Volume 5, Issue 1, January 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

SVD Based Dual Watermarking of Images

Saniya Luthra, Kiran Jot Singh
Dept. of Electronics & Comm. Engg.
CGC Group of Colleges, Gharuan
Mohali, Punjab, India

Abstract: As the technology is advancing day by day we can easily get any media file like images, video, audio etc. from the internet. To prove the rightful possessor ship of media files we have a technology known as Digital Watermarking. In this paper the dual watermarking in an image is proposed using Block SVD and Non Block SVD technique. The first watermark used is the output of edge detection technique applied to the real image using Non block SVD. The second watermark used is inserted using Block SVD scheme. Both the watermarks are embedded using Singular Value Decomposition (SVD) technique but in different manner. Experiments show that the proposed image watermarking scheme is more robustous to Gaussian, Salt & Pepper, Rotation & Compression attacks.

Keywords: Edge Detection, Non Block, CC, Robustousness, Singular Value Decomposition.

I. INTRODUCTION

As the growth of information technology has expanded to greater extent, one can easily get any media files from the internet. But the basic need is to prevent these from the unauthorized users commercially. As the technology has advanced it's very easy to manipulate the images and can be misused. So to prevent media files from different types of attacks we have a technique known as watermarking. Watermarking can be defined as the process of embedding information in media files for authentication purpose which can be extracted later on. Watermarking helps to prove the rightful possessor ship of the object. The watermark added can be either visible or invisible. Images can be processed into two main approaches as spatial domain & frequency domain. The main issues in the watermarking scheme are that the watermark should not degrade the quality of image and should not be perceptual to human eye [2]. In this paper, the author has embedded dual level watermarking in image to make it more robustous. Firstly the image to be watermarked undergoes through edge detection process. The result of this is considered as the watermark1. Then this watermark1 is embedded using technique Traditional SVD. Secondly any other image is added to the above result using Block by Block SVD technique.

Edge Detection identifies object boundaries within images. It significantly reduces amount of data, leaving unnecessary information and preserving the necessary data. It works by detecting discontinuities in brightness. There are many edge detection techniques like Sobel, Canny, Prewitt, Roberts. But the technique used in this paper is Canny as it provides us with large number of edges [8].

SVD is a mathematical technique that returns a vector of singular values. The main advantage of SVD technique is stability. When a small amount of information is added, large variation in real image does not occur. So this property is also useful in maintaining the non perceptibility of the watermark [4].

Section 1 describes the introduction of the related work. In Section 2 objectives of digital watermarking are defined. Section 3 tells about the related work done. The techniques used for watermarking are explained under Section 4. Section 5 defines the proposed algorithm steps. Section 6 shows the Experimental Results. Final Conclusion is described under Section 7.

II. OBJECTIVES OF DIGITAL WATERMARKING

Digital Watermarking is used for hiding the information that will be useful for ownership's identity to prove the copyright protection. The proposed work is done to compensate for the security and protection application issues. It also helps to prevent the illegal duplicating, interpolating & distributing the digital content technically. And to improve the robustousness of watermark so that it can be retained even after several attacks .Lastly to improve the Peak Signal to Noise Ratio.

III. RELATED WORKS

Liu et al. [1] have proposed SVD scheme for watermarking. In this algorithm watermark is added to the SV's of the whole image or a part of it. A single watermark is used in this scheme which may be lost due to attacks. To avoid this disadvantage, we propose an approach in which, the real image is segmented into blocks and the watermark is added to the SVs of each block in a modified manner. *Y.N.Song & T.N.Tan* [3] compared different methods and found out that those watermarking schemes that need the real image for extraction process are more robustous than those who do not need the real image. And the Domain Spatial methods are much faster than the Transfer Domain. Dacheng Xu [7] has

embedded two watermarks in image to make it more robustous. The method used is image segmentation and weighted linear function codec technology. Transformations used for embedding watermark are DWT and SVD.

IV. PRILIMINARY BASICS

Introduction to singular value decomposition

4.1 METHOD 1: TRADITIONAL SVD EMBEDDING PROCESS

The SVD on an image is done to obtain two orthogonal matrices U and V and a diagonal matrix S. In this approach which was proposed by Liu et al., the watermark W is added into the matrix S then again SVD process is performed on the new matrix (S+W) to get U_w, S_w, V_w. Then the watermarked image Fw is computed by multiplying the matrices U, S_w and V^T. The steps of embedding watermark are summarized below:

1. Load the real image and perform SVD on it (F Matrix).
$$\boldsymbol{F = USV^T} \quad (1)$$
2. The watermark image (W matrix) is added to the SVs of the real matrix.
$$\boldsymbol{D = S + W} \quad (2)$$
3. Obtaining the new modified matrix (D Matrix), perform SVD on it.
$$\boldsymbol{D = U_W S_w V_W{}^T} \quad (3)$$
4. The watermarked image (F_w matrix) is obtained by using the modified matrix (S_w matrix).
$$\boldsymbol{F_W = US_W V^T} \quad (4)$$

EXTRACTION PROCESS

To extract the watermark, the above steps are followed in reverse manner:

1. The SVD is performed on the possibly distorted watermarked image ($\boldsymbol{F_w^*}$matrix).
$$\boldsymbol{F_w^* = U^* S^*{}_W V^{*T}} \quad (5)$$
2. The matrix that includes the watermark is computed.
$$\boldsymbol{D^* = U_W S^*{}_W V_W{}^{*T}} \quad (6)$$
3. The possibly corrupted watermark is obtained.
$$\boldsymbol{W^* = (D^* - S)} \quad (7)$$

The * refers to the corruption due to attack.

4.2 METHOD 2: BLOCK BY BLOCK SVD

In this algorithm firstly we take an real image which is divided into blocks (e. g 8x8). And then we take a image which is to be used as watermark and divide this watermark image as well into blocks as above (8x8). Perform SVD on the real image as well as watermark image. Using the singular values of the matrices, combine the blocks to form the watermarked image [4]. The steps to be followed for embedding the watermark are as follows:

1. Divide the real image into non overlapping blocks.
2. Perform SVD on each block of the real image to obtain the singular values of each block (S_m).
Where m=1,2,3…….N.
N = number of blocks.
$$\boldsymbol{O_m = U_m S_m V_m{}^T} \quad (8)$$
3. Add the watermark image (W_i) to S matrix of each block.
$$\boldsymbol{A_m = S_m + W_i} \quad (9)$$
where **i** is the intensity
4. Perform SVD on each A_m matrix to obtain the SVs.
$$\boldsymbol{A_m = U_{wm} S_{wm} V_{wm}{}^T} \quad (10)$$
5. Use the SVs of watermark image to build the watermark image.
$$\boldsymbol{O_m = U_{mS_{wm}} V_m{}^T} \quad (11)$$

EXTRACTION PROCESS

Following steps could be followed to get the image:

1. Divide the watermarked image into blocks having the same size used in embedding process.
2. Apply SVD on each watermark block (O_{wi}).
$$\boldsymbol{O_{wi}{}^* = U_m{}^* S_{wm}{}^* V_m{}^*} \quad (12)$$
3. Using U_{wm}, V_{wm}, S^*_{wm} obtain the matrices that have the watermark.
$$\boldsymbol{A_m{}^* = U_{wm} S_{wm}{}^* V_{wm}{}^T} \quad (13)$$
4. Extract the possible watermark (W_i) from A_m^* matrices.
$$\boldsymbol{\frac{A_m{}^* - S_m}{i} = W_i} \quad (14)$$

V. PROPOSED ALGORITHM STEPS:

1. Take a real image.
2. Perform Edge Detection of Real Image using Canny Detection Operator.
3. Consider the edged of real image from step 2 as Watermark1 image.
4. Embed Watermark1 using traditional SVD method on one layer of the real image.

5. Display Real image and Watermarked1 image.
6. Consider Watermarked1 image as Real image for embedding second Watermark.
7. Load some other image as a second Watermark.
8. Apply block by block SVD (2^{nd} method) on the other layer of real image to obtain dual watermarked image.
9. Apply inverse block by block SVD to find Watermark2 image.
10. Apply inverse traditional SVD to find watermark1 image.

Figure 1 below shows the block diagram for the embedding process of dual level watermark. And Figure 2 shows the block diagram for the extraction process

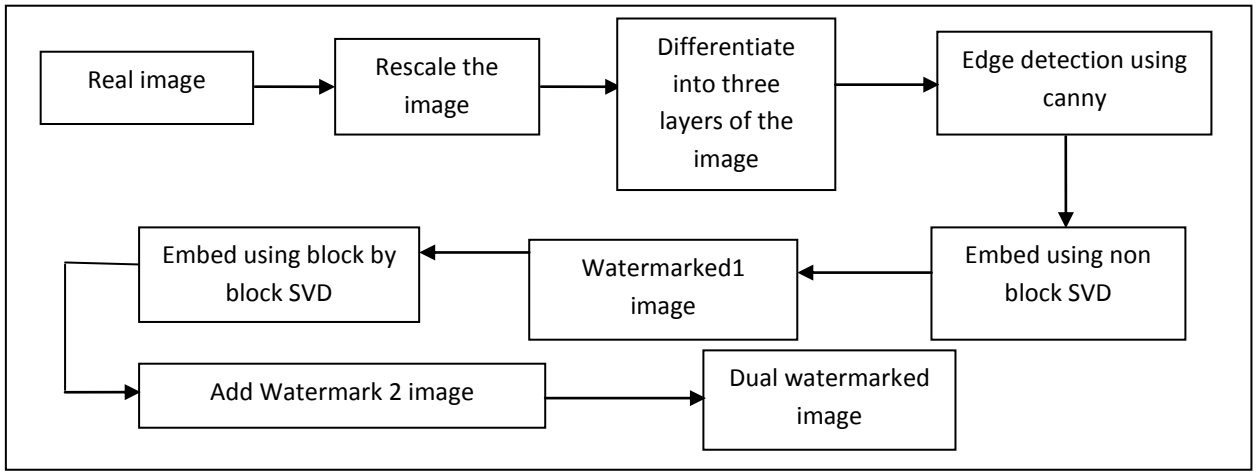


Fig 1. Block Diagram for Embedding Process

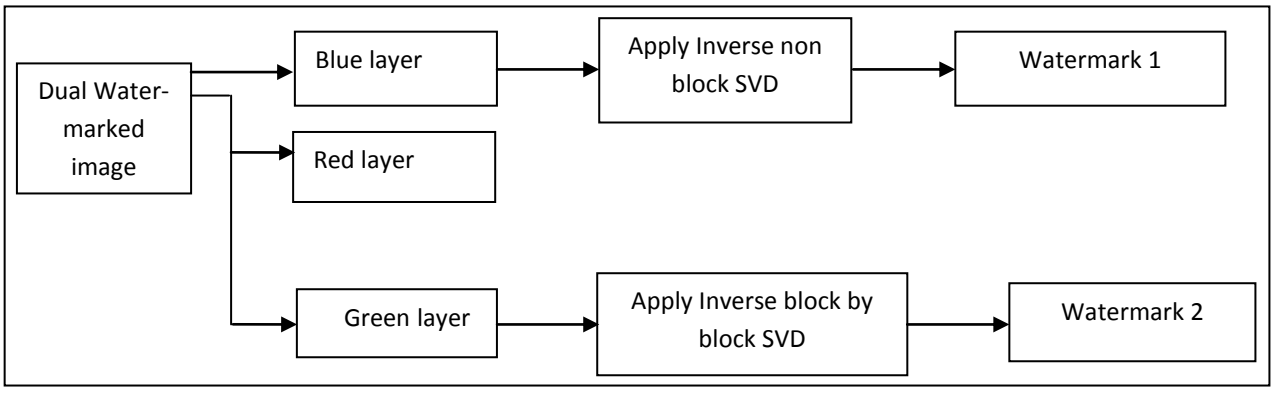
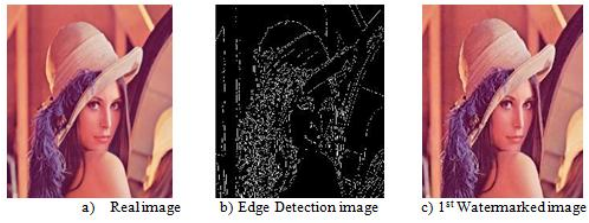


Fig 2. Block Diagram for the Extraction Process

VI. EXPERIMENTAL RESULTS AND ANALYSIS

The host image is a colored image and has dimensions of 512x512 and both the wateramrk embedded are rescaled into dimension of 512x512 before the embedding process. The performance of the proposed watermarking scheme is evaluated using various attacks such as Gaussian noise, Salt & Pepper ,Rotation. We had calculated Normalised Coefficient (**NC**) to measure the similarity of the extracted watermark & the real watermark. Peak signal to noise Ratio (**PSNR**) is also evaluated to check the quality of images after attacks. The images embedded and extacted without any attack are showm below.

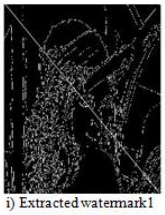


a) Real image b) Edge Detection image c) 1st Watermarked image

d) 2nd Watermark e) Dual Watermarked image f) Extracted Watermark 1

g) Extracted Wat


h) Gaussian attack o watermarked ima


i) Extracted watermark1 after attack

j) Extracted watermark 2 after attack

In literature [8] the author has used linear weighted function codec technology and the results given below in the table for different attacks applied. But the table below shows that the results of the proposed method are much better than the other method. The attacks applied to both the methods are Gaussian noise, Salt & Pepper noise, Rotation at 45° and JPEG Compression. The Comparison is done by calculating Normalised Coefficient (**NC**). This coefficient is calculated between the real watermark and the extracted watermark.

Table 1 shows the different values of normalised coefficient **(NC)** different attack after applying different attacks at default values betweenthe proposed method and literature [7].

Table 1. Numeric comparision of different attacks

ATTACK	**PROPOSED METHOD**		**Xu et al, 2013 [7]**	
	W1	**W2**	**W1**	**W2**
GAUSSIAN	0.9847	0.9514	0.4271	0.4055
SALT & PEPPER	0.9861	0.9873	0.4573	0.8710
ROTATION(45)	0.9867	0.5412	0.5227	0.4573
JPEG COMPRESSION	0.8997	0.8050	1.0913	0.4197

VII. CONCLUSION

In this paper Dual Image Watermarking scheme is proposed based on traditional SVD in combination with the edge detection technique for the primary watermark and block by block SVD is used for the secondary watermark.This is done for the authentication of real image. Experiments are conducted to demonstrate that the proposed algorithm is much more robustous to attacks like Gaussian noise,Speckle, salt & Pepper noise and Rotation. In this paper author checks the quality of watermarked image with the help of PSNR and Normalised Coefficient when different attacks are applied to it. The proposed algorithm is much efficient and robustous for colored images.

REFERENCES

[1] Ruizhen Liu and Tieniu Tan, "An SVD Based Watermarking Scheme For Protecting Rightful Ownership", *IEEE Transaction on Multimedia*, VOL.4, no. 1 , pp 121-128,2002.

[2] Zude Zhou, Bing Tang and Xinhua Liu, "A Block –SVD Based Image Watermarking Method." *IEEE Trans on Intelligent Control and Automation*, Vol. 2, pp 10347-10351, 2006

[3] Y.J. Song and T.N. Tan, "Comparison Of Four Different Digital Watermarking Techniques", *IEEE Conference*, 2000.

[4] R.A.Ghazy, N.A. EL-Fishawy, M. M. Hadhoud, M. I. Dessouky and F.E. Abd El-Samie. , "An Efficient Block by Block SVD Based Image Watermarking Scheme", *Ubiquitous Computing and Communication Journal*, Vol. 2 no. 5, pp 2006.

[5] Prabhishek Singh, R S Chadha, "A Survey Of Digital Watermarking Techniques, Applications And Attacks, *IJEIT* VOL 2, Issue 9, pp 165-175,2013.

[6] R.Z.Liu, T.N. Tan, "Survey of Watermarking for digital images", *Journal of china Institute of Communication*, vol.21, no.8,pp.39-48, 2000.

[7] Dacheng Xu, Bialiang Li,Minghui Shi, "Dual Image Watermarking Algorithm Based on Image Segmentation And Linear Weighted Function Codec Technology", *IEEE conference*, pp 1367-1371, 2013.

[8] Ranjeet Kumar Singh, Deepak Kumar, Santosh Kumar Singh, "Multilevel Image Based Data Security using Combined Approach of LSB_DCT Watermarking", *International Journal of computer application* Vol.80-no.16, pp 10-14, 2013.

[9] A. H. Tewfik, "Watermarking digital image and video data", *IEEE signal processing magazine*, September 1000.

[10] R.C Gonzalez, Digital Image Processing with MATLAB, Fifth ed. Pearson Pvt. Ltd, 2009.

