Performance Analysis of DWT-SVD-AES Watermarking

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Abstract
In this paper, the effects of various error rectification codes on the robustness of (DWT) Discrete Wavelet Transform, (SVD) Singular Value Decomposition based hybrid watermarking scheme and AES encryption is investigated. The performance of the proposed system is calculated in terms of number of signal processing attacks by changing the strength of watermarking and covers image resources. The experimental results signify that this proposed system provides better robustness without impress the quality of watermarked image. This proposed system combines the advantages and removes the drawback of the two transform techniques. It demands serious protection of user's privacy for all applications. Therefore image encryption and decryption techniques are usually used to avoid intrusion attack. It is found that the hybrid code achieves better outcome in terms of robustness.

Keywords
Discrete Wavelet Transforms, Singular Value Decomposition, Advanced Encryption Standard

I. Introduction

A. Watermarking

A watermark is an recognize image or design in paper that appears as various shades of lightness/darkness when viewed by transmitted caused by thickness or density differences in the paper. Watermarks vary greatly in their visibility [7]; while some are obvious on casual inspection, others needs some study to pick out. Many aids have been developed, such as watermark fluid that wets the paper without hurtful it. Watermarks are often used as security features of banknotes, passports, postage stamps and other government documents to prevent counterfeiting. A watermark is very useful in the interrogation of paper because it can be used for dating, recognize sizes, mill trademarks and locations, and determining the quality of a sheet of paper.
The watermarking technique is classified into two domains (i) Spatial domain (LSB substitution, spread spectrum etc.) are simple but are not robust against different attacks [7]. (ii) Transform domain (DFT, DWT, DCT, and SVD etc.) [8] are more robust against attacks but the computational complexity is higher than that of spatial domain methods. However transform domain is more preferred then spatial domain.

B. Algorithm in Digital Watermarking

(i). DWT (Discrete Wavelet Transform)

The DWT is a powerful and useful multi-resolution decomposition method in digital watermarking [4]. It is often useful on image processing, and has been functional to such as noise reduction, edge detection, and data compression. The transform is based on small waves known as wavelets of diverse, frequency and limited duration [3]. Wavelet transform provides frequency and spatial description of an image together. The DWT splits the signal into high and low frequency parts. The high frequency part accommodates information about the edge elements, while the low frequency part is separating again into high and low frequency parts. The high frequency elements [4] are usually used for watermarking since the human eye is fewer sensitive to changes in edges.

C. SVD (Singular Value Decomposition)

The SVD matrix is very useful in computer vision as a decomposition matrix [3] and it is an accomplished tool for image transformations. The SVD of a given image F in the form of a matrix is describe as
$F=USV^T$
Where, S is the diagonal matrix, U and V are the orthogonal matrices.

D. AES (Advanced Encryption Standard)

AES is mainly developed version of data encryption standard (DES). The Data Encryption Standard (DES) is feeble due to smaller key size, 56 bit. Whereas AES is use key sizes, 128 bit. The encrypted image is made highly secured by using an AES stream cipher [5]. Although a data-hider does not identify the input image content, he can embed additional data into the encrypted image using the data hiding key [2]. A recipient may firstly decrypt the encrypted image using the encryption key. This decrypted image is homogeneous to the input image. With the data-hiding key, the embedded data can be correctly extracted while the original image can be completely recovered. This is shown in the following block diagram [2].

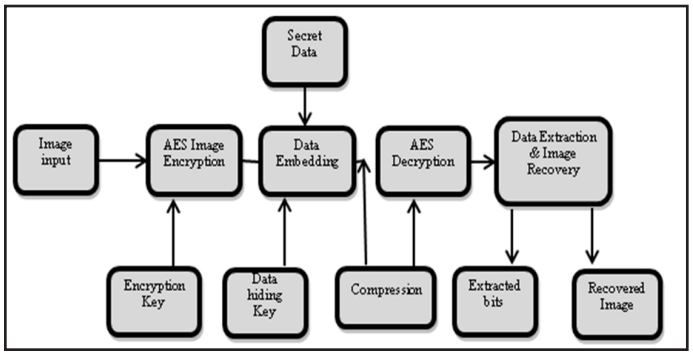

Fig. 1:

II. Related Work

Robust and Imperceptible Dual Watermarking for Telemedicine Applications
In this paper, the effects of different imperfection correction keys on the robustness and imperceptibility of DWT and singular value decomposition rooted dual watermarking scheme is investigated.

III. Proposed Methodology

In the contemporary technology digital images plays more effective role than the traditional texts. It demands serious protection of user's privacy for all applications. Therefore image encryption and decryption techniques are usually used to avoid intrusion attack

A. Encryption Process

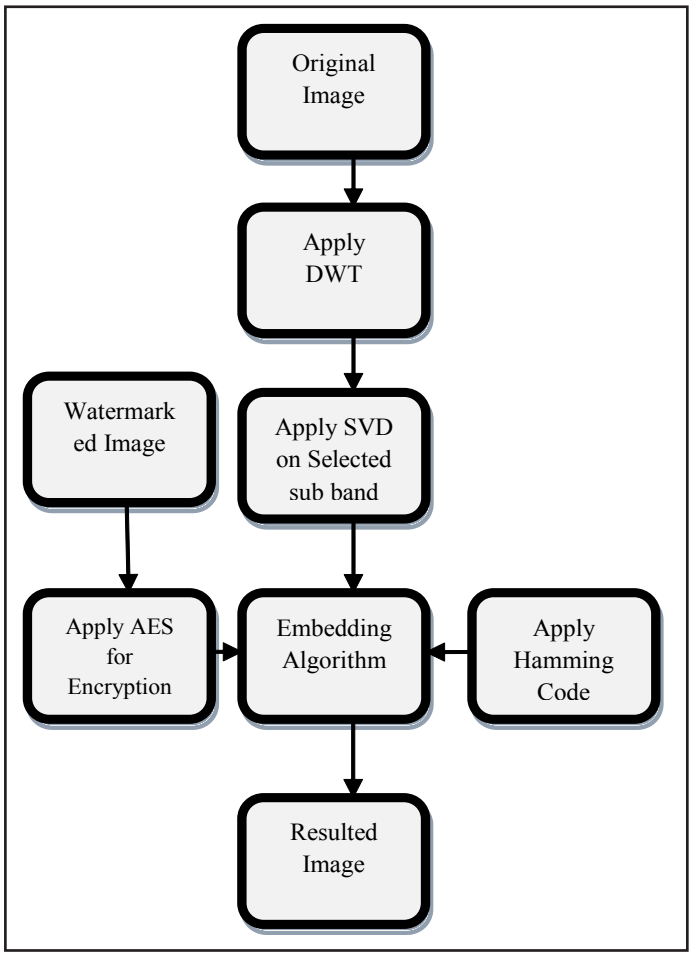

Fig. 2:

B. Decryption Process

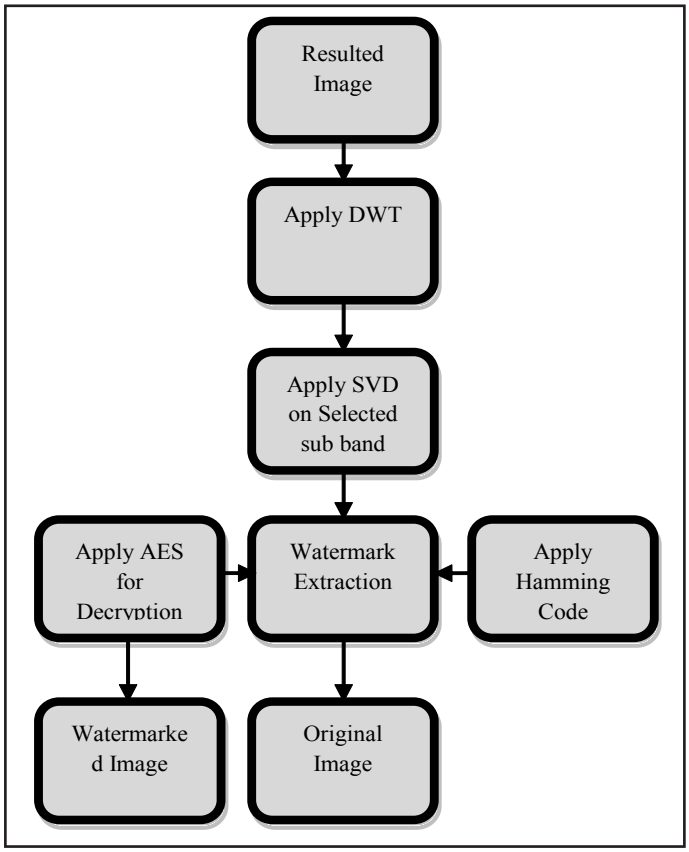

Fig. 3:

IV. Implementation

In this paper, the proposed watermarking algorithm is simulated using MATLAB R2009a. The following steps are using to implement our work -

1. First we apply DWT on the input image Lena of size 512x512. The decomposition of Lena image is shown in figure –

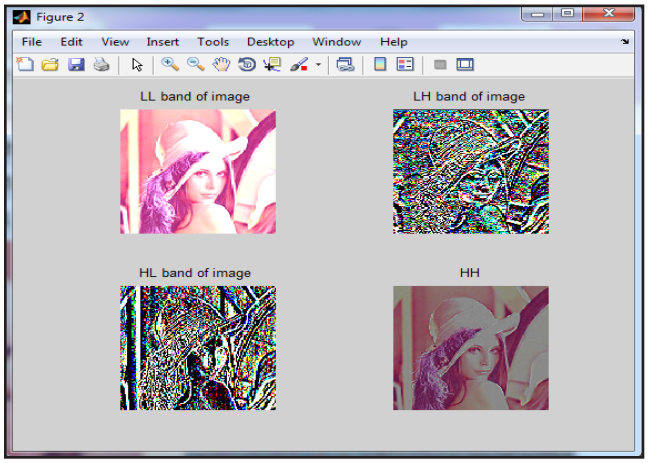

Fig. 4:

2. Now we apply SVD on the selected sub-band.

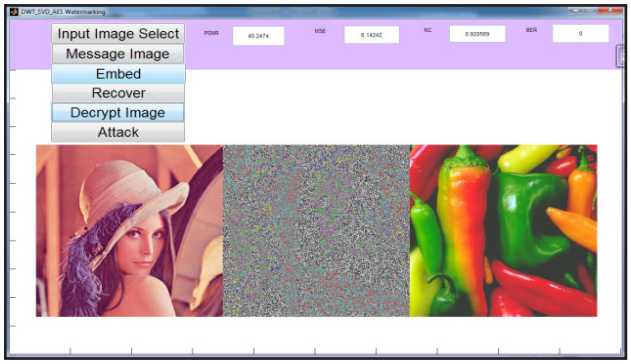

Fig. 5:

3. Now there is the embedding process takes place in which we give the image to be watermarked and we apply AES algorithm [2] for security of the embedded watermarked image and finally we get the watermarked image. PSNR, NC and BER is calculated on gain factors,and results are noted accordingly.

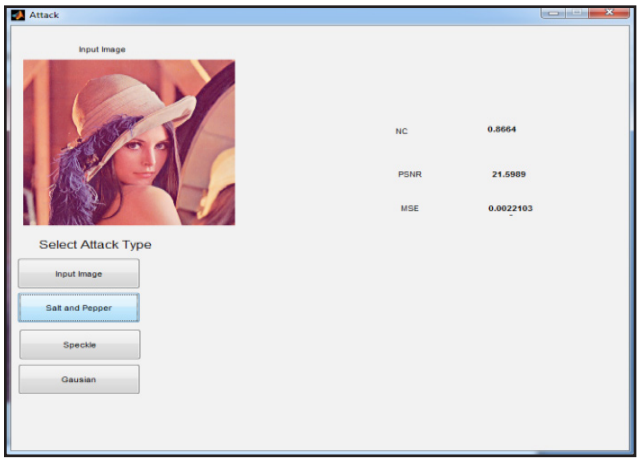

Fig. 6:

4.Watermark image is tested against various attacks like Salt and Pepper, Gaussian filter, Speckle [5] etc.

V. Result Analysis

A. Experimental Results

In this paper watermarking method is based on DWT-SVD and to provide the secure image transmission, we used AES algorithm. The result shows in Table 1 value of PSNR is 48.361 at gain factor k=0.1 is higher than other which shows that the quality of resultant image is better.

Table 1:

GAIN FECTOR (k)	PSNR	MSE	NC	BER
0.1	48.361	0.9483	0.9196	0
0.3	45.744	1.7327	0.9176	0
0.5	43.511	2.8974	0.9156	0
0.7	41.856	4.2411	0.9136	0
0.9	40.703	5.5309	0.9116	0

B. Comparison of Parameters With Attacks

We take Lena as Input image and compare all parameters with attack and without attack, which shows is Table 2

Table 2:

ATTACKS	PSNR	NC VALUE	MSE
No Attacks	48.361	0.9196	0.9483
Salt and Pepper	21.5989	0.86658	0.00221
Speckle Attack	22.5191	0.860358	0.00204
Gausian Attack	22.7029	0.868093	0.00176

In without attack condition, highest NC value and when we take with attack condition, the value of NC is higher in Gausian Noise which shows image is more robust than others.

VI. Conclusion

In this paper, we proposed a new outlook for watermarking. We have developed a robust hybrid watermarking algorithm based on DWT-SVD-AES. The DWT and SVD are recent techniques used for watermarking so their blending makes a very attractive watermarking technique. The DWT is very suitable to recognize areas in the cover image where a watermark can be imperceptibly embedded. So the proposed hybrid procedure improves the robustness and imperceptibility [1] as differentiate to DWT and SVD applied separately. In order to make the data secure, AES is added for encryption [2]. Proposed algorithm combines the benefits and removes the drawbacks of these two most popular transforms namely DWT and SVD. We have embedded two watermarks instead of single watermark into same multimedia item which have great benefits on many applications such as telemedicine. We would like to further improve the presentation, which will be reported in future communication.

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