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Hiding Information Using different lighting Color images

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Abstract. The host medium for the secret message is one of the important principles for the designers of steganography method. In this study, the best color image was studied to carrying any secret image. The steganography approach based Lifting Wavelet Transform (LWT) and Least Significant Bits (LSBs) substitution. The proposed method offers lossless and unnoticeable changes in the contrast carrier color image and imperceptible by human visual system (HVS), especially the host images which was captured in dark lighting conditions. The aim of the study was to study the process of masking the data in colored images with different light intensities. The effect of the masking process was examined on the images that are classified by a minimum distance and the amount of noise and distortion in the image. The histogram and statistical characteristics of the cover image the results showed the efficient use of images taken with different light intensities in hiding data using the least important bit substitution method. This method succeeded in concealing textual data without distorting the original image (low light) Lire developments due to the concealment process. The digital image segmentation technique was used to distinguish small areas with masking. The result is that smooth homogeneous areas are less affected as a result of hiding comparing with high light areas. It is possible to use dark color images to send any secret message between two persons for the purpose of secret communication with good security.

1. Introduction
Steganography as the hiding of a note within another so that the attendance of the hidden note is undetectable. The key notion behind steganography is that the note to be dispatch is not detectable to the casual eye. In fact, people who they are not contemplating to be the recipients of the note should not even suspect that a hidden note occurs [1].

The conflict between steganography and cryptography is that in cryptography, one can tell that a note has been encrypted, but he cannot decode the note without knowing the conflict key. In steganography, the note itself may not be hard to decode, but the most public would not detect the appearance of the note. When combined, steganography and cryptography can supply two levels of security. Computer programs exist which encrypt a note using cryptography and hide the encryption within an image using steganography [2].

1.1. LSB encoding
LSB-based programs rely on image encoding in the least significant bits per bytes in image data. By doing this, the value of each pixel is changed slightly, but not enough to make noticeable changes in the image by HVS. The 24-bit color image is used 3 bytes per pixel, so each pixel can be the 3-bit encoding of a secret message. The modified image looks identical to the human eye, even compared to
the original. However, the 24-bit images are very large and are not the common way to send images around the Internet, so the fact that they are too large would be suspicious. There is a 256 image color image, where 1 bytes are used per pixel. A 640 x 480 image of this quality will be able to store 300 kilobytes of data. With a large enough image, one could even hide an image within another image [3, 4].

1.2. Wavelet Transform and Lifting Scheme
DWT is widely used for analyzing signals, steganography art, compression, and noise reducing. DWT implements multiresolution analysis of the signals that have an adjustable location in each of space (time) and frequency domains. Because of a large number of calculations required, there have been many research efforts to improve DWT and give new fast algorithms that are used for performance DWT. The lifting scheme has numerous benefits compared with classical DWT [5]. LWT usually requires less mathematical operations compared with traditional approach convolution. LWT achievement does not require additional memory because of the in-place calculation features of the lifting. This is particularly suitable for the devices implementation of with a limited memory.LWT scheme submitted integer to integer transformation appropriate for lossless processing signal [6]

1.3. Perception the Color Vision
To realize the color requirements must be met are - :
1. There should be a variation or differences in the length of light waves that you receive in the visible eye Ocean.
2. There should be a variation in optical reflections surfaces.
3. There should be two or more of the deliverables (Receptors) differ in their impact positive lengths that make up visible light.

Thus, the color does not create subjective and objective impressions but affect our assessment and our perception of time, size, weight, heat and noise, if you can achieve good vision and catching colors for what they are relying on day-lighting [7].

1.4. Phenomena Affecting the Color Vision

1.4.1. Port Kenji Phenomenon
Is the change in the maximum degree of luster in the light spectrum visible color, from yellow to green, brighter with long waves such as red. This color loses its brightness by reducing the spotlight on it more than it loses from the gloss of a short-wave color, blue for example. Because the retina loses its sensitivity to the color red first, when you reduce the lighting ,it loses its sensitivity to green and blue colors. The color red seems to be more of the blue ,brighter lighting ,while blue has more shine in the light and dark. This phenomenon is named after the discoverer of the world [7].

1.4.2. Post-image phenomenon After Image Phenomena
Defined as the sensory image in memory and mind after the removal of the external alarm. If the eye has adapted to a particular color through the stare for some time and then shifts toward considering the surface of white or gray on a particular color, the color CMOS will appear on this surface. White Light Fallon if I stared factor or catalyst with a red color and this phenomenon is called the post-image and understanding of this phenomenon is a result of the stress-optic 10 Green will appear.

When adapted to the retina on a specific color such as red ,it censors the red color found in suffering from a temporary stress, and when replacing the catalyst red white, these censors 'response becomes more powerful and not detect the rays reflected from the College of the surface .At the same time, they are insensitive towards green work at full efficiency.
1.5 Estimation Contrast
It’s rare to see a solo and isolated color in the optic field as often noticed the existence of different colors happen simultaneously and instantaneously. This creates a visual effect and is strongly linked to the phenomenon posterior, an eye generates color for visual color and drops a drive toward the adjacent color or is imposed by it. It may be noted that the phenomenon of simultaneous contrast between the two colors of complementary or integrated happens through a simple experiment by taking gray and surrounding it with a red background colored box. We note that the color gray has become a distortion of the green color (color CMOS red color). Contrast is the difference in the optical properties that make the picture elements to distinguish between the different elements by the difference in color and lighting [7].

2. Methodology
A number of images were taken with different lighting depending on the sunlight at different times of the day ‘figure 1’ showing the different lighting images.

![Image with multiple views of the same scene with different lighting conditions.](image)

**Figure 1.** Different images with different contrast and lighting by using camera Sony

2.1. Hiding technique
A color image of size (110 * 100) pixels is hidden within host color image of different sizes (255 x 255) pixels and 400 x 400 pixels. The size of host image is increased with decreasing the number of LSB. The host image has been converted to the frequency domain using lifting wavelet transform technique (LWT). The process of replacing bits of host image bits with the secret image bits was done after converting both images to the binary system using Mat lab program techniques. (Tables 1), (table 2) and (table 3) show the runts of hiding secret image within different lighting host color images. ‘Figures 2’ ‘Figures 3’ showing the host images after performing hiding process and the secret message image.
Figure 2. Host images after hiding using 1 LSB for each pixel

Figure 3. Secret message or secret color image

Table 1. The properties statistical of image before and after hiding using 2 bits

| Image | Before hiding | std   | mean   | contrast |
|-------|---------------|-------|--------|----------|
|       | 255x255       |       |        |          |
| 1     | 0.0499        | 0.5337| 0.0936 |
| 2     | 0.0556        | 0.4683| 0.1187 |
| 3     | 0.0486        | 0.4758| 0.1021 |
| 4     | 0.0459        | 0.5046| 0.0910 |
| 5     | 0.0525        | 0.5105| 0.1028 |
| 6     | 0.0505        | 0.5310| 0.0952 |
| 7     | 0.0428        | 0.5178| 0.0826 |
| 8     | 0.0580        | 0.4942| 0.1174 |
| 9     | 0.1022        | 0.2445| 0.4179 |
| 10    | 0.1014        | 0.2884| 0.3515 |
| 11    | 0.1009        | 0.2660| 0.3794 |
12  0.0988  0.2710  0.3647  
13  0.0825  0.2333  0.3537  
14  0.0823  0.2431  0.3387  
15  0.0397  0.5384  0.0738  

Table 2. The properties statistical of image before and after hiding using 2 bits
(standard deviation, mean, contrast )

| Image 255x255 | After hiding using two bits size(110x110) | std   | mean   | contrast | SNR  |
|---------------|-----------------------------------------|-------|--------|----------|------|
| 1             |                                         | 0.0269| 0.4040 | 0.0665   | 8.5e-5|
| 2             |                                         | 0.0263| 0.3688 | 0.0712   | 8.5e-5|
| 3             |                                         | 0.0207| 0.3838 | 0.0540   | 8.5e-5|
| 4             |                                         | 0.0195| 0.4040 | 0.0482   | 8.5e-5|
| 5             |                                         | 0.0262| 0.4110 | 0.0636   | 8.4e-5|
| 6             |                                         | 0.0259| 0.4225 | 0.0613   | 8.3e-5|
| 7             |                                         | 0.0205| 0.4164 | 0.0493   | 8.4e-5|
| 8             |                                         | 0.0237| 0.3973 | 0.0596   | 8.1e-5|
| 9             |                                         | 0.0628| 0.2102 | 0.2989   | 8.3e-5|
| 10            |                                        | 0.0559| 0.2437 | 0.2293   | 5.3e-5|
| 11            |                                        | 0.0599| 0.2238 | 0.2678   | 5.2e-5|
| 12            |                                        | 0.0583| 0.2270 | 0.2568   | 5.3e-5|
| 13            |                                        | 0.0529| 0.2047 | 0.2584   | 5.3e-5|
| 14            |                                        | 0.0520| 0.2105 | 0.2473   | 5.2e-5|
| 15            |                                        | 0.0231| 0.4319 | 0.0535   | 8.5e-5|

Table 3. The properties statistical of image before and after hiding using 1 bits
(standard deviation, mean, contrast )

| Image 400x400 | Before hiding | After hiding using one-bit size message(110x110) | std   | mean   | contrast | std   | mean   | contrast |
|---------------|---------------|--------------------------------------------------|-------|--------|----------|-------|--------|----------|
| 1             |               |                                                  | 0.0495| 0.5301 | 0.0934 | 0.0408| 0.4409| 0.0926 |
| 2             |               |                                                  | 0.0557| 0.4666 | 0.1194 | 0.0359| 0.3945| 0.0910 |
| 3             |               |                                                  | 0.0488| 0.4742 | 0.1028 | 0.0407| 0.4084| 0.0997 |
| 4             |               |                                                  | 0.0458| 0.5030 | 0.0911 | 0.0411| 0.4305| 0.0955 |
| 5             |               |                                                  | 0.0524| 0.5086 | 0.1029 | 0.0419| 0.4475| 0.0936 |
| 6             |               |                                                  | 0.0504| 0.5297 | 0.0951 | 0.0458| 0.4674| 0.0980 |
| 7             |               |                                                  | 0.0427| 0.5162 | 0.0828 | 0.0455| 0.4538| 0.1003 |
| 8             |               |                                                  | 0.058 | 0.4926 | 0.1176 | 0.0418| 0.4284| 0.0975 |
| 9             |               |                                                  | 0.1017| 0.2434 | 0.4177 | 0.0766| 0.2202| 0.3479 |
| 10            |               |                                                  | 0.1009| 0.2868 | 0.3518 | 0.0753| 0.2579| 0.2918 |
| 11            |               |                                                  | 0.1007| 0.2650 | 0.3798 | 0.0766| 0.2373| 0.3226 |
| 12            |               |                                                  | 0.0987| 0.2699 | 0.3657 | 0.0752| 0.2412| 0.3116 |
| 13            |               |                                                  | 0.0823| 0.2322 | 0.3543 | 0.0626| 0.2123| 0.2948 |
| 14            |               |                                                  | 0.0820| 0.2419 | 0.3391 | 0.0635| 0.2202| 0.2885 |
| 15            |               |                                                  | 0.0397| 0.5368 | 0.0739 | 0.0521| 0.4791| 0.1087 |
From the above tables, the results of the statistical measures indicated that the characteristics of the images that were hidden in them replaced with one bit of each pixel is the closest to the original image statistics before hiding. While the images hidden in the replacement of two bits of each pixel notes that they were more affected by the process of concealment. It is also noted that the images that were taken in low lighting condition and high light condition are the best as host images compared to those where taken at medium lighting condition.

2.2. Minimum Distance Classification

For each feature image, the distances towards class means are calculated, the steps of minimum distance are:

1. detection the shortest Euclidean distance to a mean class;
2. If the user-defined threshold is larger than shortest distance to a class mean, then this class name is assigned to the output pixel.
3. Else the undefined value is assigned.

To apply the classification algorithm, 20 blocks of different image regions were cut out, ‘figure 5’ shows the blocks taken from the images.

The result of method classification showing in ‘Figures 6’ for images different lighting ‘figures 7’ and ‘figures 8’ showing the result classification method to host images after performing hiding process and the secret message image.

For the purpose of explain which regions are most affected by hiding using (1, 2) LSB, blocks of different image regions were cut out from homogeneous and heterogeneous regions as shown in ‘figure 9a’ and ‘figure 9b’. The properties histogram of homogeneous and heterogeneous regions was shown in ‘figure 10a’ and ‘figure 10b’.

Where we observe through the study of the histogram that the most affected regions of hiding are homogeneous regions, but heterogeneous regions less affected by the process of hiding.

Figure 4. Host images after hiding using 2 LSB for each pixel
**Figure 5.** The blocks of regions from different lighting image

**Figure 6.** Original images applying classification method
Figure 7. Host images after hiding using 1 LSB and applying classification method

Figure 8. Host images after hiding using 2 LSB and applying classification method
Figure 9. Region (a) homogeneous, (b) heterogeneous

Histogram for homogenous region for original image

Histogram for homogenous region for images after apply hiding

Figure 10 a. The histogram for homogenous region before and after apply hiding
Histogram for heterogeneous region for original image

![Histogram for heterogeneous region for original image](image1)

Histogram for heterogeneous region for image after apply hiding

![Histogram for heterogeneous region for image after apply hiding](image2)

Figure 10 b. The histogram for heterogeneous region before and after apply hiding

3. Conclusion
Steganography plays an important role in secret communication in digital worlds. The result of hiding show properties of images that were hidden in them replaced with one bit of each pixel is the closest to the original image statistics before hiding. While the images hidden in the replacement of two bits of each pixel notes that they were more affected by the process of hiding and to more secret using the images were lighting low. The result of classification method in this paper shows the smooth homogeneous areas are less affected as a result of hiding comparing with high light areas.

References
[1] Fridrich Goljan M Soukal D 2014 Searching for the Stego Key Proc SPIE Electronic Imaging Security Steganography and Watermarking of Multimedia Contents VI. \textbf{5306} pp 70–82
[2] Nivedhitha R 2012 Image Security using steganography and cryptographic techniques department of computers science & engineering Tamil Nadu India \textbf{3 3}
[3] Bouman C A 2013 Digital Image Processing
[4] Shalieder G 2012 Information hiding using Least significant bit stegaogy and cryptography department of electrical & electronics engineering YMCAUST Faridabad India \textbf{V 6} pp 27-34
[5] Salehi S A Amirfattahi R 2011 VLSI Architectures of Lifting-Based Discrete Wavelet Transform Isfahan University of Technology
[6] Acharya T Chakraabati C 2006 A Survey on Lifting-based Discrete Wavelet Transform Architectures \textit{Springer} \textbf{42} 3 321-39
[7] Frank M H and Rudolf M 1987 Color and Light in man –mad Environments New York 28-9