

An Improved Performance of Watermarking In DWT Domain Using SVD

Ramandeep Kaur¹ and Harpal Singh²

¹Research Scholar, Department of Electronics & Communication Engineering, RBIEBT, Kharar, Pin code 140301, India

²Faculty, Department of Electronics & Communication Engineering, RBIEBT, Kharar, Pin code 140301, India

Abstract In this paper, the concept of hybridizing the transforms is used in order to enhance the performance of watermarking method. Apart from this, the original image is first performed with DCT compression operation before decomposition of image which reduces the mean square error (MSE) and hence increases the quality of watermarked image. The performance of proposed DWT-SVD based methods is evaluated both quantitatively as well as qualitatively. For quantitative evaluation, the metrics like: peak signal to noise ratio (PSNR) by considering human visual system and correlation coefficient (CC) are computed. The results indicate that there is an enhancement in the quality of watermarked image by reducing the MSE. Robustness of the method is also tested by performing various attacks on the watermarked image.

Keywords DWT, SVD and Digital Watermarking

I. Introduction

Watermark is a type of marker which is covertly embedded on digital information such as audio, video, text files or images for the purpose of authentication. So, Digital Watermarking is a process of hiding digital information within the signal itself [1]. A pattern of bits inserted in digital images, audio or video that identifies the copyright protection of the author information. In this, a low energy signal is imperceptibly embedded into another signal. The success of watermarking scheme depends upon the choice of watermark structure and the insertion strategy. Digital watermarking may be visible or invisible. In visible watermarking, the information i.e. the text or logo which identifies the owner of the media is visible in picture or video. In invisible watermarking, the information is added as digital data to audio, video or picture but it can't be perceived as such without the help of owner [2].

II. Proposed Work

The wavelet transform and SVD have been used in the present work for developing the algorithm along with the addition of DCT compression before applying WT on host image. This increases the visual quality measure i.e. PSNR-HVS by few dB, hence by using proposed model of watermarking, one can enhance the performance of algorithm. Therefore the efforts have been made to integrate the WT with SVD in order to enhance the performance. Block diagram of embedding and extraction scheme is shown in Figure 1 and 2 respectively; algorithm

for the same is given below.

Algorithm for Watermark Embedding

- Step1. Apply DCT compression on host image for pre-processing.
- Step2. Load the processed image and watermark.
- Step3. Apply wavelet transform on host image.
- Step4. Identify the low frequency subband of wavelet transformed host image.
- Step5. Apply SVD on watermark and response obtained from step 4.
- Step6. Combine the SVD values obtained from step 5 to embed the watermark.
- Step7. Apply inverse wavelet transform by merging all the subbands.
- Step8. Collect the watermarked image.

Algorithm for Watermark Extraction

- Step1. Load the image and watermarked image.
- Step2. Apply wavelet transform on host and watermarked images.
- Step3. Apply SVD on transform responses of host and watermarked images.
- Step4. Subtract the SVD values obtained from step 3 using key to extract the watermark.
- Step5. Collect the extracted watermark.

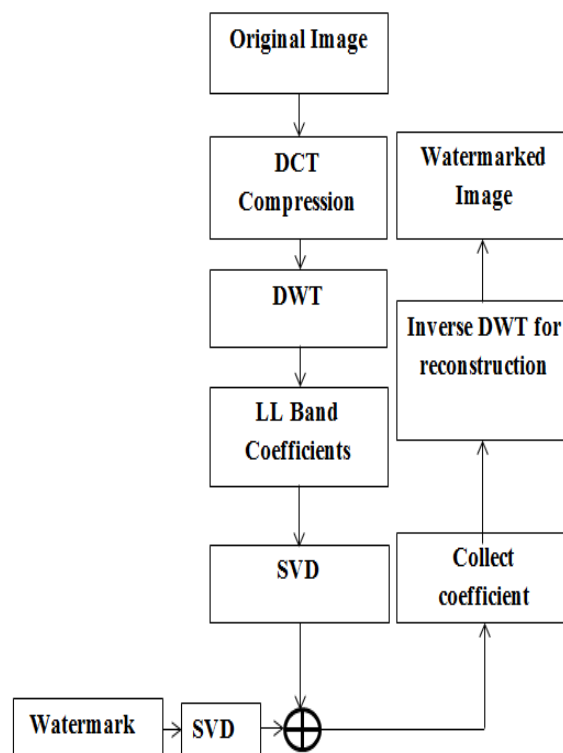


Figure-1: Block Diagram of embedding algorithm

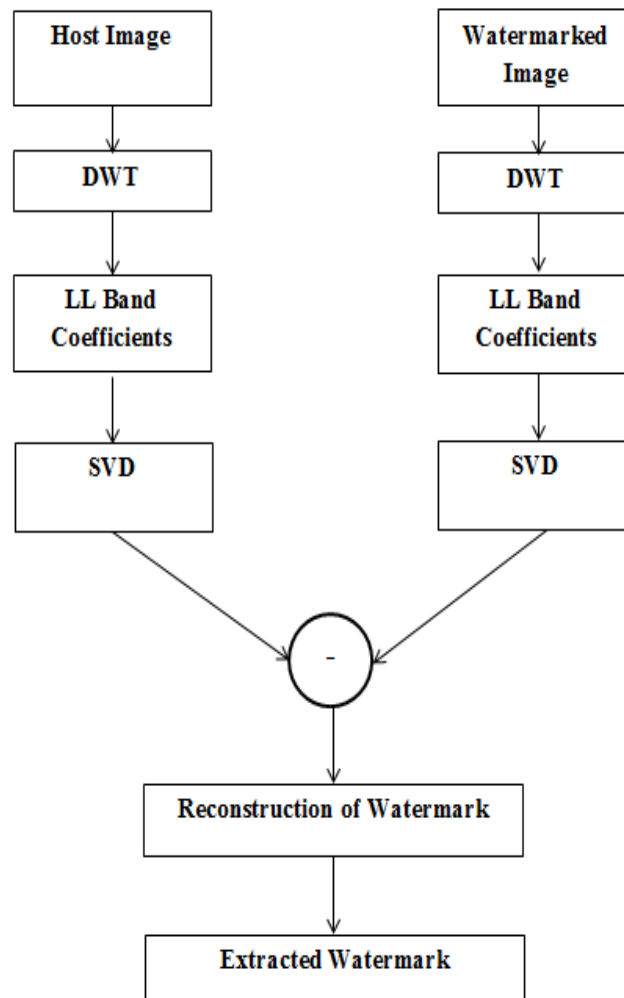


Figure-2: Block Diagram of Extraction algorithm

III. Results and Discussions

The performance of proposed watermarking technique is evaluated both quantitatively as well as qualitatively on various images. Quantitative evaluation is performed by using PSNR by considering the human visual system & Correlation Coefficient. The PSNR is used to investigate the amount of error which was introduced while embedding the watermark. The Correlation coefficient is used to determine the closeness of extracted watermark to the original watermark. Original & watermarked images are presented for qualitative analysis in Figure 3. The robustness of the techniques is also tested by using well known attacks i.e. contamination of additive white Gaussian noise, Salt & Pepper noise & DCT Compression. The results are also taken by increasing the value of attacks shown in Figure 4, 5, 6 and table 1 and observe that the watermark can also be recovered at high value of attacks. Visual & high value of quantitative results shows that a less error was introduced in embedding algorithm and also a good quality watermark was extracted by using the proposed watermarking method shown in Figure 3. Table 1 shows the correlation coefficient between the original and extracted watermark after increasing the attack values. It is clear from the results presented in table 2 that the proposed watermarking method improves the PSNR in comparison to other existing method.



Figure-3: Results of watermarking by proposed DWT-SVD technique



Figure-4: Results of watermarking by proposed DWT-SVD technique after Gaussian noise attack



Figure-5: Results of watermarking by proposed DWT-SVD technique after salt & pepper noise attack





Figure-6: Results of watermarking by proposed DWT-SVD technique after DCT compression attack



Figure-7 (a): original Cameraman image, **(b):** original watermark

Table 1: Correlation Coefficient Between Original Raman@Mtech Watermark And Extracted Watermark From Cameraman Watermarked

Image For Varying Gaussian Noise, Salt & Pepper Noise And DCT Compression Attack

GAUSSIAN NOISE ATTACK	CORRELATION COEFFICIENT (CC)	SALT & PEPPER ATTACK	CORRELATION COEFFICIENT (CC)	COMPRESSION ATTACK	CORRELATION COEFFICIENT (CC)
0.01	0.974353	0.01	0.994429	84%	0.995866
0.02	0.939474	0.02	0.983668	77%	0.998590
0.03	0.909565	0.03	0.970299	67%	0.999503
0.04	0.871743	0.04	0.954199	56%	0.999856
0.06	0.804425	0.06	0.928062	44%	0.999960
0.09	0.704668	0.09	0.864789	33%	0.999993

Table- 2: Comparison In Terms Of PSNR For Various Watermarking Techniques With Proposed Technique

PSNR		
Watermarking Techniques	Barbara Image	Lena Image
DWT-SVD based watermarking, (Bao et.al, 2005) [3]	42.54	43.83
DCT-SVD based watermarking, (Lu et.al, 2007) [4]	41.21	37.71
DCT-SVD based watermarking, (Abdulfateh et.al, 2009) [5]	43.26	47.59
SVD based watermarking (Deepa et.al, 2010) [6]	46.11	47.66
DCT based watermarking, (Randeep et.al, 2012) [7]	37.5	37.3
DWT-DCT-SVD based watermarking, (Harish et.al, 2013) [8]	45.95	46.00

DCT-SVD based watermarking	40.29	38.42
DWT-SVD based watermarking	47.85	47.31
Proposed DWT-SVD based watermarking	48.19	48.32

IV. Conclusion

The performance evaluation of DCT-SVD, DWT-SVD and proposed watermarking techniques are simulated in MATLAB software. The algorithms are assessed quantitatively as well as qualitatively on various images. The PSNR by considering the human visual system and CC are work out for quantitative evaluation. Watermarked images and extracted watermarks are presented to prove the quality of watermarking method. To demonstrate the robustness, extracted watermark after various attacks on the watermarked image is also presented. The high value of PSNR shows that the proposed watermarking method introduces less error in embedding algorithm. Hence, the presented method introduces less mean square error in comparison to other existing methods shown in table 2. It is also observed from the results that there is not serious degradation in watermarked images and good quality watermark was extracted after the various image processing operations.

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