Global Journal of Computer Science and Technology: F
Graphics & vision
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Non Blind Watermarking Process using RSA Encryption Method

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Abstract- With the growth of technology and continuous rapid improvement in this field, the digital content took an important role in this current era of time. Online transactions keep growing in many parts of the world. As a result it becomes the prime target for hackers and intruders. Consequently security of data has become a critical issue for experts. In this paper a robust algorithm is proposed in watermarking image to secure the digital data. The proposed algorithm is based on SVD-DWT with Harr Wavelet Transform (HWT) for embedding and extracting a digital watermark in an image. The experimental result shows that this technique is robust against few attacks like Gaussian, average and JPEG compression.

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GJCST-F Classification : E.3, C.2.0

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I. Introduction

Digital content become more available than ever in the daily use of our life due to the increase and easy access of internet. E-commerce becomes more popular in the recent time as trading habit of people has changed. As a result cyber security becomes important factor to protect the digital content from unauthorized access and temperament. Digital watermarking has an important role in this context. In digital watermarking process secret information is embedded in the original content without or insignificant distortion of cover data to identify the authentication and protect the copyright of the author and tracing back the distribution.

There are two techniques available for watermarking process. One is spatial domain approach and other is frequency domain schemes [1]. Though the later one is more robust than the prior one against image processing attacks like compression or cropping [1][2]. The frequency domain approach mainly use discrete Fourier transform (DFT), discrete cosine transform (DCT), discrete wavelet transformation (DWT) and others. The discrete wavelet transformation (DWT) based on singular value decomposition (SVD). In this approach the image is embedded into the transformed coefficients.

On the other hand in spatial domain approach the image is processed in the form of matrix. These techniques are comparatively easier to implement. Though there is a tradeoff between robustness and easier implementation. A good watermark should be invisible into the cover image so that it does not attract intruder. The perceptibility of the image should be good after embedding. It also should be robust under different types of attack [4] and if it is altered then watermark should be recovered.

The Discrete Wavelet Transformation (DWT) combined with Singular Value Decomposition (SVD) is one of many effective methods that researchers use for signal processing for the purpose of watermarking technique. The Harr Wavelet Transform (HWT) is simple and widely used for signal processing.

In this paper a non-blind watermarking algorithm is used for embedding and extracting image in the frequency domain. The proposed method used RSA algorithm to encrypt the secret message before embedding it into the cover image. The cover and the secret images are decomposed using the Harr DWT and encrypted secret image into four sub band (CLL_3 , CLH_3 , CHL_3 & CHH_3) and (SLL_3 , SLH_3 , SHL_3 & SHH_3). After that Apply SVD to CHL_3 & SHL_3.

$$(C_u , C_d , C_v) = \text{SVD } (CHL_3)$$
$$(S_u , S_d , S_v) = \text{SVD } (SHL_3)$$

This paper has been organized as follows: section 2 explains the Haar Wavelet Transform (HWT), section 3 is the review of related works, section 4 is the proposed method used in this paper, section 5 is the analysis of the result and conclusion is drawn in section 6.

II. Haar Wavelet Transform (HWT)

Haar wavelet transformation (HWT) is used to decompose signal. When it decomposes a signal it does it into two components [5].

The Haar wavelet's mother wavelet function ψ (t) can be denoted as:

$$\psi(t) = \begin{cases} 1 & 0 \le t < \frac{1}{2}, \\ -1 & \frac{1}{2} \le t \quad , \\ 0 & otherwise, \end{cases} \qquad (1)$$

Its scaling function ϕ(t) can be described as:

$$\phi(t) = \begin{cases} 1 & 0 \le t < 1, \\ 0 & \text{otherwise.} \end{cases}$$

After decomposing an image using HWT it produce four sub-bands LL, LH, HL and HH [6].

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III. Review Literature

Jing and Jen-Ho used a halftone watermarking method with kernels-alternated error diffusion and haar wavelets transform [7]. Mais and Hassan proposed phase-shifting 2-D no separable Haar wavelet coefficients [8]. Chen and Jiun proposed watermarking scheme for 3d models using haar discrete wavelet transform [5].

a) Algorithm for Embedding Formula

1. Read secret image and cover image
2. Encrypt the secret image using RSA algorithm with a key
3. Use three levels Haar DWT to decompose the cover image and encrypted secret image into four sub bands (CLL_3 , CLH_3 , CHL_3 & CHH_3) and (SLL_3 , SLH_3 , SHL_3 & SHH_3)
4. Apply SVD to CHL_3 and SHL_3
   a. $(C_u , C_d , C_v) =$ SVD (CHL_3)
   b. $(S_u , S_d , S_v) =$ SVD (SHL_3)
5. Add diagonal matrix (C_d) with the another diagonal matrix (S_d) using the following equation:
   c. $M_d = C_d + \alpha \times S_d$
   d. Where M_d is a modified diagonal matrix and α is a scaling factor which is used to control the strength of watermark.
6. Apply inverse SVD to the matrixes M_d , C_u , C_v to get modified band (M_b).
7. Obtain watermarked image by applying inverse DWT on one modified band (M_b) and other non-modified band.

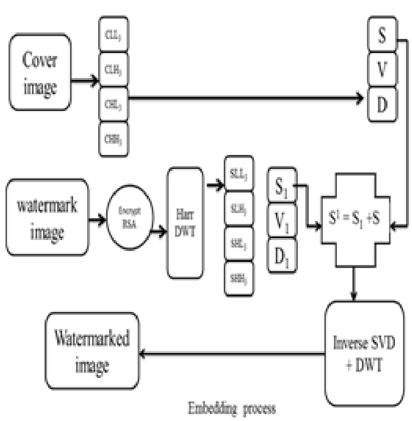

Figure 1 : Embedding process

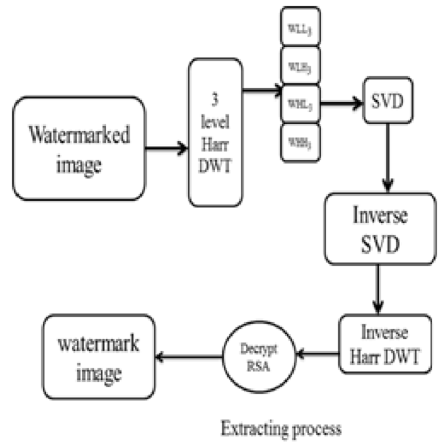

Figure 2 : Extracting process

b) Algorithm for Embedding Formula

1. Read Watermarked image
2. Apply three levels Haar DWT to decompose watermarked image into four sub bands (WLL_3, WLH_3, WHL_3 & WHH_3) .
3. Apply SVD to WHL_3

$$(W_u, W_d, W_v) = \text{SVD } (WHL_3)$$

4. Compute the extracted diagonal matrix (E_d) using the following equation:

$$E_d = (W_d - C_d)/ \alpha$$

Now apply inverse SVD, inverse Haar DWT and decrypt RSA algorithm to get secret image which is called watermark image.

IV. Experiment Result

The proposed algorithm has been tested to check its robustness against some image attacks. The watermarked image went through few attacks to experiment the result. The obtained results are measured to observe its performance with the peak signal to noise ratio (PSNR) and normalized correlation (NC) criteria. The table1 illustrates the PSNR values for correlation between watermarked image and compromised image. Higher PSNR ratio indicates the better quality of the image. It also shows the NC values between original watermark and extracted watermark after being attacked. Higher the NC values better is the robustness of watermark. The higher ratio also indicates the better perceptibility of the image which is extracted after being attacked. The proposed algorithm performs better under the attack of Gaussian, average and JPEG compression.

Figure 3 : watermarked image

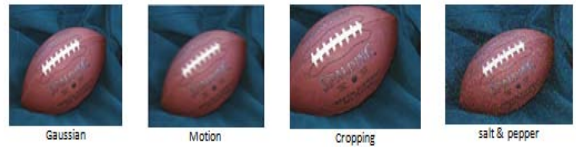

Figure 4 : Different types of attacks

Attack	PSNR	NC
Gaussian noise(.01)	48.9993 db	1.0
Gaussian noise(.02)	47.3897 db	1.0
Gaussian noise(.03)	46.9999 db	1.0
Salt and Pepper	49.1797 db	.9999
JPEG compression	51.4063 db	.9124
Rotation	48.6328 db	.8956
Cropping	37.6572 db	.9234
Motion	36.4215 db	.9289
Average	55.2135 db	1.0

Figure 4 : Performance of PSNR and NC

V. Conclusion

In the proposed algorithm of this paper we have used the DWT-SVD with Haar Wavelet Transform (HWT) technique for watermarking procedure. We have tested the algorithm by analyzing the result received from experiment. The obtained data clearly indicates the better perceptibility of the extracted image which went through different attacks. It also proves the robustness of the proposed algorithm used in this paper. In future experiment we will focus our concentrate for different methods to improve the robustness of the algorithm.

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