) - K(i, j)\|^2$$

MSE equation requires two input images, and then look for its value. After that calculated the value of PSNR. PSNR values are reasonable on the comparison of two image file is above 30 dB. [1]

### EXPERIMENTS

In this chapter the experiment would be conducted against the two methods of steganography.

**Table 1:** Sample GIF image

Image	Image Size
	4 x 4 pixel
	6 x 6 pixel
	8 x 8 pixel
	10 x 10 pixel
	12 x 12 pixel

**LEAST BIT SPECTRUM (LSB) METHOD**

In this experimental individually-focused on testing how the maximum number of characters or the length of a message that can be inserted into a gif image using the method of Least Significant Bit (LSB). The way used to obtain maximum message length the results using the method of calculating with the formula:

$$p = \frac{m \times n \times 1}{8}$$

The calculation formula of obtained data the results of the experiments has been performed using the five sample image gif with different image size in the following table.

**Table 2:** Experimental results using the spread spectrum method

Image size	The number of char
4 × 4 pixel	2
6 × 6 pixel	3
8 × 8 pixel	8
10 × 10 pixel	12
12 × 12 pixel	18

**SPREAD SPECTRUM METHOD**

In this experimental individually-focused on testing how the maximum number of characters or the length of a message that can be inserted on a gif image using Spread Spectrum Method. The way used to obtain maximum message length the results using the method of calculating with formula:

$$p = \frac{m \times n \times 1}{8}$$

The calculation formula of obtained data the results of the experiments has been performed using the five sample image gif with different image size in table 3.

**Table 3:** Experimental results using the spread spectrum method

Image size	The number of char
4 × 4 pixel	2
6 × 6 pixel	3
8 × 8 pixel	8
10 × 10 pixel	12
12 × 12 pixel	18

**CHECKING OF PSNR AND MSE VALUE**

After checking the value of PSNR and MSE by inserting the character 'N' and 'O' then obtained the following results :

**Table 4:** The results of experimental calculations of PSNR and MSE

Image size	The number of char	MSE	PSNR
4 × 4 pixel	2	0.3125	58.23380318
6 × 6 pixel	2	0,222222222	61,19505388
8 × 8 pixel	2	0,15625	64,25440309
10 × 10 pixel	2	0,08	70,06900387
12 × 12 pixel	2	0,076388889	70,47019975

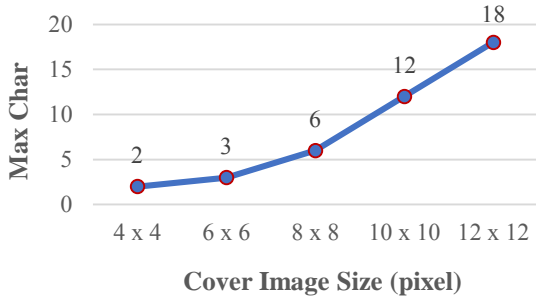
PSNR and MSE experiment results by adding a cryptographic Vigenere Ciphers, inputed character is "N" and "O". then in the cryptographic key with "ST" and the results will be inputed character is transformed into "FH" in table 5.

**Table 5:** The result PSNR and MSE by adding a cryptographic vigenere ciphers

Image size	The number of char	MSE	PSNR
4 × 4 pixel	2	0.3125	58.23380318
6 × 6 pixel	2	0.166666667	63.69382862
8 × 8 pixel	2	0.125	66.19260335
10 × 10 pixel	2	0,07	71.22884281
12 × 12 pixel	2	0.0625	72.21320326

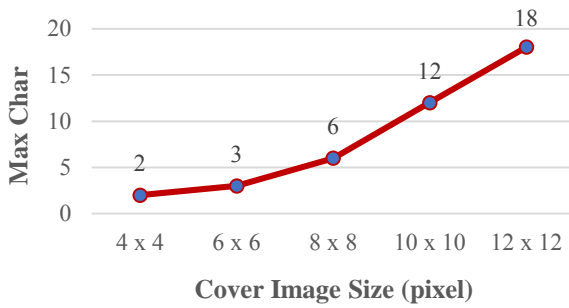
**ANALYSIS AND DISCUSSION**

From the results of previous experiments against gif image about how much the message maximum number of characters that can be inserted by the method of least significant bit (LSB), then the maximum number of characters can be seen from figure 5.



**Figure 5:** Graph of Cover Image Size vs Maximum Char using LSB Method

And then experiments against gif image about how much the message maximum number of characters that can be inserted by the spread spectrum method, then the maximum number of characters can be seen from figure 6.

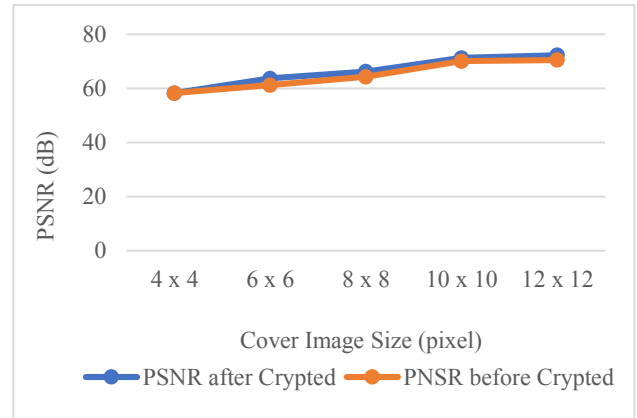


**Figure 6:** Graph of Cover Image Size vs Maximum Char using Spread Spectrum Method

The graph above shows that the blue line illustrates the method of LSB, whereas an orange colored lines depicting the spread spectrum method. From figure 5 and figure 6 can be seen that the maximum number of characters that can be inserted using the LSB method and method of spread spectrum in the same magnitude. It happened because in calculation formulas in use in finding the length of the message is the same, the difference method of least significant bit with spread spectrum method is in terms of the image will be inserted when processing the message. On the methods of LSB data to be inserted directly inserted into the picture without in advance while the sport at a spread spectrum method of data that will be on the insert must be in advance or sport through XOR.

From the level of security is clearly spread spectrum method is more secure compared with the method of least significant bits, because already in explain earlier that spread spectrum methods on the data that you want to insert in the process first before inserted. So others will be more difficult to decipher the message in a picture that has been in the sport with a spread spectrum method.

From the results of checking the value of the MSE and PSNR in getting results either, PSNR values > 30 dB, then it can be said that the performance of image restoration is nice. If the value of PSNR > 50 dB then it can be said that the performance of the image of the perfect restoration results approaching the original image.



**Figure 7:** PSNR values comparison before and after cryptography

In figure 7 from the results of a comparison of the MSE and PSNR before and after cryptography cryptography can result in that after cryptography better PSNR values than before in cryptography.

### CONTRIBUTION

Expected in this journal are the experiments conducted using the GIF format which is still rarely used in experiments using spread spectrum method and method of LSB. What distinguishes the GIF format with other image formats, i.e. a limited amount of color palette that is only 256. the existence of this journal are expected to use in the experiment using steganography help spread spectrum method and method of LSB with GIF format. This journal also describes how the values for the PSNR and MSE in gif format that has filled the message.

The most significant bit is comparisons and method of spread spectrum that distinguish it from the second of these methods is the method of spread spectrum in the steganofragi in the process of doing a little before randomization can be filled with messages. While the method most significant bits can be directly filled randomly with no message in advance.

This journal is different to other journals, because in terms of the methods used to conduct experiments on Steganography GIF format. Already in advance that explain in the journal using the method of Spread spectrum and method of LSB. most of the journal using both of these methods only on image formats, namely PNG, JPG, JPEG, BMP. Therefore this

journal can be set as a reference in the processing of images with the GIF format.

Another plus this journal with added cryptographic vigenere cipher which create messages which we will insert a lot better security level and is not easily noticed by others.

## CONCLUSION

The conclusion that can be drawn after the experiment and analysis as well as the discussion towards how much the number of characters that can be inserted on the application of steganography using method of least significant bit (LSB) and the method of spread spectrum is the number of characters that can be inserted in the same.

But in terms of security is clearly spread spectrum method is more secure compared with the method of least significant bits, because the method of spread spectrum data in insert in the first process that is inserted before the XOR process compared to method of least significant bits that directly inserts a message without processing it first. So others will be more difficult to decipher the message in a picture that has been in the sport with a spread spectrum method.

From the results of checking the value of the MSE and PSNR in getting results either, PSNR values  $> 30$  dB, then it can be said that the performance of image restoration is nice. If the value of PSNR  $> 50$  dB then it can be said that the performance of the image of the perfect restoration results approaching the original image.

From the results of a comparison of the MSE and PSNR before and after cryptography cryptography can result in that after cryptography better PSNR values than before in cryptography.

## REFERENCES

- [1]. Morkel, T., Jan H. P. Eloff and Martin S. Olivier. "An overview of image steganography." ISSA (2005).
- [2]. L.M. Marvel, C.G. Boncelet, C.T. Retter, "J.: *Spread Spectrum Steganography*", IEEE Trans. on Image Processing, vol. 8, no. 8, pp. 1075-1083, 1999.
- [3]. Fridrich, Jessica J., Miroslav Goljan and Rui Du. "Detecting LSB Steganography in Color and Gray-Scale Images." IEEE MultiMedia 8 (2001): 22-28.
- [4]. Cheddad, Abbas, Joan Condell, Kevin Curran and Paul Mc Kevitt. "Digital image steganography: Survey and analysis of current methods." Signal Processing 90 (2010): 727-752.
- [5]. Munir, Rinaldi. "Application of the modified EzStego algorithm for hiding secret messages in the animated GIF images." 2016 2nd International Conference on Science in Information Technology (ICSITech) (2016): 58-62.
- [6]. Chunhui Xie, Yimin Cheng, Yangkun Chen, "Spread-spectrum steganalysis and PN sequence estimation", Image and Signal Processing (CISP) 2010 3rd International Congress on, vol. 9, pp. 4143-4147, 2010.
- [7]. Maria Gkizeli, Dimitris A. Pados, Michael J. Medley, "Optimal Signature Design for Spread-Spectrum Steganography", Image Processing IEEE Transactions on, vol. 16, pp. 391-405, 2007, ISSN 1057-7149.
- [8]. R. Chandramouli, K.P. Subbalakshmi, "C.: *Active Steganalysis of Spread Spectrum Steganography*", IEEE International Symposium on Circuits and Systems, vol. 3, pp. 830-833, May 2003.
- [9]. Nadeem Akhtar, Vasim Ahamad, Hira Javed, "A compressed LSB steganography method", Computational Intelligence & Communication Technology (CICT), 2017 3rd International Conference on
- [10]. Morkel, T., JHP. Eloff, dan MS. Olivier. An Overview of Image Steganography. Pretoria. Information and Computer Security Architecture (ICSA) Research Group, Department of Computer Science, University of Pretoria
- [11]. Marvel, Lisa M., Charles G. Boncelet, and Charles T. Retter. 1999. Spread Spectrum Image Steganography. IEEE Transaction on Image Processing
- [12]. Mario Tessa Juzar, Rinaldi Munir, "Message hiding in animated GIF using multibit assignment method", Electronics and Smart Devices (ISESD), International Symposium on
- [13]. Dr. Ekta Walia, Payal Jain, Navdeep, "An Analysis of LSB & DCT based Steganography, Global Journal of Computer Science and Technology", Vol. 10, Issue 1, April 2010, pp. 4-8
- [14]. M Bashardoost, GB Sulong, P Gerami, "Enhanced LSB image Steganography method by using knight Tour algorithm, Vigenere Encryption and LZW compression", IJCSI International Journal of Computer Science Issues 10 (2), 221-227