IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 8, August 2016

Digital Image Watermarking using Modified DWT&DCT Combination and Bi Linear Interpolation

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Abstract: This paper presents a robust Hybridized Watermarking scheme based on 3- level DWT (Discrete Wavelet Transform) and DCT (Discrete cosine Transform) using Bilinear Interpolation. The host image is subjected to DWT and DCT. The DWT coefficients of host image are modified with DCT coefficients of scrambled watermark logo to get watermarked image and then, various attacks are applied on this watermarked image to check the robustness. To enhance the quality of embedding logo, bilinear interpolation is applied to get optimal NCC value. Proposed method gives better results in terms of better image quality of watermarked image and robust watermark logo in terms of PSNR and NCC values.

Keywords: DCT, DWT, Bilinear interpolation, PSNR, NCC

I. INTRODUCTION

In recent times in the area of s0ignal processing, re-production of original signal is playing a crucial role. To have an efficient processing of signal which was watermarked, DCT-DWT algorithm is useful to retrieve the signal. Signal watermarking technology is to hide the confidential signals based on threshold level into the digital products of signals. The widest development of effective signal copyright protection methods recently have become an urgent and necessary requirement in multimedia industry due to ever increasing un-authorized manipulation and reproduction of digital signals. In this project we are performing watermarking technique to 2D signal which is an image. The DCT and DWT transforms have been extensively used in the digital image watermarking. DCT algorithm provides imperceptibility, security, robustness against higher common signal processing and improves secret image quality further. Proposed watermarking approach is superior over existing Techniques in terms of Peak Signal to Noise Ratio(PSNR) and Normalized Cross Co-relation (NCC). Bi-linear interpolation technique modifies the extracted signal and amplifies the signal to noise ratio. This technique is superior to remaining techniques for embedding and extraction of watermark to host image. This technique was widely applicable in copy right protection, ownership authentication in case of ATM cards and credit cards, label and content protection .In Bio-medical image processing, it highlights the specific regions for testing the organs and compares in terms of PSNR whether the tested organ is healthier ornot In military applications watermarkingtechnique which is widely used to hide the confidentialinformation from others can know dummy information but is notaware of what the original information is hidden. Thiswatermarking technique can be explored to any signal. Signal isprotected against illegal attempts of attacks and manipulations,using the proposed algorithm. It shows better PSNR and NCC values among remaining watermarking techniques and is efficient. It amplifies the hidden signal which is confident andeven chances of getting effected by noise are less.Extractedwatermark can be achieved better using Bi-linear interpolationtechnique for an image on the hidden information in terms ofNCC

II. USED TRANSFORM TECHNIQUES

USED TRANSFORM TECHNIQUES IN PROPOSED ALGORITHM

A. DISCRETE WAVELET TRANSFORM(DWT)
B. DISCRETE COSINE TRANSFORM(DCT)
C. SCRAMBLED PERMUTATION METHOD
D. BI-LINEAR INTERPOLATION TECHNIQUE

A. Discrete Wavelet Transform (DWT)

Wavelet transform is an efficient tool to represent an image. The wavelet transform allows multi resolution analysis of an image and multi resolution analysis offers an efficient frame work for extracting information from images at various levels of resolution. The wavelet transform is generally termed as mathematical microscope in which big wavelet gives an approximate image of signal, while the smaller wavelets zoom in on the small details. The basic idea of the wavelet transform is to represent the signal to be analysed as superposition of wavelets. DWT provides time frequency representation of an image. DWT can simultaneously localize signals in time and frequency, whereas the DFT and DCT can localize signals only in the frequency domain. A wavelet transform divides a signal into different frequency bands:

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- Low frequency band(LL)
- Mid frequency band(LH&HL)
- High frequency band (HH)

As level conversion on host image increases, may get Better security. Multi resolution analysis provides better Reconstruction of watermarked image and gives better results in terms of PSNR to watermarked image.

B. Discrete Cosine Transform (DCT)

DCT is a technique for converting a signal into elementary frequency components and it is widely used in image compression. The main property of DCT is energy compaction. Most of the energy in spatial domain is concentrated in low frequency. This property represents an image into non overlapping 8x8 blocks of distinct frequency bands which makes easier to embed watermark in the desired area of the image. DCT represents an image into set of frequency coefficients, in order to increase robustness of secret image. Experimentally this technique proved to be highly resistant to JPEG compression as well as significant amount of noise

C. Scrambling of watermark image

To protect secret image from illegal attempt of manipulations and attacks we must scramble the image before embedding. In this paper we are using scrambled permutation method for scrambling an image .In this method we generate random noise up to the size of watermark than perform XOR operation in between the watermark image and the random noise. Scrambled image provide better security to the watermark image and no one expect what the original image is, while inverse scrambling perform XOR operation between scrambled watermark and random noise to extract watermark.

Watermark image | Scrambled watermark image | Extracted watermark image

D. Bi-linear interpolation technique

To increase the quality of secret image we are using Bi-linear Interpolation technique,this technique provides boosting in thesignal by padding zeros in accordance with co-ordinates.

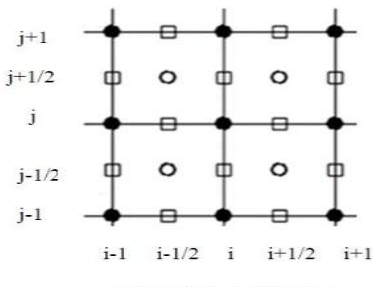
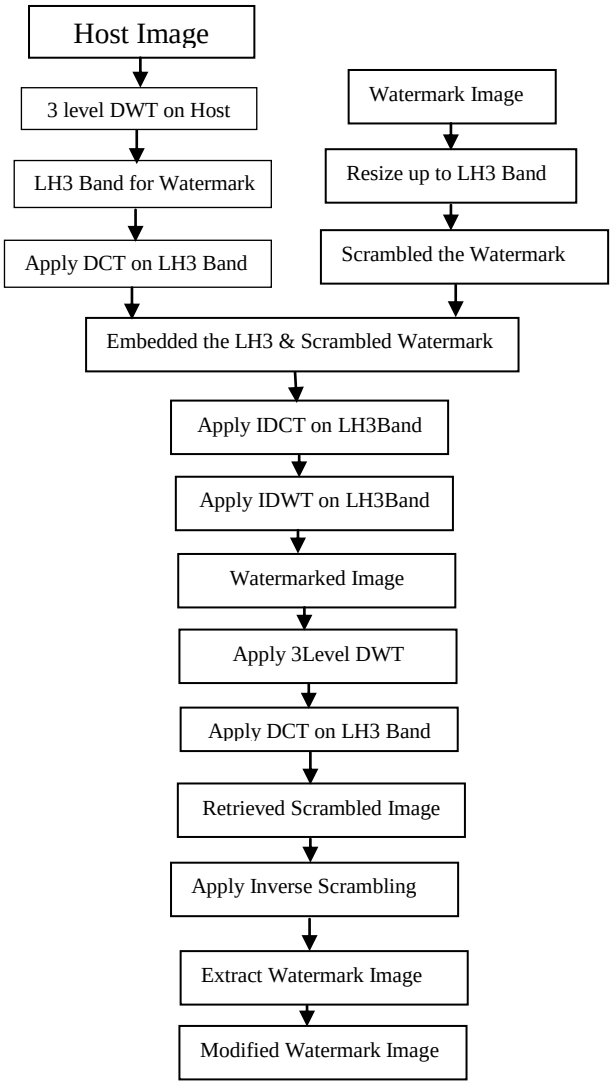


Fig.2.Bilinear interpolation

III. PROPOSEDALGORITHM FOR WATERMARKING

The process of Watermarking is obtain based on these simulation model ,the block diagram of simulation work is



IV.FEATURES OF COMBINED DWT-DCT

- Combined DCT-DWT transformation gives more compression ratio compared to JPEG and JPEG2000
- Watermarking is done by altering the wavelets coefficients of carefully selected DWT sub- bands, followed by the application of the DCT transform on the selected sub-bands.
- DCT increases robustness to the image and DWT increases the quality of the watermarked image as level of DWT increases.
- DWT-DCT algorithm improves the quality extracted watermark and gives better perception to human eye .
- DWT-DCT combination algorithm provides better higher order of security against any attacks and illegal manipulations in information .thus this algorithm be n checkmark for watermarking an image.

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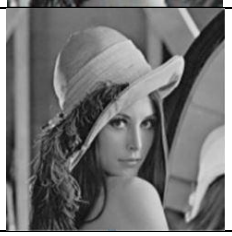
- Preserving most of the image information and create good quality of reconstructed image. (DCT+DWT) Transform reduces blocking artifacts, false contouring and ringing effect.

V.WATERMARKING IN VARIOUS FREQUENCY BANDS

This paper proves choose LH band for watermarking, as low frequencies (LL) are very well perceived by human eye, than the chances of watermark being perceptible was high where as high frequencies (HH) are prone to attacks such as scaling and compression .

So we choose mid frequency levels (LH and HL) for watermark, we can get better PSNR values after watermarking in mid frequencies than lower frequency and higher frequency band. If embedded watermark in LL band it generates disturbed image, because of at lower frequency levels transpiration is very low. High frequency band have good transparency but while manipulations and illegal attempt to copy of information make disturbed in extracted watermark

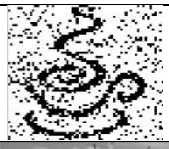
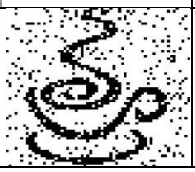
TABLE I. WATERMARKING IN LL&HH BANDS

Type of frequency For Watermarking	Watermarked image	Results
LL Band (Lower Frequency)		Very Low PSNR
LH or HL Band (Middle Frequency)		Extracted Watermark image was good even at attacks
HH Band (Higher Frequency)		Prone to attack

VI. STIMULATION RESULTS

These are the results for Different Host Images
And their PSNR and NCC values are
Peak Signal to Noise Ratio (PSNR):
PSNR values calculated in between the Host image and Watermarked image. PSNR value denotes how much of energy compaction co-related in between Host image and Watermarked image. When attacks applied calculate PSNR between attacked watermarked image and Host image, to know how much of energy compaction achieved even attacks are applied to the watermarked image.

TABLE II EXPERIMENTED HOSTIMAGES

Various Images	Host Image & Watermark image	Watermarked image & Extracted Watermark	PSNR & NCC
Host Image 1: Lena			39.8754
			0.9077
Host Image 2: Baby			39.6167
			0.9658
Host Image 2: Baby			39.6167
			0.9658

Normalized Cross Correlation (NCC):
NCC calculated in between watermark image and extracted watermark image. In this project we are using Bi-Linear Interpolation technique to improve quality of secret image.
We are also calculate NCC between watermark and modified watermark to cheek how better the quality of retrieved watermark

$$NCC = \left(\frac{\sum_{x=1}^{N}\sum_{y=1}^{N}(W(x,y) - W_{men})(W'(x,y) - W'_{mean})}{\sqrt{\sum_{x=1}^{N}\sum_{y=1}^{N}(W(x,y) - W_{mean})^2 \sum_{x=1}^{N}\sum_{y=1}^{N}(W'(x,y) - W'_{mean})^2}} \right)$$

W_{mean} = Mean of the original Watermark
W'_{mean} = Mean of Extracted Watermark
$W(x,y)$ = Pixel Intensities of the original Watermark
$W'(x,y)$ = Pixel Intensities of the Extracted Watermark

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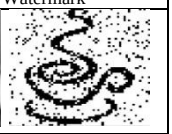
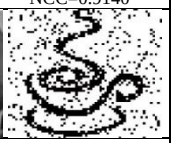
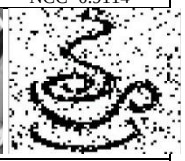
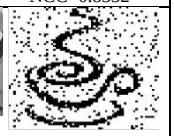
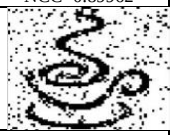
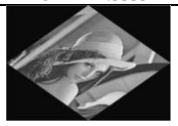
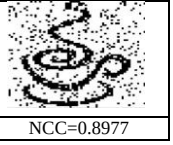
TABLE III APPLIED ATTACKS

S.NO	Type of Attack	Attacked Image	Extracted Watermark
1	Cropping		
		PSNR=29.3781	NCC=0.9140
2	HorizontalFlipping		
		PSNR=39.4587	NCC=0.986
3	VerticalFlipping		
		PSNR=39.4092	NCC=0.9114
4	Averaging filtering		
		PSNR=34.8386	NCC=0.8332
5	Sharpening		
		PSNR=39.2813	NCC=0.9015
6	Gaussiannoise		
		PSNR=39.2218	NCC=0.9143
7	Motionblur		
		PSNR=39.3425	NCC=0.89962
8	Salt &peppernoise		
		PSNR=22.3553	NCC=
9	Rotation		
		PSNR=25.3621	NCC=0.9099
10	Scaling		
		PSNR=39.3553	NCC=0.8985
11	Disk blur		
		PSNR=39.4489	NCC=0.8977

VII. CONCLUSION

The quality of the watermarked image is good in terms of perceptibility. The PSNR value 39.8386 and NCC value was 0.9015 for Lena image. This proposed method is superior to the existing one in applying 3 level DWT to the host image and is highly imperceptible so that no one can extract watermark without knowledge of embedding depth.

VIII. FUTURE SCOPE

By combining DWT, DCT and SVD another hybrid technique can be obtained, and it is conceivable to get betterresults in terms of robustness and perceptibility. In the futurework it is suggested to implement DWT-DCT based hybridwatermarking technique using Genetic Algorithm.

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BIOGRAPHIES

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