A Study And Analysis of Dwt and DWT-SVD Digital Image Watermarking Techniques

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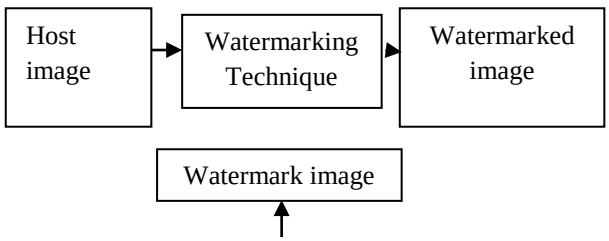
***Abstract*- The tremendous growth of multimedia applications has led to an increase of tools and algorithms that help to secure and maintain privacy in digital data. As digital data can be easily duplicated and edited, some copyright protection tool must be there. Digital watermarking is the technique of hiding or embedding some information in the original file which is used for identifying piracy, sensing tampering or reassuring integrity. In this paper, a survey on different digital watermarking techniques has been done based on their visibility, robustness and fragility. Techniques in spatial domain and frequency domain has been discussed, as they can be applied to text, audio and video along with their comparison, uses and limitations. [1-2]**

Keywords – Digital Watermarking, Spatial domain, Frequency domain, LSB, DCT, DWT, DFT.

I. INTRODUCTION

Watermarking is a technique to preserve the original digital image known as cover image according to watermark image. Host image is passed through any of the watermarking techniques along with the watermark and the resultant watermark image is full of security and accuracy.



Digital Watermarking techniques broadly classified into two domains:

1) Spatial domain based Watermarking Techniques
2) Transform domain based Watermarking Techniques

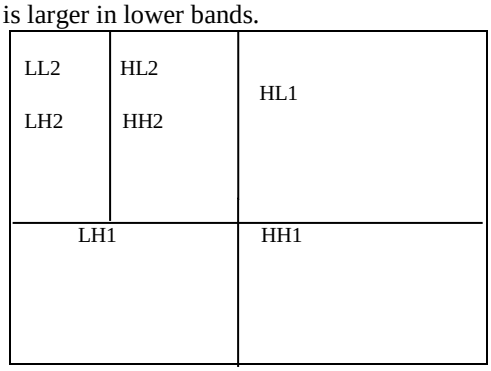
Spatial domain based Watermarking techniques does not gain much preference over transform domain based watermarking techniques as the watermark embedded by the above method is found to be easily destroyed and attacked by the attackers. In Transform domain based watermarking techniques, many techniques came into existence like DCT (Discrete Cosine Transform), DFT (Discrete Fourier Transform) but due to their some shortcomings like less robustness, imperceptibility and susceptible to attacks, another technique DWT and hybrid DWT-SVD technique gained tremendous popularity as it overcomes all the above mentioned shortcomings. [16][20]

II. DWT (DISCRETE WAVELET TRANSFORM)

Discrete wavelet transform is based on the concept of wavelets which are the small waves of limited duration and varying frequency [18]. DWT is a frequency domain based technique in which host image is converted into frequency coefficients and these coefficients are then modified according to the transformed coefficients of the watermark. The image is decomposed in three spatial directions i.e horizontal, vertical and diagonal thus separating the image into four different components LL, LH, HL and HH.

1) LL is the lowest resolution level shows the approximate part of the host image.
2) LH, HL and HH levels gives detailed information of host image. [16-18]

This is DWT Level 1. For DWT level 2, the LL band is further decomposed into four bands LL2, LH2, HL2 and HH2. LL band is preferred as the magnitude of wavelet coefficients is larger in lower bands.



Algorithm for DWT

1) Original image is decomposed into various sub bands
2) Water mark is embedded into suitable sub band.
3) Wavelet coefficients of sub band are modified according to the watermark image.
4) After embedding, watermarked image is formed.

DWT level 3 is further preferred as maximum level of decomposition increases the robustness of watermarked image.

SVD (Singular Value Decomposition)

Singular value decomposition, used in the field of image processing, is a linear algebra transform technique used for the factorization of a real or complex matrix of the digital

image. SVD of image matrix M of dimensions m*m is:

$$M = USV^T$$

U and V are the orthogonal matrices and singular matrices S is a diagonal matrix of nonnegative singular values of M. Left singular matrix U and right singular matrix V represents the horizontal and vertical details of the original image respectively. Diagonal values of S are in decreasing order

There are two main properties of SVD which makes it a beneficial technique for digital watermarking techniques.

1) Quality of image is not affected by the small variations in singular values.
2) Singular values are less susceptible to various types of attacks.

Host Image

Joker as a Watermark

III. HYBRID DWT - SVD

Hybrid means the fusion of DWT-SVD technique to]]improve the quality of watermarked image. Its features of high robustness, imperceptibility and less prone to attacks makes it a very attractive technique.

Algorithm for hybrid DWT-SVD technique [18]

1) Using DWT, the host image is decomposed into various sub bands. Here two level decomposition is used.
2) A suitable sub band is chosen to embed the watermark
3) SVD is applied on the suitable sub band of the host image
4) Singular values of the particular sub band are modified according to the watermark image.
5) Inverse IDWT of the image is done to get watermarked image.

Decomposition

The host image is decomposed into various sub bands using DWT

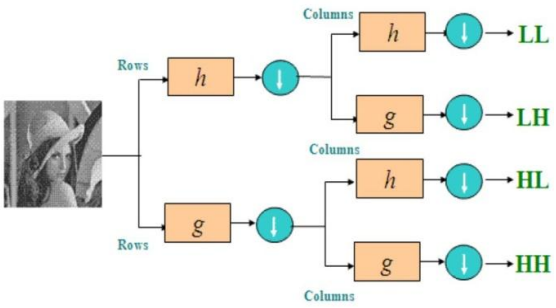


Figure 1: 2-D DWT Analysis or Decomposition Tree

IV. RECONSTRUCTION

Signals can be decomposed or analyzed by DWT. However since there is no loss of any piece of info or components the same can be used to assemble original signal while suffering no loss in the process.

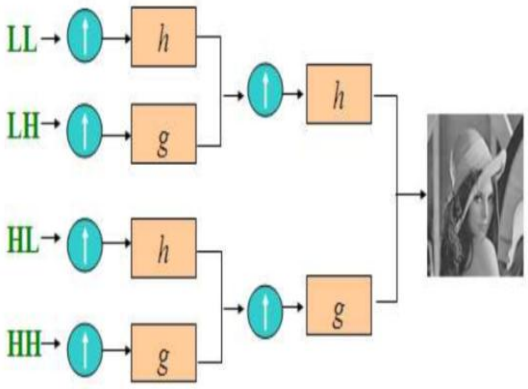


Figure 2: 2-D IDWT Synthesis or Reconstruction Tree

V. RESULTS

Two parameters are mainly taken into consideration while comparing the performance of different digital watermarking techniques.[22] These parameters are mean square error (MSE) and peak signal to noise ratio (PSNR).

$$MSE = 1/MN \sum_{i=1}^{M} \sum_{j=1}^{N} [I(i,j) - I'(i,j)]2$$

M*N is the dimensions of the image

I(i,,j) is the original image.

I'(i,,j) is the Watermark image.

Using the value of MSE, PSNR is calculated by the formula

$$PSNR = 10 \log_{10}[255^2/MSE]$$

To carry out the experiments, MATLAB R2015a software has been used. Value of PSNR has been observed at various scaling or transparency factor alpha.

Scaling factor alpha	PSNR DWT	PSNR DWT-SVD
0.01	44.1	76.1
0.02	36.5	62.4
0.03	33.2	53.2
0.04	30.2	49.1
0.05	28.1	46.2
0.06	26.2	43.2
0.07	25.2	41.1

VI. CONCLUSION

Comparison of PSNR values at various values of alpha concludes that hybrid technique DWT-SVD has better results than DWT technique. Value of PSNR is more in hybrid technique at a particular value of alpha. Less value of PSNR shows more degradation in the quality of original image. This shows that the quality of original image degrades more after watermarking when DWT is used for embedding the watermark in comparison to DWT-SVD Technique.

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