Digital Image Watermarking using Discrete Cosine Transform and Discrete Wavelet Transform

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ABSTRACT

Digital Watermarking is one of the most popular technology to preserve and secure the digital copyright of multimedia data. In the steganography concept, it is used to hide message or watermark into data in order to keep it secret and avoid attention from others. In the Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) algorithm mainly used to hide the secret message using the Graphical Interchange Format (GIF). In the cover image (GIF) to insert a watermark, it is used to achieve high robustness and imperceptibility. The proposed method has been implemented in MATLAB and the experimental results show that is quite satisfactory under various categories of attacks.

Keywords: Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Graphical Interchange Format (GIF)

I. INTRODUCTION

The growth of our well-advanced technology has the construction of justifiable issues in the information age. Internet users and access has grown into very straightforward nowadays. Due to the rapid and frequent use of the internet, the authentication of digital data and copyright protection has become very crucial. The digital image watermarking concerns to solve some controversy properly, the main characteristics of the digital image watermarking are:

Robustness

The digital watermarking should be accomplished to resist after normal image

processing operations such as image cropping, transformation, compression etc.

Imperceptibility

The watermarked image should appear like the same as the original image to the natural eye. The observer cannot expose that watermark is embedded in it.

Security

An illegal person cannot detect, retrieve or modify the settled watermark.

Transparency

The transparency discloses to the properties of the human sensory. A transparent watermark motive no artifacts or character loss.

Capacity

Capacity describes how many information bits can be rigid. It addresses also the circumstance of embedding multiple-watermarking is one document in parallel capacity requirement always attempt against two other critical requirements that are, imperceptibility and robustness. Higher capacity is usually attained at the expense of either robustness strength or imperceptibility or both.

Digital Image watermarking execute in two distinct aspects namely:

A. Spatial Domain Technique

In this spatial domain access, the pixels of host image value is in a straight line effect through water effect through watermark pixels image value. This mechanism gives enhance imperceptibility but immensely very less in robustness. In the watermark embedding technique, it attains through exactly adjust host image pixel values. The most broadly used procedure in the host image was modified to fix private information [5].

B. Frequency Domain Technique

In this frequency domain technique, the private information is hidden in lower or middle-frequency restricted image portions because improve frequency portion is increased seemingly to cover up through compression watermarked image. But how to prefer the best frequency portions of the picture for that watermarking is another important and concentrated topic.

II. LITERATURE SURVEY

[1] The high capacity of blind digital image information hiding and authentication scheme using DCT moments propose a blueprint of combining both information hiding and image watermarking technique that embeds and mask the DCT moments, of several full gray-scale hidden images (as opposed to binary) and several full grayscale watermarking watermarked image of the same full size as a given irrational carrier host image, into the depth of the host carrier image with very huge imperceptibility.

[2] In the optimize watermarking technique the Principle Component Analysis (PCA) is usually used for data compression by shortening the dimensions without much loss in the quality of the image and it can also be used to represent the data. It performs better because it tries to analyze the patterns by giving importance to coincidence and differences so that the low loss of information even after compression.

[3] The DCT and DWT based new image watermarking algorithm are mainly used to enhance the imperceptibility and robustness. The watermarked image is encrypted first before fortify into the

original image, the noticeable quality of the watermarked image does not reduce and it improves the aspect of watermark entrenched image.

[4] In the unbreakable digital watermarking the Least Significant Bit (LSB) technique are used to modify the image into pixels to bits. It uses a pseudo-random number generator which verifies the pixels to be used for embedding watermark primarily based upon the private key. The combined approach of LSB-DCT watermarking for multilevel image primarily based on intelligence security.

[5] In the 2-DCT and 2-DWT in gray images are mainly used to protect the digital watermarking and it is used for image recognition and for preservation against numerous attacks.

[9] In the robust technique on Red component for steganography approach. In the steganography process the hiding or embedding an imperceptible signal (data) into the given signal (data). The invisible sign is called as watermark and given is assigned to cover work. This cover-up painting might be image, audio or video file. It has been taking advantage of in JPEG image for popular image compression. The robust approach for virtual watermarking or steganography on Red component using DCT with DWT algorithm.

III. ALGORITHM

Discrete Cosine Transform (DCT)

Discrete Cosine Transform is a procedure in which data point progression is to be used to change the spatial domain to a sum of sine and cosine waveforms with various extent in the frequency domain. The DCT is a linear transform, which outlines an n-dimensional vector to n coefficients set. It is most robust to the JPEG compression since JPEG compression itself uses DCT. However, DCT methods shortage of conflicts to vigorous geometric distortions.

Discrete Fourier Transform (DFT)

It is version rotation and invariant challenging, which explicate to strong strength to the geometric attacks. DFT uses complex numbers. While DCT uses current real numbers.

Discrete Wavelet Transform (DWT)

Discrete Wavelet Transform is a novel approach frequently used in numerous digital image processing approach, compression, watermarking, hiding etc. The transforms are based on little waves known as wavelet, of differing frequency and limited period. The wavelet transform is mainly breakdown the original image into three different spatial commands, i.e. horizontal, vertical and diagonal. Therefore, wavelet emulates the properties of anisotropic of HVS increased literally.

IV. PROPOSED METHODOLOGY

In the proposed technique we implement the combined approach of both Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) algorithm to hide the secret data using the Graphical Interchange Format (GIF). The third person understands both the sender and receiver (authorized persons) are communicating with each other but they are sharing some secured data between themselves. The combined approach of both DCT and DWT

of the embedding algorithm are discussed below:

Step 1: Apply DWT to decompose the cover host picture into four non-overlapping multi-resolution sub-bands: LL1, HL1, LH1, and HH1.

Step 2: Apply DWT repeatedly to sub-band HL1 to get four smaller sub-bands and designate the HL2 sub-band. Or, apply DWT to sub-band HH1 to get four minor sub-bands and choose the HH2 sub-band.

Step 3: Split the sub-band HL2 (or HH2) into 4 x 4 blocks.

Step 4: Apply DCT to separate block in the chosen sub-band (HL2 or HH2).

Step 5: Re-formulate the grey-scale watermark image into a vector of zeros and ones.

Step 6: Develop two uncorrelated pseudorandom sequences. One sequence is used to embed the watermark bit 0 (PN0) and the other arrangement issued to embed the watermark bit 1 (PN1). A number of elements in each of the two pseudorandom sequences must be equal to the number of mid-band elements of the DCT-transformed DWT sub-bands.

Step 7: Enclose the two pseudorandom sequences, PN0 and PN1, with a gain factor α in the DCT transformed 4x4 slab of the chosen DWT sub-bands of the host image. Embedding is not tested to all coefficients of the DCT block, but only to the mid-band DCT coefficients. If X is indicated as the matrix of the mid-band coefficients of the DCT transformed block, then embedding is concluded as follows:

If the watermark bit is 0 then

$X + = X + \alpha * PN0$

Otherwise, if the watermark bit is 1 then,

$X + = X + \alpha * PN1$

Step 8: Apply inverse DCT (IDCT) to each block after its mid-band coefficients have been modified to embed the watermark bits as illustrated in the previous step.

Step 9: Apply the inverse DWT (IDWT) on the DWT transformed image, including the modified sub-band, to yield the watermarked host image.

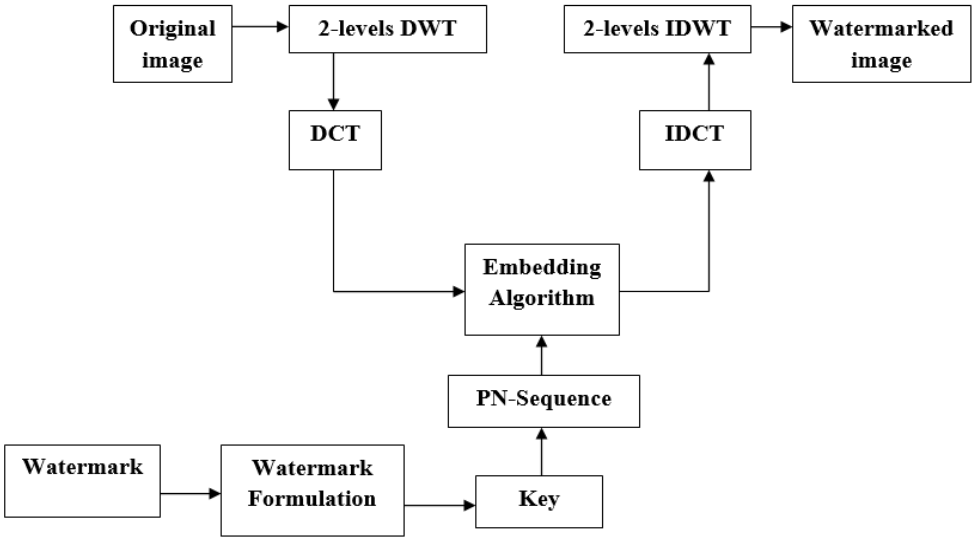

Fig 1 Embedding procedure of DCT-DWT

The combined approach of both DCT-DWT of the extraction algorithm discussed below:

Step 1: Apply DWT to disintegrate the watermarked image into four non-overlapping multi-resolution sub-bands: LL1, HL1, LH1, and HH1.

Step 2: Apply DWT to HL1 to get four smaller sub-bands, and choose the sub-band HL2. or, apply DWT to the HH1 sub-band to grab four smaller sub-bands, and choose the HH2 sub-band,

Step 3: Isolate the sub-band HL2 (or HH2) into 4×4 blocks.

Step 4: Apply DCT to each slab in the picked sub-band (HL2 or HH2), and extract the mid-band coefficients of each DCT transformed block.

Step 5: Regenerate the two pseudorandom sequences (PN_0 and PN_1) using the equal seed used in the watermark embedding procedure.

Step 6: For each block in the sub-band HL2 (or HH2), measure the correlation is centrally located the mid-band coefficients and the two accomplish pseudorandom sequences (PN_0 and PN_1). If the interaction (correlation) with the PN_0 was above than the correlation with PN_1, then the extracted watermark bit is treated as 0, otherwise, the extracted watermark is treated as 1.

Step 7: Reconstruct the watermark using the extracted watermark bits, and figure out the resemblance between the original and extracted watermarks.

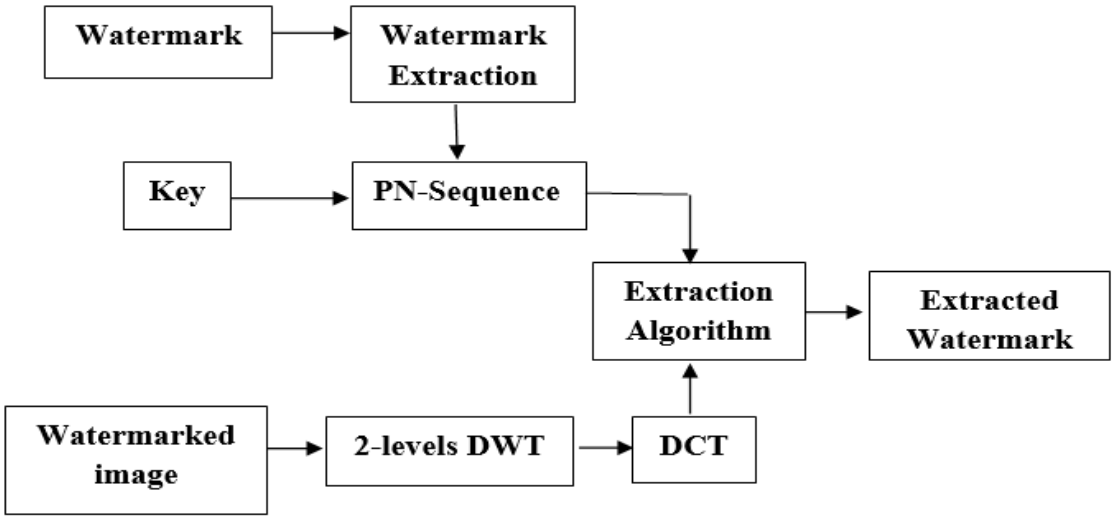

Fig 2 Extraction procedure of DCT-DWT

V. PERFORMANCE METRICS

Peak Signal to Noise Ratio

PSNR is a systematization expression for the ratio between the superlative achievable power of a signal and the power of corrupting noise that disturb the loyalty of its narration.

Because many signals have a very enlarge dynamic range, PSNR is commonly expressed in terms of the logarithmic decibel scale.

$$PSNR=10 \log_{10} \frac{(MAX\ I^2)}{MSE} db$$

Here, MAXI is the maximum feasible pixel value of the image

Mean Square Error

The mean squared error (MSE) which for two m×n monochrome images I and K where one of the images is investigated a noisy resemblance of the other are defined as in the equation

$$MSE = \frac{1}{MN} \sum_{i=1}^{N} \sum_{j=1}^{M} \left[\left(I\ (i,j) - K(i,j) \right) \right]^2$$

VI. EXPERIMENTAL ANALYSIS

In the Digital image watermarking using DCT and DWT concept Graphical Interchange Format (GIF) is used to hidethe secret messages (data) from the unauthorized user.

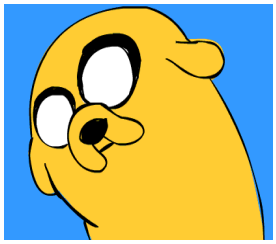

Fig 3 Input.gif

The above figure shows the input image in the Graphical Interchange Format (GIF).

The performance of the combined DWT-DCT algorithm. For the sake of comparison, the performance of only DWT was used. The result shows that only the DWT approach indicates the better imperceptibility performance was obtained when the watermark was embedded in the HL_2 or HH_2 sub-bands. To improve the performance of the robustness combined both DWT-DCT watermarking algorithm imperceptibility performance was better than another kind of approach. Moreover, the improvement of robustness brought by the combined DCT-DWT algorithm was considerably high.

VII. CONCLUSION

The Discrete Wavelet Transform (DWT) and the Discrete Cosine Transform (DCT) have been applied profitably in many in digital image watermarking. In this paper, we characterized a combined DWT-DCT digital image watermarking algorithm. Watermarking was executed by embedding the watermark in the first and second level DWT sub-bands of the host image, pursue by the function of DCT on the preferred DWT sub-bands. The combination of the two transforms enhance the watermarking work considerably when compared to the DWT-Only watermarking access. In conclusion, in DWT-based digital watermarking applications, combining applicable transforms with the DWT may have a confident impact on the achievement of the watermarking system.

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