Digital Watermarking using Integration of DWT & SVD Techniques

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Abstract- In this paper 2-level DWT & SVD techniques are employed on images to perform watermarking process. Watermarking of an image plays an important role in communication for authentication purpose. For more security multilevel DWT& SVD techniques are applied on the images. Initially cover image decomposed into multiple bands using multilevel DWT. Apply SVD on LL band of multilevel DWT & watermark image also. The embedding process is initiated on singular values of watermark & cover image. The robustness of the proposed algorithm is verified with Jpeg compression, median filtering, Rotation etc.

I. INTRODUCTION

In present days digital multimedia technology is very popular of internet by use of distribution of digital images. The main purpose of this technology is hiding information and authentication issues. Several researchers worked in watermarking field to find out different types of methods such as frequency domain techniques and DFT based techniques etc.

Watermarking techniques are two types these are 1) spatial domain 2) frequency domain. In frequency domain LSB, correlation-based technique, predictive coding, etc. By using this it is easy to implement and we are not getting the good results in attacks.so we are prefer frequency domain methods like 1)Discrete Cosine Transform (DCT),2) Discrete Fourier Transform (DFT), and 3)Discrete Wavelet Transform (DWT) it is withstand the attacks. And give good results.

Watermarking is nothing but embedding information in to video images or audio images. Every watermarking technique holds of an insert watermark algorithm and extracting algorithm Watermarking has many properties Strength, Faithfulness and Tamper Resistance. So we need to satisfy these properties by using spatial domain techniques. Discrete wavelet transform is fit to identify zones in the cover image SVD having the important mathematical property by using this it will not effect on watermark image these will provide good and efficient results like robustness.

By using **Discrete Wavelet Transform (DWT)** techniques are not strong against the attacks like JPEG compression, Median filtering, rotation etc.

Singular value decomposition (SVD) is additional type of transformation discovered for digital watermarking. Singular value decomposition in digital image processing have more advantage the size of matrices are square and rectangular second singular values less effected by the images.

In proposed algorithm using Discrete wavelet transform & Singular valued decomposition watermarking technique embedding process to get more accuracy and robustness.

In this method first the cover image disintegrated into 3rd level DWT using it will provides 4 sub bands these are LL3 and LH3 and HL3 and HH3.after that embedding the watermark image in to LL band we will get the poor results. And also the watermark image is decomposed by Second level Haar wavelet providing LL21,LH21,HL21,HH21and these sub bands adding to the cover image sub bands will give better results compare to previous one. Third approach is cover image decomposed by Discrete wavelet transform by using Haar wavelet and then SVD is applied on LL sub band and then directly Embedding the watermark image in to LL band of cover image, by using this approach give better results compare to previous work, and then finally the cover image is decomposed by Two level Haar wavelet and then SVD is applied by LL Sub band and then embedding the watermark image of singular value decomposition will get the better results compare to the previous approach

II. DWT

Discrete wavelet transform splits the image into 4 parts Low resolution division (LL) Such as vertical horizontal (HL) and diagonal (HH) Detailed component. Sub band LL is received after Low filters on rows and columns. High frequency components on diagonals. HL And sub hands LH is the result of lower infiltration destination and high frequency filtration in other places Directions. When the image is handled by a wavelet changes most of the information checked in the machine Images are gathered in LL images. LH subcase there is mostly information about the vertical details Relate to the horizontal edge. The HL

panel represents Horizontal details from the vertical edge. Best of all, this process can be repeated to produce more "scales "Separation. Below Figure shows DWT Decomposition.

Discreet wavelet transform plays a main role in the image processing. It having simple transforms those are DCT and DWT and DFT. However, there are cases of changes implemented in a method reduce the problem. For these reasons the wavelength-based watermark technique has evolved

When there is DWT the coefficients corresponding to that area will be edited only coefficient changes. Basically greatest of them the image energy is focused in LL band. So embedding the deep in the LL sub Stripes can make the image worse. Embedding In lower-secondary sub-groups, however, significant Improves resistance. Also HH sub bands contain the boundaries and surfaces of Pictures and human eyes have little effect such sub bands.

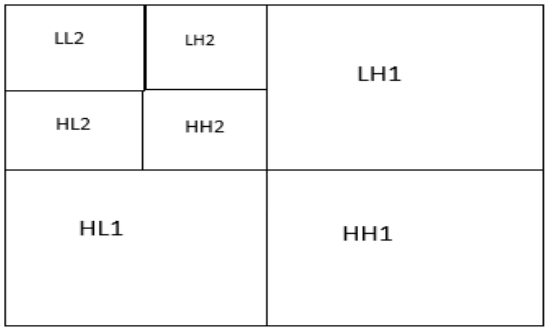


Fig : DWT Decomposition

III. SVD

The SVD is a matrix it contains real and complex values it is an real or complex matrix and is a rectangular diagonal matrix By using the SVD in digital image processing having the advantage is less effected and the matrix size is not changed and the singular values are

$$S = \begin{bmatrix} \sigma_1 & & & \\ & \sigma_2 & & \\ & & \ddots & \\ & & & \sigma_n \end{bmatrix}$$

The SVD-based method generally works on the detection policy Separate the image and then modify the unit values to put watermark in it. The new SVD technique has been mixed up with additional techniques, with discrete cosine transform & discrete wavelet transform. These hybrids Technics have become very popular in the digital imaging software.

IV. PROPOSED ALGORITHM

For digital watermarking the proposed algorithm is DWT and SVD.let I be the Cover image and J be the Watermark image these are gray scale images of size is RxC and R/2 x C/2 respectively.

Watermark embedding:

The embedding technique of watermark is given as follows

1. Take Cover image (I(x,y)) size is MxN(256x256)
2. Perform discrete wavelet transform using haar wavelet on the Cover image providing four sub bands.
   [LL1 LH1 HL1 HH1]=dwt2(I(x,y)) -- (4.1)
3. Again perform discrete wavelet transform using haar wavelet on the LL band of Cover image providing four sub bands.
   [LL2 LH2 HL2 HH2]=dwt2(LL1) – (4.2)
4. Perform SVD transform on the LL2 sub band in eq (4.2)
   [U S V]=svd(LL2) --- (4.3)
5. Extract diagonal elements of singular

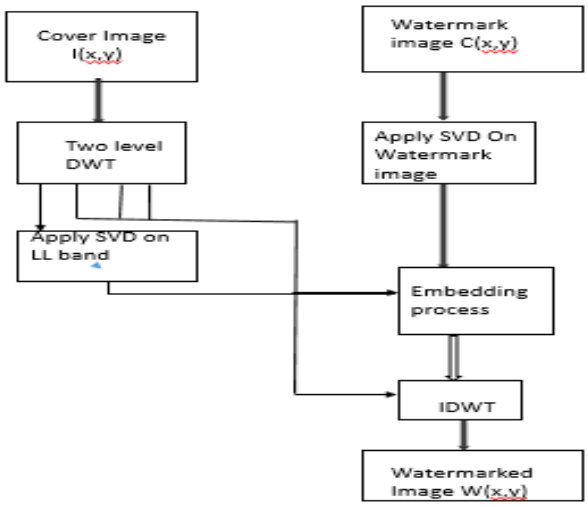
   Matrix **S** in eq (4.3) **, L=**diagonal(**S**).
6. Take Watermark image(C(x,y))size is M-xN-(64x64).
7. **P**erform SVD transform on the Watermark image and then Extract singular values

   [Uy Sy Vy]=svd(C(x,y)) --- (4.4)
8. Now embed the singular values of cover image and watermark image from eq (4.3) and (4.4).

   $K=S+\alpha Sy$ --- (4.5)
9. Perform Inverse SVD on eq (4.5).

   $K1=U*K*V^T$ --- (4.6)
10. Perform inverse DWT on Embedding image will get the Watermarking image.

    W(x,y)=idwt(K1, LH2 HL2 HH2) --- (4.7)



Watermark extraction:

The main aim is removal of watermark image from the watermarked image. For extraction following steps are performed

1. Perform 2 level discrete wavelet transform of water

Marked image it providing four sub bands.

[LL12 LH12 HL12 HH12]=dwt2(W(x,y)) --- (4.8)

2. **P**erform SVD transform on LL12 Sub band

[Uw Sw Vw]=svd(LL12) --- (4.9)

3. Then will remove the singular components of cover image.

I1=(Sw-S)/α --- (4.10)

4. Now Perform the inverse SVD on watermarked image now will get the Watermark image.

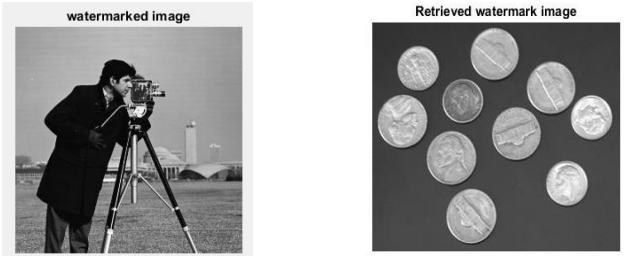
$C(x,y)=Uy*I1*Vy^{T}$ --- (4.11)

V. EXPERIMENTAL RESULTS

By using MATLAB the Proposed algorithm is tested.. Figure 5.1(a) & 5.1 (b) shows the Cover image and watermark images. Figure5.2 (a) and (b) shows the watermarked image and removed watermarks minus noise attacks. It can be realized that the future method will give the better results in previous algorithm. In proposed algorithm by using embedding factor 'α' in various values will give the results shown in Table 1.

(a) (b)

Fig 5. 1: (a) Cover image, (b) Watermark image



(a) (b)

Fig 5.2: (a) Watermarked image, (b) Retrieved Watermark image

VI. PERFORMANCE ANALYSIS

To learning the strength of the algorithm, the watermarking image is subjected to different types of attacks such as Median filter, JPEG compression, Rotation. JPEG compression is compression standard, which is widely used in image processing. The watermarking algorithm against Joint Photographic Experts Group (JPEG) compression is proposed. The original watermarking image is made twisted by Legendre disordered to enhance watermarking security Media Filter is a visual processing technique that aims to reduce the presence of noise in the image by increasing image quality. A media filter is the most popular filter, an off-line filter type. The average filter is based on the sorting or order of pixels in the image area covered by the filter, and then its name is displayed instead of a pixel in the center of the value, with a continuous intensity value near the pixel. . Media filters are very popular, while there are some random noise they provide with excellent sound reduction, resulting in less opacity than lightweight filters of similar size. Medium filters are especially effective in suppressing the presence of noise, because of the appearance of the white and black spots on the image. The resulted images are pretentious by various attacks such as Jpeg compression, cropping, & rotation. Using These attacks terminate the implanted watermark,. The proper insertion of watermark because of to decrease the

properties of attacks with current algorithm.PSNR is used to learning the quality of a proposed technique. The PSNR among the input image and the watermarking images is calculated a lower deprivation of images high value of PSNR so by different types of attacks our proposed technique is better than previous one

PSNR=20log10 (255/RMSE)

RMSE, the square root of mean square error is defined as:

$$RMSE=\sqrt{\frac{1}{T}\sum_t^T (I(t)-J(t))^2}$$

Different types of values occurring in DWT algorithm and DWT AND SVD algorithm Comparision of watermark & removed watermark from the watermarked image the correspondences, the correlation coefficient was Employed. The normalized coefficient (NC) gives a amount of the strength of watermarking and its highest value is one.

$$NC=\frac{\Sigma_i \Sigma_j w(i,j).w'(i,j)}{\sqrt{\Sigma_i \Sigma_j w(i,j)}\sqrt{\Sigma_i \Sigma_j w'(i,j)}}$$

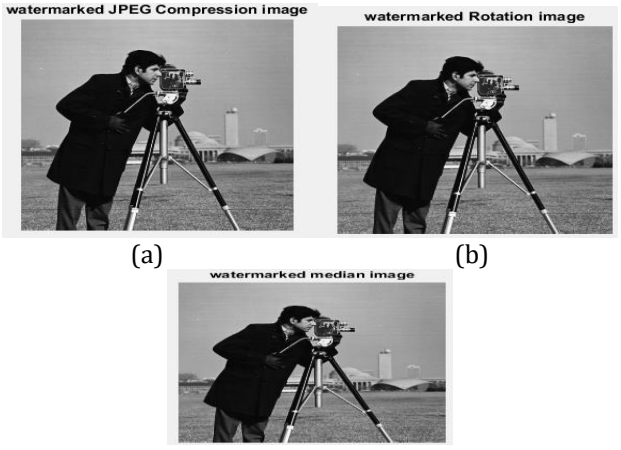


Fig 5.3 (a), (b) & (c) watermarked image after attacks

Table1: Performance measures with various Embedding factor of water mark image

Embedding factor 'α'	Without attacks		With attacks		
	NCC	PSNR	Median filter (PSNR)	Rotation (PSNR)	JPEG compression (PSNR)
0.01	1	64.94	64.3	64.6	50.1
0.006	1	69.3	69.1	68.3	53.2
0.003	1	75.4	75.1	72.06	58.3
0.001	1	84.9	84.6	74.1	60.1

Table2: NCC& PSNR values of water marked image from different attacks

		DWT&SVD 'α=0.001'
Without attacks	PSNR	**84.9**
	NCC	**1**
With attacks	Median filter(PSNR)	**82.6**
	JPEG compression(PSNR)	**68.6**
	Rotation(PSNR)	**62.3**

VII. CONCLUSIONS

The effectiveness of proposed algorithm is verified with PSNR & NCC Parameters. The proposed algorithm is robust under Jpeg compression, rotation, and median filtering attacks.

The proposed can also extended with high level of DWT & multistage of SVD and is also extendable with various other transformation techniques also by applying various multilevel transformation here techniques the authentication is very strong in watermark and cover image and SVD on watermark image

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