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# DWT-SVD Based Hybrid Approach for Digital Watermarking Using Fusion Method

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## Abstract

***With the rapid development of multimedia and the widespread distribution of digital data over the internet networks, it has become easy to obtain the intellectual properties. Consequently, the multimedia owners need more than ever before to protect their data and to prevent their unauthorized use. Digital watermarking has been proposed as an effective method for copyright protection and an unauthorized manipulation of the multimedia. In our study DWT-SVD based hybrid digital image watermarking scheme using fusion method is proposed. The idea of the proposed technique is based on fusing multiple original input images using wavelet fusion algorithm. Then the watermark is embedded in the resultant fused original image using hybrid DWT-SVD watermarking algorithm to produce the watermarked image. Extensive experiments are conducted throughout this investigation in order to examine the performance of the proposed watermarking schemes. It is shown that the proposed watermarking schemes developed in this thesis provide a performance superior to that of the existing schemes in terms of robustness against various types of attacks while preserving the perceptual quality of the image.***

**KEYWORDS*: DWT, SVD, DWT-SVD, Watermarking***

## I. Introduction

Privacy is the ability of an individual or group to make the information about the individual or the group secluded and thereby reveal the information selectively. Data privacy or data protection is the relationship between collection and dissemination of data, technology, public expectation about privacy and the legal issues. It has become increasingly important as more and more systems are connected to the internet.

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Watermarking is a pattern of bits inserted into digital image, audio or video file that identifies the file's copyright information such as author and rights. Thus, watermarking is an approach to make sure the data are protected.

An algorithm is designed to embed watermark data in images using watermarking approach. The proposed algorithm inserts all the data inputted in the images to protect the privacy of the watermark.

Once the watermarking is done, user can send the watermarked image to other computer so that other user is able to read the watermark or the hidden message in the image only if the same algorithm is used. Thus, the watermark can be protected without being revealed.

## II. Watermarking Schemes

Mapping an image into another transform domain may make the coefficients of the transformed image uncorrelated to each other and the energy of the original data may get concentrated into just a few coefficients. Many of the watermarking schemes have exploited these features of the transformed data. In this section, we briefly review some of the transforms commonly used in watermarking.

**Singular value decomposition (SVD)**

Singular value decomposition is a fundamental mathematical analysis tool used to analyze matrices and it has been successfully applied to different applications, such as signal processing, pattern analysis, and data compression. The singular value decomposition of an matrix of rank r.

$$C=USV^{T}$$

**Discrete wavelet transform (DWT)**

The DWT has received considerable attention in various signal processing applications, including digital image watermarking. The basic idea of the DWT for a one-dimensional signal is the following. A signal is split into two sub-bands, as illustrated in Figure 1 The output coefficients of the low-pass filter are called the approximation coefficients, whereas those of the high-pass filter are called the detail coefficients. A down-sampling by a factor of 2 is carried out at each level of decomposition, to keep the number of coefficients constant and equal to the length of the original signal being decomposed.

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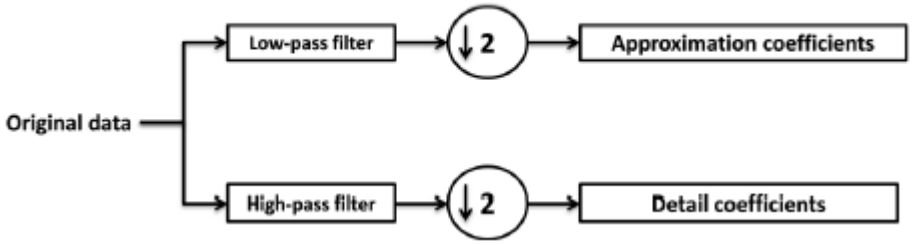


**Figure 1 Wavelet sub-bands with 1-level decomposition of a 1-dimensional signal.**

## III. Proposed Technique

The proposed hybrid image watermarking technique consists of two phases as shown in Figure 2. In the first phase, the primary original input is fused with the secondary original input using wavelet fusion to produce fused original input image. In the second phase, the watermark is embedded in the fused original input image using the hybrid DWT-SVD watermarking algorithm. On the other hand the extraction of watermark image occurs.

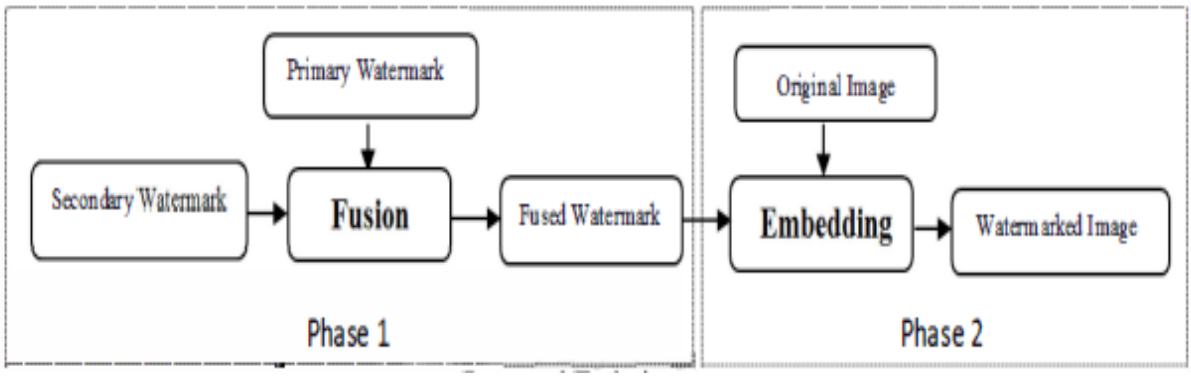


**Fig. 2: Proposed Technique**

**Embedding Algorithm**

The watermarking algorithms (techniques) can be performed either in spatial domain or in the transform domain. The spatial-domain techniques directly modify the intensities or color values of some selected pixels. One commonly used spatial domain technique is the Least Significant Bits (LSB) technique. In this technique the watermark is embedded in transform domain. In a similar manner to spatial domain watermarking, the transform domain techniques modify the values of selected transformed coefficients.

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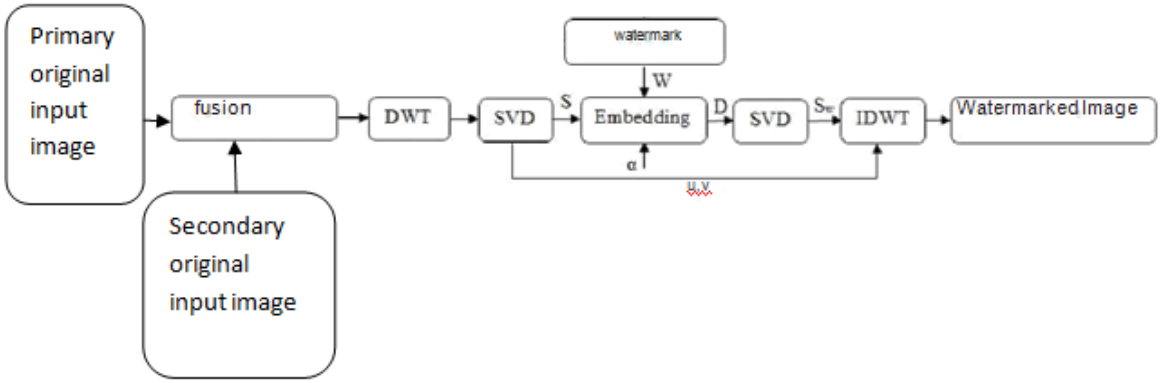
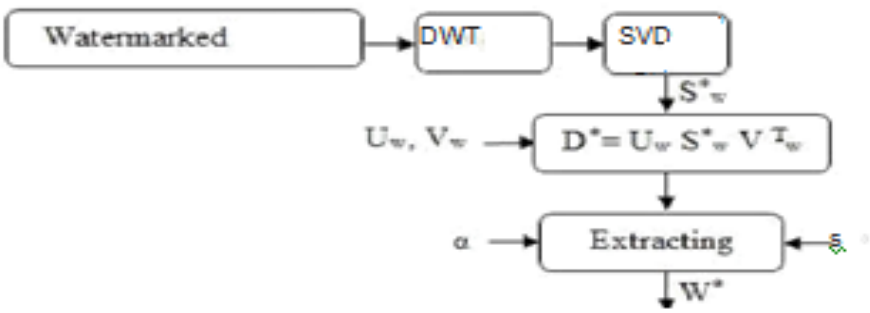



The watermarking embedding algorithm is shown in Figure. The algorithm works as follows:

1. The original image is transformed into four sub-bands using the one-level DWT.
2. The SVD is performed on the A matrix.
   $A = US\ V^T$ (1)
3. The primary and secondary original input are fused using wavelet fusion.
4. The W matrix (fused image) is added to the SVs of the A matrix.
   $D = S + \alpha W$ (2)
   To keep the image undistorted, small value of a is chosen (0.01)
5. The SVD is performed on the new modified (D matrix).
   $D = U_W\ S_W\ V_w^T$ (3)
6. The Aw matrix (watermarked image) is obtained using matrix Sw.
   $A_W = U\ S_W\ V^T$ (4)
7. The watermarked image is inversed using one level IDWT.

**Extracting Algorithm**

The watermarking extracting algorithm is shown in Figure below. The algorithm works as follows:



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## IV. Result and Discussion

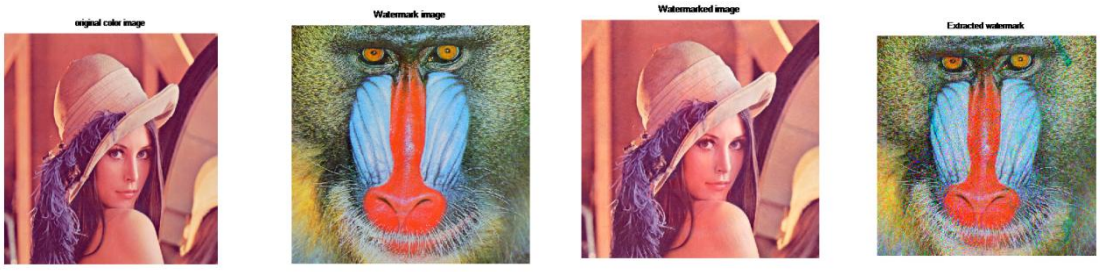
### MATLAB Output of DWT


**(a)** **(b)** **(c)**

**(d)** **(e)**

Fig. 3 (a) leena image (B )Dwt of leena image C)baboon image D)Dwt of baboon image E)watermarked image

### Extraction of Watermark




**(a)** **(b)** **(c)** **(d)**

Fig. 4 (a) original image (B )watermark image C)watermarked image D)extracted image

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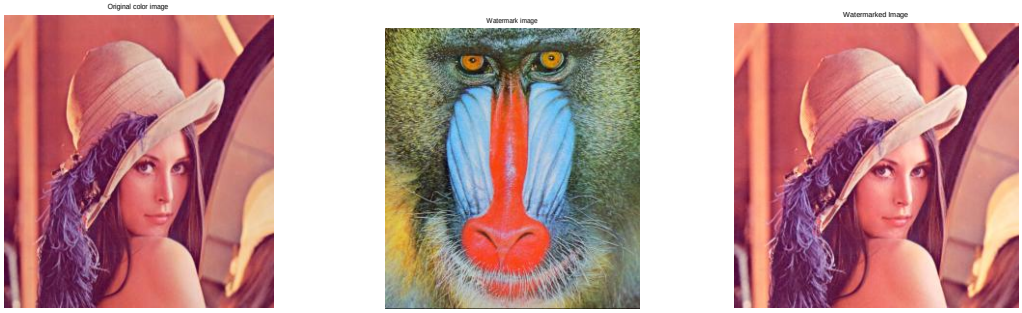
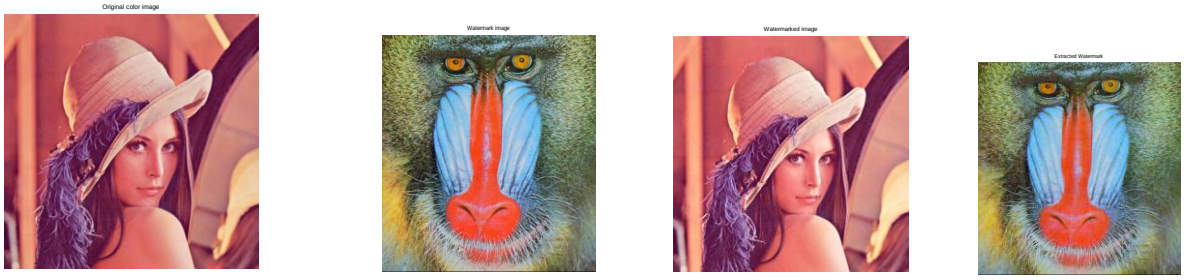
## MATLAB Output of DWT-SVD




**(a)** **(b)** **(c)**

Fig. 5 (a) original image (B )watermark image C)watermarked image

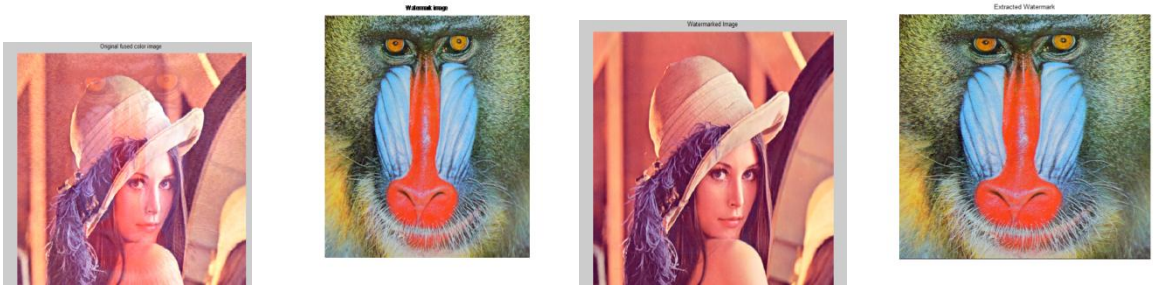
## Extraction




**(a)** **(b)** **(c)** **(d)**

Fig. 6 (a) original image (B )watermark image C)watermarked image D)extracted image

## MATLAB Output of DWT-SVD with Fusion




**(a)** **(b)** **(c)** **(d)**

Fig. 7 (a) original image (B )watermark image C)watermarked image D)extracted image

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**Comparision Of DWT,DWT-SVD&DWT-SVD With Fusion**

| SR.NO | NAME OF THE TECHNIQUE | MSE | PSNR |
|---|---|---|---|
| 1 | DWT | 2.9081e+003 | 13.4947 |
| 2 | DWT-SVD | 3.1519e+003 | 13.1451 |
| 3 | DWT-SVD WITH FUSION | 2.3819e+003 | 14.3616 |

**Table 1 comparison of the techniques**

It has been proved that the use of DWT-SVD with fusion method has improved the security of the watermarking scheme. Particular attention is given to the proposed scheme to guarantee secure watermark embedding and easy extraction. The watermark is imperceptible to the human eye and recoverable most of the time. The watermarked images were assessed for fidelity by using PSNR and MSE. The results show that if used appropriately, the distortion caused by the watermarking embedding is invisible. This was concluded from the high values of PSNR . This proves that the perceptual quality was improved using the new scheme. In the case of robustness, the results show that the new algorithm is more better than already existed algorithms.. The algorithms were designed using grey level images and the RGB color images.

## V. Conclusion

It has been proved that the use of DWT-SVD with fusion method has improved the security of the watermarking scheme. Particular attention is given to the proposed scheme to guarantee secure watermark embedding and easy extraction. The watermark is imperceptible to the human eye and recoverable most of the time. The watermarked images were assessed for fidelity by using PSNR and MSE. The new techniques could offer significant advantages to the digital watermark field and provide additional benefits to the copyright protection industry.

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