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Research Article

Efficient Watermarking Approach For Textured Images Using Dct And Dwt

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ABSTRACT

in the current era, Image processing technology has been developed rapidly. Changing the digital information of an image is made easy to everyone due to the growth of the internet and increasing availability of multimedia applications. It is a necessary requirement to protect the integrity and authenticity of digital information. The DCT and DWT have been proved the most significant approach of digital watermarking. This research proposed the hybrid image watermarking algorithm based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). The experiment is tested over the color image. The source image is converted into RGB color space into YCbCr color. The DCT conversation was performed on each block individually. After the DCT extraction the DWT is performed on vertical component. The watermark image is embedded in LH component of DWT. The notable outcome from this research is the average PSNR values of all images is 49.17 db achieved the 100% accuracy of watermark recovery. The accuracy is calculated based on subjective to following attack Wiener, Gaussian Noise, Median filter, Cropping, Resizing, Sharpening, Blurring, JPEG Compression and Low pass filter. The results achieve optimal NCC values under the different attachments such as compression and filtering. The simulation result shows the proposed algorithm is robust and dynamic for the digital watermarking approach.

Keywords: Watermarking, Discrete Cosine Transform, Discrete Wavelet Transform, Restoration Parameter

I. INTRODUCTION

In the image processing, the watermarking is the method for hiding the digital information or message in a carrier signal to maintain security in multimedia data [1]. The technology of image processing has been developed rapidly in recent years. Modifying the information of an image is easy for everybody, but is the prohibited activity for an attacker. In the current technological era the digital multimedia play a significant part. The security regarding integrity, authenticity of the digital data is the most challenging project [2]. For the security purpose, such as content authentication, copyright protections, numerous watermarks have been broken. The digital multimedia includes photograph, music, digital video, specific protected information. The watermark has been inserted in two manners such as visible and non-visible mode. The visible mode watermark can be identified by observing, but the invisible watermark is not grasped by the observer. Improving the protection of digital content without losing the character of the source image is the aim of digital watermarking. The Robustness to Attacks, Visual Imperceptibility and Capacity are three important highlighted parameters for development of digital watermarking [3].

The universal watermarking system consists of watermark generation, watermarking embedding, watermark detection and recovery of watermark data. The watermark information can be a logo, gray scale image, binary image and random act which have been engrafted in the source picture. The embedded watermark image suffers the unintentional and intentional approach. The methodology of watermark should be robust

regarding the attack issues. The statistical measure used for the performance checking on the watermarking process based on the quality of the source image. The basic steps of universal watermarking steps are graphically depicted in figure 1 [4].

Fig. 1. basic system of universal watermarking system

The applications of watermarking methods are used in numerous areas such as medical science, security, certification, data hiding and digital information authentication. The approach of semi-fragile watermarking has achieved superior performance than fragile watermarking with considering the ability of resisting common image operations. For the development domain, the watermarking techniques are classified into frequency and spatial domain [5]. The watermarking process in the spatial domain is directly changing the pixel values of the source image. This spatial domain is easy for implementation and has low computational complexity. The limitation of spatial domain watermarking that is not proved as robust for image processing operation such as a degree. In the frequency domain image watermarking watermark information modifies the frequency coefficient of the original source image. The frequency domain watermarking proved robust and dynamic as compared to spatial domain image watermarking. There are many more mathematical transformations applied for the image watermarking such as discrete cosine transform (DCT), discrete Fourier transform (DFT), discrete wavelet transforms and singular value decomposition [6]. Researchers are proposing many typical watermarking schemes related to medical image processing. The Lagrangian support vector regression (LSVR) and lifting wavelet transform (LWT) is the right choice for digital image watermarking. The Arnold scrambled watermark information is embedded into low frequency sub- set by one level DWT of source image [7]. The innovative watermarking scheme proposed by researcher towards SVD and Integer wavelet transforms to solve and master the false positive problem [8].

The singular matrix-based watermark information is embedded in the singular value of host source image. Multi-objective colony optimization (MOACO) approach is practiced for the digital watermarking towards the optimize the scaling element. The color image watermarking approach divides the source picture into three channels and calculates the entropies of each patch with respective to block [9]. For security and authenticity, microscopic image watermarking is the better choice. The researcher proposed the strategy of innovative watermarking for embedding the information in con-focal microscopy image [10]. The traditional watermarking algorithm has robustness for handling common attacks such as cropping, noise addition and filtering operation. The information about geometric attack destroyed the watermark synchronization and failure regarding the watermark information extraction [11].

In the current epoch of digital information many algorithms proposed to work the problem based on feature point, harmonic transform, and Zernike moment [12, 13, 14]. The researcher proposed an innovative watermarking scheme using SIFT for the circular shape patches over the invariant features [15]. The watermarking synchronization error is resolved using the watermarking approach based on DFT and SIFT methods [16].

The rest of this paper is arranged as follows: in Section 2, the related work is explained. Section 3 introduces the Methodology of digital image watermarking. Section 4 describes the concrete experimental analysis and observation. The concluding remark is explained in section 5.

II. RELATED WORK

In the current technical era, digital image watermarking is a robust and challenging area of research. The digital watermarking is solved based on mathematical algorithms. The digital watermarking is classified based on working domain, type of document for watermarking, perceptions, and application [17, 18]. The detailed classification of the digital watermarking is shown in figure 2.

Fig. 2. classification of digital watermarking

Different types of mathematical transformation such as FFT, DCT and DWT are used for digital watermarking.

DCT based robust watermarking tested by researcher for 1000 random samples. The 1000 largest is DCT coefficients of original image except the DC term. The DCT and inverse DCT term is used to solve the digital watermarking. Watermark is extracted based on exact frequency location of watermark information in source image [19]. The adjustment of DCT in low frequency coefficients is used for the preservation of quality of original source image. The watermark information is embedded into a low frequency component of the source image using DCT domain. The robust results performed on the JPEG compression metrics [20]. Watermark of pseudo random numbers generated by Linear Feedback Shift Register (LFSR) is extracted using DCT methods. The robustness of the results is achieved for all image processing attacks [21].

The DFT is also a good choice for digital image watermarking. The embedding of the circularly symmetric watermark in the magnitude is a part of the DFT. The watermark in circular shape is tested and it achieved a robust against the geometric rotation attack [22]. The researcher developed the process of embedding the watermark in the magnitude of the DFT part for source image. The quality degradation is measure using the PSNR ratio metrics [23]. The DWT approach is used for the filtering, fusion, watermarking and decomposition of the image. The novel blind watermarking scheme has been presented by an author which exploits the characteristics of HVS. The results vary due to location of watermark in four DWT bands [24]. In DWT the selection of the location of the embedding watermark scheme is proposed by the researcher. In this work watermark is embedded into a significant wavelet coefficient of dynamic block with the strong edge [25]. It is observed that there is much more scope to develop the proposed hybrid digital watermarking algorithm using DWT and DCT.

III. METHODOLOGY

Numerous algorithms proposed the watermarking scheme such as DCT and DFT. This section explained the working of DCT and DWT towards the digital image watermarking. Our proposed method using DWT and DCT is explained here. The Exact selected parameter and functionality of proposed method is Elaborated in detail.

A. Discrete Cosine Transform

The images converted from spatial domain to frequency domain with the help of Discrete Cosine Transform (DCT) algorithm. Due to great advancement parameters such as high energy compaction and robustness the DCT is a widely used approach for the image watermarking. The DCT provides the interchange between image distortion and Human Visual System (HVS) model. The functionality of DCT watermarking is classified into two modes such as Block-based DCT and Global DCT watermarking. In the Global DCT watermarking the computation has been done on the whole region of image whereas the block based DCT mode works towards non-overlapping blocks. The outcome of the block based DCT is low, mid, and high frequency sub bands. The watermark message or information is embedded into a mid-frequency sub band, which proves as robust as compared against common watermarking attack with HVS model [26,27,28,29,30,31]. The image of M x N size is forwarded towards the DCT is explained in equation 1 and 2.

$$F(U,V) = c(u)c(v)\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\cos\left[\frac{n(2x+1)u}{2M}\right]\cos\left[\frac{n(2y+1)v}{2N}\right]$$

Equation 1

$$f(x,y)=\sum_{x=0}^{M-1}\sum_{y=o}^{N-1}c(u)c(v)F(u,v)\cos\left[\frac{n(2x+1)u}{2M}\right]\cos\left[\frac{b(2y+1)v}{2N}\right]$$

Equation 2

Where u=1....M-1, V=0.....N-1 and

$$c(u)=\begin{cases}\sqrt{\frac{1}{M}}, u=0\\ \sqrt{\frac{2}{M}}, u=1\ldots M-1\end{cases}$$

$$C(v)=\begin{cases}\sqrt{\frac{1}{N}}, v=0\\ \sqrt{\frac{2}{N}}, v=1,2..N-1\end{cases}$$

B. Discrete Wavelet Transform

The promising algorithm of digital image watermarking in frequency domain is the discrete wavelet transform (DWT). The DWT approach is a mathematical tool used for the decomposition, filtering, fusion and watermarking . The DWT decomposition is decomposed the image into four sub band such as lower resolution (LL), horizontal (HL), vertical (LH) and diagonal (HH). The process of decomposition is applied over recurrent manner to computer the multi-level wavelet decomposition . From the four sub bands the LL sub band is contain the important structural information of image so, is not suitable HVS based watermarking model. This LL band based watermarking causes the image distortion. The HH sub band is proved as less robust for image processing operation such as compression so, it is also not suitable for watermarking [2,22]. From the over four sub band the appropriate band for digital watermarking are LH and HL. The robust and reliable performance without distortion of images is achieved using LH and HL bands. The figure 3 is elaborated the sub band decomposition of image at 3 level decomposition.

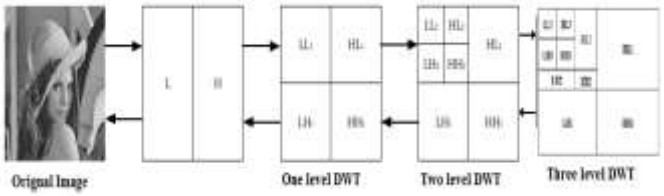

Fig. 3. three level decomposition of image using wavelet.

The DWT approach is highly integrated with HSV model for the watermarking application. It has spatial frequency localization property which is helpful to identification of watermark position. It compatible with image compression standards .It improved the ROI of researcher demands and provides low bit rate transmission. The results of DWT for compression and watermarking are versatile and quality based. Due to all these numerous advantages of DWT, it proves as reliable and robust in data compression, image recognition , de-noising , fusion , speech synthesis, signal processing and computer vision application [32,33,34,35,36,37]

C. Proposed Method

As reported study explain that the DCT and SWT both methods prove efficient towards the digital image watermarking. The transform domains are better choice for watermarking than spatial domains due to robustness under conventional attack and visual impact [38,39]. This section explains the proposed image watermarking algorithms towards frequency domain using DWT and DCT approach.

Let's use the N1xN2 size of original 24 bit color image as the source image. The Binary watermark of size M1xM2 pixels to be embedded with original host image at the W (where 0 used as black and 1 for white). The flow diagram of the proposed algorithm for the watermarking is explained as three modes. The steps of proposed algorithm development are Pre-Watermarking, watermark insertion and post watermarking.

The original source image is converted into YCbCr color space, and the luminance component Y is selected for watermarking. The BxB non-overlapping blocks are filled in the Y component. Each block of image is separated by DCT approach. DCT is transformed separately for each separated block. The mid frequency band of DCT is the most important part for us to embed the information. DWT is performed and LH vertical component is taken to embed the watermark information in binary format. We insert the watermark at vertical region because, the robustness and impact of quality of the images [40]. The watermark is embedded using the functionality of equation 3.

D.
$$LH1 = \{LH1 - (\alpha 1 x PRN), w = 0$$
$$LHI = \{LH1 + (\alpha 1 x PRN), w = 1 \quad \text{equation 3}$$

After the insertion of watermarking in the source image, the extraction of watermark image from the source image is the challenging task. The extraction of the watermarking image is shown in the figure 4. The steps of watermark extraction are pre-extraction and watermark extraction. The aim of the watermark extraction is robust and dynamic method without loss of source image information. The quality of the source image is the post prominent task for the watermark extraction.

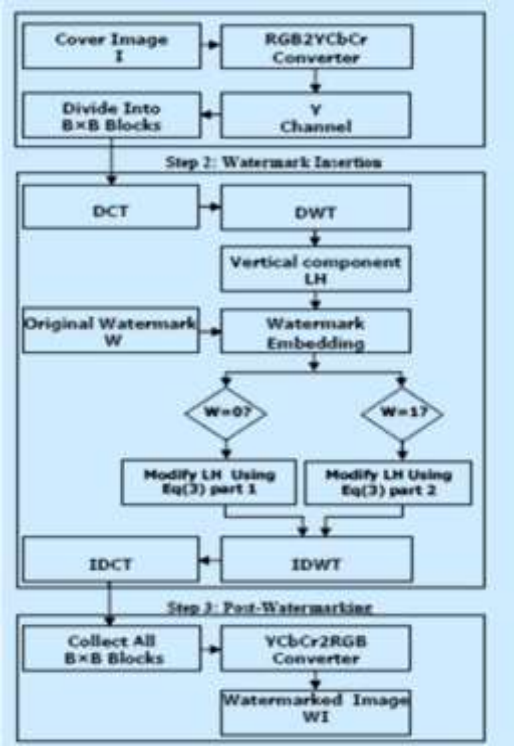

Fig.4. steps of proposed digital watermarking algorithm

IV. Experimental Analysis

To design and development digital image watermarking have proposed DWT and DCT based hybrid approach. The performance of the proposed method is calculated on Matlab inbuilt image database including Lena, Pepper, Baboon, and Sailboat of size 512*512 (24 bit per pixel) . The 32x32 size binary watermark image is used for embedding in source image. The original selected image database is shown in figure 5. The selected watermark image is graphically shown in figure 6. The quality of the watermark image is extracted using peak signal to noise ratio (PSNR) measure.

Fig.5. Graphical results of selected Matlab inbuilt image source database include Lena, Pepper and Sailboat

Fig. 6. Selected watermark image for watermarking

For the quality control of the watermark image PSNR is used. The quality and strength of the control factor play an important role. We have conducted variant experiment for control factor to get optimal values. For this experiment a set of integer values ranges as 10 to 50 and quality factor q1 with respective s1 strength. The PSNR values are calculated without attack of NCC values of original and watermark image. The quality factor of different variant experiment is shown in table 1. Table 1 describes the quality factor q1 and strength factor s1. PSNR parameter is improved for less quality factor and the value of PSNR has been degraded for the high quality factor. PSNR has been improved for less quality factor and the value of PSNR has been degraded for the high quality factor. The graphical representation of quality measure is shown in figure 7.

TABLE I. DIFFERENT QUALITY AND STRENGTH FACTOR REGARDING AVERAGE PSNR, NCC VALUES

Quality Factor q1	Average PSNR(dB)	Strength Factor s1	Average NCC
10	49.1756	10	0.8312
20	40.4015	20	0.9357
30	36.3561	30	0.9613
40	33.8613	40	0.9815
50	32.1581	50	1.0018

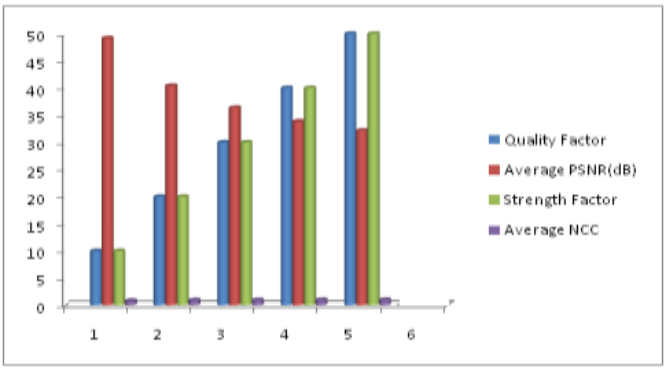

Fig. 7. Graphical representation for the quality measure.

The graphical variation in original source image embedding the watermark image and representation some attack values is shown in figure 8. Here we show the graphical results of Lena source image.

Fig. 8. graphical outcome of Lena image with different attacks

TABLE II. ***ROBUSTNESS OF THE PROPOSED ALGORITHM AGAINST DIFFERENT TYPES OF COMMON ATTACKS***

Types of Attacks	**Intensity**		**NCC**			
	Factor	**Value**	**Lena**	**Pepper**	**Baboon**	**Sailboat**
JPEG Compression	Quality	10	1	1	1	1
Low pass filter	Window size	4x4	1	1	1	1
Salt & pepper Noise	Density	0.8	1	0.9797	0.984	1
Gaussian Noise	Variance	1	1	1	1	1
Median filter	Window size	7x7	1	1	1	1
Cropping	Remaining area	50%	1	1	1	1
Resizing	Scale	0.25	1	1	1	1
Sharpening	Alpha	0.5	1	1	1	1
Blurring	Radius	5	1	1	1	1
Motion	Len	30	1	1	1	1
Wiener	Window size	5x5	1	1	1	1

From the above experimental result, it has been observed that the proposed algorithm achieved the 100% accuracy of watermark recovery. The accuracy is calculated on the basis of subjective to following attack Wiener, Gaussian Noise , Median filter , Cropping, Resizing, Sharpening, Blurring, JPEG Compression and Low pass filter.

It also yields full answers with some other group of attacks like noise addition (Salt and Pepper, Gaussian) and geometric distortion (cropping). These outcomes are due to that applying attacks on the watermarked image leads to fluctuation in the pixel values, but this mutation does not present an obstruction to the extraction algorithm discussed in section III, with respect to extracting the watermark in a right way.

V. CONCLSUION

Watermarking plays an important role in digital information security. The watermark in the source image is visible or non- visible manner. Numerous mathematical transformation approaches are used for the implementation of digital watermarking problem. DCT and DWT are robust and dynamic watermarking transformations but the individual having some limitation. In this research we have proposed the new innovative algorithm of the combination of DWT and DCT. The proposed algorithm is tested over the color image. The notable outcome from this research is the average PSNR values of all images is 49.17 db achieved the 100% accuracy of watermark recovery. The accuracy is calculated because of subjective to following attack Wiener, Gaussian Noise, Median filter, Cropping, Resizing, Sharpening, Blurring, JPEG Compression and Low pass filter. The results achieve optimal NCC values under the different attachments such as compression and filtering. The author recommended the proposed algorithm to be robust and dynamic for digital watermarking. This process does not affect the quality of source image so, this algorithm can be used in private applications.

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