



A COPYRIGHT PROTECTION OF DATA OVER INTERNET BY USING WATERMARKING

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Abstract: As the growing demand for security of copyright protection against unauthorized attacks. It is necessary to protect the ownership of the data mainly during the transferring of data, which leads to call the embedding of watermark to the data for security. This paper proposed a combined algorithm of Discrete Wavelet Transform [DWT]-Singular Value Decomposition [SVD]. This combined technique gives a better authentication against various and common unauthorized attacks. Here we embed the invisible watermark to the host image by using this combined technique. We use the R plane of the host image to embed the watermark. Firstly, we split the three color bands named as R, G and B Band. And select the R band for embedding the watermark. The watermark can be extracted at the receiver side further by splitting the three color bands and by applying the Inverse Discrete Wavelet Transform (IDWT) and Inverse Singular value Decomposition. In this paper four level decomposition has been done. The various experimental results have been shown in this paper which gives the better robustness against various unauthorized attacks.

Keywords: Watermarking, DWT-SVD, Embedding, key matrix, Extracting, color bands, host image.

I. INTRODUCTION

Basically the watermarking is a message that can be embedded into the digital data like video, pictures, audio etc. [1] [2]. Watermarking explains the ways and mechanisms to hide the data. The data can be a number, text or more or less transparent in digital media. After embedding the watermarking into the image the quality and the perceptibility of the image should not be distorted. The embedded information can be extracted from the watermarked image by using appropriate method for authenticity. The watermark can be visible or can be invisible. That means, the watermarking has visible or invisible message. Invisible watermarking is useful for secret communication [3]. For example, currency have a visible watermarking. There are mainly two methods that can be used for embedding the watermark to the digital media. The first method is spatial domain method and second one is transform domain method. But the second one method is used very widely than first one because it has a numerous advantage over the first one and more robust than it. That's why most of the researchers have the interest in this domain. The most common method for spatial domain is LSB (Least Significant Bit). Spatial domain is basically the procedures that operate directly on the pixels of the Image. The spatial domain is less complex as compared to transfer domain because no transform is used. When inverse transform is done to the image then watermark is distributed irregularly on the image, which makes the attacker in difficulty to read it. The transform domain also has many techniques to embed and extract the watermark to the image named as DWT (Discrete Wavelet Transform), DCT (Discrete Cosine Transform), DFT (Discrete Fourier Transform), SVD (Singular Value Decomposition) [4]. Among all the watermarking techniques DWT is gaining more popularity because of its numerous advantages like

scalability, quality, progressive etc. Due to this, this technique is widely used for watermarking applications.

II. REVIEW OF DWT AND SVD

A. DISCRETE WAVELET TRANSFORM (DWT)

Discrete Wavelet Transformation (DWT) is a process of composition of image in the terms of frequency as shown in figure 1 [5]. The DWT first convert the image into four subbands i.e, LL, LH, HL, HH [6]. The low frequency sub-band contain most of the energy but watermarking is embedded on the higher frequency sub and (LH, HL and HH). The frequency term is the change in the contrast over pixels. The Higher the change in contrast will give a high frequency. Large surfaces, even if it has a contrast of an image change, then it gives a lower frequency. The higher frequency is mostly found around the edges and the textures, where the contrast or color are changed very rapidly.

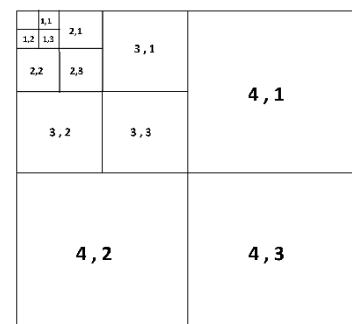


Fig. 1 four level decomposition of an image.

B. SINGULAR VALUE DECOMPOSITION (SVD)

The SVD is a very powerful numerical tool for matrices, which has a minimum least error truncation. This is because, potential degree of freedoms is equal to the input of the host image for three matrices. This technique is used to

extract the image value in the form of matrix. The SVD method decomposes the matrix into three matrices as $A=USV(T)$. Where A is a matrix which contain three different matrices i.e U, S, V . S is the diagonal matrix. By adding the information to this diagonal matrix (S) provides insignificant effect on the image.

III. EMBEDDING PROCESS

A. ALGORITHM FOR EMBEDDING PROCESS

- First of all select the image to which we want to embed the watermark.
- Separate the R, G and B planes of the image and it titled as “original image”.
- Select the R plane for embedding.



Fig. 2 Host image

- Now, apply the DWT method to the R plane of the host image.
- Decompose the image into four levels for finding the HL4 band for embedding.



Fig. 3 Four level decomposition of the R plane

- Now, set the watermark $(1:r, 1:c) = 0$ where $r = c$
- Select the key and generate the key matrix using two matrices where $K \leq r$

$$K_{mat1} = \begin{bmatrix} \alpha_{1,1} & \alpha_{1,2} & \alpha_{1,3} & \dots & \dots & \dots & \dots & \alpha_{1,key} \\ \alpha_{2,1} & \alpha_{2,2} & \alpha_{2,3} & \dots & \dots & \dots & \dots & \alpha_{2,key} \end{bmatrix}$$

$$K_{mat2} = \begin{bmatrix} \beta_{1,1} & \beta_{1,2} & \beta_{1,3} & \dots & \dots & \dots & \dots & \beta_{1,key} \\ \beta_{2,1} & \beta_{2,2} & \beta_{2,3} & \dots & \dots & \dots & \dots & \beta_{2,key} \end{bmatrix}$$

- Conditions for both matrix are K_{mat1} and K_{mat2} are $\leq r$ for $w = 1$ and $i = 1$ to 2

$$\alpha_{1,1} \leq \alpha_{2,1} \leq \alpha_{1,2} \leq \alpha_{2,2} \leq \alpha_{1,3} \leq \alpha_{2,3} \leq \dots \leq \alpha_{1,key-1} \leq \alpha_{2,key-1} \leq \alpha_{1,key} \leq \alpha_{2,key}$$

$$\beta_{1,1} \leq \beta_{2,1} \leq \beta_{1,2} \leq \beta_{2,2} \leq \beta_{1,3} \leq \beta_{2,3} \leq \dots \leq \beta_{1,key-1} \leq \beta_{2,key-1} \leq \beta_{1,key} \leq \beta_{2,key}$$

Then set watermark to 1. Repeat i for key matrix 1 and repeat j for keymatrix2.

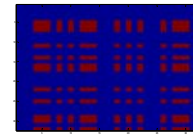


Fig. 4 Watermark embedded

- Then apply SVD technique to the watermark image. Watermarked image is $= HL3 + S$;

where S is the diagonal matrix of the random key image and $HL3$ is the fourth level of decomposed image.

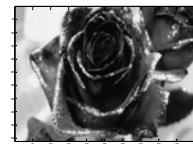


Fig. 5 Watermarked embedded R plane

- Apply inverse DWT to the watermarked image and construct watermark to the image as $I(\text{watermarked image}) = R(\text{WC})\text{band} + G \text{ band} + B \text{ band}$
- Where R (WC) is the watermarked R channel. This watermarked image is shown in fig. 6 .



Fig. 6 watermarked image

B. VARIOUS EXPERIMENTAL RESULTS OF EMBEDDING PROCESS

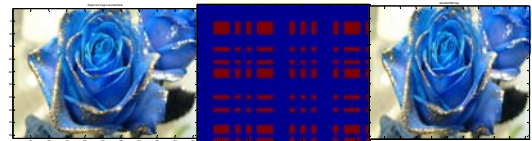


Fig. 7 Blue Rose



Fig. 8 Punjabi University

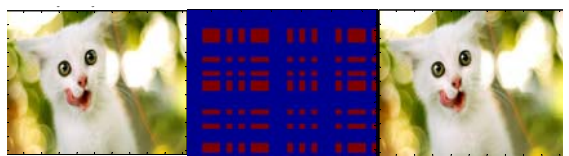


Fig. 9 Funny cat

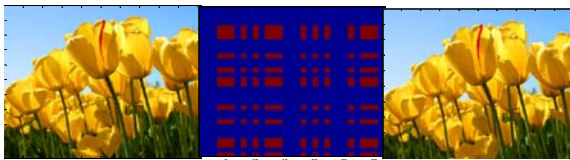


Fig. 10 Tulip

IV. EXTRACTION PROCESS

A. ALGORITHM FOR EXTRACTION PROCESS

For extracting the original image, firstly decompose the watermarked image i.e. I (watermarked image) and obtain the R channel and decompose it for four times to obtain $HL3$ of the watermarked image. To remove the watermark from the watermarked image use equation $S_2 = S_1 - S$, Where S_1 is the diagonal matrix.

When SVD is applied to the fourth level $HL3$ of the watermarked image and S is the diagonal matrix of the r plane of the watermarked image. When SVD is applied to the r plane only. Now apply the inverse SVD as second process for extracting the watermarking use equation: $W(f) = U_1 * S_2 * V_1'$

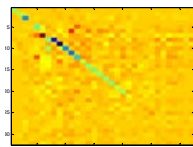


Fig. 11 Watermark before thresholding

After inverse SVD, apply threshold to the fig. 11.

The third process for extracting the watermarked image that was reduced in host image by using the following condition is

Extracted watermark = If $W(f) \geq \text{threshold}$ then it is 1, otherwise it is 0. Where, threshold=1.

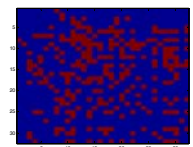


Fig.12 Watermark after thresholding

Then to find the R channel we have used equation

$$R_{band} = HL3 - W(f)$$

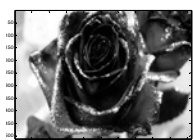


Fig.13 R plane after extracting watermark

After applying the inverse DWT-2 we will reconstruct the image without watermark by adding three bands together, which is shown in figure 14.

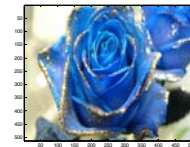


Fig. 14 Image after extraction watermark

B. VARIOUS EXPERIMENTAL RESULTS OF EXTRACTION PROCESS

EXTRACTED WATERMARK RECOVERED IMAGE

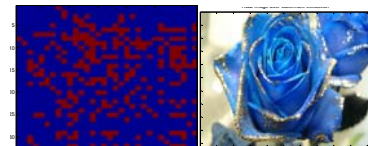


Fig. 15 Recovered blue rose

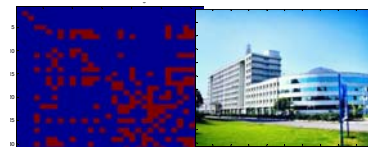


Fig. 16 Recovered Punjabi university image

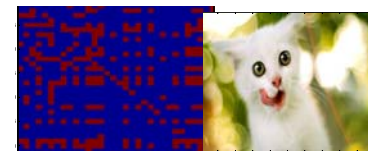


Fig. 17 Recovered funny cat image

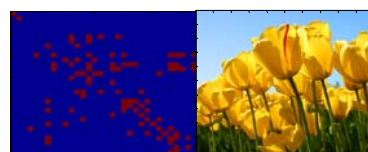


Fig. 18 Recovered tulip image

V. DISCUSSION ON EXPERIMENTAL RESULTS

In this paper, the quality measurement of a watermarked image is calculated by Peak Signal To Noise Ratio (PSNR). The higher the PSNR, better the quality of a watermarked image. It is calculated in decibels (dB). The Mean Squared Error (MSE) and Peak Signal To Noise Ratio (PSNR) are the two error matrices used to compare the image quality of watermarked image. The MSE measures the squares of errors between watermarked image and the original image whereas, the PSNR represents the peak error. The lower the

MSE, the lower the error between the watermarked image and the original image. The PSNR and the MSE is given in the following formula,

$$MSE = \frac{\sum_{M,N} [I_1(m,n) - I_2(m,n)]^2}{M * N}$$

Where, $I_1(m,n)$ is the input image and $I_2(m,n)$ is the reconstructed image. M and N are the row and columns of an inout image.

$$PSNR = 10 \log_{10} \left(\frac{R^2}{MSE} \right)$$

Where R is the maximum possible pixel value of the input image.

In the Table 1, we compare the values of PSNR and MSE with the existing method and the proposed method.

TABLE NO.: 1 COMPARISON OF RESULTS BETWEEN EXISTING METHOD AND PROPOSED METHOD ON THE BASIS OF PSNR & NC

IMAGES	EXISTING MEHOD (DCT-DWT) [7]		PROPOSED METHOD (DWT-SVD)		
	PSNR	NC	MSE	PSNR	NC
LENA	47.2717	1	3.26E-04	89.039	1
PEPPERS	47.2717	1	6051E-04	80.028	1
BABOON	47.2718	1	0.0148	66.4725	1
CAMERAMAN	47.2724	1	3.26E-04	83.039	1

VI. CONCLUSION

In this paper, we are focusing on the robustness of the image which can be achieved by applying the combination of two

transformations rather than applying one transformation. The DWT and SVD method is good for Gaussian and motion attack with less distortion. By using this combinational technique, we have perceptual quality value of the proposed method, that is, 89.039 of LENA image, whereas, the perceptual quality of the existing method is 47.2717 . The quality value of the proposed method is more than the existing method as shown in table no.1.

VII. REFERENCES

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