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Robust Technique For Digital Watermarking on Red Component Using 2-DCT-DWT Transform

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***Abstract**— In this paper, we proposed a robust technique for digital watermarking on Red Component using 2-Discrete Cosine Transform (CDT) with discrete wavelet transform (WDT) algorithm. In this scheme, we used two images- first one is cover image and secondly is secret image. For improved protection, we performed on Red Component. We worked on two mechanisms- firstly is 2-DWT and secondly 2-DCT. In this proposed, we applied 2-DWT and 2-DCT on RGB (red, green and blue) elements. The experimental results based on psnr value and its reach upto 56%.*

***Keywords**— DWT, DCT, PSNR, NAE*

I. Introduction

The growth in Internet in past few years made it possible that transmit, create, copy and distribute digital data. This has led to a strong demand for reliable and secure copyright protection techniques for digital data. Digital Watermarking is the process of hiding or embedding an imperceptible signal (data) into the given signal (data). The imperceptible signal is called watermark and the given signal is called cover work. This cover work can be an image, audio or a video file. This embedded information can later be removed from multimedia for the purpose of security. A watermarking algorithm contains the structure of watermark, an embedding algorithm, and a mining or finding algorithm. Watermarks can be embedded in the transform domain or a pixel domain [3].Digital watermarking is a technique designed to secure a message by hiding that message within another object so that it can be kept secret from everyone except the intended recipient.

Watermark techniques can be divided into two groups: Visible and invisible, the visible watermark is used if embedded watermark is intended to be seen by human eyes, For example, a logo inserted into corner of an image. While the invisible watermark is embedded into a host image by sophisticated algorithms and is invisible to the human eyes [3].

II. Related Work

Saroya et al. (2014) in this paper comparative analysis of various Image compression techniques for different images is done based parameters mean square error (MSE), peak signal to noise ratio (PSNR). DWT gives better results without losing more information of image. Pitfall of DWT is, it requires more processing power. DCT overcomes this disadvantage since it needs less processing power, but it gives less compression ratio. DCT based standard JPEG uses blocks of image. In wavelet, there is no need to block the image.

A.Venkateswarlu (2014) in this research work, a hybrid scheme combing the Discrete Wavelet Transform and the Discrete Cosine Transform algorithms under great compression ratio constraint for image and video compression has been presented. The algorithm was tested on numerouskinds of the images, such as, medical, natural, and benchmark images. Moreover, the proposed algorithm was also compared with some standards and already Developed hybrid algorithms. It was observed that the proposed hybrid algorithm performs better than the existing algorithms.

Sangeeta et.al (2014) in this paper, a Digital Watermarking Algorithm based on the Discrete Wavelet Transform - Discrete Cosine Transform- Arnold Transform and Singular Value Decomposition is suggested. The Discrete Cosine Transform - Singular Value Decomposition based technique is very time consuming while the procedure of Singular Value Decomposition - Discrete Wavelet Transform Discrete Cosine Transform and Arnold Transform technique is found to be very fast and this novel technique was found to fulfill entirely the requisites of an ideal watermarking system such as imperceptibility, robustness and also good capacity. This technique can be used for data hiding and authentication purposes.

Aswathy Mohan et al (2014) Image enhancement contracts with the enhancing the image so that it offers more information. Numerous methods are suggested for contrast enhancement of theimages which is based on low-contrast satellite and CT scans. Here a novel method has been planned based on the DWT (Discrete Wavelet Transform) SVD (Singular Value Decomposition) and DCT (Discrete Cosine Transform). The suggested method splits the image into blocks and converts all blocks of the image into the Discrete Wavelet Transform - Singular Value Decomposition - Discrete Cosine Transform domain after the normalizing singular value matrix. Then the altered image is rebuilt by applying inverse Discrete Cosine Transform and Discrete Wavelet Transform and the blocks are collective. AHE (Adaptive Histogram Equalization) has been used here. The outcomes of the suggested technique clearly specify

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improved effectiveness and flexibility perceptually and quantitatively over the obtainable approaches like Discrete Wavelet Transform - Singular Value Decomposition technique.

Maklachur Rahman (2013) In this paper, a knowledge of the watermarking is suggested and also implemented. In suggested watermarking technique, the original image is rearranged applying the zigzag order and Discrete Wavelet Transform is applied tothe rearranged image. Then Discrete Cosine Transform and Singular Value Decomposition is appliedin totally extraordinary bands HL, LH and HH. A watermark is then the embedded by altering the singular values of these bands. Removal of the watermark is executed by the inversion of the watermark embedding procedure. For selecting of the these three bands it provides capacity of the pure high band and mid-band that ensures decent imperceptibility and more robustness beside the different types of the attacks.

K.Saraswathy et al. (2013) [4] in this paper „A Discrete Cosine Transform Approximation with the Little Complexity for the Image Compression" have described an orthogonal approximation for the 8 point DCT (Discrete Cosine Transform). The suggested transformation matrix holds only zeros and ones. Multiplication operations and Bit shift operations are inattentive. The estimated transform of Discrete Cosine Transform is obtained to meet the little complexity requirements. The simulation results obtained from the work will show clearly the efficiency of the proposed transform in image compression. Finally, the novel estimate proposals the users other options for mathematical analysis and circuit implementations. The novel estimated transform matrix has rows built from a different mathematical construction when compared to the Discrete Cosine Transform. These rows can be considered in the design of hybrid algorithm which mat takes advantage of the best matrix rows from the existing algorithm pointing at new developed estimated transform

Vellaiappan Elamaran et al. (2012) [2] in paper „Comparison of the Discrete Cosine Transform and Wavelets in Image coding" have defined the simple idea of the compression is to effort to decrease the average amount of the bits per pixel to adequately signify the image. Fourier based transforms (e.g. Discrete Cosine Transform and Discrete Fourier Transform) are effective at exploiting the little frequency nature of an image. The great frequency coefficients are the coarsely quantized, and hence the reassembled feature of the image at the edges will have the humble feature. On the other hand, wavelets are effective in signifying non stationary signals because of the adaptive time-frequency window. So the DWT (Discrete Wavelet Transform) is applied to an image and the PSNR of both DCT (Discrete Cosine Transform) and Discrete Wavelet Transform is compared. An analysis and comparison of image compression using Discrete Cosine Transform and Discrete Wavelet Transform is demonstrated.

Maneesha Gupta et al. (2012) [5] in this paper „Analysis Of the Image Compression Algorithm applying Discrete Cosine Transform " have defined that here develop certain simple functions to compute the Discrete Cosine Transform and to the compress images. An image compression algorithm was the comprehended applying the Matlab code, and improved to implement better when implemented in the hardware depiction language. Image Compression is studied applying 2-D discrete Cosine Transform. The original image is thentransformed in the form of the 8-by-8 blocks and then inverse transformed in the 8-by-8 blocks to generate the reconstructed image. The inverse Discrete Cosine Transform would be performed applying the subset of Discrete Cosine Transform coefficients.

III. DISCRETE WAVELET TRANSFORM

Wavelet Transform is a modern method to frequently used in the digital image processing, compression, watermarking, etc. The wavelet transform offers the time-frequency representation of a given signal. The transforms are based on the minor waves, known as wavelet, of varying frequency and limited duration. The wavelet transform decomposes the image into three spatial directions, horizontal, vertical and diagonal. Hence wavelets reflect the anisotropic properties of HVS more precisely. Magnitude of DWT coefficients is larger in the lowest bands (LL) at each level of decomposition and is smaller for other bands (HH, LH, and HL). A two dimensional transform can be the accomplished by the acting two dispersed one-dimensional transforms. First, the image is the filtered along the x-dimension applying high pass and low pass study filters and destroyed by two. Low pass filtered coefficients are kept on the left part of high pass filtered on the right and matrix. Because of the decimation the whole size of the transformed image is similar as the previous image. Then, it is followed by the filtering the sub-image along withthe y-dimension and decimated by the two. Finally, we have split the image into the four bands signified by LL, HL, LH and HH and one level decomposition and figure shows second level and one level decomposition [3].

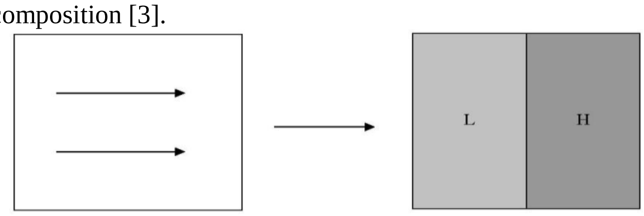

Fig 1 Horizontal Transform-2 subbands

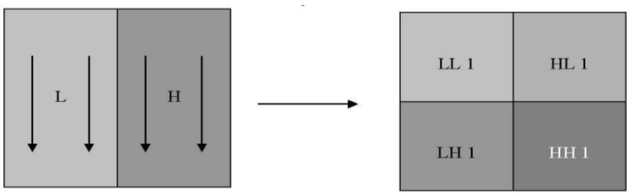

Fig 2 Vertical Transform-4 subbands

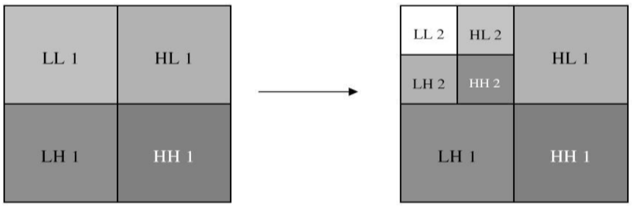

Fig 3 Second level filtering

After decomposing the cover image and the watermark at the desired level, the watermark coefficients are hidden to the appropriate coefficients of the cover image *[4]*.

IV. Discrete Wavelet Transform

The DCT [5] is the most well known change capacity utilized as a part of sign preparing. It changes a sign from the spatial area to recurrence space. Because of good execution, it has been utilized as a part of the JPEG standard for picture pressure. It is a capacity speaks to a method connected to picture pixels in a spatial area to change them into a recurrence space in which repetition can be marked. DCT methods are more powerful contrasted with spatial area systems. Such calculations are strong against straightforward picture preparing operations like alteration, splendor, obscuring, differentiation and low pass separating, etc. Yet, it is hard to execute and computationally more extravagant. The one-dimensional DCT is helpful in handling one dimensional signs, for example, discourse waveforms. For examination of two-dimensional (2D) signs, for example, pictures, we require a 2D rendition of the DCT. The 2D DCT and 2D IDCT changes are given by comparing 1 and 2.

Formulae of 2-D DCT:

$$F(m,n) = \sum_{i=0}^{N-1}\sum_{j=0}^{N-1} C(m)\ C(n) f(i,j) \cos\left[\frac{\pi(2i+1)m}{2N}\right] * \cos\left[\frac{\pi(2i+1)m}{2N}\right] \ldots\ldots\ldots\ldots\ldots(1)$$

Formulae of 2-D inverse DCT:

$$f(i,j) = \sum_{i=0}^{N-1}\sum_{j=0}^{N-1} C(m)\ C(n) F(m,n) \cos\left[\frac{\pi(2i+1)m}{2N}\right] * \cos\left[\frac{\pi(2i+1)m}{2N}\right] \ldots\ldots\ldots\ldots\ldots(2)$$

Where as

$$C_{(m)}C_{(n)} = \begin{cases} \sqrt{\frac{1}{N}, m.n=0} \\ \sqrt{\frac{2}{N}}\ , m,n = 1\ upto\ N\_1 \end{cases}$$

V. Proposed Algorithm

a) Watermark Embedding Process

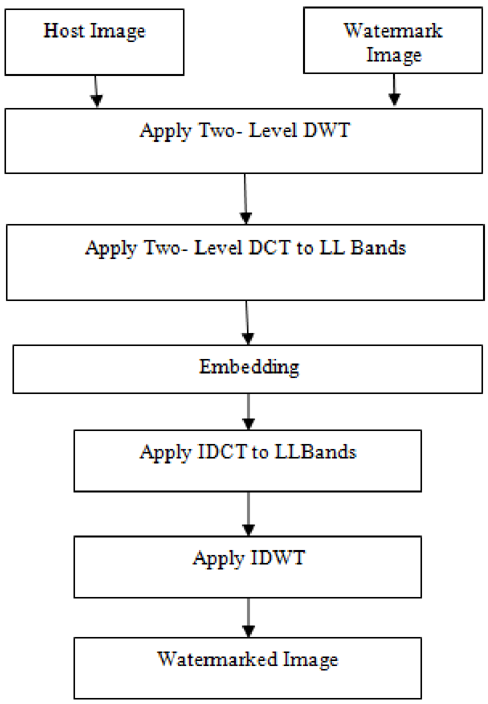

Fig 4: Block dig Watermark Embedding Process

b) Watermark Extraction Process

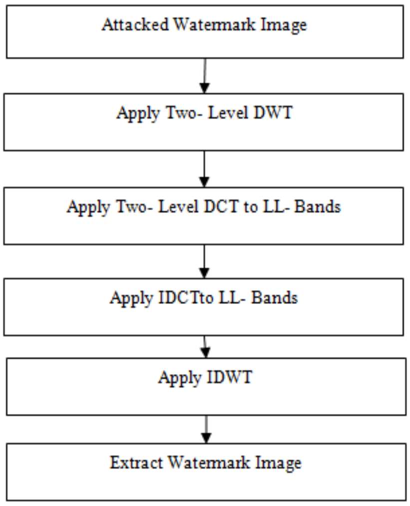

Fig 5: Block dig of Extract Watermark Image

c) Proposed Algorithm

1: Select cover image and secret image.
2: Convert both RGB images into three elements- red, green and blue.
3: Perform DWT on the red image to divide it into four coefficient sets: h_LL, h_HL, h_LH and h_HH.
4: Perform DWT again on two h_HL and h_LH coefficient sets to get smaller coefficient sets and choose four coefficient sets: h_LL1, h_HL1, h_LH1 and h_HH1.
5: Divide four coefficient sets: h_LL1, h_HL1, h_LH1 and h_HH1 into 4 x 4 blocks.
6: Apply DCT to every block in the chosen coefficient sets (h_LL1, h_HL1, h_LH1 and h_HH1). These coefficients sets are selected to see if both of imperceptibility and strength of algorithms equally.
7: Perform DWT on the secret red image to divide it into four coefficient sets: s_LL, s_HL, s_LH and s_HH.
8: Perform DWT again on two s_HL and s_LH coefficient sets to get smaller coefficient sets and choose four coefficient sets: s_LL1, s_HL1, s_LH1 and s_HH1.
9: Divide four coefficient sets: s_LL1, s_HL1, s_LH1 and s_HH1 into 4 x 4 blocks.
10: Apply DCT to every block in the chosen coefficient sets (h_LL1, h_HL1, h_LH1, h_HH1 and _LL, s_HL, s_LH and s_HH). These coefficients sets are selected to see if both of imperceptibility and strength of algorithms equally.
11: Apply inverse DCT (IDCT) on every block after its mid-band coefficients have been modified to embed the watermark bits as described in the previous step.
12: Apply the inverse DWT (IDWT) on the DWT distorted image, including the customized coefficient sets, to make the watermarked cover image.

1) Image Database

Fig 6: Image database

2) Read Cover Image

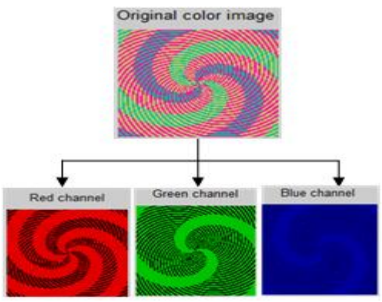

Fig 7: Original Cover Image

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3) Read Secret Image

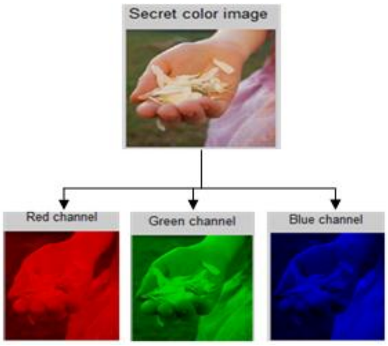

Fig 8: Secret Color Image

4) Embedding Process

Fig 9: Secreted Red Image

5) Extracting Process with Noise Attack

Fig 10: Extracted Image

VI. RESULT ANALYSIS

Table1. PSNR Comparison between base and proposed work

COVER IMAGE	BASE PSNR	PROPOSED PSNR
(A)	48.653	55.783
(B)	48.594	52.312
(C)	48.150	55.426
(D)	49.083	55.427
(E)	48.534	54.043
(F)	48.836	54.753

Table2. NAE Comparison between base and proposed work

COVER IMAGE	BASE NAE	PROPOSED NAE
(A)	1.542	0.996
(B)	7.784	0.996
(C)	9.802	0.9961
(D)	8.911	0.9961
(E)	7.836	0.9961
(F)	1.225	0.9961

VII. CONCLUSIONS

In this paper proposed algorithm is robust against watermarking technique and watermark image. In this algorithm, we worked on Robust Technique For Digital Watermarking on Red Component Using 2-DCT-DWT Transform. The watermark can be done by start adding watermark on the first level amd then on second level DWT sub-bands of original image, followed by DCT component on some selected DWT sub-bands. The watermarking performance enhanced by combining two transform in comparison to DWT single levelwatermarking approach. In this proposed, we applied 2-

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DWT and 2-DCT on red element. The experimental results based on psnr value and normalized absolute error. It reached upto 56% of PSNR. And we decreased its NAE upto 0.99.

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