# Digital Image Watermarking based on DWT and SVD Techniques

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**Abstract – In digital world, multimedia content and data can easily be used in an illegal way being copied, modified and distributed again. Watermarking is identified as a major technology to achieve copyright protection. Because of its growing popularity, the Discrete Wavelet Transform (DWT) is commonly used in recent watermarking schemes. In this paper a digital watermarking method that uses a combination of DWT (Discrete Wavelet Transform) and SVD (Singular Value Decomposition) is applied. By using this combination of these techniques in our proposed work, it increases the robustness and imperceptibility of extracted image.**

**Index Terms – DWT (Discrete Wavelet Transform), SVD (Singular Value Decomposition),DigitalWatermarking, PSNR(peak signal-to-noise ratio ).**

## 1. INTRODUCTION

A digital watermark is a pattern of bits inserted into a digital file – image, audio or video. Such messages usually carry copyright information of the file.

Originally a watermark is a more or less transparent image or text that has been applied to a piece of paper, another image to either protect the original image, or to make it harder to copy the item e.g. money watermarks or stamp watermarks.A digital watermark added to a photo, is a more or less visible information in the form of a text or some other photo/image that ha been added to the original photo. The added information can be more or less transparent to make it either easy or hard to notice the watermark.

### 1.1 TYPES OF WATERMARKING:

A visible watermark is a visible semi-transparent text or image overlaid on the original image. It allows the original image to be viewed, but it still provides copyright protection by marking the image as its owner's property. Visible watermarks are more robust against image transformation (especially if you use a semi-transparent watermark placed over whole image). Thus they are preferable for strong copyright protection of intellectual property that's in digital format.


An invisible watermark is an embedded image which cannot be perceived with human's eyes. Only electronic devices (or specialized software) can extract the hidden information to identify the copyright owner. Invisible watermarks are used to mark a specialized digital content (text, images or even audio content) to prove its authenticity.

A Dual Watermarking is a combination of visible and invisible watermark. An invisible watermark is used as a backup for the visible watermark.

Digital video watermarking can be achieved by either applying still image technology to each film frame or using dedicated methods that exploit inherent features of the video sequence.

Watermark can be inserted into a digital data by various methods. These methods are mainly classified into two

- Spatial domain
- Transform domain

In spatial domain based watermarking method, watermark is inserted inside the digital content by modifying the pixel values. The most common algorithm for spatial domain watermarking is Least Significant Bit Modification. This method changes the least significant bits (LSB) of chosen pixel in the image. It is possible to use more LSB bits of the container image in the similar way. The watermark object may also be embedded many times within the container image. Even if most of the watermarks are lost due to attacks, a single surviving one is enough.

This method is comparatively simple. It can survive simple operations such as cropping and addition of noise. However lossy compression is going to defeat the watermark. Also, a simple attack that sets all the LSB bits to '1' will defeat the watermark with negligible perceptual impact to the cover

object. To extract the watermark, the LSB plane is extracted from the watermarked image and an exclusive-or operation is done using the watermark template.

In transform based watermarking method, digital data is represented in terms of frequencies. Digital watermarking using transform domain method is done by different method, where each method have their own advantages and disadvantages. DCT, DWT, DFT, FFT comes as an example of various transform domain based techniques.

1.2 Discrete Wavelet Transform (DWT)

The Discrete Wavelet Transform (DWT) is currently used in a wide variety of signal processing applications, such as in audio and video compression, removal of noise in audio and the simulation of wireless antenna distribution. Wavelets have their energy concentrated in time and are well suited for the analysis of transient, time-varying signals. Wavelet transform use wavelet filters to transform the image. There are many available filters, although the most commonly used filters for watermarking are Haar Wavelet Filter, Daubechies Orthogonal Filters and Daubechies Bi-Orthogonal Filters. Each of these filters decomposes the image into several frequencies.

DWT involves decomposition of image into frequency channel of constant bandwidth. This causes the similarity of available decomposition is done in multistage transformation. At level 1: image is decomposed into four sub bands: lower (LL), vertical (LH), horizontal (HL), and diagonal (HH) detail components. Where LL denotes the coarse level coefficient which is the low frequency part of the image.LH, HL, and HH denote the finest scale wavelet coefficient. The LL sub band can be decomposed further to obtain higher level of decomposition. This decomposition can continues until the desired level of decomposition is achieved for the application. The watermark can also be embedded in the remaining three sub bands to maintain the quality of image as the LL sub band is more sensitive to human eye.

1.3 Singular Value Decomposition (SVD)

Another technique introduced to generate the proposed algorithm is SVD is the tool in linear algebra available to analyze image in matrices form. In this technique, image is decomposed in three same size matrices. Presume that image is denoted as matrix A. Let A be a p x q matrix with p = q. The structure of SVD of A is:
A= U* S* VT

In this formula, U and V are matrices of type orthogonal and S is square diagonal matrices. SVD method can be applied to transform matrix i.e. A into product U,S,VT , which helps us to re-factor digital image in three matrices. The exploitation of singular values for such refactoring helps us to represent image with less significant set of values, which is capable of preserving useful and functional features of the original image, also require less storage space in the memory, and in this way reach the image compression ratio.

## 2. RELATED WORK

Lots of work towards the area of digital watermarking have been done in past. This section presents a brief survey of existing approaches to embed the watermark and extract the cover image successfully with their advantages and limitations.

Nikita Kashyap puts forward a technique for image watermarking based on a 2 level DWT. On this method the invisible watermark is embedded into salient points of the picture using alpha blending manner.

Ensaf hussain and mohammed A.Belel who were thefaculty of computers and information in helwan university proposes a paper based on watermarking techniques in frequency domains. This paper presents explores the role of discreate cosine transform DT, discreate wavelet transform DWT andcontourlet transform T in generating robust emebedding technique that resist various attacks.

Another proposal was by Mayak Awsthi and himashi Lodhi together proposes a “Roust image watermarking based o DWT and DCT. The technique of digital watermarking is one of the valid methods for copyright protection. In this paper, we propose a digital watermarking algorithm with grey image based on 2 dimensions discrete wavelet and cosine transform in order to protect digital media copyright efficiently. We transform the image into discrete wavelet domain for three timely and split the image into sub-blocks, which is lower in horizontal direction and high in vertical direction, and then transform every block into discrete cosine domain, the watermarking components, which is also transformed into discrete cosine domain, are embedded into cover image. Finally, the secret image is obtained by reverse transform of wavelet and cosine domain. The experimental results show that the watermarking is robust to the common signal processing techniques including JPEG compressing, noise, lowpass filtering and cutting.

Digital image watermarking algorithms based on dual transform domain and self-recovery by Zhu Yuefeng from Hefei university of technology, China. In view of dual watermarking algorithm for dual two value image watermarking, the watermark information there is a gray image watermarking in the expression is obviously insufficient. The proposal emebedded in the carrier image on the carrier image on the dual watermark includes a two watermark image and gray image watermark algorithm,the persuasive power while maintaining the orginal two values of the watermark robustness at the same time, improve the watermark information.

Another proposal was Digital Watermarking using Discrete Wavelet Transform by Malika Narang and Gurgaon Sharda Vashisth from the Department of electrical, electronics and

communication engineering, ITM University . It is very easy to copy and modify digital media resulting in great loss in business. So the viable solution for this problem is digital watermarking. Digital watermarking is a technique by which we embed copyright mark into digital content which is used to identify the original creator and owner of digital media. It is prominently used for tracing copyright infringements. In this paper technique based on 1-level discrete wavelet transform is used for insertion and extraction of watermark in original image by using alpha blending. This technique is much simpler and robust than others.

## 3. PORPOSED MODELLING

### 3.1 Watermarking Embedding procedure:

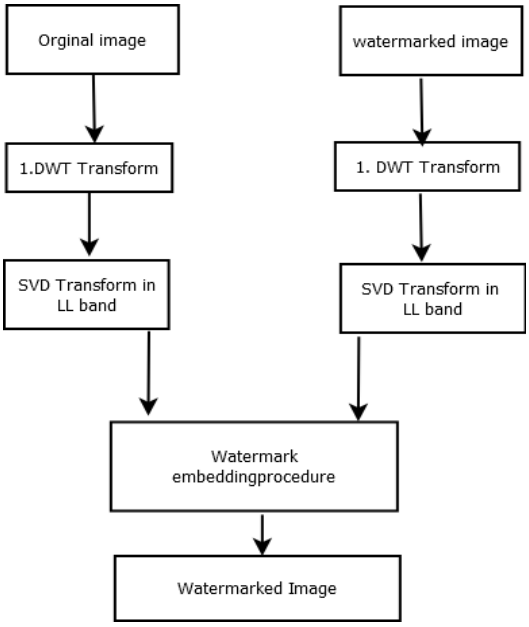
The procedure for embedding the watermark that we are following in this project is given as follows:

a. Select the host and the watermark image.

b. Apply DWT transform on both original and the watermark image.

c. Apply SVD on the LL sub band of both original and the watermark image.

d. Apply the watermarking algorithm on the two images and generate the resulting watermarked image.




### 3.2 Watermark extraction procedure:

The watermark extraction process that we are going to use in our project is given as follows:

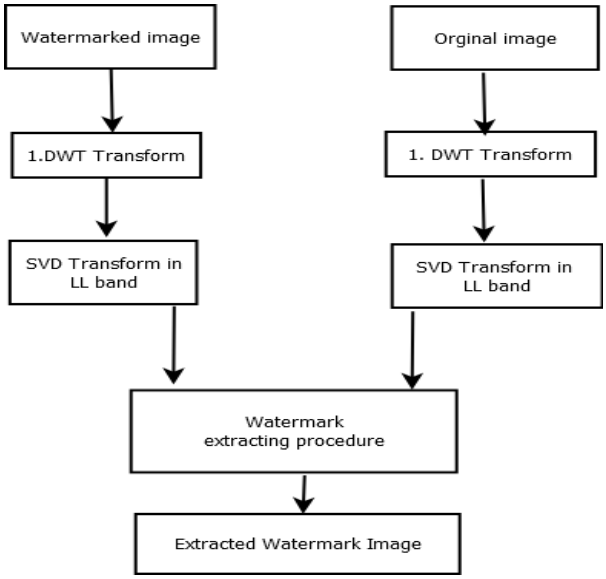
To demonstrate the proposed approach, Lena's image is used as an original image and copy-right image is used as the watermark.

a) Select the host and the watermarked image.

b) Apply DWT transform on both original and the watermarked image.

c) Apply SVD on the LL sub band of both original and the watermarked image

d) Apply extraction algorithm on the images and generate the resulting watermarked image




## 4. RESULTS AND DISCUSSIONS

Orginal image

host image

Waremarked image

extracted image

By implementing the above watermarking algorithm, the following are the results from which we can compare and evaluate the quality of the embedding andextracting methods.

The peak signal-to-noise ratio (PSNR) was used as a measure of the quality of a watermarked image.

Table 1: Evaluation Parameters

| | PSNR | MSE |
|---|---|---|
| Embedding | 30.0764 | 15.0981 |
| Extraction | 16.9087 | 504.6703 |

Table 2: Evaluation Parameters after Attacks

| | PSNR | MSE |
|---|---|---|
| Rotation | 14.9860 | 1.0864e+03 |
| Crop | 10.0933 | 4.0523e+03 |

## 5. CONCLUSION

In this paper, we studied about different watermarking techniques and basic watermarking technique known as DWT-SVD is proposed. The implemented algorithm works only for the RGB images. Proposed method has been tested under different attacks and the performance was observed under those attacks.

## REFERENCES

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