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Analysis of Digital Image Watermarking using SWT-SVD

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ABSTRACT: In this paper digital image watermarking method is analysed by using Discrete Stationary Wavelet Transform and Singular Value Decomposition. This method contains two processes, embedding and extraction process. In embedding, SVD coefficients of diagonal values of watermark image are embed in SVD coefficients of diagonal values of cover image by using the embedding equation. Extraction process is reverse of embedding. The robustness of this method is calculated by applying the various attacks. The efficiency of this algorithm is measured by calculating PSNR.

KEYWORDS: Watermarking techniques, SWT, SVD, and PSNR.

I. INTRODUCTION

In recent years communication is playing an important role. Communication is very important for every human being, without the communication life will become difficult to lead. As computers and internet technologies are developed, more multimedia-based information is being transmitted over the internet and wireless networks. An image is a picture that has been created or copied and stored in the electronic form. There are two types in images which are color image and gray scale image [1]. In present day's video, audio, images are available at anytime, anywhere because of using the internet and multimedia tools. So, security, copyrighting and authentication problems will arise. The solution for this problem is watermarking technique.

The word "Watermark" was derived from the German term "Wessmark". The term "Digital Watermark" was first discovered in December 1992 by Andrew Tirkel & Charles Osborne [2]. A watermark is one kind of identification marks. The first watermarks appeared during the 13th century in Italy, but their use rapidly spread across Europe after 13th century. The primary case of innovation like advanced watermarking is a patent field in 1954 by Emil Hem Brooke [3]. In 1988 Komastu and Tominaga have all the watermarks of being the first to utilize the expression "computerized watermarking" [4].

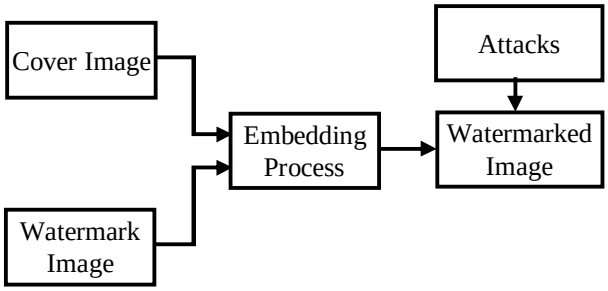

Fig. 1 Block diagram of embedding process

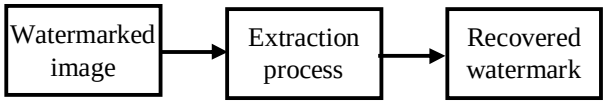

Fig. 2 Block diagram of extraction process

Watermarking is characterized as concealing the watermark picture into cover picture. If the seal of the organization is present on the watermarked image is called visible watermarking technique and it is perceptible to human eye. If the seal of the organization is hided in cover image and is not perceptible to human eye is called as invisible watermarking technique.

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Watermarking is consisting of two process which are embedding process and extraction process. In embedding process, the watermark picture is embedded in the cover image after that it will shape watermarked image is showed in Fig. 1. In extraction process watermark image is removed from the watermarked image. To check the robustness attacks are applied to the watermarked image. Then comparison of both original and recovered watermark is taking place is showed in Fig. 2. The imperative properties of undetectable watermarking are strength, robustness, limit and security are accomplished.

II.RELATED WORK

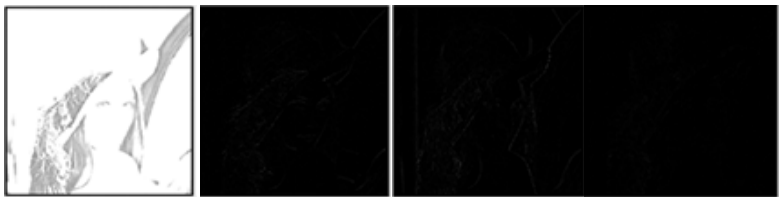
The watermarking technique is classified into spatial and frequency domain [4]. In spatial space by modifying pixel value hiding of watermark image is taking place [5] and in frequency domain by using the transform techniques both images are first converted into different frequencies then modification of the watermark is done. The watermarking of color image [6] is by using the block based probability in spatial domain. From secrete key and gray code the sequence numbers are generated these are used in binary watermarking technique [7]. The information of the watermark image is inserted in busy areas of the cover image in LSB watermarking [8]. The non-blind digital image watermarking [9] includes hybridization of Discrete Wavelet Transform and Discrete Cosine Transform which is imperceptible in nature. In DCT based watermarking [10] embedding is done in middle part of the cover image. The PPLU decomposition [11] is secure watermarking technique. In block based watermarking [12] multiple watermarks are embed in cover image because it having more space. In secure watermarking technique [13] DWT-Singular Value Decomposition is used to get more robust in nature. The nature of watermarked image assessed assistants of PSNR esteem.

III.METHODOLOGY

In prospect of providing the robust watermarking this algorithm uses a Stationary Wavelet Transformation technique combined with the SVD. The entire watermarking contains two parts embedding process and extraction process. The flowchart of embedding process and extraction process is showed in Fig. 5 and Fig. 6 respectively.
SWT is transformation technique in the digital image processing in which wavelets are discretely sampled. SWT contains both frequency and location information. SWT is an extended form of DWT. It is designed to overcome lack of translation invariance of the DWT. The LL, LH, HL and HH bands are obtained after applying the SWT to the cover image and watermark image is shown in Fig. 4. Here each band is consisting of complete spectrum of the whole image.
LL band contains approximate low frequency component.
HL band contains horizontal middle frequency component.
LH band contains vertical middle frequency component.
HH band contains diagonal high frequency component.
The color image is made up of three components red, green and blue. These colours are added together to produce array of colours is showed in Fig. 3.

(a) (b) (c) (d)

Fig. 3 RGB color components



(a) (b) (c) (d)

Fig. 4The second level of SWT decomposition

SVD is a straight algebraically numerical strategy. SVD is applied to an image it will give three lattices U, S and V.

Where diagonal matrix S and orthogonal matrices are U and V is given by equation 1.

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$$A = USVT \quad \text{..... (1)}$$

U – Unitary matrix having size M x M

V – Unitary matrix having size N x N

S – Diagonal matrix having size M x N

S matrix is containing singular values and these values are arranged in ascending order. The singular values are very much stable. S values are non-negative numbers. SVD is used in image watermarking to maintain the quality as well as stability.

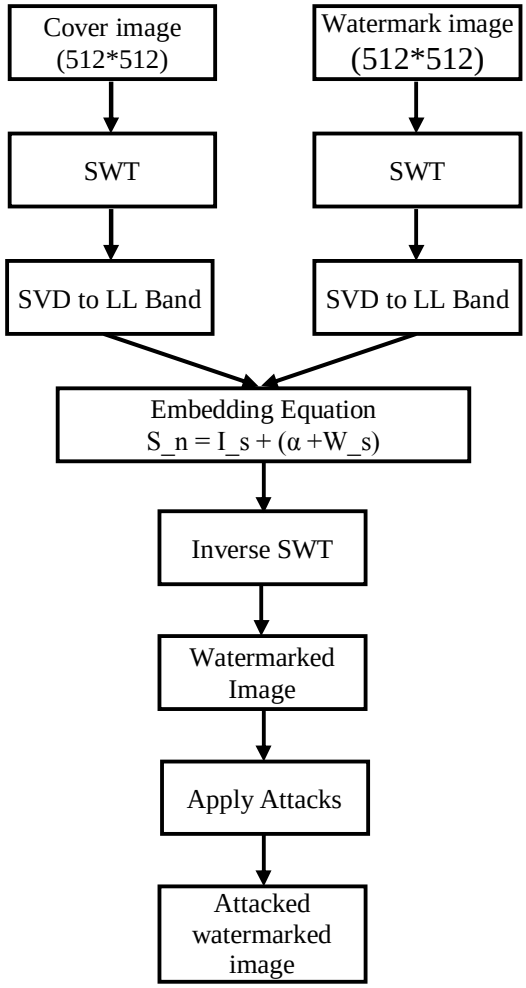

Fig. 5 Flow chart for embedding process

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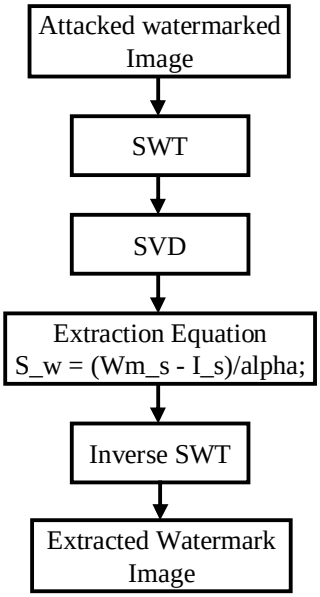

Fig. 6 Flow chart for extraction process

In embedding process first read the cover and watermark image. Then apply SWT to both cover and watermark image both will decomposes into 4 sub bands. Then we have to apply SVD to LL bands of both images. By using the embedding equation embed the watermark image into cover image. Then apply inverse SWT to get the watermarked image. The various attacks are applied to check the robustness of the watermarked image.

In extraction process read the attacked watermarked image. Then apply SWT to watermarked image and then SVD to the LL band of the watermarked image. By using extraction equation extract the watermark image from the watermarked image. Then apply inverse SWT to get recover watermark image.

IV. RESULT AND DISCUSSION

The digital image watermarking using SWT and SVD is simulated by using the latest version of MATLAB. The standard sizes of images are taken to study the effect of robustness of this algorithm. After applying the embedding and extraction algorithm will get the watermarked image. Salt and Pepper noise, Speckle noise, Gaussian noise, Rotation attack and Median filters are applied to the watermarked image to check the robustness. The efficiency is evaluated by calculating the PSNR values.

Peak Signal to Noise Ratio

PSNR is used to measure the quality of image. The increasing in the value of PSNR shows the higher the quality of the image. The value of PSNR is given by equation 2.

$$PSNR=10\log\frac{255\text{^}2}{\frac{1}{MN}\sum_{M=0}^{M-1}\sum_{N=0}^{N-1}(C(m,n)-WD(m,n))} \quad \ldots\ldots (2)$$

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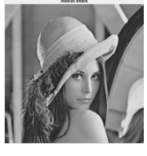
(a) (b) (c) (d)

Fig.7 (a) Cover image (b) Watermark image(c) Watermarked image (d) Extracted watermark image

Figure 7 shows that (a) Lena image as the cover image and (b) Cameraman image as the watermark image. By using the embedding algorithm will get the watermarked image which similar to the cover image is showed in fig.6(c). By using the extraction process will get the watermark image back is shown in fig .6(d). The nature of watermarked image assessed assistants of PSNR esteem. The PSNR value of this image is 37.6759dB.

Table 1 watermarked and separated watermark pictures in the wake of applying the assaults with the PSNR esteems

Sl. No.	Attacks	Watermarked Images	Extracted Watermark Images	PSNR (dB)
1	Salt and pepper noise			35.1010
2	Gaussian noise			25.6165
3	Speckle noise			33.3810
4	Rotation			11.0255
5	Median filter			33.5902

To check the robustness of watermarked image various attacks like Salt and Pepper noise, Speckle noise, Gaussian noise, Rotation and Median filter are applied to the watermarked image are showed in Table 1 with their respective PSNR values. The PSNR value of Salt and Pepper noise attack gives as 35.101dB, Gaussian noise attack gives as

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25.6165dB, Speckle noise gives as 33.3869dB, Rotation attack gives as 11.0255dB and Median filter gives as 33.5902dB. This means that after applying the attacks also we can still extract the watermark images which are more robust in nature.

Table 2 Different values of noises in the watermarked images and their respective PSNR values

Attacks	Density	PSNR
Salt and Pepper Noise	0.1	15.3783
	0.01	25.1128
	0.001	35.1010
Gaussian Noise	0.1	16.6141
	0.01	20.0166
	0.001	25.6165
Speckle Noise	0.1	15.8551
	0.01	21.8740
	0.001	33.3869

Table 2 shows that different values of salt and pepper noise, Gaussian noise, speckle noises in the watermarked image with their respective PSNR values. When less noise in the watermarked image it is more robust in nature.

VI.CONCLUSION

In this paper, a SWT-SVD algorithm was analysed for digital image watermarking technique using SWT and SVD. We have showed the methodology of embedding and extraction process. The evaluation parameter PSNR is measured to check the robustness of the watermarked image. This algorithm is simulated by using the latest version of MATLAB. Different types of attacks are applied to watermarked image to check the robustness. In future algorithm will be modified to increase the level of robustness of watermarked image by using the different transformation techniques.

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