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Hiding of Image Data behind a Colored Image Using Advanced DWT Method

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Abstract: Digital image watermarking is one such technology that has been developed to protect digital images from illegal manipulations. In general, digital image watermarking algorithms which are based on the discrete wavelet transform have been widely recognized to be more prevalent than others. This is due to the wavelet characteristics like excellent spatial localization, multi-resolution and frequency spread, which are like theoretical models of the human visual system. But, the two-dimensional (2D) DCT decimation technique are incorporated in digital images to provide spatial-temporal scalability. Also, DCT has an important characteristic of energy-compression. If this characteristic is combined with existing DWT watermarking algorithm, it can improve the transparency of digital watermark. So, a more imperceptible and a robust combined algorithm of digital watermarking based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) has been proposed in this paper. In this algorithm, the information of digital watermark which has been discrete Cosine transformed (DCT), is put into the high frequency band of the image which has been wavelet transformed. Then, we can filter the digital watermark with the help of the watermarked image. PSNR, normalized correlation and computational time has been taken as performance evaluation parameters. All the simulation is done using MATLAB R2008a vol. 7.6 as an implementation platform.

KeyWords:Watermarking,Steganography,DCT,DWT.

I. INTRODUCTION

The watermark is a signal embedded into the host media to be protected, such as an image or audio or video. It contains useful certifiable information for the owner of the host media, such as producer's name, company logo, etc; the watermark can be detected or extracted later to make an assertion about the host media [1,2]. For this aim, digital watermarkingtechniquesdevelop and their number is growing,searching all for the equilibrium between three criteria: data hiding capacity, imperceptibility, and robustness, depending on the image domain representation [1, 2]. The choice of a domain lies mainly on robustness criteria required relating to specific data manipulations or malicious attacks. Between these domains the spatial presentation is robust against geometrical attacks [3-4]. In the other, hand its restrictions dissuades its use because of the poor capacity of data embedding with respect to the imperceptibility condition [3-5]. In order to further performance improvements in DWT based digital image watermarking algorithms could be obtained by jointing DWT with DCT [6-8]. The reason of applying two transform is based on the fact that jointed transform could make up for the disadvantages of each other, so that effective watermarking approaches could acquire [7].

1.1 DWT (DISCRETE WAVELET TRANSFORM) & DCT (DISCRETE COSINE TRANSFORM)

1.1.1 DWT (Discrete Wavelet Transform)

Wavelet transform decomposes an image into a set of band limited components which can be reassembled to reconstruct the original image without error. Since the bandwidth of the resulting coefficient sets is smaller than that of the original image, the coefficient sets can be down sampled without loss of information. Reconstruction of the original signal is accomplished by up sampling, filtering and summing the individual sub bands [9]. For 2-D images, applying DWT corresponds to processing the image by 2-D filters in each dimension. The filters divide the input image into four non-overlapping multi-resolution coefficient sets, a lower resolution approximation image (LL1) as well as horizontal (HL1), vertical (LH1) and diagonal (HH1) detail components. The sub-band LL1 represents the coarse-scale DWT coefficients while the coefficient sets LH1, HL1 and HH1 represent the fine-scale of DWT coefficients.
To obtain the next coarser scale of wavelet coefficients, the sub-band LL1 is further processed until some final scale N is reached. When N is reached we will have 3N+1 coefficient sets consisting of the multi-resolution coefficient sets LLN and LHX, HLX and HHX where x ranges from 1 until N. Due to its excellent spatio-frequency localization properties, the DWT is very suitable to identify the areas in the host image where a watermark can be embedded effectively [10]. In particular, this property allows the exploitation of the masking effect of the human visual system such that if a DWT coefficient is modified, only the region corresponding to that coefficient will be modified. In general most of the image energy is concentrated at the lower frequency coefficient sets LLx and therefore, embedding watermarks in these coefficient sets may degrade the image significantly. Embedding in the low frequency coefficient sets, however, could increase robustness significantly. On the other hand, the high frequency coefficient sets HHx include the edges and

textures of the image and the human eye is not generally sensitive to changes in such coefficient sets [10]. This allows the watermark to be embedded without being perceived by the human eye. The agreement adopted by many DWT-based watermarking methods, is to embed the watermark in the middle frequency coefficient sets HLX and LHX is better in perspective of imperceptibility and robustness [9, 10].

1.1.2 DCT (Discrete Cosine Transform)

A discrete cosine transform (DCT) expresses a sequence of finitely many data points in terms of a sum of cosine functions oscillating at different frequencies. DCTs are important to numerous applications in science and engineering, from lossy compression of audio (e.g. MP3) and images (e.g. JPEG) (where small high-frequency components can be discarded), to spectral methods for the numerical solution of partial differential equations. The use of cosine rather than sine functions is critical in these applications: for compression, it turns out that cosine functions are much more efficient whereas for differential equations the cosines express a particular choice of boundary conditions [9, 10]. In particular, a DCT is a Fourier-related transform similar

to the discrete Fourier transform (DFT), but using only real numbers. DCTs are equivalent to DFTs of roughly twice the length, operating on real data with even symmetry (since the Fourier transform of a real and even function is real and even), where in some variants the input and/or output data are shifted by half a sample. There are eight standard DCT variants, of which four are common. The most common variant of discrete cosine transform is the type-II DCT, which is often called simply "the DCT"; its inverse, the type-III DCT, is correspondingly often called simply "the inverse DCT" or "the IDCT". Two related transforms are the discrete sine transform (DST), which is equivalent to a DFT of real and odd functions, and the modified discrete cosine transform (MDCT), which is based on a DCT of overlapping data. [9, 10].

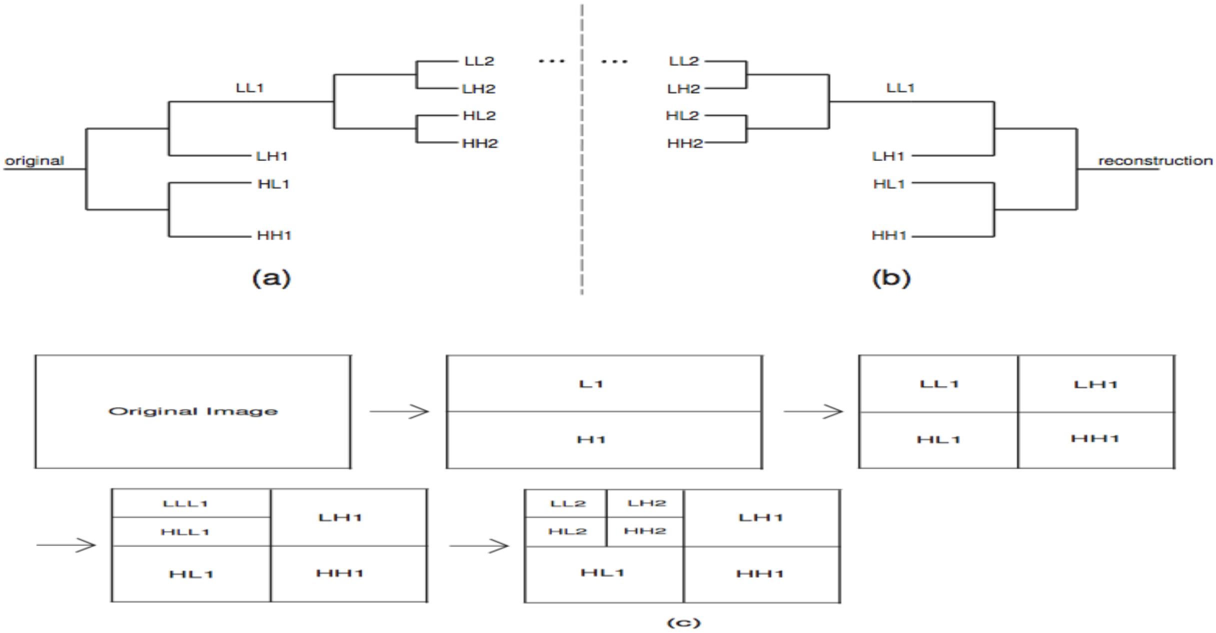

Figure 1: 2D DWT decomposition into two levels: (a) Decomposition of an Image, (b) Reconstruction of an image, (c) Scheme of decomposition up to the SECOND (2^{nd}) level

II. METHODOLOGY

We Take Original image and watermark image as input. After that Read and Transform the watermark image using DCT for improving the watermark algorithm and the secrecy of watermark image, then Read and Decompose the host image by L-levels using two-dimensional DWT. After this approaching sub-image (low frequency band information) and 3L detail sub-images (high-frequency band information) are obtained. The higher DWT level is, the better the concealing effect of embedding watermark.

Embedding the watermark

Amend the wavelet coefficient values of the chosen streak blocks of watermark image to complete the watermark embedding. Inversing transform: After embedding the Watermarked signal, unite the information of the lowest frequency band and the mended high frequency band. Then the wavelet transform of the image is inversed by the L-level, and the watermarked image is obtained.

Distilling of Watermark

DWT transform: Transform the original image and the watermarked image by L-levels using DWT. And the information of the lowest frequency band and the high frequency band are obtained. Finding of right streak block from both Transformed images.Comparison of streak blocks of both images, when this value is bigger than a certain threshold value, it's thought that there is watermarking component weight information in the streak block watermarked image. Then it's signed as 1, else 0.Inversing transformation of watermark: Then the discrete cosine transform of the disordered watermarking image is inversed, and the watermark image is obtained.

III. IMPLEMENTATION AND RESULTS

All the simulations have been performed in MATLAB R2012a. After simulation of program some results or output parameters i.e. value of PSNR, computational time and value of normalized correlation has been driven along with some figures, representing input and output from the simulation. Fig. 2 shows the original cover image of baboon.jpg. Fig. 3 shows the original watermark image. Fig. 4 shows the decomposed watermark image. Fig. 5 shows the embedded watermarked image. Fig. 6 shows the extracted watermark image. And last but not the least Fig. 7 shows the normalized correlation coefficients plot between original and extracted watermark image. If we compare both the watermark analytically both have no difference, which is a good sign for proposed method in terms of correlation. Also, the calculated correlation value is 1. The PSNR value of extracted watermark is 59.25 dB. The time which elapsed during whole simulation is 6.64s. Comparison of fig. 2 and fig. 5 clearly tells that watermark is totally invisible in the watermarked image. Also, comparison of fig. 3 and fig. 6 tells that original and extracted watermark are exactly same.

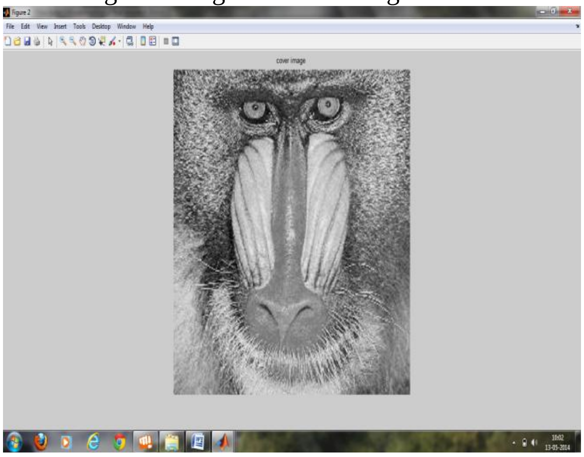

Fig. 2 Original cover image

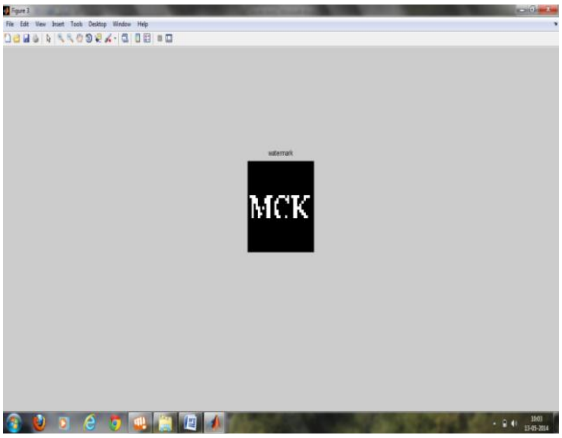

Fig. 3 original watermark

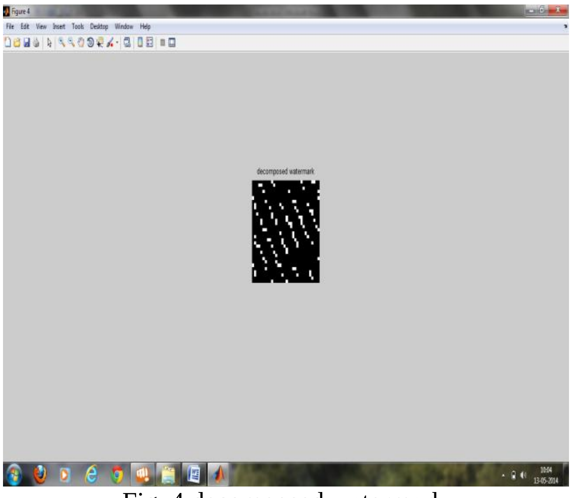

Fig. 4 decomposed watermark

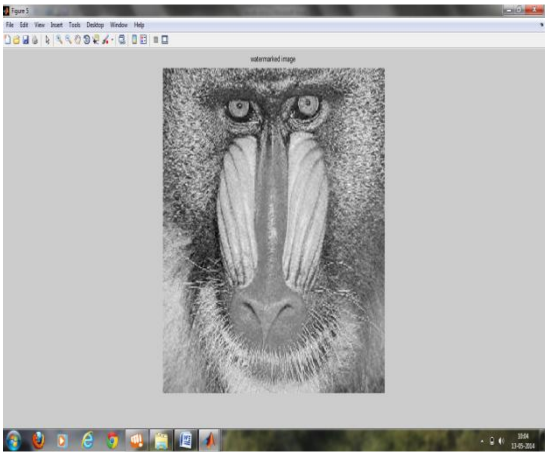

Fig. 5 DCT-DWT watermarked image

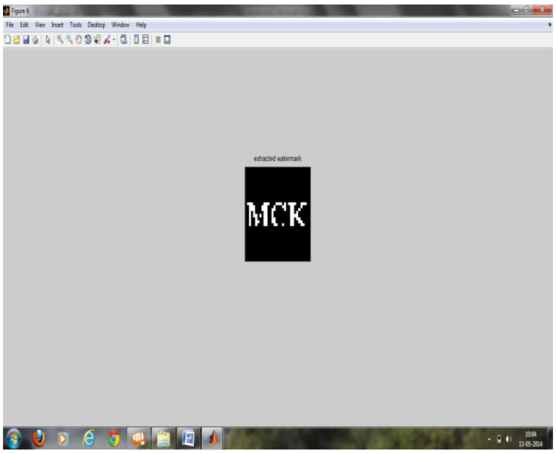

Fig. 6 DCT-DWT extracted watermark image

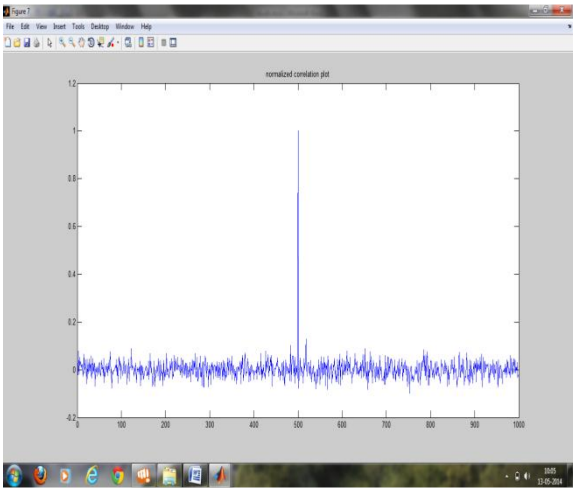

Fig. 7 plot for correlation co-efficient

IV. CONCLUSION AND FUTURE WORK

It can be concluded from the above study that there some commonly present problem such as inability to withstand attacks in traditional watermarking techniques are absent in SVD based algorithms. However, they offer a robust method of watermarking with minimum or no distortion. Other techniques are less robust because watermark is darkly marked i.e. with high amplitude. Almost all techniques are more complex and gain is much smaller in presence of attacks. Also, while using DWT for watermarking, Computational complexity of DWT is more compared to that of DCT. DWT only takes 54 multiplications to compute DCT for a block of 8x8, unlike wavelet calculation depends upon the length of the filter used, which is at least 1 multiplication per coefficient. The extracted watermark also not much correlates with original watermark, while using DCT and DWT separately. So, there is a need of a watermarking methodology which must be less complex, more efficient in manner of computational time, PSNR and correlation value. The two-dimensional (2D) DCT decimation technique are incorporated in digital images to provide spatial-temporal scalability. Also, DCT has an important characteristic of energy-compression. If, this characteristic is combined with existing DWT watermarking algorithm, can improve the transparency of digital watermark So, a more imperceptible and a robust combined algorithm of digital watermarking based on Discrete Cosine Transform(DCT) and Discrete Wavelet Transform(DWT) is needed for watermarking.

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