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Robust Digital Watermarking for Colored Image using SVD and DWT Technique

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Abstract:
Digital watermarking can be used to protect digital information from illegal manipulations and distributions The Recent years have seen the rapid growth of digital media, and their proliferation, especially images. This makes protecting multimedia information become more and more important and a lot of copyright owners are concerned about protecting any illegal duplication of their data or work. Some serious work needs to be done in order to maintain the availability of multimedia information but, in the meantime, the industry must come up with ways to protect intellectual property of creators, distributors or simple owners of such data. This is an interesting challenge and this is probably why so much attention has been drawn toward the development of digital images protection schemes. Of the many approaches possible to protect visual data, digital watermarking is probably the one that has received most interest.

Keywords: Digital Watermarking, Copyright ProtectionSVD and DWT Technique,SVD-DWT composed algorithm for embedding and extraction ,noise effects on Watermark

I .INTRODUCTION

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 as its plus points. But on the contrary, spatial domain method is not immune to image processing operations and other attacks. Whereas, the transform domain (frequency domain) carries the embedding of the watermark by modulating the magnitude of the coefficients of the image in the desired transform domain, for instance: discrete cosine transform(DCT), discrete wavelet transform (DWT), and singular value decomposition (SVD). 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 . On taking into account the DWT, it has its spatial frequency localization property which sectors the entire image into different frequency coefficients and the areas where the watermark can be embedded imperceptibly are easily accessible. SVD has a mathematical property where minute amendments in the singular values do not cause much havocon the visual perception of the cover image, thereby improving the robustness and transparency.

II. BACKGROUND REVIEW

Section II contains the jest of the frequency domaintransform being used for watermarking. Discrete Wavelet Transform and Singular Value Decomposition are themethods that are elaborated in this section and worked on.

A. Singular Value Decomposition:

Singular value decomposition is a numerical method which is used in numerical assay for in diagonal matrix. For several of applications singular value decomposition is evolve as an algorithm. In image processing applications singular value decomposition has some features. SVs or singular values of digital image have wonderful indelible, for instance, when any disarrange is done on the digital image huge diversity in the singular values do not betide. Singular value decomposition (SVD) is used to un-ridden various numerical issues in linear algebra. The watermarking which is based on SVD method, many inlets are feasible. In original images high frequency band SVD is imposed, which is mostly used inlet and embed the watermark information to modify the singular values. The notable feature of singular value decomposition is when huge of the tampered singular values change that is very small for many types of attacks [1]. The Singular Value decomposition yields the purpose ofreduction of complexity by dividing the non-negative imagematrix into U * S * VT, where U and V are the orthogonalmatrices and S is the diagonal matrix of singular values of theoriginal matrix arranged in decreasing order [2].

B. Discrete Wavelet Transform:

Wavelet domain is a promising domain for watermark embedding. Wavelet refers to small waves. Discrete Wavelet Transform is based on small waves of limited duration and varying frequency [3]. This is a frequency domain technique in which firstly cover image is transformed into frequency domain and then its frequency coefficients are modified in accordance with the transformed coefficients of the watermark and watermarked image is obtained which is very much robust. DWT decomposes image hierarchically, providing both spatial and frequency description of the image [4]. It decompose an image in basically three spatial directions i.e, horizontal, vertical and diagonal in result separating the image into four different components namely LL, LH, HL and HH. Here first letter refers to applying either low pass frequency operation or high pass frequency operations to the rows and the second letter refers to the filter applied to the columns of the cover image [5].

- LL level is the lowest resolution level which consists of the approximation part of the cover image,
- Rest three levels i.e., LH, HL, HH give the detailed information of the cover image.

For second level of decomposition any one sub-band is selected and is further decomposed into four levels. Maximum the level of decomposition, maximum will be the robustness of the watermarked image.

At every level of decomposition, the magnitude of DWT coefficients is larger in lower bands (LL), and is smaller in other three bands (LH, HL, and HH). Larger magnitude of wavelet coefficients shows their higher significance in comparison with the wavelet coefficients of smaller magnitude [6].

HVS (Human Visual System) is more sensitive to the low frequency parts (the LL sub-band), so watermark is preferably placed in other three sub-bands to retain the quality of original image.

C.PROPOSED DWT-SVD SCHEME

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

2) One level Haar Discrete Wavelet Transform todecompose cover image into four subbands.
[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 welllike for the image, with (:, :, 1).

6) Modify the singular values of vertical and horizontalplane in 2. Along with the inputted scale factor (□).
S1 + αW1 = Uw *Sw *VwT(5)
S2 + αW2 = 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. idwton 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 Imageobtained 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 water marked 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 Uand V of the original watermark along with the singular valueS 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) / □ (15)
W2* = (M_c_h – S2) / □ (16)

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

III.EXPERIMENTAL RESULT

The observation ofthe proposed approach yields the preserved high perpetualquality of the watermarked image. As a parameter of quality, peak Experiments are conducted to demonstrate the proposed approach. The coloured image “Dhoni” of size 512 × 512 is used as the cover image and “cameraman” of size 256 × 256 is used as the watermark image. These images are shown in Fig.1(a) and 1(b) which are of the cover and watermark respectively. Fig. 1(c) illustrates the watermarked image and Fig. 1(d) is the extracted signal-to-noise ratio(PSNR) has been used. The PSNR illustrates the maximumfluctuation of pixels with the mean square error of the imagesand helps in easy analysis of the variations and degradationsbeing caused on the image by comparing the peaking pixel values.

PSNR = 10 log10 (R2 / MSE) (18)

MSE = sum [(I1 (m, n) – I2 (m, n)) 2] / m*n (19)

where, R is the maximum fluctuation of pixels and m, nare the row and column matrix of the images.

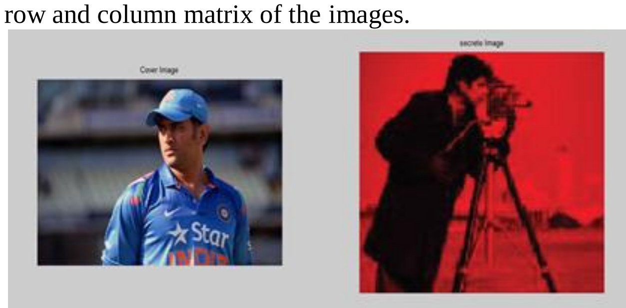

Figure.1.(a)cover image (b)secrete image

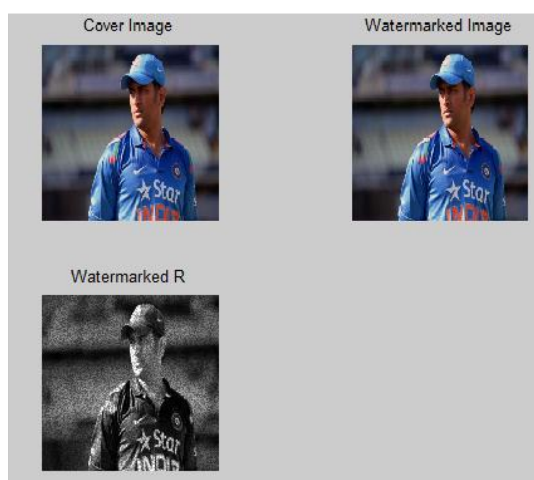

Figure.1(c)Cover image (d)Watermarked image (e)Watermarked image in RED Component

In the experiment the values of the scale factor has beencarried out from 0.01 to 0.09 with a constant interval of 0.02. The graph presented in the Fig. 2 illustrates the PSNR of theextracted image, and of the watermarked image. It is clearfrom the presented graph that the robustness of the watermarkis maintained at a perpetually high level.

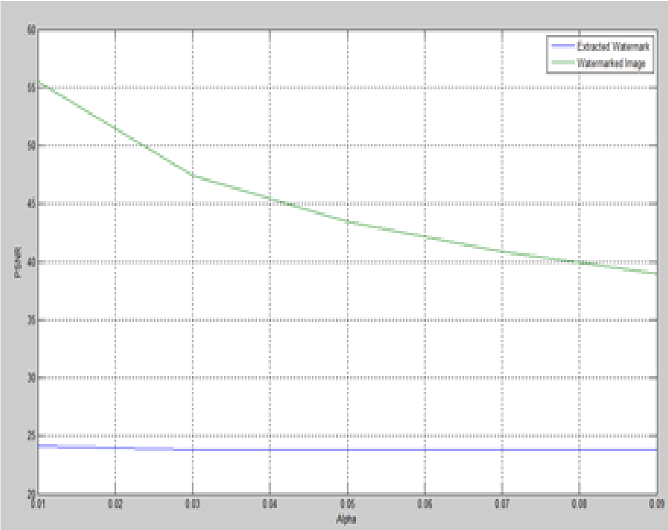

Figure.2 PSNR of Watermarked image and Extracted image

The varying range of the PSNR of the images used inorder to draw the comparison has been presented in the Table I below:

Table I.Comparative Analysis of PSNR at Different Scale Factor values for Resultant Image

Alpha	0.010	0.030	0.050	0.070	0.090
Watermarked	55.50	47.46	43.42	40.83	38.99
Extracted	24.08	23.80	23.79	23.79	23.79

On changing the value of the scale factor the PSNRfluctuates indicating the status of the robustness of thewatermark in the image and after extraction. To contemplate the robustness of the presented approachthe watermarked image is tested against various attacks Fig. 3(a) and (b)demonstrates the effect of noise on the watermarked image and the extracted watermark with high robustness.

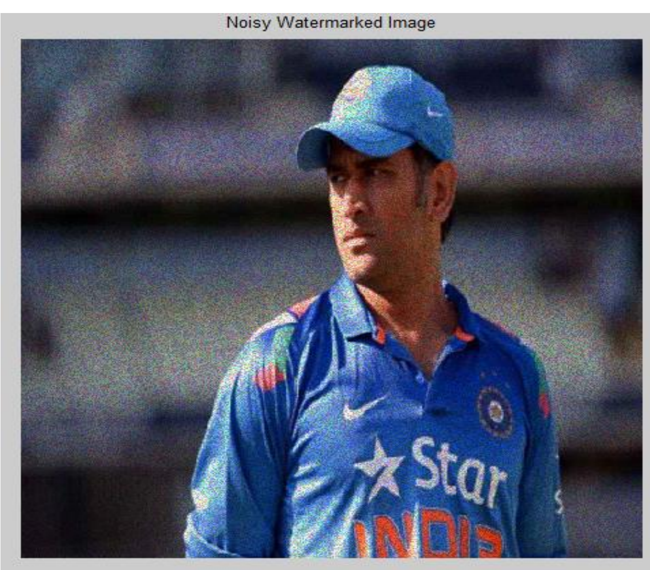

Figure.3(a) Speckle Noise added on Watermarked image

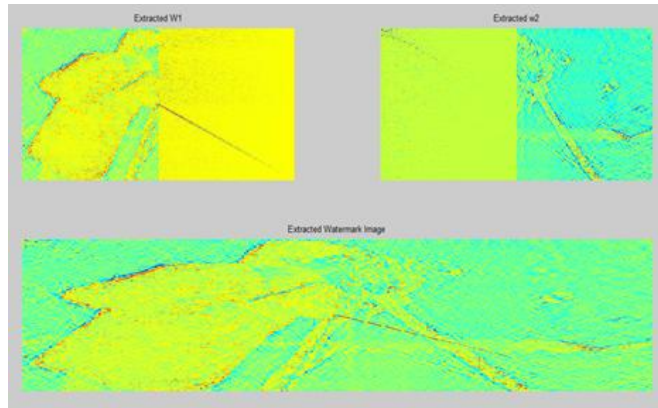

Figure.3(b)Speckle Noise added on Extracted Watermark

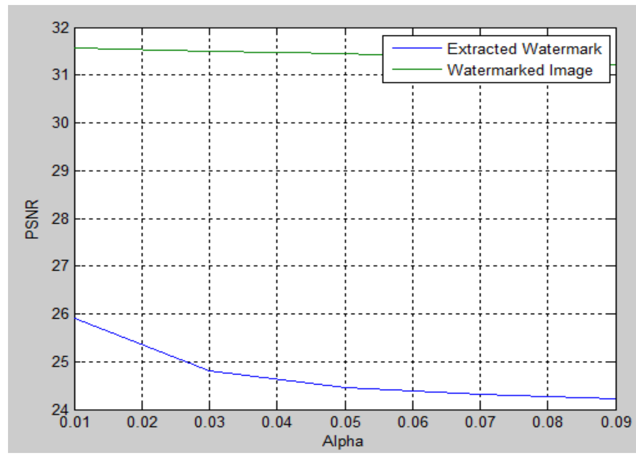

Figure.4.PSNR of Watermarked image and Extracted image after adding Noise

The robustness of the image is of great authentication and proves to enhance the copyrights and amenable to various attacks being forecast on the image.

IV. CONCLUSION

The proposed watermarking algorithm using SVD and DWT technique that contribute more robust in comparison with many watermarking algorithm.The intrinsic algebraic properties of the image represented by SVD and the spatial frequency localization of DWT are well utilized .SVD & DWT techniques have higher PSNR ratio of Extracted watermark image.GOOD quality watermarking scheme should have maximum PSNR.Robust watermark that is difficult to remove from the object in which it is embedded. The basic functionalities contain imperceptibility, robustness, capacity, speed, and security.

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