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Robust and High Limit Watermarking using DWT-IWT

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Abstract

Watermarking is an innovation that supplements cryptography by inserting imperceptible signals in work. Data concealing procedures have as of late turned out to be vital in various application zones. Advanced sound, video and pictures are progressively outfitted with recognizing however impalpable imprints, which may contain a shrouded copyright see that anticipates unapproved duplicating specifically. One approach is to present an undetectable picture known as digital watermark, into a picture succession. This paper presents secured calculations for inserting digital watermarks into pictures. The proposed strategy performs indistinct watermarking of pictures in recurrence space. The watermark is implanted in the Discrete Wavelet (DWT) and Integral Wavelet (IWT) space of a picture in a multi-determination way. In the translating stage, once the watermark is removed from the watermarked picture, certain execution measures, as peak signal to mean noise ratio (PSNR) and correlation are computed. Despite the fact that IWT strategy gives better outcomes when contrasted with DWT, outcomes by combining both IWT-DWT together are incredible.

Keywords: *Watermarking ,IWT, DWT, BER, Design of Watermarking Systems, Embedding Capacity, Robust*

1. Introduction

The need to make duplicate, transmit and convey digital information as a part of widespread multimedia technology in internet era is common . Thus copyright security has turned out to be basic to keep away from unauthorised copy issue. Digital image watermarking gives copyright assurance to image by hiding appropriate information in original image to declare rightful ownership. Robustness, Perceptibility, embedding capacity and bit error rate are four essential factors to determine quality of watermarking scheme [2-3]. The Watermarking calculations are comprehensively sorted as Spatial Domain Watermarking and Transformed area watermarking. In spatial domain, watermark is embedded by directly modifying pixel values of cover image. Least Significant Bit insertion is example of spatial domain watermarking. In Transform domain, watermark is inserted into transformed coefficients of image giving more information hiding capacity and more robustness against watermarking attacks because information can be spread out to entire image [1] . In order to further performance improvements in transformed based digital image watermarking algorithms are obtained by combining each transforms [4] . As a result of combination of algorithms Robust and secure watermarked image are obtained [5] .

In this paper we aim at increasing the embedding capacity and robustness to obtain a imperceptible watermarked image. As a combination we use-DWT-IWT . Use of IWT increases embedding capacity of the watermarked image [6]. The DWT is nearer to human visual system than DCT. Since both transforms used are wavelet transforms the scaleability and tolerance to the embedding algorithm applied is expected to be good .

2. DWT and IWT

2.1 Discrete wavelet transform

The basic idea of discrete wavelet transform (DWT) in image process is to multi-differentiated decompose the image into sub-image of different spatial domain and independent frequency district [7-8]. After the original image has been applying DWT transformed, it is decomposed into four frequency region which is one low frequency region (LL) and three high-frequency regions (HL,LH,HH).If the information of low frequency region is DWT transformed the sublevel frequency region information will be obtained. A two dimensional image after three-level DWT decomposed can be shown as Fig.1. Where, H represents high-pass filter, L represents low-pass filter. An original image can be made of frequency regions of HL1, LH1, and HH1. The low-frequency region information also can be decomposed into sub-level frequency region information of LL2, HL2, LH2 and HH2. By performing this the original image can be decomposed for n level wavelet transformation.

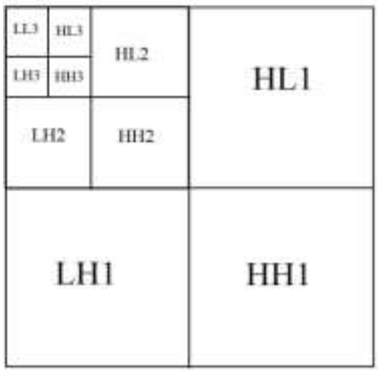

Fig. 1 Sketch Map of Image DWT Decomposed

Normally most of the image energy is concentrated at the lower level frequency sub-bands LLx and therefore embedding watermarks in these sub-bands may even though degrade the image it could increase robustness significantly. In another way, the high frequency sub-bands HHx include the edges and textures of the image and the human eye is not generally sensitive to changes in such cases sub-bands. This allows the watermark to be embedded without being perceived by the human eye. The compromise adopted by many DWT-based watermarking algorithm, is to embed the watermark in the middle frequency upper-bands LHx and HLx where acceptable performance of robustness and imperceptibility can achieved. [9-10].

2.2 Integer wavelet transform .

Integer Wavelet Transform is used for lossless compression. The transform coefficients exhibits the feature of being exactly represented by finite precision numbers, and this allows for truly lossless coding. IWT- Integer Wavelet Transform is much faster than the floating point arithmetic because floating point wavelet transforms demands for longer data length than the integer wavelet transform does . Another benefits of IWT is reversibility. This means the image can be reconstructed without any loss because all the coefficients are in integers and can be stored without rounding off the errors.

3. THE COMBINED DWT –IWT ALGORITHM

Watermark embedding algorithm

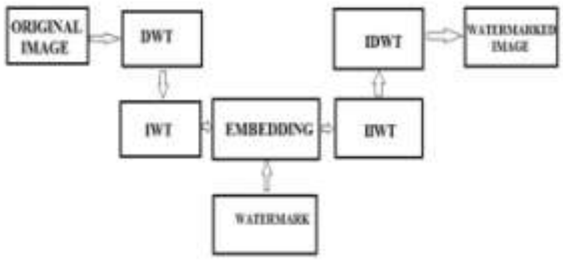

Fig. 2 Watermark embedding

Step 1: Apply DWT technique to decompose the cover host image into four non-overlapping multi-resolution sub-bands: LL1, HL1, LH1, and HH1.
Step 2: Divide the any of the sub-band HL1 (or HH1) into 16 x 16 blocks.
Step 3: Apply IWT watermarking to each block in the chosen sub-band.
Step 4: Re-formulate the grey-scale watermark image into a vector of zeros and ones.
Step 5:Generate two uncorrelated pseudorandom sequences. One sequence is used to embed the watermark bit 0 (PN_0) and the other sequence is used to embed the watermark bit 1 (PN_1).
Step 6:Embed the two pseudorandom sequences, PN_0 and PN_1, with a gain factor, in the IW transformed 16x16 blocks of the selected DWT sub-bands of the host image. Embedding is not applied to all coefficients of the IWT block, but only to the selected coefficients.
Step 7:Apply inverse IWT (IIWT) to each block after its coefficients have been modified to embed the watermark bits as described in the previous step.
Step 8: Apply the inverse DWT (IDWT) on the DWT transformed image, including the modified sub-band, to produce the watermarked original (host) image.

The watermark Extraction algorithm

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Step 1: Apply DWT to decompose the watermarked image into non-overlapping four multi-resolution sub bands: LL1, HL1, LH1, and HH1.
Step 2: Divide the sub-band into 16x16 blocks.
Step 3: Apply inverse wavelet transforms (IIWT) to each block in the chosen sub-band and extract the coefficients of each IWT transformed block.
Step 4: Regenerate the two different pseudorandom sequences (PN_0 and PN_1) using the same seed used in the previous watermark embedding procedure.
Step 5: Reconstruct the watermark using the extracted watermark bits, and compute the similarity between the original image and extracted watermarks.

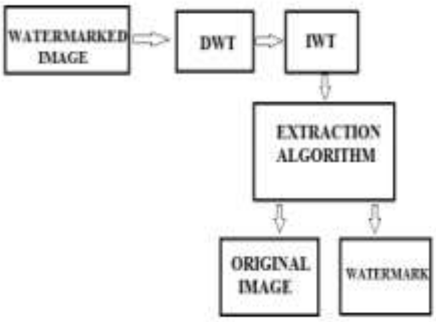

Fig 3.Watermark Extractions .

4. Results and Discussion

The MATLAB (R2015a) is utilized to implement and to analyze the proposed algorithm due to its advances in image processing tool boxes and inbuilt functions. The parameters used are RGB original images of size 512X512 jpg and png formats the three RGB watermark images of size 64x64 bmp format. For the illustration only three orginal images and watermarks are given figure 4

(a) (b) (c)

(d) (e) (f)

Fig 4: a,b,c -orginal images d,e,f-watermarks

The experimental analysis was conducted by using various original images and watermarks and the performance parameter PSNR values of the proposed algorithm are calculated and tabulated only for few images. The PSNR (peak signal to noise ratio) value is an image quality measurement index. The PSNR and MSE between the watermarked image and original image is calculated using Eq.(1) and (2)

$$PSNR = 10 \cdot log_{10}\left(\frac{MAX_I^2}{MSE}\right) = 20 \cdot log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) = 20 \cdot log_{10}(MAX_I) - 10 \cdot log_{10}(MSE) \quad ..(1)$$

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2 \quad .(2)$$

Ii,j = original-image
Ki,j = reconstructed image at reception.
m&n = number of row and coloumn .

Results for host image quality

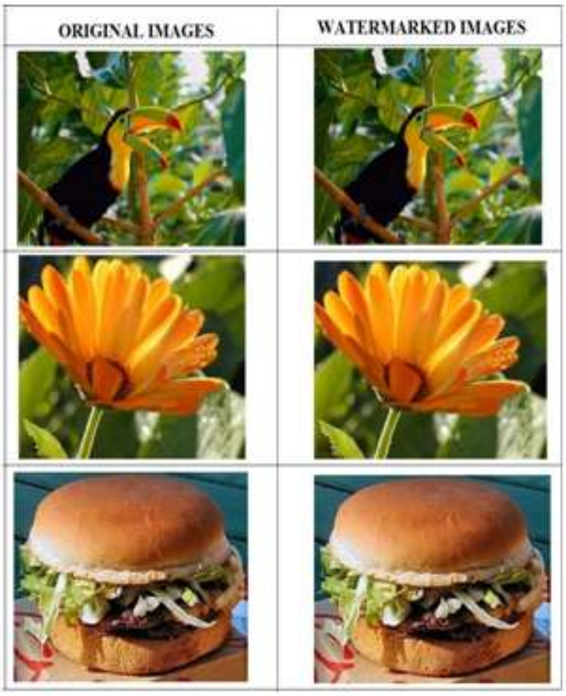

Fig 5: Original and watermarked images

Table 1: MSE Comparison with other Algorithm for different images .

Image	DCT-DWT MSE	DWT-IWT MSE
Kingfisher	2.5538	1.9702
Sunflower	2.2501	1.8903
Burger	2.9222	2.1072

Table 2: PSNR Comparison with other Algorithm for different images.

Image	DCT-DWT PSNR	DWT-IWT PSNR
Kingfisher	43.956	49.048
Sunflower	44.574	51.365
Burger	43.439	49.893

Table 3: BER Comparison with other Algorithm for different images .

Image	DCT-DWT BER	DWT-IWT BER
Kingfisher	720028.00	1567.00
Sunflower	744912.00	4205.00
Burger	737378.00	490.00

5. Conclusions

By combing the two common frequency domain methods, we could take the advantageous of both two algorithms to improve the performance in IWT-based digital image watermarking .Two transforms are combined to get a high embedding capacity in watermarking with reduced Bit Error Rate , Since both transforms used are wavelet transforms the saleability and tolerance to the embedding algorithm applied is good and also we get the robust watermarked image with high quality which is more robust then the Spatial technique. There is a scope of future work in developed technique, this technique is still applicable for images only but it technique can also developed for audio, videos because we know that audio is also represented in frequency component and video is a collection of image frame so watermarking can be inserted in that both and make audio and video watermarking effectively.

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