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A Review on Robust Digital Watermarking for Coloured Images using SVD and DWT Technique

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Abstract: Watermarking is the method to solve the issue of copyright degradation, yet this must be resolved by keeping a steady Check on the imperceptibility and robustness which incur to be its main objective. In order to get done these objectives the usage of a hybrid transform is adopted in this paper, the idea behind using a hybrid transform is that the cover image is amended in its singular values rather than on the DWT sub bands, then the watermark makes itself vulnerable to vivid attacks.

Keywords: Authentication; copyright protection; robustness; Discrete Wavelet Transform (DWT); Singular Value Decomposition (SVD).

I. INTRODUCTION

Watermarking Refers to hiding a message within an image or signal; it can be a video also. Watermarking is mainly used for security purposes. Level of threats faced by watermarking depends on the application area. In a robust Watermarking scheme, an image is less damaged after retrieving. The watermarked image can be noticed easily, if the quality of the watermarked image is seriously affected after embedding. Watermark insertion is in the particular Domain, i.e. either in the spatial Domain or the Transfer Domain. in instance of spatial domain the embedding of the watermark is a straightforward method. The spatial-domain components of the original image are embedded with the digital watermark. due to the straightforward acting behaviour the spatial domain has a low complexity and easy implementation. Here shown the figure classification of digital watermarking domain.

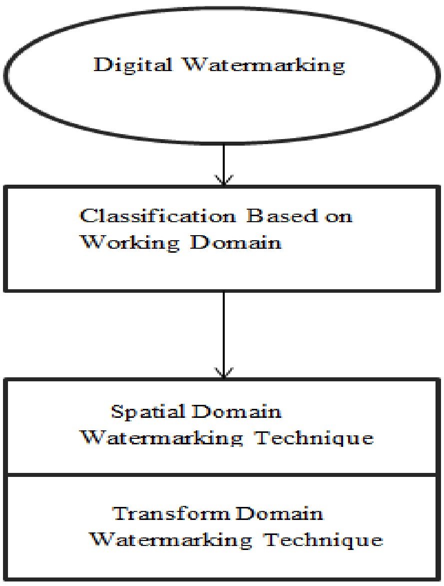

Figure 1 Classification of Digital Watermarking Domain

Though, the transfer domain (Frequency Domain) carries the embedding of watermark by modulating the magnitude of coefficient of the image in the desired transform domain, (DCT), discrete wavelet transform (DWT), and Singular value decomposition (SVD) [3]. The positives of a transform domain is its ability to yield maximum information after embedding the watermark and improved robustness against various attacks, but it has a flaw of increased computational cost in comparison to spatial-domain [4].

Paper provides a review on Robust digital watermarking for coloured images using SVD and DWT technique Section 1 gives introduction to Digital watermarking domain classification. Section 2 Background review. Section 3 Experiment results. Section 4 Conclusion.

II. BACKGROUND REVIEW

Section II contains the digital watermarking phases and frequency domain transform being used for watermarking. DWT (Discrete Wavelet Transform), and SVD (Singular Value Decomposition) are the methods that are elaborated in this section and worked on.

Digital watermarking life-cycle phases:

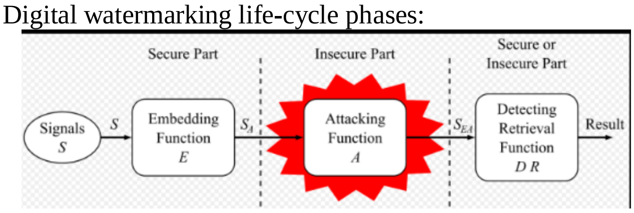

Figure 2: Architecture of Digital Watermarking

Watermarking system is usually divided into three distinct steps, embedding, attack, and detection (extraction). Digital watermark means the difference between the

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watermarked signal and the cover signal. The signal where the watermark is to be embedded is called the host signal. In embedding, an algorithm accepts the host and the data to be embedded, and produces a watermarked signal. Then the watermarked digital signal is transmitted or stored, usually transmitted to another person. If this person makes a modification, this is called an attack. Detection (often called extraction) is an algorithm which is applied to the attacked signal to attempt to extract the watermark from it. Discrete Wavelet Transform and Singular Value Decomposition Methods Described.

A)DWT

Discrete Wavelet Transform can be characterized as any wavelet transform for which waves are discretely sampled. DWT enumerates the high and the low frequency components by splitting the image into its respective frequency components. The high frequency components bequeath for the edge detection whereas the low frequency components are again bifurcated into high and low frequency components. The purpose of watermarking is served by the high frequency components as the human eye is sensitive on the edge variations [6].

The levels of DWT implementation can be on a multistage Level transformation. For the first stage decomposition by DWT the image is divided into its LL, LH, HL, and HH plane. The LH, HL, and HH plane represent the finest scale wavelet coefficient whereas the LL plane represents the coarse-level coefficient. Therefore fro edge detection purposes the LL plane can undergo the desired number of DWT levels [7].

B) SVD

The Singular Value decomposition yields the purpose of reduction of complexity by dividing the non-negative image matrix into U * S * VT, where U and V are the orthogonal matrices and S is the diagonal matrix.

C. Proposed DWT-SVD Scheme

The proposed DWT-SVD scheme is formulated as given under:

1) Extract the red component of the image with (:, :, 1).

2) One level Haar Discrete Wavelet Transform to decompose cover image into four sub-bands.
[ca1, ch1, cv1, cd1]=dwt2 (image,'haar') (1)

3) Apply Singular Value Decomposition to the vertical (cv1) and horizontal (ch1) coefficients.

[U1, S1, V1]= svd (ch1) (2)
[U2, S2, V2]= svd (cv1) (3)

4) Divide the watermark into two parts.
W=W1+W2 (4)

5) Extract the red component of the watermark as well like for the image, with (:, :, 1).

6) Modify the singular values of vertical and horizontal plane in 2.Along with the inputted scale factor (a).
S1+aW1=Uw*Sw*VwT (5)
S2+aW2=Uw*Sw*VwT (6)

7) Two sets of modified DWT coefficients are made available by 4.
Mod_c_h=U1*Sw*V1T (7)
Mod_c_v=U2*Sw*V2T (8)

8) Apply the inverse Discrete Wavelet Transform, i.e. idwt on the two sets of modified coefficients in 5 (cv1 and ch1) and non-modified coefficients in 1 (ca1 and cd1).
WI=idwt2 (ca1, Mod_c_h,Mod_c_v,cd1,'haar') (9)

9) Replace the first component of the image that is processed with the original image's first component.

10) Extraction of the watermark:
For the Extraction of the watermark: (in the red component).

Apply one level Haar DWT to the watermarked image obtained in 6.
[ca2, ch2, cv2, cd2] = dwt2 (WI,"haar') (10)

11) Apply SVD to the vertical and horizontal coefficients, where U and V are of original image and S is of the watermarked image from 2 and 4 respectively.
[U1, Sw, V1] = svd (ch2) (11)
[U2, Sw, V2] = svd (cv2) (12)

12) Compute the replaced coefficients by placing the U and V of the original watermark along with the singular value S used in 8.
M_c_h = Uw*Sw*VwT (13)
M_c_v = Uw*Sw*VwT (14)

13) Extract half of the watermark by
W1* = (M_c_h – S1) / a (15)
W2* = (M_c_h – S2) / a (16)

14) Combine the results of 4 to obtain the original watermark.
W* = W*1 +W*2 (17)

III. EXPERIMENTAL RESULTS

Experiments are conducted to Demonstrate the proposed approach. The coloured image "Monarch" of size 256 × 256 is used as cover image and "Barbara" of size 256 × 256 is used as watermark image. This image are shown in fig (a) and (b) which are of cover and Watermark respectively. (c) illustrates the watermarked image and (d) is the extracted image. The observation the proposed approach yields the preserved high perpetual quality of the watermarked image.

As a parameter of quality, peak signal-to-noise ratio (PSNR) has been used. The illustrates the maximum

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fluctuation of pixels with the mean square error of the images and helps in easy analysis of the variations and degradation being caused on the image by comparing the peaking pixel values.

PSNR = 10 log10 (R2 / MSE)

MSE = sum [(I1 (m, n) – I2 (m, n)) 2] / m*n

Where, R is the maximum fluctuation of pixels and m,n are the row and column matrix of the images.

a) Cover Image b) Watermark

(c) Watermarked Image (d) Extracted Image

In the experiment the values of the scale factor has been carried out from 0.01 to 0.05.

Scale Factor	0.01	0.03	0.05
Watermarked Image	73.7188	59.564	51.49
Extracted Watermark	40.0758	48.155	49.015

Table 1. Comparative analysis of PSNR at different scale factor values for resultant images

On Changing the Value of Scale factor the PSNR fluctuates indicating the status of the robustness of watermark in the image and after extraction. Limitations in this work, It is Very Time Consuming and Complex Method.

The main drawback of the current methods is that they require complex computation. Therefore, watermarks or signatures cannot be attached to the images at the time when they are taken because most cameras are not equipped with such hardware.

IV. CONCLUSION

Here, In this paper hybrid watermarking technique using SVD and DWT has been introduced, where watermark is embedded in the singular values of the red component of the cover image's DWT sub-band and then combined with other two i.e. green and blue components to yield watermarked image. Experimental results are made available which depict the improved imperceptibility and robustness under attacks and preserve copyrights by using this technique.

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