Multiple Watermarking Techniques using Visual Cryptography for Secured Copyright Protection

Vijaya Kumar. Kurapati[1], Venu Gopal. K[2], M.Nagaraju.[3]
[1] Asst. Professor, Dept. of ECE, St. Ann's Colege of Engineering & Technology, Chirala -523187
[1]Vijaykumar.kurapati@gmail.com
[2] Asst. Professor, Dept. of ECE, St. Ann's Engineering College, Chirala -523187
[2]venubabu459@gmail.com
[3] Asst. Professor, Dept. of CSE, St. Ann's College of Engineering and Technology,Chirala -523187
[3] info2nag.mtech@gmail.com

Abstract : Copyright Protection has become a need in today's world. To achieve a secure copyright protection we embedded information in images and videos and that image or video is called copyright protected. In this paper, a new robust watermarking technique for copyright protection based on Discrete Wavelet Transform and Singular Value Decomposition is proposed. The high frequency subband of the wavelet decomposed cover image is modified by modifying its singular values. A secret key is generated from the original watermark with the help of visual cryptography to claim the ownership of the image. The ownership of the image can bec claimed by superimposing this secret key on the extracted watermark from the watermark image. The robustness of this technique is tested by applying different attacks and the visual quality of the extracted watermark after applying these attacks is good. Also, the visual quality of the watermarked image is undistinguishable from the original image.

Index Terms: Image Watermarking, Visual Crptography, singular value decomposition, discrete wavelet transform, robustness.

1. INTRODUCTION

Introduction to Digital information is easy to distribute, duplicate and modify which leads to the need for copyright protection techniques. Digital watermarking technique is one of the solutions to avoid unauthorized copying or tampering of multimedia data.

The watermarking schemes are broadly classified into two main domains i.e. Spatial domain and the Transform domain. In Spatial domain, the watermark is embedded by directly modifying the intensity values of the cover image. The most popular technique is the Least Significant Bit (LSB) method. In transform domain, the watermark is embedded by modifying the frequency coefficients of the transformed image. The common methods are Fourier Transform (DFT), Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Singular Value Decomposition (SVD). SVD is one of the most usseful numerical analysis techniques having property that the singular values (SVs) of an image do not change significantly when a small perturbation is added to an image. [1-4] With the rapid development of internet technology, transmission of multimedia information becomes important. While transmitting these data security of multimedia data is a prime concern. One of the sloutions to deal with this security problems is Visual Cryptography. [5]

The two major considerations in visual cryptography are pixel expansion and number of shares encoded. Chin-Chen Chang et al[6] also suggested spatial- domain image hiding schemes to hide a binary watermark into two shares. Embedding images can be superimposed to decode the hidden messages. Liguo Fang [7] proposed scheme based on combination. Xiao–qing and Tan[8] has suggested a threshold visual secret sharing schemes based on binary linear error corercting code. In 2005, Hsu and Hou[9] proposed a copyright protection based on sampling distribution of means and Visual Cryptography to achive the requirements of robustness and security.

Section 2 gives preliminaries used for the proposed technique. Section 3 presents the technique for splitting a watermar using visual cryptography and embedding and extraction of the share. The expreimental results is given in Section 4 followed by Conclusion in Section 5.

2. PROPOSED TECHNIQUE

The proposed Technique is divided into two sections, Embedding and extraction technique.

2.1. Embedding Technique:

1. Apply 1- DWT on the cover image. It gives four subbands. The HH subband is selected for the embedding of watermark.

2. SVD is calculated for HH subbabnd only.

$$CD1 = CU + CS + CV'$$

3. The watermark is now encrpyted to increase the security of the scheme. For this we applied the visual cryptography on the watermark. This will divide the watermark
4. . Hence we will use share1of the watermark for the embedding purpose. While share2 of the watermark is provided as the secret key.
5. Apply SVD on the share1 of the watermark.

$$W\,share1 = WU + WS + WV'$$

6. Modify the singular values of HH subband of cover image and apply inverse SVD.

$$W1 = CS + \alpha\, Ws$$

Where, CS is the SV's of the cover image and WS are the SV's of the watermark. α is the embedding strength.

$$CD1' = CU + W1 + CV'$$

7. Perform inverse DWT by combining the subbands with the modified one to get the watermarked image.

2.2 Extraction Technique

The extraction technique is exactly the reverse of the embedding technique.

1. Perform 1-DWT on watermarked image.
2. Perform SVD on the HH subband.
3. Extract the singular values of the watermark.

$$WS\ extract = (W1 - CS) / \alpha$$

4. Perform inverse SVD to get the share 1 of the decrypted watermark 1 i.e. share 1 of the watermark.
5. Share 2 which acts as secret key is superimposed on the decrypted watermark share 1 to get the extracted watermark.

3. EXPERIMENTAL RESULTS

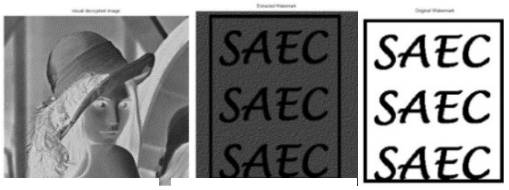
In order to authenticate the performance of the proposed technique, simulation is done on wide set of cover images and watermarks using MATLAB 9. The cover image is of size 512 × 512 gray scale image as shown in figure 1 and watermark is of size 256 × 256 as shown in figure 2. As indicated in figure 3, the watermark is divided in to two shares after applying visual cryptography.

This is represented as visual crypt watermark 1 and 2 respectively. The decrypted watermark 1 is the Share 1 of the watermark extracted from the watermarked images. This is combined with the visual crypt watermark 2 to get the extracted watermark. The following images are the test images for the proposed technique.

into two shares, viz., share1 and share2. The original watermark can be obtained it both the shares of the encrypted watermark are superimposed on each other

Figure 1: (a). Lena, (b). Brabara, (c). Woman, (d). Boat, (e). Mandrill, (f). Cameraman

(a). Embedded Watermark (b). Visual Crypt Image (Share1) (c). Visual Crypt Image (Share2)



(d). Visually Decryted image (e). Super Imposed Image (f). Extracted Watermark

Figure 2, 3 : Embedded and extracted Watermarks.

Figure 4 shows the PSNR obtained between cover image and watermarked image for all standard images. The PSNR indicates that the imperceptibility of the watermarked image is good and the watermarked image is indistinguishable form the cover image.

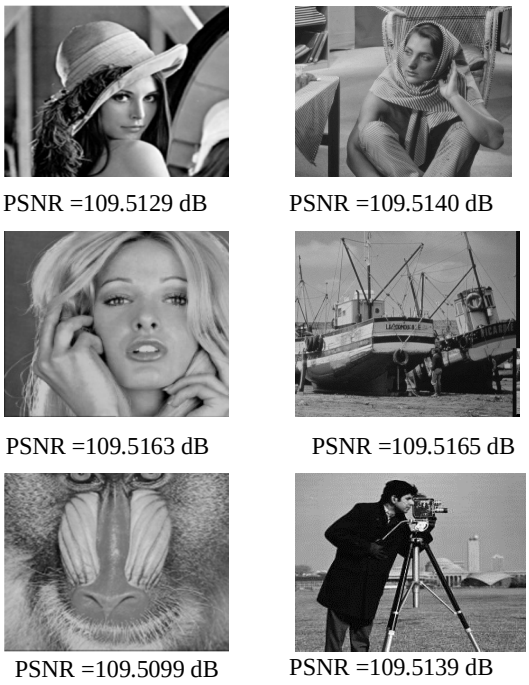


Figure 4 : Peak Signal to Noise Ratio (PSNR) of test images

To check the robustness of the algorithm we applied a wide set of attacks on the test images. The effect of these attacks on the watermark images with corresponding extracted decrypted watermark by combining the share of the watermark.

Type of attack	Extracted Cover image	Recovered Watermark	NCC
Scaling (0.25)			0.9984
Cropping (25%)			0.9979
3. Rotation (35 degree)			0.9975
4. JPEG Compression (20%)			0.9931
5. JPEG Compression (90%)			0.9989
6. Salt & pepper (0.02)			0.9996

Figure 6 : Analysis of attacks on cover image (Lena) and watermarked image, Normalized Cross Correlation(NCC).

4. CONCLUSIONS

In this paper a new robust multiple watermarking technique for Secure copyright protection has been proposed. We applied the Singular Value Decomposition (SVD) along with the Discrete Wavelet Transform (DWT). Since the technique utilizes the properties of both DWT and SVD the proposed technique is more robust against different attacks. The security of the algorithm is increased with the help of visual cryptography on the watermark image. If the second share of watermark which acts as the key is not possible to extract the exact watermark information. It is very difficult to change or remove the watermark without knowing the secret key share as the watermark is split into two shares with random patterns. The robustness of the technique is justified by giving analysis of the effect of attacks and still we are able to get good visual quality of the embedded watermark.

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Authors

Kurapati. Vijaya Kumar received M.Tech. Degree from Bapatla Engineering College, Bapatla in 2008. Presently, he is working as an Asst. Prof. in the Dept. of ECE of St. Ann's College of Engineering & Techlogy, Chirala. He is having 5 years of teaching experience. His current research interest includes Digital Image Watermarking, Digital Image compression, Signal Processing.

K. Venu Gopal received M.Tech. Degree from SRM Uiniversity, Chennai in 2007. Presently, he is working as an Asst. Prof. in the Dept. of ECE of St. Ann's Engineering College, Chirala. He is having of 6 years of teaching & Industrial Experience. His current research interest includes Digital Image Watermarking, Embedded Systems.

M .Nagaraju received M.Tech. Degree from Gokul Institute of Technology and Sciences ,Vijayanagaram in 2011. Presently, He is working as an Asst.Prof in the Dept.of CSE of St.Ann's College of Engineering and Technology, Chirala. He is having 6 years of teaching experience. His current research interest includes Mobile Adhoc Networks, Digital Image Compression, Digital Image Water marking.