Improve Digital Watermark Image Using Embedding Method

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ABSTRACT

Digital Image watermarking is the process of inserting hidden information in an image by introducing modifications of minimum perceptual disturbance. Robustness, perceptual transparency, capacity and blind watermarking are four essential factors to determine quality of watermarking scheme. Image watermarking techniques proposed so far can be divided into two group's accordingly processing domain of host image. One is to modify the intensity value of the luminance in the spatial domain and the other is to change the image coefficient in a frequency domain.

Keywords: **Digital Watermarking, Robustness, DCT (Discrete Cosine Transform), DWT (Discrete Wavelet Transform), Chaos Method**

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1 Introduction:

Digital Watermarking means embedding Digital stream of bits into Multimedia file. Multimedia file can be an image, video, audio or text. It describes the methods and technologies to hide the information in digital form in the digital media. A watermark can be perceived as an attribute of the carrier (cover). It may contain information such as copyright, license, tracking and authorship etc.

Watermarking is the process of hiding the Information into the digital media which can be extracted later by using some algorithm. Suppose one person A creates his own Image and put it on the Internet for selling[2]. Now, another person B steals this Image and start selling without the permission of the person who is actual owner of this Image. Original owner A notice that his Image is selling by B without his permission. How can A prove that the work being sold is his and the B has to pay him for his work. To withstand such situation a new technique came in existence which is known as watermarking. Watermarking technique based on Domain: 1. Spatial domain. 2. Transform domain

1. Spatial Domain:
   - Pixels are taken into consideration.
   - Host image pixels are embedded on cover image pixels.
   -Most common method used for it is least significant bits (LSB).
2. Transform Domain:
   - Coefficient is taken into consideration.
   - Information is embedded into cover image by altering its transform coefficient.
   - Robust watermarking with respect to the spatial domain.

1.1Framework of Watermarking:

Digital Image Watermarking describes methods and technologies that hide information, for example a number or text, in images. Information hiding is the process of embedding a message into digital media. Figure 1.1 shows simple watermarking process.

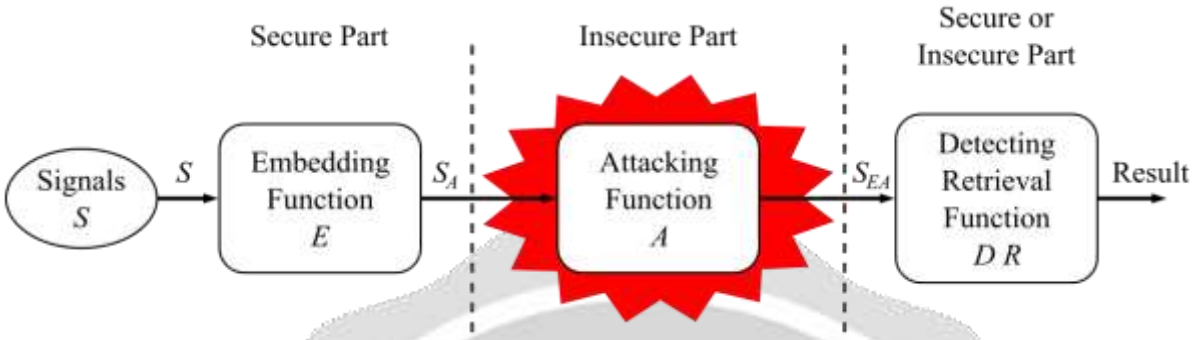

Fig.1.1 watermark image workflow

2. WATERMARKING METHOD USING TO IMPROVE VARIANCE RESULT:

Commonly used frequency-domain transforms include the Discrete Wavelet Transform (DWT) and the Discrete Cosine Transform (DCT). However, DWT has been used in digital image watermarking more frequently due to its excellent spatial localization and multi-resolution characteristics which are similar to the theoretical models of the human visual system and DWT gives perfect reconstruction of decomposed image[3].

The DCT has special property that most of the visually significant information of the image is concentrated in just a few coefficient of the DCT. Moreover DCT based watermarking techniques offer compression while DWT based watermarking technique offer scalability.

Further performance improvements in DWT-based digital image watermarking algorithms and DCT-based watermarking algorithms could be obtained by combining DWT with DCT.

The idea of applying two transform is based on the fact that combined transforms could compensate for the drawbacks of each other, resulting in effective watermarking. In nature image, the energy of each block is concentrated on the low frequency after transformation. It is known that embedding watermark in low frequency makes the watermark perceptible.

On the other hand, to survive lossy data compression, watermark information should not be inserted into the higher frequency. Traditional techniques select the middle-frequency range to embed the watermark.

Discrete Wavelet Transform (DWT):

- Transforms are based on small waves, called wavelet.
- Decompose an image into a lower resolution approximation image (LL) as well as horizontal (HH), vertical (LH) and diagonal (HL) detail components.

Watermark Embedding[1]:

The algorithm to embed a watermark in the original image is summarized as follows:

- Decompose the original image into four levels (thirteen subbands).
- Any binary image with approximately equal number of 0s and 1s is utilized as a watermark image. 3- Map 0– 1 and 1– +1 to generate a pseudo-random binary sequence containing either 1 or +1.
- The subband pairs (LH3, LH2), (HL3, HL2), and (HH3, HH2) at level 3 and level 2 are selected to calculate the changes made in these middle frequency subbands.

- The pseudo-random binary sequence generated from the binary image is rearranged in three different ways to be embedded in the LH3, HL3, HH3, LH2, HL2, and HH2 using the pixel-wise computation.
- Apply the IDWT (Inverse Discrete Wavelet Transform) using the newly updated sub-band values at the level 3 and level 2 to obtain the watermarked image.

Watermark Extraction[1]:
Watermark detection is accomplished without referring to the original image. The correlations Z between the DWT coefficients and the watermarking sequence to be tested at level 2 and computed by using the watermark embedding algorithm. This correlation is compared to the thresholds T saved in the watermark embedding procedure. The watermark is present if and only if one of the following conditions is true:

Z >= T

Then watermarking revealed it means watermarked image

Z < T

Then watermarking not revealed it means non watermarked image.

Discrete Cosine Transform:

- Linearly transform data into the frequency domain.
- Data can be represented by a set of coefficients in the frequency domain.
- DCT express a signal into terms of sum of cosine functions with different frequency.
- 1-D DCT using the formula below:

$$w_k = \sum_{t=0}^{n-1} a_t cos\left[\frac{\pi}{n}\left(t+\frac{1}{2}\right)k\right], \quad k = 0, \dots, n-1$$

Where: n DCT coefficients.

Watermark Embedding:

The algorithm consists of the following steps:

- The first step is the conversion of the scaled input image from the RGB color model to the grayscale color model[1].
- An original gray-level image of size (NxN) is divided into n = (NxN) /(8x8) non-overlapped blocks (8x8) which are transformed to frequency domain by the DCT. The watermark bit stream is embedded into eight coefficients in lower band of each block.
- For the purpose of scattering watermark into the host image and prompting security, we use pseudo random system to generate a random position in watermarking algorithm. Obtain a random number, generated by pseudo random system, which points to one of n blocks of host image.
- Embed extracted the 8-bit watermarking data into the 8 lower-band coefficients in the block pointed by previous step.
- Apply inverse DCT (IDCT) into the 8 lower-band coefficients in the block to obtain the watermarked image.

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Then watermarking not revealed it means non watermarked image.
Binary bits of watermark are embedded into the low frequency of DCT coefficients of the selected frequency subband of DWT. For embedding we use pseudorandom number(Key).

3. Proposed work:

3.1 Proposed Flowchart:

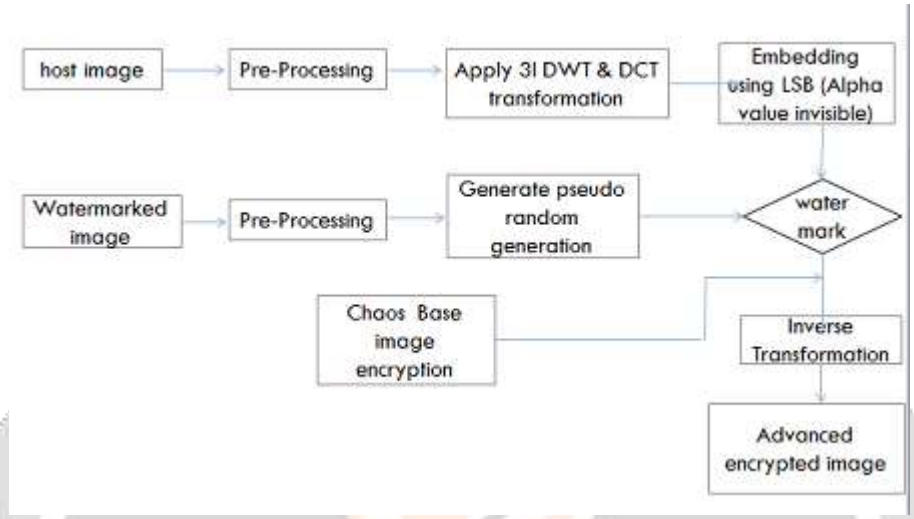

Fig.3.1 proposed flowchart

3.2 Proposed Algorithm:

- The steps in the proposed algorithm are as below:
- Input image.
- Apply filter on the input image.
- Apply 3Level DCT and DWT method.
- Embedding input image using LSB approach with 3bit alpha value (invisible).
- Take one watermarked image.
- Apply filter on that image.
- Generate pseudo random number.
- Chaos base image encryption.
- After watermark image, remove alpha value.
- Apply inverse DCT and DWT.
- Getting result as a watermarked image.

4. Performance Factor:

After using many images for experiments, rk and paper image 512*512, which shown below, is used for as an input image. One images extension is .png and other one is .tiff. This proposed algorithm work on all typs of extension images.

(a) (b)

Fig.4.1 (a)"Rk" image which worked as the host image (b) paper Watermark image which is embedded to the host image

In these paper, Working on PSNR, MSE and NC Metrics. PSNR block computes the peak signal to noise ratio in decibels between two images. MSE and PSNR both are error metrics used to compare images compressions quality[4].

Imperceptibility: Imperceptibility means that the perceived quality of the host image should not be distorted by the presence of the watermark. As a measure of the quality of a watermarked image, the peak signal to noise ratio is typically used. The PSNR has been utilized to calculate similarity between the original image and the watermarked image[4].

The mathematical representation is given below:

$$PSNR = 10\log_{10}\frac{255^2}{MSE}$$

$$\text{where } MSE = \frac{\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}[I_1(i,j) - I_2'(i,j)]^2}{N \times N}$$

The MSE (mean square error) will be compute firstly and then the value for PSNR will be available secondly. Here (,)1 I i j and) (,' 2 I m n respectively represent the gray value of the original image and the watermarked image.

Robustness[4]: Robustness is a measure of the immunity of the watermark against attempt to remove it, intentionally or unintentionally, by different types of attacks. We measure the similarity between the original watermark and the watermark extracted from the attacked image using the Normalized Correlation (NC) factor, which is given below:

$$NC = \frac{\sum_{j=0}^{J-1}\sum_{k=0}^{K-1} W_1(j,k)W_2(j,k)}{\sum_{j=0}^{J-1}\sum_{k=0}^{K-1} W_1(j,k)^2}$$

Where $W_1(j,k)$ and $W_2(j,k)$ is original watermarked images.

5. FUTURE ENHAMCEMENT

- Work on PSNR, MSE and NC Factor and increases result compare to existing paper.
- DWT and DCT with different function and filtering based on papers studied.
- Try to get approximation in result as per literature paper and define which the accurate method is.
- After that try to increases result than old one.

6. CONCLUSION

In this paper, a joint DWT and DCT based watermarking technique with low frequency watermarking with weighted correction has been proposed. The technique is based on the frequency domain that the watermark is mainly inserted into the low frequency. To increase the imperceptibility, the watermark image is adjusted by the weighted correction in the spatial domain. The watermarks are embedded into different position of the low frequency for each block of selected subband of DWT domain. The result of experiments have showed that the algorithm has better visibility and has stronger robustness when it is attacked by joint photographic experts group (JPEG) compression, cropping, contrast adjustments, filtering , noise and so on.

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