PSNR Comparison When Using LSB Steganography On Each RGB Color Components

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Abstract**—***This paper contains explanation about image, color space, steganography, experiment to determine color component effect on steganography, and connection to another paper researching the same topic using different way. The best color component to be used in steganography in RGB color space is the blue component and further work needs to be done on the topic of determining each color component and color space effect on steganography.*

Index Terms**—***image, color space, steganography, PSNR.*

I. Introduction

One criteria from security in message exchange is secrecy. One way to keep the message secrecy is by hiding the message into another media dan send it. That way is known as steganography.

One method of steganography is concealing message bits as the last bit of the media bytes. That method known as least significant bit. One media to do this is image. Image has color space red, green, blue, or shorten as RGB. The LSB method means concealing message bits in the blue component as the least significant byte.

This paper contains comparison of concealing the message bits to LSB of each image color component. This paper contains explanation of image, color space, steganography, experiment done, analysis, and conclusion.

II. Image and Color Space

Image is a representation of objects or things. In digital media image use several ways to represent a color. This ways called as color space. Color space is mathematical model to describe ways of color to be represented as numbers.

Example of color space is binary image. In binary image there only exist two color, which is black and white. Black represented as the number 0 and white represented as the number 1. Another example is image which uses 4 bits for one color. That means the image can shows 16 colors.

Color space that widely used is true color. In true color color space a color represented using 24 bits or 3 bytes. Each byte represented one color component. So, red is one byte, green is one byte, and blue is one byte. True color can produce more than 16 million colors. In one pixel of true color color space red component is placed first and blue component is placed last.

III. Steganography and Experiment

Steganography is art and science of writing hidden messages in such a way that no one, apart from the sender and intended recipient, suspects the existence of the message. The message to be hidden is called as stego text. The media to hide the message is called cover media. Lastly, the media containing hidden message is called stego media.

Widely used method of steganography is least significant bit. The method conceal message bits as the least significant bit of the cover media. When using image as cover media, the least significant bit is in blue component.

Christopher state that green component of RGB is not good to be used in LSB because green component is easily observed by human eyes [6]. Christopher generated colors by changing each component and observed the colors generated to come up with his conclusion.

This paper take another way to compare using each color component in LSB. The experiment is done by concealing the stego text bits as each component's LSB. So, that means the stego text bits is concealed in stego image red component LSB in one experiment, in green component in another experiment, and lastly in blue component.

Comparison is being done by counting each experiment's PSNR. PSNR is abbreviation of peak signal-to-noise ratio which is the ratio between maximum possible power of a signal and the power corrupting noise that affects the fidelity of its representation.

PSNR is calculated using below equation:

$$PSNR = 20 \times \log_{10}\left(\frac{256}{rms}\right)$$

The variable rms (root mean square) is calculated using equation: $rms = \sqrt{\frac{1}{MN}\sum_{i=1}^{N}\sum_{j=1}^{M}(I_{ij} - \hat{I}_{ij})^2}$

The experiment is being done using 5 images with one stego text sized 6.38 kilo bytes. The images is divided into two category. First category is digital images produced using digital softwares. Second category photograph produced using camera. The program for the experiment implemented by me.

Below are images used in experiments.

Figure 1 Ashe

Figure 2 Image1

Figure 3 Image2

Figure 4 Photo1

Figure 5 Photo2

IV. EXPERIMENT RESULT

The experiment result is shown in table 1. Numbers shown is PSNR of the experiment. Ashe, image1, and image2 belong to first category. Photo1 and photo2 belong to second category.

Image Name	Red	Green	Blue
Ashe	-39.551	8.618	56.762
Image1	-28.588	19.560	67.727
Image2	-29.207	18.979	67.167
Photo1	-43.476	4.694	52.834
Photo2	-34.412	13.702	61.827

Table 1 PSNR Values

Color Component	Average	Standard Deviation
Red	-35.0468.	5.789
Green	13.1106	5.786
Blue	61.2634	5.8

Table 2 Averages and standard deviations

V. Analysis

A. PSNR values

Experiment shown that red has the worst PSNR value and blue has the best PSNR value. Blue has the best PSNR value because blue component is the least significant byte in one color. Change to blue component will not affect color significantly. As opposed to change to red component will affect color significantly.

PSNR calculation is being made by calculating cover image and stego image each pixel delta. Change to blue component will produce small delta and change to red component will produce big delta.

Interestingly each component produce similar standard deviation value. That means the value distribution is roughly same for each component modification. This can be further researched using many images to find out whether type of image affect the PSNR result distribution or not.

B. Connection with Christopher's work

According to my eyes I can't differentiate cover image and stego image. Cristopher state that green colors are easier to be observed using human eyes which means change in green component of a color is easier to be observed.

Mathematically speaking PSNR value representing the stego image differentiation with cover image. The smaller this value is the differentiation is bigger. That means stego image will look more different and will be easier to be observed and differentiated with cover image.

Change in green component produce bigger PSNR value than change in red component. That means change in green component is harder to be observed than change in red component. But, change in green colors is easier to be observer per Christopher statement. The main problem of these two contradicting statements is the change is observed using different base.

Christopher research observed green change based on green colors. Christopher observed how observable green colors change using humans eyes. In other words how fast the color change when observed using human eyes. This paper observed how observable colors change when one part of the colors is changed. In other words how different the color change when observed using human eyes.

Christopher didn't pay attention to color space. Green component in RGB color space is located in middle. If the green component is located in the front part, which will make RGB to GRB, Christopher and this paper analysis will be the same that green component is easier to be observed using human eyes. Further work need to be done on this matter using images mainly in red, green, and blue.

VI. Conclusion

Three things can be concluded. First, image steganography in RGB color space will produce the best result if being done on blue component and will produce the worst result if being done in red component.

Second, Christopher and this paper method to compare observable is different. Christopher use previous generated color and this paper use cover image. Christopher didn't pay attention to color space and this paper paid attention to color space. So, which color component change easier to be observed is different.

Third, further work needs to be done on color component, color space, and it effects when used in steganography. For example what are the PSNR values of an image only consist of green colors used as cover image and the message is hidden to each component.

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Declaration

I hereby declare the paper is my own writing, not an adaptation, nor translation from another person paper, and nor a form of plagiarism.

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