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Comparative Analysis of Image Steganography Using Wavelet Transform and Statistical Methods

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Abstract— In this paper Comparative analysis of Image Steganography using Wavelet Transform and Statistical parameters is described. Steganography is the art and science of hiding the secret message, existence of data in another communication medium. The word Steganography is a Greek origin and means "concealed writing' from the Greek words steganos meaning "covered or protected" and graphic meaning "writing". The first term Steganography was used in 1499. In this paper we used DWT (Discrete Wavelet Transform). This method provides satisfactory imperceptibility and robustness.

Keywords-Steganography; Skin tone detection; DWT; IWT, Statistical Methods, Fusion process.

I. INTRODUCTION

In this paper Comparative Analysis of Image Steganography using Wavelet Transform is described. Steganography is the method of hiding secret data in such a way that no one apart from the sender and intended recipients, known the existence of the message. Steganography method provides good security and secret Communication. Steganography method provides secure communication and better security. Steganography is a fantastic and effective method of hiding data. This technique employed error detection and correction coding technique to increase robustness which has excellent PSNR and high level of security [8]. Image Steganography technique that depends on wavelet transform with acceptable levels of imperceptibility and distortion on the cover image with high levels of overall security [5]. This method introduces DWT, IWT, and Skin Tone Detection and also satisfactory PSNR and MSE are obtained. a high capacity method form transform domain image steganography and this algorithm works on the wavelet transform coefficients of the original image to embed the secret data by retaining the integrity of the wavelet coefficients at high capacity embedding[9]. Evaluation process obtained fusion quality and achieved fused image looks very similar to the original one with excellent PSNR with high levels of security [7].
This paper is organized in the following sections. Methodology, Embedding and Extraction process, Result.

II. METHODOLOGY

A. Skin color Tone Detection

Skin detection means detecting image pixels and regions that contain skin tone color. We also adjust human skin tone values within the permissible value ranges, to embed secret data without introducing artifact on the carrier image. A Skin detector typical transforms a given pixel into an

appropriate color space and then uses skin classifier to label the pixel whether it is a skin or nonskin pixel. A Skin classifier defines decision boundary of the skin class in color space.

B. Discrete Wavelet Transform (DWT)

DWT is a multiresolution decomposition of a signal. The DWT for which wavelets are discretely sampled. DWT is a frequency domain in which steganography can be implemented. DWT offers better energy compaction than DCT therefore DWT method is used. DWT applies on entire image. In DWT decomposes signal into a set of basis functions. These Basis function is called Wavelets. The Discrete Wavelet Transform was developed to apply the wavelet transform to the digital world. DWT has been employed in order to preserve the high frequency components of the image in to different sub band images, namely LL, LH, and HL, HH. High frequency sub band contains the high frequency components of the image. Following figure shows the Discrete Wavelet Transform (DWT).

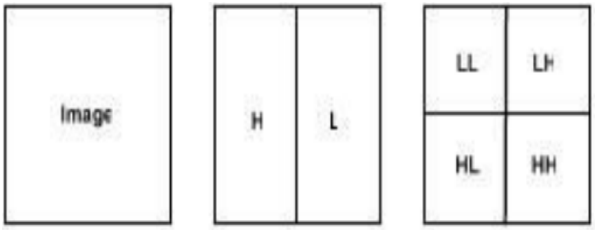

Figure 1. Discrete Wavelet Transform

C. Integer Wavelet Transform

Generally wavelet domain allows us to hide data in regions that the human visual system (HVS) is less sensitive to, such as the high resolution detail bands. (HL, LL and HH). Hiding data in these regions allow us to increase the robustness while maintaining the good visual quality. Integer Wavelet Transform maps an integer data set into another data set. To avoid problems with floating point precision of the wavelet filters, we used Integer Wavelet Transform.

III. EMBEDDING AND EXTRACTION PROCESS

A. Embedding and Extraction process of Skin Tone Based steganography:

1. Select the input image.
2. Convert the input image rgb2hsv and apply equation to detect the skin pixel of the image.
3. Apply median filter for skin detected image.
4. Crop the skin part of the image, and separate the R G B Panels.
5. Apply Discrete Wavelet Transform for B panel cropped skin image.
6. Select the logo image.
7. Embedded the logo in high frequency (HH) components DWT.
8. Apply Inverse Wavelet Transform to reconstruct the image.
9. Merge the reconstructed image with original B-Panel and reconstruct into color image.
10. Validate PSNR and MSE between Input and Stego image.
11. For Extraction select the stego image and apply reverse process to get logo.

B. Embedding Process of Dual Transform Based Steganography using Wavelet Transform:

1. Read the cover image. Convert the skin pixel of cover image into a gray scale image.
2. Apply image preprocessing to get grayscale cover image.
3. Read the secret image. Apply image preprocessing on the secret image.
4. Apply DWT/IWT transform technique into a cover grayscale and secret grayscale image.

5. Apply Fusion Process on grayscale cover image and secret image to get fused image.
6. Finally perform IIWT/IDWT on fused image to get stego image.

C. Extraction Process of Dual Transform Based Steganography using Wavelet Transform:

1. Receive the stego image performs IWT/DWT on both stego image and cover image.
2. Apply Fusion process on both stego and cover image to get fused image.
3. Take inverse IIWT/IDWT of the fused image then to get reconstruct secret image.

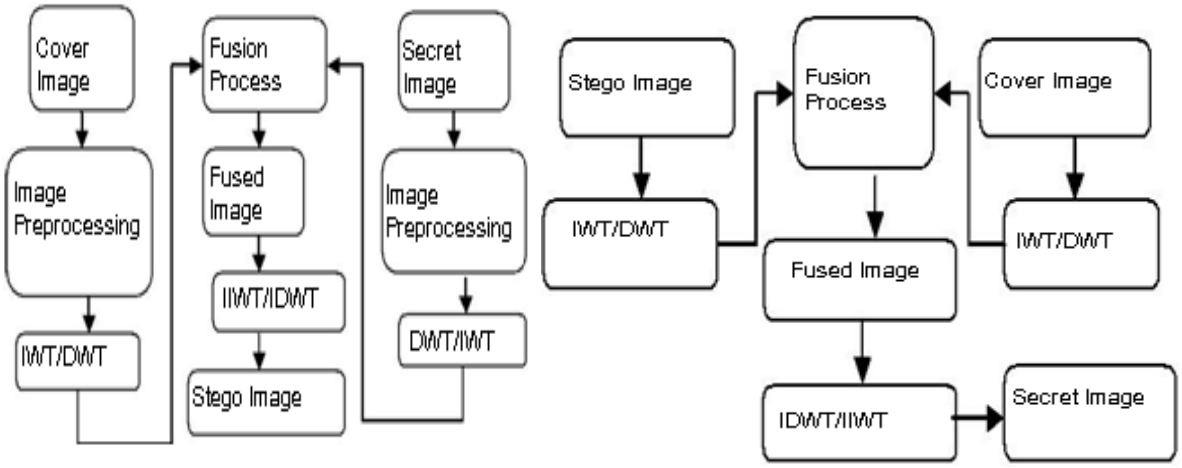

Figure 2. Flow Chart of Dual Transform Based Steganography 1. Embedding process, 2. Extraction process

IV. RESULT

MATLAB is the high performance language for technical computing. Results have been implemented using MATLAB. Here we are going to perform Image Steganography using Wavelet Transform and Statistical parameters. Representation of Cover image cover.jpg and Secret image secret.jpg are considered. PSNR and MSE are calculated. PSNR is used to measure the quality of the reconstructed image which is expressed in decibels (db) and MSE is the mean square error representing the difference between original image and stego image. RESULT 1 Show the Skin Tone Based Steganography. Result 2 shows Dual Transform Based Steganography using Wavelet Transform.

A. RESULT

1. Skin Tone Based steganography

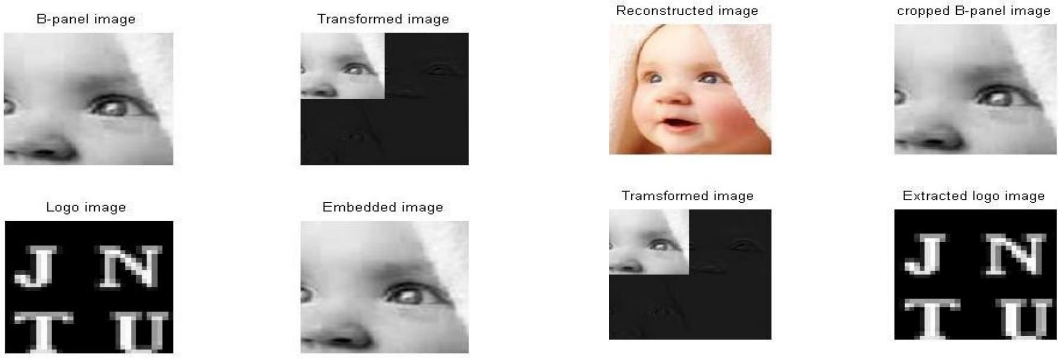

Figure 3. Skin Tone Based steganography

B. RESULT

2. Dual Transform Based Steganography

Figure 3. Combination of DWT and DWT of Embedding process and Extraction process

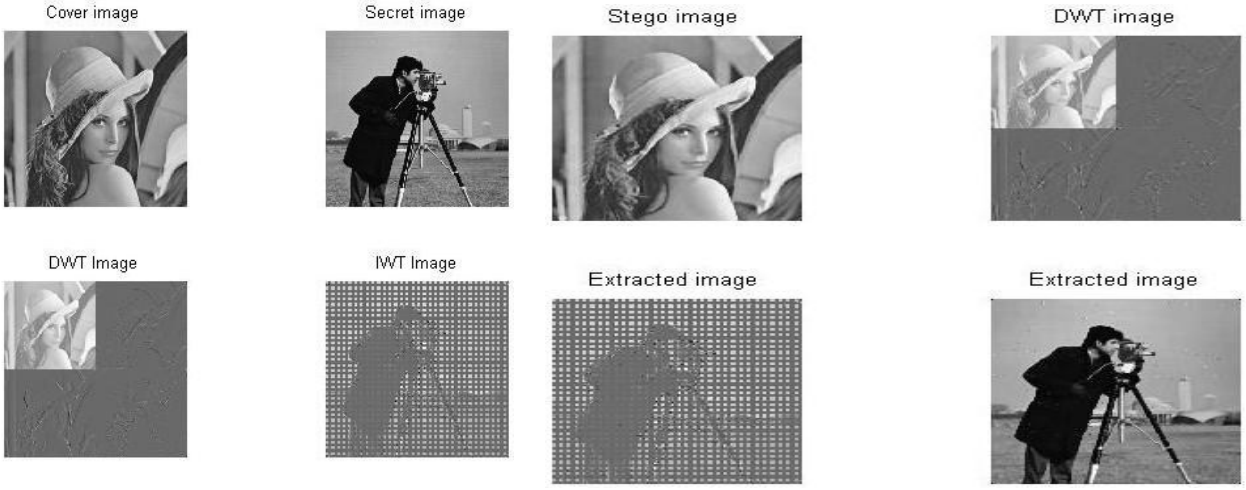

Figure5. Combination of DWT and IWT of Embedding and Extraction process

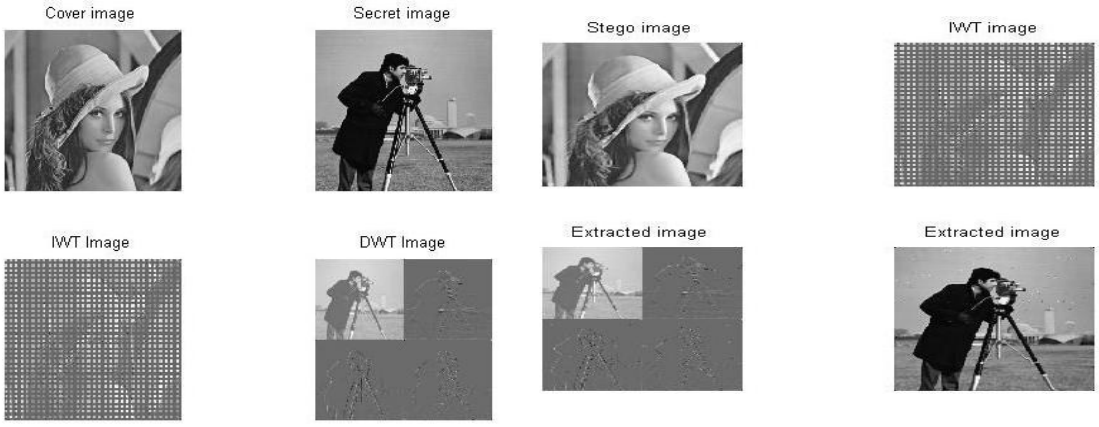

Figure 6. Combination of IWT and DWT of Embedding and Extraction process

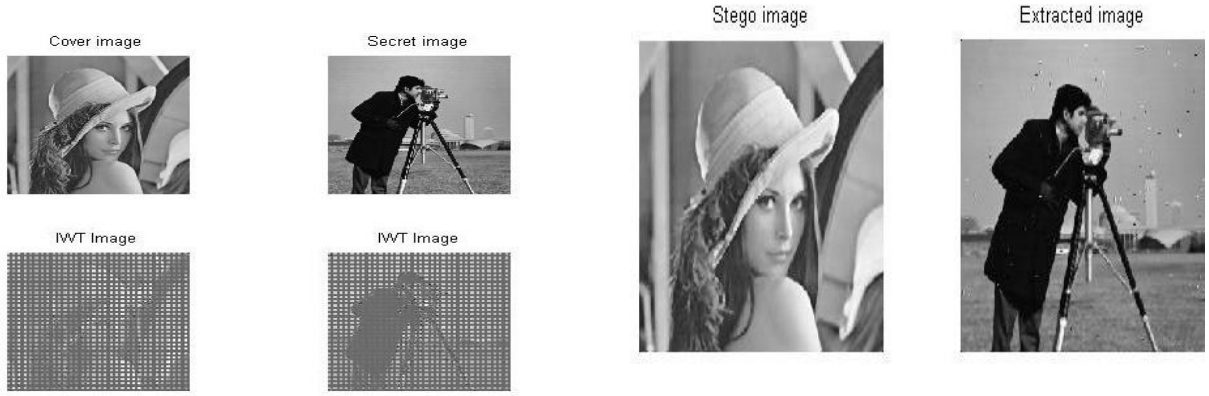

Figure 7. Combination of IWT and IWT of Embedding and Extraction process

TABLE 1. Skin Tone Based Steganography

Images	PSNR	MSE
Image 1	69.510419	0.007278
Image 2	74.042510	0.002563

D. Dual Transform Based Steganography with respect to Statistical Parameters

Table 2. Dual Transform Based Steganography

Cover image	Secret image	PSNR	MSE	NCC	AD	SC	MD	NAE
Cover.jpg DWT	Secret.jpg DWT	37.2137	12.3513	0.9926	-0.5337	0.9917	11	-0.0043
Cover.jpg DWT	Secret.jpg IWT	37.2137	12.3513	0.9926	-0.5337	0.9917	11	-0.0043
Cover.jpg IWT	Secret.jpg DWT	37.4062	11.8158	0.9926	-0.5316	0.9917	11	-0.0043
Cover.jpg IWT	Secret.jpg IWT	34.6841	22.1143	0.9926	-1.3648	0.9787	10.3600	-0.0109

(PSNR= Peak Signal To Noise Ratio), (MSE= Mean Square Error), (NCC= Normalized Cross Correlation), (AD= Average Difference), (MD= Maximum Difference), (NAE= normalized Absolute Error)

V. CONCLUSION

All types of Steganography techniques provide high imperceptibility and robustness. The performance of Comparison of Image Steganography using Wavelet Transform is described. And Statistical parameters are calculated. Skin Tone Based Steganography PSNR value ranged between 65-80 and in Dual Transform Based Steganography PSNR value ranges from 35-50. Our method is applicable for information hiding, secret communication, medical systems, and military application.

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