Implementation Of Digital Watermarking

On Images Using The Least Significant Bit Method

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Abstract

The ease of accessing the internet in this modern era has led to illegal crimes, especially data copying, data distribution and abuse of intellectual property rights. From these problems emerged a method of securing data and information, namely watermark. Watermark is used for data security techniques, both for copyright protection and digital signatures in the visible and invisible realms. One of the data security techniques used here is to use the least significant bit (LSB) method. This method is used for data security or images that contain watermarks, for example on currency there is usually a logo to distinguish real and fake currencies. This study uses nine host images taken from the https://www.kaggle.com/datasets/felicepollano/watermarked-not-watermarked-images dataset with different sizes, namely 513 x 513 pixels, 488 x 350 pixels, 467 x 350 pixels, 500 x 333 pixels, 512 x 301 pixels, 490 x 350 pixels, 500 x 332 pixels, 400 x 266 pixels, and 500 x 308 pixels. As for the label image, it uses the uty logo which has a size of 50 x 50 pixels, 80 x 80 pixels, and 124 x 124 pixels. From the results of the watermark testing that has been carried out, it is found that the quality of the host image and label has an effect on the PNSR value obtained. It is proven in the Cut fur white file with a host pixel size of 513 x 341 and a label size of 50 x50 resulting in the highest value with a value of 70 dB. As for the Canada geese file with a test host image of 512 x 301 and a label size of 124 x124, the lowest value is 61.2 dB. The overall results in the test using the LSB method get an average PNSR value of 65 dB, so it can be concluded that watermark research using the LSB method obtains fairly good image results and can be used for data security.

Keywords: Watermark, Least Significant Bit, Peak Signal to Noise Ratio (PNSR)

I. INTRODUCTION

In today's increasingly rapid technological era, the internet has become one of the sources of information for people among the community. The amount of data in the digital world causes a lot of data copying, and illegal distribution of data and abuse of intellectual property rights [1]. From this problem, it is necessary to make water for the security of existing data. Watermark is the process of hiding information into the host image which later must be protected and extracted for data security and verification of existing data [2]. Watermarking is the process of permanently adding a secret code or identity from image data digitally. The code here can be text, sound, image or video [3][4]. The way watermarks work is to take advantage of the shortcomings of the human senses, especially the eyes and ears [5]. The benefits of watermark include copyright protection, namely for authentic evidence of the creator's ownership rights to the created work, data security so that it is not hijacked or duplicated, and fingerprints used to identify each user and distribution of works or content [6].The classification technique based on the domain in making watermarks is as follows [7]:

a. Watermarking in the spatial domain works directly on the pixels that make up an image or image. An example of this method is the LSB watermarking insertion technique.
b. Watermarking that works in a transformation or frequency domain. The way it works is that watermarking is done on the frequency coefficient of the original image that has been transformed. Examples of this method are DCT, DWT, DLT and DFT.
c. The creation of water from a combination of spatial domains and transformations. The way this technique works is that it is carried out on the frequency pixels of several images whose image characteristics have been selected.

A good watermarking technique must meet the following requirements [8]:

a. Imperceptibility is watermark that cannot be seen by the naked eye so it needs to be computerized for testing.
b. Robustness is watermark that must have endurance trials regarding compression and image scanning
c. Security is watermark that can be detected by the owner or authorized official.
d. Recovery is a watermark that must be retrieved for the authentic owner of the image or image.

In previous research on watermarking made using water-making applications using the LSB method. The results of the trial application allow users to insert watermarks into digital images. This study uses digital images with the extension .png and .jpg with the original image size 770 kb (768 x 512) and for the cat logo the size is 3.54 kb (60x60) and the text reads budianto. In the LSB method does not make a significant difference between the original image and the resulting image, while in the original image with the .jpg extension, the watermark process makes a significant change in size due to changes in the extension of the resulting image [9]. In this research, invisible watermarking for digital images uses a combination of discrete cosine transformation and discrete wavelet transform methods. Choose this method because it is more resistant to manipulation of digital image data, especially for compression and digital image quality. The test results obtained in this study, the DCT and DWT methods are better than using only the DWT method, which have been proven to produce a PNSR value of 39.7119 dB for the combined DCT and DWT method, while the use of the DWT method alone produces a PNSR value of 17.3545 db. The highest PNSR value indicates that the image resembles the original image [10]. In research on copyright protection for watermark images using the LSB algorithm on color pictures. Selection of the LSB algorithm because it produces a small effect on an image or photo. In the smallest case using the third and fourth and fourth airmarks and pixel coordinates of the image before inserting the watermark, this is flexible depending on the length of the watermark of the pasted text. The trial conducted will compare the 1-LSB algorithm and Lee's algorithm using the PNSR value. The results of the image quality experiment with a higher LSB watermarking proved that the PNSR value in 56.6 dB [10]. The watermarking insertion frequency is selected as the highest. From the test results, the watermarking image is resistant to image compression up to 50% using the DCT method. This DCT method is applied because it is able to provide high security on digital images. Evidently this method is very vulnerable to the dangers of duplication of image compression. Adding text and changing color produces a better watermark than changing the background, adding filters, and rotating which can spoil the water creation after extraction [11].

In this study, we tried to apply watermarking using the LSB algorithm to secure data and insert watermarking into an image. The LSB method used is expected to be able to secure the watermark image so that it is safe from irresponsible parties. In building this application using matlab which has a data limit, namely for bmp images. consists of nine original images and one image to be inserted. For testing water production, PNSR values are used for the feasibility of producing produced water, the aim is to determine the quality of the resulting image.

II. METHOD

A. System

The system used for the process of hiding image data into the media in the form of digital images. In addition to the process of hiding image data, there is also a process of separating hidden image data into digital image media. The image research used is the https://www.kaggle.com/datasets/felicepollano/watermarked-not-watermarked-images dataset. In Figure 1 the animal seen in Figure 1. has a size of 513 x 341 pixels. This means that animal image.bmp has 513 columns and 3 rows of pixels. While the watermark used to hide the image is a watermark with .bmp format. The Uty.bmp watermark shown in Figure 1 has a size of 50 x 50 pixels. That means it has 50 columns and 50 rows of pixels. The illustration of the Watermark carried out is presented in Figure 1.

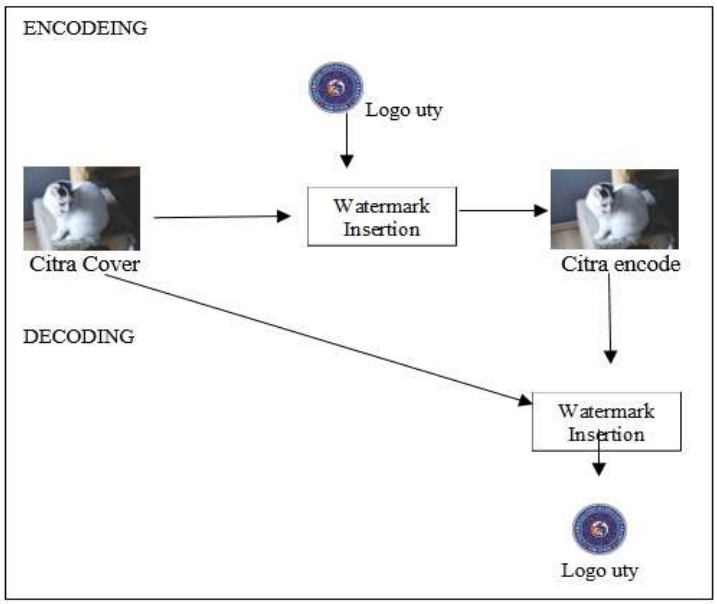

Figure 1. Illustration of the Watermark

In Figure 1 the watermark illustration is carried out, among others, carrying out the encoding and decoding process. Encoding is the process of inserting a watermark into the cover image. Decoding is the process of separating (extracting) the watermark from the encoded image so that the watermark can be seen [12]. Cover image is an image used for media whose ownership will be protected by providing a copyright label in the form of a watermark. The encoded image is the image generated from the encoding process in which there is already a hidden watermark. A watermark is an image that is used to be inserted into the cover image.

The The watermark process is carried out using 2 stages, namely encoding and decoding. Flowchat encoding and decoding are presented in Figure 2 and Figure 3.

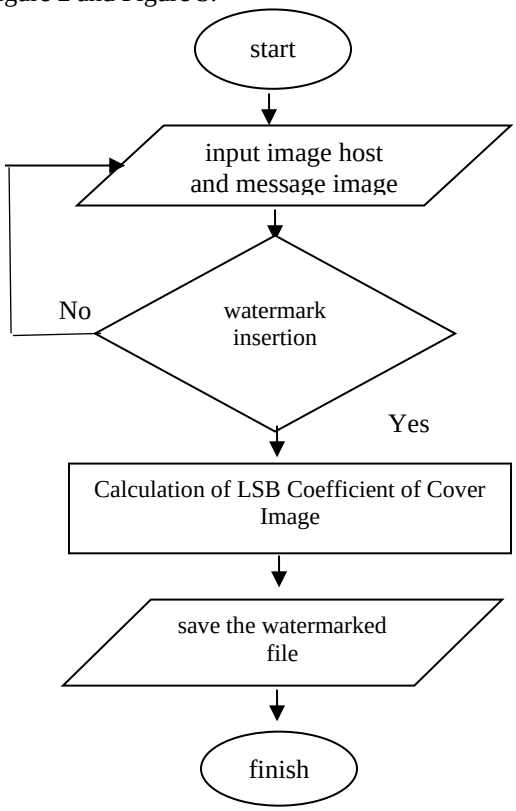

Figure 2. Encoding Stage

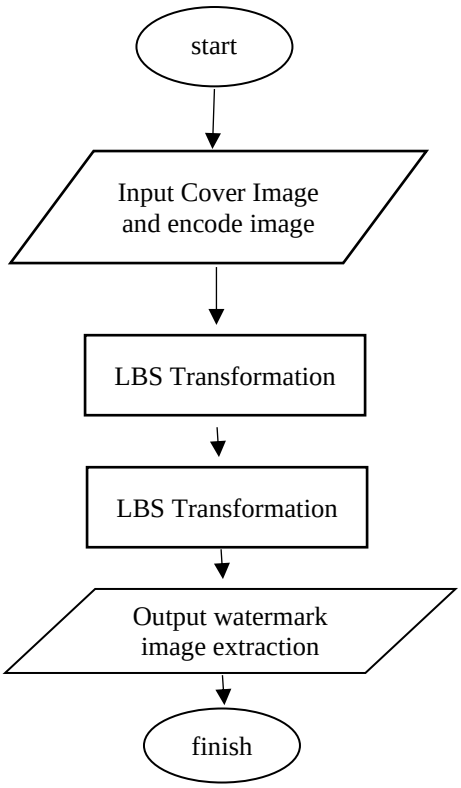

Figure 3. Decoding Stage

In Figure 2 is the encoding process, namely first entering the cover image and watermark, after the cover image and watermark are entered the system will read the number of pixels in the cover image and watermark. The watermark used has pixels of 50 x50, 80 x 80 and 124 x 124. The watermark has been successfully entered by the system and will be converted to get a binary value. This binary value will later be included in the cover image. The last step is to calculate the LSB coefficient from the cover image that has been entered at the initial stage. After the system has finished calculating the watermark value can be saved.

In Figure 3, the decoding stage is carried out to remove the watermark embedded in the encoded image by requiring a cover image and an encoded image. These two things are needed in the decoding process to determine the difference in the resulting watermark image. Not all decoding processes run properly displaying the stored watermark, therefore all those related to encode images or media want to protect the quality of the image.

B. Evaluation Watermarking

Watermark encoding evaluation technique is done by measuring image quality based on the PNSR value. Meanwhile, watermark decoding is carried out with several attack techniques on images that have been watermarked. Measurement of image quality based on the PSNR value [13]:

Peak Signal-to-Noise Ratio (PSNR) is a tool to measure image file distortion. The PSNR equation is shown in equation 2. MAX is a possible pixel value for an image pixel.

$$\boldsymbol{PNSR} = \log_{10} 10\left(\frac{MAX_I^2}{MSE}\right) \quad (1)$$

III. RESULT AND DISCUSSION

The result of the implementation is a technical application of hiding digital image data based on a desktop. In this study, the data used for the experiment is the original image and the same message image in bmp format. This test uses a cover image and for the creation of water using a uty logo measuring 50 x 50 pixels, 80 x 80 pixels, and

124 x 124 pixels. The cover image is 513 x 513 pixels, 488 x 350 pixels, 467 x 350 pixels, 500 x 333 pixels, 512 x 301 pixels, 490 x 350 pixels, 500 x 332 pixels, 400 x 266 pixels, and 500 x 308 pixels.

1) The Encoding system is part of the menu which processes the cover image to be performed labeling in the form of a watermark in the image. Process of encoding is to enter the cover image first first as the image to be labeled. The encoding system display is presented in Figure 4.

Figure 4. Encoding System

2) Decoding system is part of the menu which processes the release of watermark labeling, so that the watermark embedded in the image the encode will be visible. The encoding system display is presented in Figure 5.

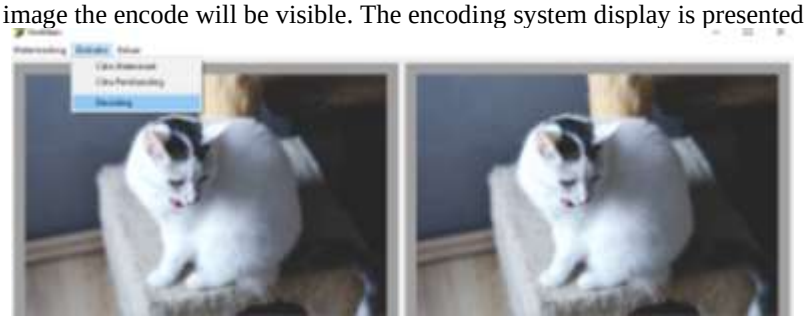

Figure 5. Decoding System

B. System Testing

Watermark system testing is carried out for measure the level of image quality. The testing phase is done by performing various inputs in the form of images and watermarks with different pixel sizes. The stage of measuring the level of quality of the resulting image can use the PSNR and MSE theory. The following are the results of the encoding test as shown in table 1.

Table 1. Testing Encoding

No	**Table testing encoding**			
	filename	***Pixel Size Image Host***	***Pixel Size Image Label***	*PNSR Value (dB)*
1.	Cut fur white	513 x 341	50 x 50	70
2.	Owl eagle owl wisdom	488 x 350	50 x 50	69,3
3.	Stting animals inside	467 x 350	124 x 124	61,5
4.	Bouquet young animal ostrich	500 x 333	124 x 124	61,6
5.	Canada geese	512 x 301	124 x 124	61,2
6.	crane bird	490 x 350	80 x 80	65,5
7.	Cat feline furry pet	500 x 332	80 x 80	63.4
8.	Dog puppy cute	400 x 266	80 x 80	63,8
9.	Common redstart bird garden	500 x 308	50 x 50	69
			Average	65

Based on table 1 the results of successful PSNR testing with good with a fairly good average PSNR value of 65 dB db. The following is a graph of the PSNR value that can be presented in Figure 6.

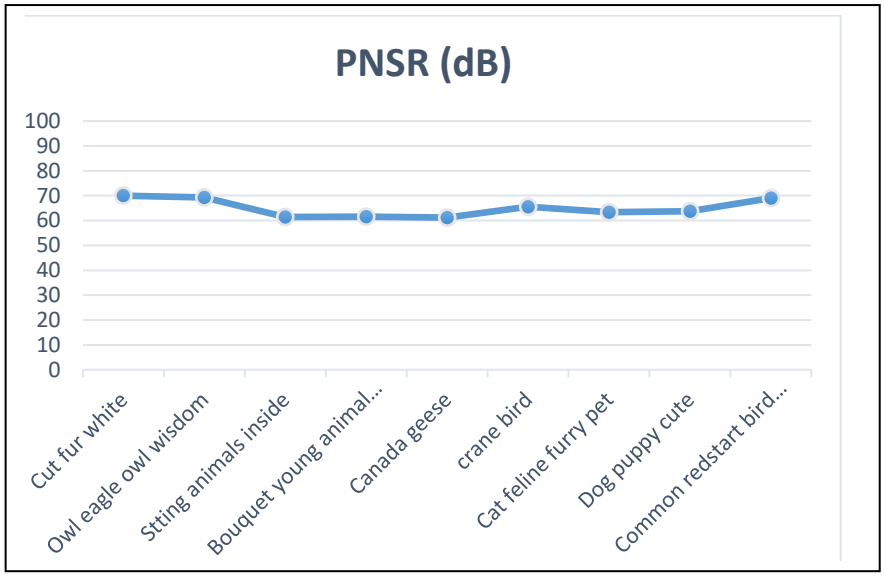

Figure 6. PSNR value chart

Based on the test results in Figure 6, it can be seen that the image quality of the host image and label has an effect on the PNSR value obtained. It is proven in the Cut fur white file with a host pixel size of 513 x 341 and a label size of 50 x50 resulting in the highest value with a value of 70 dB. Meanwhile, the Canada geese file with a test host image of 512 x 301 and a label size of 124 x124 produces the lowest value of 61.2 dB. It can be concluded that the larger the host size, the better the results and the smaller the image label, the better the results.

In the decoding test, the watermark is released using the appropriate one according to the previous encoding process. The results of the decoding test are presented in table 2.

Table 2. Testing Decoding

No	**Table testing decoding**			
	filename	***Pixel Size Image Host***	***Pixel Size Image Label***	*Watermark Image Extraction*
1.	Cut fur white	513 x 341	50 x 50	
2.	Owl eagle owl wisdom	488 x 350	50 x 50	

No	Table testing decoding			
	filename	***Pixel Size Image Host***	***Pixel Size Image Label***	*Watermark Image Extraction*
				
3.	Stting animals inside	467 x 350	124 x 124	
4.	Bouquet young animal ostrich	500 x 333	124 x 124	
5.	Canada geese	512 x 301	124 x 124	
6.	crane bird	490 x 350	80 x 80	

No	Table testing decoding			
	filename	***Pixel Size Image Host***	***Pixel Size Image Label***	*Watermark Image Extraction*
				
7.	Cat feline furry pet	500 x 332	80 x 80	
8.	Dog puppy cute	400 x 266	80 x 80	
9.	Common redstart bird garden	500 x 308	50 x 50	

Based on the test results contained in table 2, decoding test can be seen watermarks shown in table 2 watermarks in good condition and not damaged, but there some are broken or the watermark is not clear. Broken or unclear

watermarks occur due to the size of the watermark is small, namely 50 x 50 pixels as well as a cover image to accommodate the watermark is small so that it results in the watermark is broken if you force it embedded in the cover image.

IV. CONCLUSION

On the results of the watermark tests that have been carried out, this study shows that:

a. The LSB method has been used as a means of measuring the quality of the resulting image using the PSNR value. The test results obtained an average PSNR value of 65 dB, so it can be concluded that the resulting image quality is quite good.
b. Based on the test results, it can be seen that the image quality of the host image and label has an effect on the PNSR value obtained. It is proven in the cut fur white file with a host pixel size of 513 x 341 and a label size of 50 x50 resulting in the highest value with a value of 70 dB. As for the canada geese file with a test host image of 512 x 301 and a label size of 124 x124, the lowest value is 61.2 dB.

- Suggestion

For further research, LSB can be combined with other algorithms or can also be used to be tested with other evaluation tools. The development of this application still needs to be done to improve the application. As for further research, there are several application developments that can be done, including adding a combination of methods so that the watermark is more resistant to compression and embedding manipulation in addition to using digital images for example with video, audio and others so as to get the best accuracy results.

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