

Analysis Low Frequency Component of DWT-SVD Hybrid Technique for Digital Image Watermarking

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ABSTRACT: In this research work adopted the frequency domain watermarking scheme which is embedded using discrete wavelet transform (DWT) and singular value decomposition (SVD). By singular values factoring it represent smaller set of values and it can preserve constructive feature of an original image. After that, apply discrete wavelet transform in decomposed in low frequency sub-band on both images to improve the value PSNR. The MSE, PSNR and computation time performance parameters are taken to measure the efficiency of the propose method. The simulated experimentation is done in MATLAB and the simulation results of propose method (DWT-SVD) gives improved results than the existing method (DWT).

KEYWORDS: Discrete Wavelet Transform, SVD, PSNR, MSE

I. INTRODUCTION

Because of the current advancement in web technology, redistribution of computerized substance has turned out to be simple. It prompts to the intense need of sheltered and real condition for the handling of advanced substance. This downside can be overcome by utilizing watermarking technology. Watermarking of images has as of late obtained enormous interest in a scope of applications like, identification of image, copyright protection, verification of image and information stowing away, among others. Duplication and dissemination of sight and sound information have been rendered simple and for all intents and purposes costless because of huge advances in systems administration and high speed processors. Digitized information can without much of a stretch be controlled along these lines losing its inventiveness [1]. Thus it makes copyright security of advanced media a stern challenge. In this way the idea of advanced watermarking comes into picture. Advanced watermarking is the handle that implants information called a watermark into a sight and sound protest in a manner that the watermark can be later on recognized or extricated for a question declaration purposes. The sight and sound articles, in which the watermark is inserted, are as a rule called the first, cover flag, have flag or basically the work [2]. The watermark ought to be inserted in such a way, to the point that the inventiveness of the host picture ought not be twisted [3]. A advanced watermark is a recognizing snippet of data that is appointed to the information to be secured. One imperative necessity by this is the watermark can't be effectively extricated or expelled from the watermarked project. A powerful digital watermarking technique must fulfill the two primary prerequisites of impalpability and robustness to basic images attacks like trimming, revolution, Gaussian clamor, movement obscure, salt and pepper clamor, pressure and numerous more flag preparing operations. Advanced picture watermarking strategies are assembled into spatial and frequency domain.

Spatial Domain

- It is manipulating or changing an image representing an object in space to enhance the image for a given application.
- Techniques are based on direct manipulation of pixels in an image
- Used for filtering fundamentals, smoothing filters, sharpening filters, unsharp masking and laplacian

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Frequency Domain

- This technique are based on modifying the spectral transform of an image
- It transforms the image to its frequency representation
- Carry out an image processing
- Figure out inverse transform back to the spatial domain
- High frequencies correspond to pixel values that modify hastily across the image (e.g. text, texture, leaves, etc.)

Strong low frequency components correspond to huge scale features in the image (e.g. a single, homogenous object that dominates the image) the image watermarking processing is shown in fig.1. In this research, we proposed DWT-SVD – HF technique to watermark the images which improve the quality and security of image.

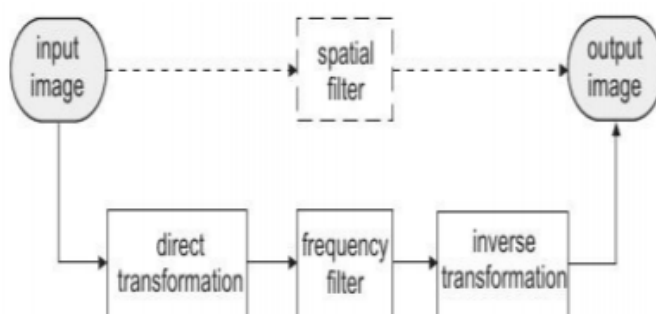


Figure 1: Digital Image Watermarking

II. LITERATURE REVIEW

Gourav Kumar et al. [1], image compression is used to reduce the amount of data required to represent a digital image. The aim of this paper is to analyze the various image compression methods, factors on which image compression techniques are based and examine the performance of image compression using a detailed empirical evaluation of wavelet function, discrete cosine transform and neural network in term of retained energy, peak signal to noise ratio, output image size etc.

Pradeep Kumar Bhatia et al. [2], feature extraction techniques are applied to get features that will be useful in classifying and recognition of images. Feature extraction techniques are helpful in various image processing applications e.g. character recognition. As features define the behavior of an image, they show its place in terms of storage taken, efficiency in classification and obviously in time consumption also. Here in this paper, we are going to discuss various types of features, feature extraction techniques and explaining in what scenario, which features extraction technique, will be better. Hereby in this paper, we are going to refer features and feature extraction methods in case of character recognition application.

V Srinivasa Rao et al. [3], the paper presents Comparative Analysis of Image Compression Using Haar Wavelets on MATLAB and DSP has shown the speed of image compression is more on Digital Signal Processors when compared to General Purpose Processors. The increase in speed and the reduction of size of an image due to compression is useful to achieve rapid data transfer over the internet or any channel. DWT produces an image having a high quality when compared with Discrete Cosine Transform. Because DWT processed digital images at multiple resolutions.

Ahmed A. Nasha et al. [4], Discrete Wavelet Transform, (DWT), is known to be one of the best compression techniques. It provides a mathematical way of encoding information in such a way that it is layered according to level of detail. In this paper, we used Haar wavelets as the basis of transformation functions. Haar wavelet transformation is

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composed of a sequence of low pass and high pass filters, known as filter bank. The redundancies of the DWT detail coefficients are reduced through thresholding and further through Huffman encoding. The proposed threshold algorithm is based upon the statistics of the DWT coefficients.

After going through the review of various existing work taken in the DCT and DWT the following problem formulation:

- According to the DCT properties, a DC is transformed to discrete delta-function at zero frequency. Hence, the transform image contains only the DC component. The work to be done is to perform the inverse transform of the transformed image and also to generate the error image in order to give the results in terms of MSE (Mean Square Error), as MSE increases, the image quality degrades and as the MSE would decrease, image quality would be enhanced with the help of changing the coefficients for DCT Blocks.
- Though in DWT, we get very high compression ratio, we lose minimum amount of information. But if we do more than one level then we get more compression ratio but the reconstructed image is not identical to original image. MSE is greater if DWT apply more than one level.

III. DISCRETE WAVELET TRANSFORM

Multiresolution analysis (MRA) is a characteristic feature of SB and it is used for better spectral representation of the signal. In MRA, the signal is decomposed for more than one DWT level known as multilevel DWT. It means the low-pass output of first DWT level is further decomposed in a similar manner in order to get the second level of DWT decomposition and the process is repeated for higher DWT levels. Few algorithms have been suggested for computation of multilevel DWT. One of the most important algorithm are pyramid algorithm (PA), this algorithm are proposed Mallet (1989a) for parallel computation of multilevel DWT. PA for 1-D DWT is given by

$$Y_l^j(n) = \sum_{i=0}^{k-1} h(i)Y_l^{j-1}(2n-i) \quad (1)$$

$$Y_h^j(n) = \sum_{i=0}^{k-1} g(i)Y_h^{j-1}(2n-i) \quad (2)$$

Where $Y_l^j(n)$ is the n-th low-pass sub band component of the j-th DWT level and $Y_h^j(n)$ is the n-th high-pass sub band component of the j-th DWT level. Two-dimensional signal, such as images, are analyzed using the 2-D DWT. Currently 2-D DWT is applied in many image processing applications such as image compression and reconstruction [Lewis and Knowles (1992)], pattern recognition [Kronland *et al.* (1987)], biomedicine [Senhadji *et al.* (1994)] and computer graphics [Meyer (1993)]. The 2-D DWT is a mathematical technique that decomposes an input image in the multiresolution frequency space. The 2-D DWT decomposes an input image into four sub bands known as low-low (LL), low-high (LH), high-low (HL) and high-high (HH) sub band.

IV. PROPOSED METHODOLOGY

DWT involves decomposition of image into frequency channel of constant bandwidth. This causes the similarity of available decomposition at every level. DWT is implemented as multistage transformation. Level wise decomposition is done in multistage transformation.

S is a diagonal matrix of singular values in decreasing order. The basic idea behind SVD technique of watermarking is to find SVD of image and the altering the singular value to embed the watermark. In Digital watermarking schemes, SVD is used due to its main properties:

- 1) A small agitation added in the image, does not cause large variation in its singular values.
- 2) The singular value represents intrinsic algebraic image properties. [3]

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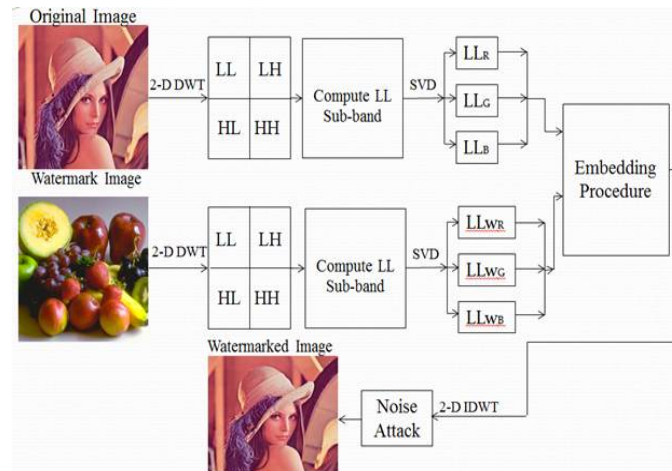


Figure 3: Flow Chart of Proposed Methodology

Algorithm for Watermark Embedding

- Step 1: Input Host image
- Step 2: Rearrange the host image (RI)
- Step 3: Apply 2-D DWT on rearranged image RI to decompose it into four sub-bands LL, HL, LH and HH.
- Step 4: Select sub-band LL of RI.

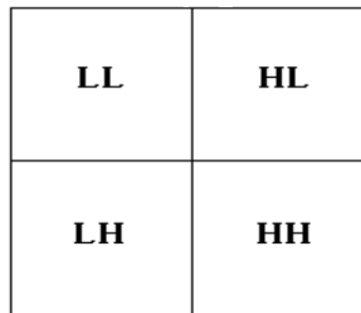


Figure 4: 2-D DWT

- Step 5: Then apply SVD to sub-bands LL to get SH1, SH2 and SH3.
- Step 6: Input watermark image Wi. Apply 2-D DWT to decompose it into four sub-bands LL1, HL1, LH1 and HH1.
- Step 7: Select sub-bands LL1 of Wi.
- Step 8: Then apply SVD to sub-bands LL1 to get SW1, SW2 and SW3.
- Step 9: Modify SH1, SH2 and SH3 by using equation

$$SH1 = SH1 + (0.10 * SW1);$$

$$SH2 = SH2 + (0.10 * SW2);$$

$$SH3 = SH3 + (0.10 * SW3);$$
- Step 10: Construct modified SVD matrix SH1, SH2 and SH3.
- Step 11: Apply inverse DWT and finally get watermarked image WI.

V. SIMULATION RESULT

Discrete Wavelet Transform (DWT): The digital wavelet transform are scalable in nature. DWT more frequently used in digital image watermarking because of its excellent spatial localization and multi resolution techniques. The

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excellent spatial localization property is very convenient to recognize the area in the cover image in which the watermark is embedded efficiently.

Singular value decomposition (SVD): Singular value decomposition is a linear algebra technique used to solve many mathematical problems. Any image can be considered as a square matrix without loss of generality. So SVD technique can be applied to any kind of images. The SVD belongs to orthogonal transform which decompose the given matrix into three matrices of same size.

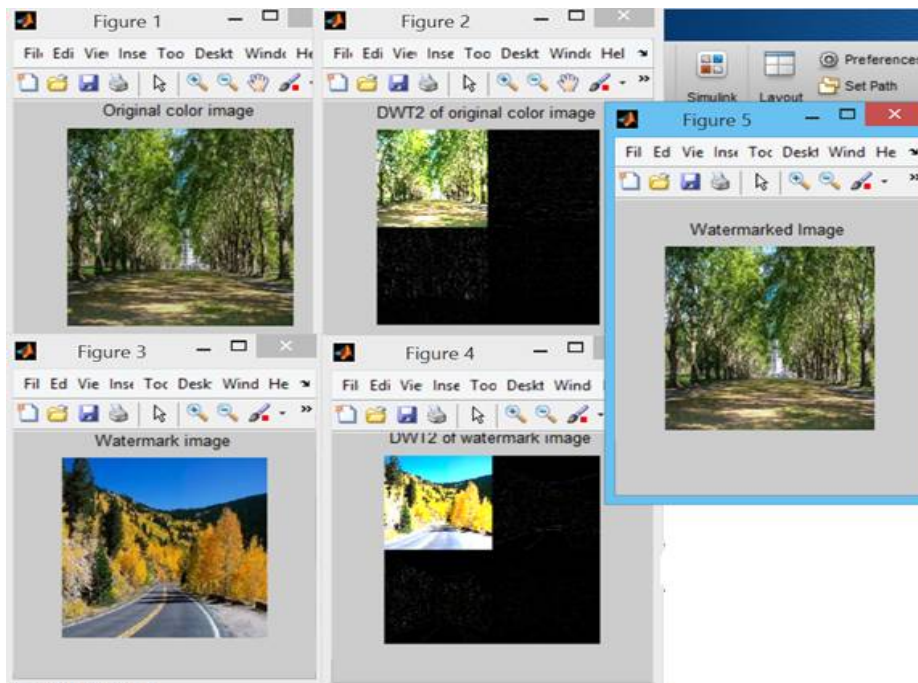


Figure 5: DWT-SVD Technique are applied to the Host Image

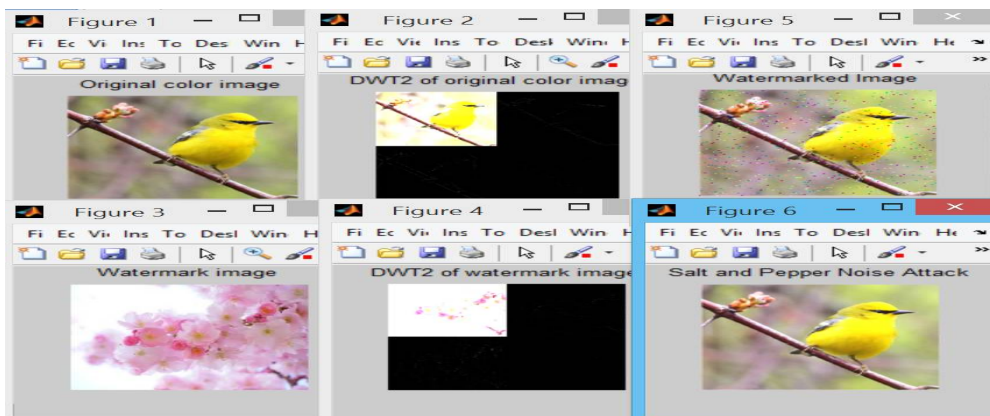


Figure 6: DWT-SVD Technique are applied to the Brid Image

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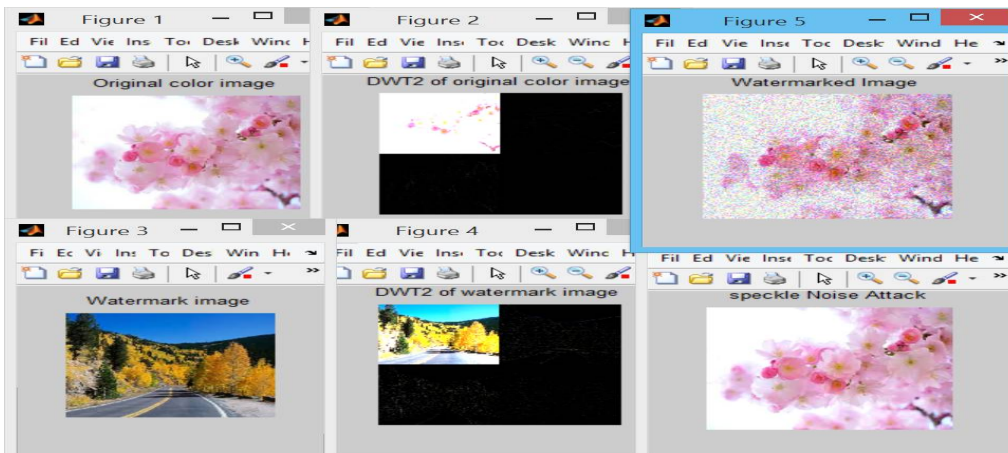


Figure 7: DWT-SVD Technique are applied to the Flower Image

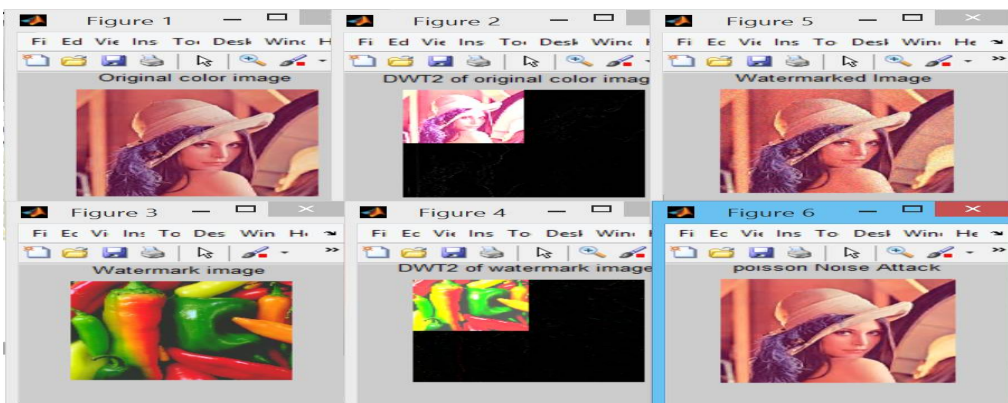


Figure 8: DWT-SVD Technique are applied to the Green Image

Table 1: Result Obtained

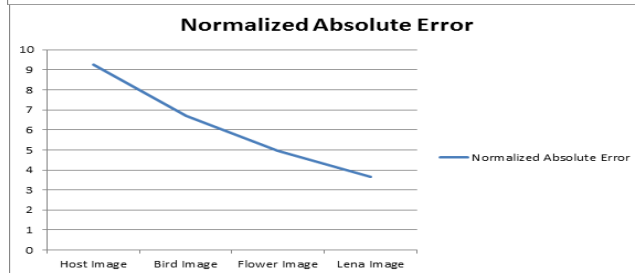
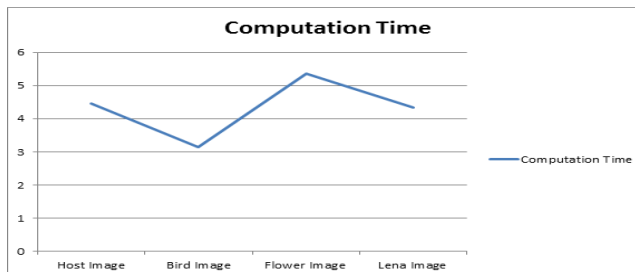
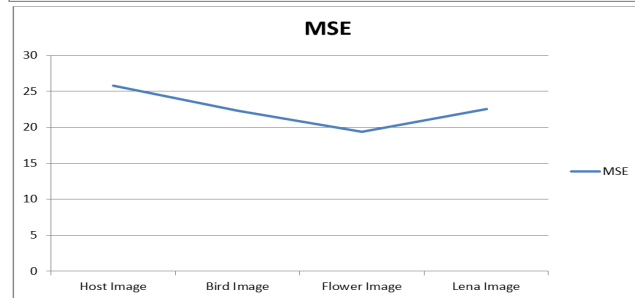
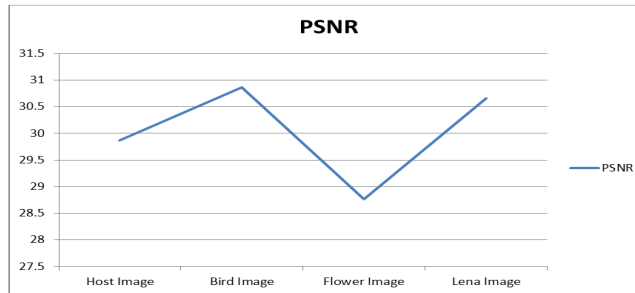
Image	PSNR (dB)	MSE	RMSE	NAE	Computation Time (ns)
Host Image	29.864	25.7597	8.3286	9.241	4.451
Bird Image	30.865	22.2821	7.4443	6.702	3.145
Flower Image	28.765	19.4129	5.2992	4.962	5.347
Lena Image	30.654	22.543	6.954	3.654	4.332

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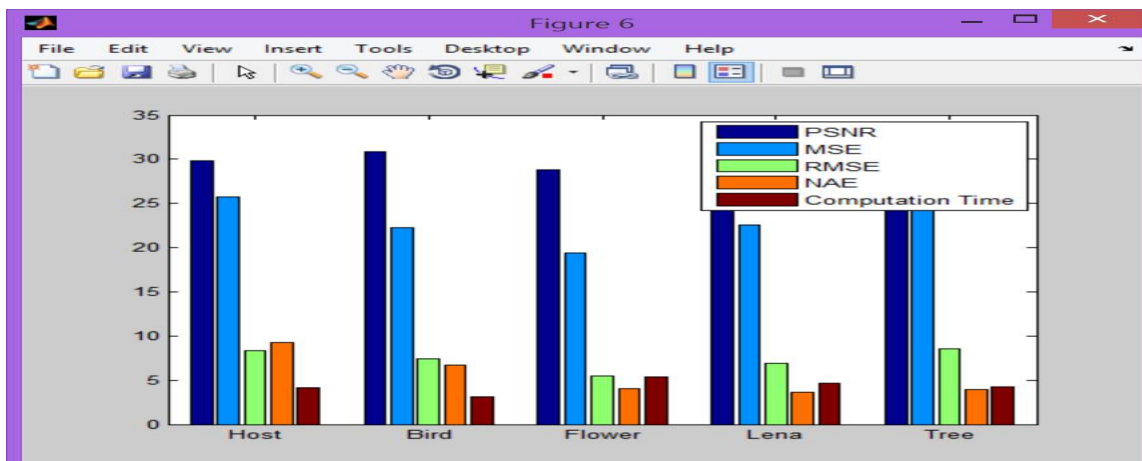


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VI. CONCLUSION

In this paper DWT is proposed to overcome the drawback of DWT-SVD based watermarking scheme. The redundancy in the DWT provides the robustness to the watermarked image. As the embedding of watermark image occurs in all sub-bands, more information can be transferred and principal components help to avoid the false positive problem. Thus the proposed scheme can satisfy the capacity, robustness and imperceptibility.

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