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Robust Digital Image Water Marking Via Efficient Affine And DT-CWT

T.VENUGOPAL[1], DR.V. SIVA KUMAR REDDY[2]
[1]Research Scholar, Dept of ECE, Rayalaseema University, Kurnool, AP, India.
[2]Principal & Professor, Dept of ECE, Malla Reddy Institute of Technology, Hyderabad, India.

Abstract: Digital media is the need of a people now a day as the alternate of paper media. As the technology grown up digital media required protection while transferring through internet or others mediums. Data or information which is stored in the digital data format can be easily copied without loss in quality, and can be distributed efficiently. To solve the problem of piracy taking place in the digital data format, the concept of digital watermarking was introduced. Digital watermarking is the method of embedding a piece of code in a digital data such as video, audio or image, in order to provide copyright information. This concept presents an efficient image watermarking using affine transformation and dual tree complex wavelet transformation. This technique embeds different parts of a watermark into different blocks of an image under the complex wavelet domain. Further, affine transformation also plays a reliable frequency decomposition transformation. Applying an affine transformation to a uniformly distorted image can correct for a range of perspective distortions by transforming the measurements from the ideal coordinates to those actually used.

Keywords: Digital Image Water Marking, Copyright, Embedding, Affine Transformation, Dual-Tree Complex Wavelet Transformation.

I. INTRODUCTION

With the fast growth development of computer network technique and multimedia technology, digital media (such as image, video, audio or text) are stored, transmitted and distributed through Internet without any loss in the quality of the content. Hence, some way of protection of copyrighted digital data is required. A digital watermarking technique has been developed to protect intellectual property from illegal duplication and manipulation. Digital watermarking means embedding information into digital media in such way that it is imperceptible to a human observer but easily detected by means of computing operations in order to make assertions about the data. The watermark is needed to be robust against intentional removal by malicious parties. Thus by means of watermarking, the data is still accessible but permanently marked. Piracy is a form of selling, acquiring, copying or distributing copyrighted material without authorization from the right holder. Independent filmmakers and film studios are facing various challenges with respect to piracy. Although digital technology has brought many benefits to content creators and the public, it has also increased the comfort by which movies can be pirated easily. In recent years the phenomenal growth of data changes in the open networks and an extensive use of digital media. Consequently, security of multimedia data as well as the copyright protection becomes an important question [1, 2].

Digital watermarking technique has been identified as one of the possible solutions for copyright protection in the past two decades. It consists of hiding secret information in a robust and invisible manner into digital media, (e.g., image, audio and video). Many, digital watermarking algorithms has been proposed and applied with success in a wide variety of applications including copyright control(owner identification, proof of ownership, transaction tracking and copy control) broadcast monitoring and device control. Today's generation is witness of developments of digital media. A very simplest example of digital media is a photo captured by phone camera. The use of Digital media is common in present era. Other example of Digital media is text, audio, video etc. We know an internet is the fastest medium of transferring data to any place in a world. As this technology grown up the threat of piracy and copyright very obvious thought is in owners mind. So Watermarking is a process of secure data from these threats, in which owner identification (watermark) is merged with the digital media at the sender end and at the receiver end this owner identification is used to recognize the authentication of data. This technique can be applied to all digital media types such as image, audio, video and documents. From many years researchers and developers worked in this area to gain best results.

II. LITERATURE REVIEW

In 2008 [3], Lino E. Coria, Mark R. Pickering, Panos Nasiopoulos and Rabab Kreidieh Ward, proposed a method on video watermarking. A one-level wavelet transform is applied to the watermark, which is a random set of 1's and -1's, and the coefficients of this transformation become the data that are embedded into a 3-level wavelet transform of each frame of the original video sequence. The drawback in this method is that it cannot retrieve the watermark. In 2014 [1], Md. A. S Sikuzzaman, Md. Jahangir Alam, Andrew J. Lambert and Mark Richard Pickering, proposed three versions of the digital video watermarking algorithm based on the wavelet transforms. The first version describes a method in which the watermark is embedded into the low frequency components of the U channel in a YUV representation. The major drawback in this paper is that if the co-relation coefficient is not equal to 1, then actual recovery of the watermark sequence is not possible. In 1997 [17], Swanson, M. D., Bin Zhu, Chau, B., and Tewfik, A. H., proposed a procedure to embed copyright protection into digital video, which exploits the temporal and masking properties to embed a robust and invisible watermark. In 1997 [8], Kundur, D., and Hatzinakos D., suggested an approach for still image watermarking, for which they use multi resolution fusion techniques along with Human Visual System (HVS). This model shows high robustness for Joint Photographic Experts Group (JPEG) compression, additive noise and linear filtering. In 1998 [22],

Zhu, Wenwu , Zixiang Xiong and Ya-Qin Zhang, suggested a unified approach of digital watermarking for both image and video using a multi resolution detection of the digital watermark, which will be a Gaussian distributed random vector added to all high pass bands in the wavelet domain. In 1998 [9], Kundur, D., and Hatzinakos, D., proposed a novel robust technique for digital watermarking of still images, which is based on multi resolution wavelet decomposition, which overcomes the disadvantage - which was requirement of original image in the extraction process of watermark. In 2014 [10] by Kundur, D., and Hatzinakos, D., proposed a novel fragile watermarking scheme for tamper proof, to multimedia signals by quantizing the corresponding coefficients with user specified keys. When an image or video is tampered, then, the spatial and frequency domain information is provided on how the signal is modified. In 2000 [12] Piva, A., Caldelli, R. ,and De Rosa, A., suggested a digital code, which is directly embedded into the video signal. This method is robust against all sorts of conversions. In 1999 [6], Jong Ryul Kim and Young Shik Moon, used wavelet transform to equally embed the watermark into the whole image without disturbing the original image properties. The coefficients of all sub-bands including an LL sub-band are used. In 1991 [21], Yung-Sik Kim, O-Hyung Kwon and Rae-Hong Park, proposed a scheme that employs HVS, in which more than one watermark is embedded into each band after wavelet decomposition in proportion to the energy contained in each band.

In 2000 [16], Shen-Fu Hsiao, Yor-Chin Tai and Kai-Hsiang Chang, presented an embedded ZeroTree Wavelet (EZW) algorithm. Each symbol is independently encoded in Significant MAPping (SMAP) and those in the Successive Approximation Quantization (SAQ). In 2012[2],Cho, J.S., Shin S.W. and Kim, J.W., proposed a watermarking technique which embeds image data invisibly into a coloured image based on the wavelet transform and discrete cosine transform, so that the watermark data willnot impaired in case of any alterations to the image. This technique is highly effective against tampering. In 2003 [20], Xiangui Kan and Jiwu Huang - the main aim of this research was to provide robustness against geometric distortion and JPEG compression at the same time. A blind DWT-DFT (Discrete Wavelet Transform (DWT) and the Discrete Fourier Transform (DFT))composite image watermarking algorithm uses 2-D interleaving and synchronization technique. They use both lower bad and middle frequencies in wavelet transform. In 2008 [4],Deng Minghui and Zhen Jingbo, proposeda 3D wavelet transform basedrobust watermarking scheme, which is based on HVS that splits the 3D video wavelet into images, and the watermark is applied to the middle frequency region. In 2008 [15], Senthil, V. Thiagarajar, proposed the robustness of both blind and non-blind multiple watermarking methods in color images using Haar, Daubechies and Bi-orthogonal wavelets. The embedding process uses a canny edge detection method and hides the watermark with perceptual considerations on different modalities of images. In 2009 [18],

Taherinia, A. H., and Jamzad, A., proposed a blind, low frequency watermarking scheme on gray level images, which is based on Discrete Cosine Transform (DCT)and spread Spectrum Communication technique.In 2010 [5], Jadhav, S.D., proposed a new color image watermarking which adopts Blind Source Separation (BSS) technique for watermark extraction.This method uses DWT for embedding; the determination of mixing matrix for BSS is done by Quasi-Newton's technique, which analyses energy content of the image. In 2012 [14],Rajendra S. Shekhawat, Siva venkateswara Rao V., and Srivastava V. K., illustrated a watermarking technique which uses a Bi-Orthogonal Wavelet Transforms. The blue channel is selected for embedding watermark which is then decomposed using wavelet transform, because of its property of exact reconstruction and smoothness. In 2012 [19], Verma, A.K., proposed a scheme which embeds a binary watermark into a specifically prepared plane in the temporal dimension of Y channel of host RGB(Red-Green-Blue)video, to gain maximum imperceptibility and robustness. In 2013 [11],Mehta, R., and Rajpal, N., proposeda hybrid image watermarking algorithm based on DWT and Singular Value Decomposition (SVD), in which SVD transform is used for embedding and extraction of watermark.This HVS based watermarking model is robust to JPEG compression, median filter, sharpening, cropping and the addition of Gaussian noise.

III. IMAGE WATERMARKING

Image Watermarking is the technique of embedding of owner copyright identification with the host image. When and how watermarking is used first is the topic of discussion but it can used at Bologna, Italy in 1282 .at first it is used in paper mills as paper mark of company [1]. Then it is common in practice up to 20th century. After that watermark also used in the postage stamp and currency notes of any country. Digital image watermarking is actually derive from Steganography, a process in which digital content is hide with the other content for secure transmission of Digital data. In particular conditions steganography and watermarking are very similar when the data to be secure is hidden in process of transmission over some carrier. The main difference between these two processes is in steganography the hidden data is on highest priority for sender and receiver but in watermarking bot source image and hidden image, signature or data is on highest priority.

A. Watermarking

Embedding the process of image watermarking is done at the source end. In this process watermark is embedding in the host image by using any watermarking algorithm or process. Below shows the general block diagram.

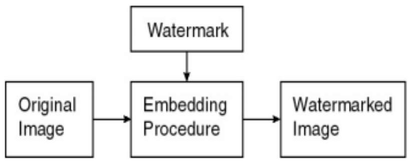

Fig1. Watermarking Block Diagram

B. Watermarking Extraction

This is the process of Extracting watermark from the watermarked image by reverse the embedding algorithm. The process is shown in below figure

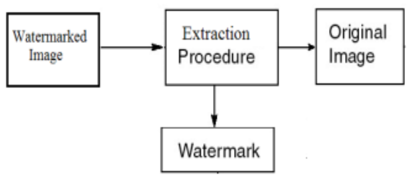

Fig2. Watermarking Extraction

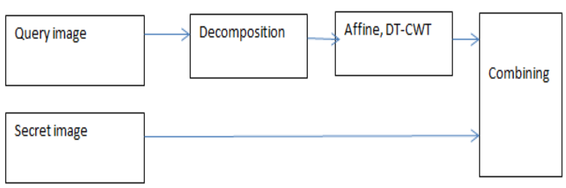

Fig3. Proposed Methodology

C. Affine Transform

Assume f(x,y) is an image signal, an affine geometric distorted image f d (x,y) is defined by parameters {A,d} as

$$f_d(x,y) = f(x_d,y_d)$$

where

$$\bar{X} = \begin{bmatrix} x_d \\ y_d \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} d_1 \\ d_2 \end{bmatrix} = A\mathrm{X} + \mathrm{d}$$

By recentering the signal with respect to the center of mass, we can remove the translation factor d easily. Based on singular value decomposition (SVD), the matrix A can be decomposed as:

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} \cos(\phi) & \sin(\phi) \\ -\sin(\phi) & \cos(\phi) \end{bmatrix} \begin{bmatrix} \sqrt{\lambda_1} & 0 \\ 0 & \sqrt{\lambda_2} \end{bmatrix} \begin{bmatrix} \cos(\tau) & -\sin(\tau) \\ \sin(\tau) & \cos(\tau) \end{bmatrix}$$

Where λ_1 and λ_2 are eigen values of AAT , φ and τ are angles related to the eigenvectors of AAT . If A is nonsingular matrix, λ1 and λ2 will have positive values. From above two equations, it can be concluded that any affine transform can be decomposed as combination of translation, rotations, scaling or aspect ratio change.

D. DT-CWT

A complex wavelet transform (CWT) solves four problems (directionality, shifting, oscillation also, associating) that are available in discrete wavelet change using complex valued basis functions [9]. This change is inspired by the Fourier change premise capacities. CWT is spoken to in the form of complex values scaling functions and complex valued wavelet functions as follows [3]:

$$\psi o\,(s) = \psi a\,(s) + j\,\psi b\,(s)$$

where ψa (s) are real and j ψb (s) are imaginary. ψa (s) and ψb (s) shape a Hilbert change pair and ψo (s) is the analytic signal.

The complex scaling function is characterized in comparable ways. The CWT is acquired by anticipating the signal into complex basis functions as follows:

$$dx\,(s,t) = da\,(s,t) + jdb\,(s,t)$$

where s is the scaling factor and t is the time shift. CWT is shift invariant and does exclude associating.

For immaculate remaking reason, dual tree complex wavelet transform has been used. Images are converted from low frequency into high frequency by using DT-CWT (Dual Tree - Complex Wavelet Transform). In low frequency image it consists of overall information about images. So, the tumor areas are not viewed exactly. Here high frequency is used for detecting the tumor areas. An input noisy image will be decomposed into components like textural and auxiliary points of interest utilizing double tree complex wavelet transform. It is the shift and rotation invariant transform which denotes the textures and edges in various directions[3]. Because of the property of the DTCWT is directionally selective in two and higher dimensions.The high-frequency sub bands in six different directions give to the sharpness of the image details.[2] The real and complex band coefficients are utilized and low frequencies are kept same. The dual-tree complex wavelet change utilizes two genuine DWTs. These two changes together give an overall transform. The first DWT transform is the actual part and the second change shows the imaginary part. The two real wavelets incorporated with each of the two real wavelet transforms are represented as ψi (s) and ψj (s) [2]. After the filters are generated, the complex wavelet is approximately expected as follows:

$$\psi\,(s) = \psi i\,(s) + j\psi j\,(s)$$

IV. RESULT

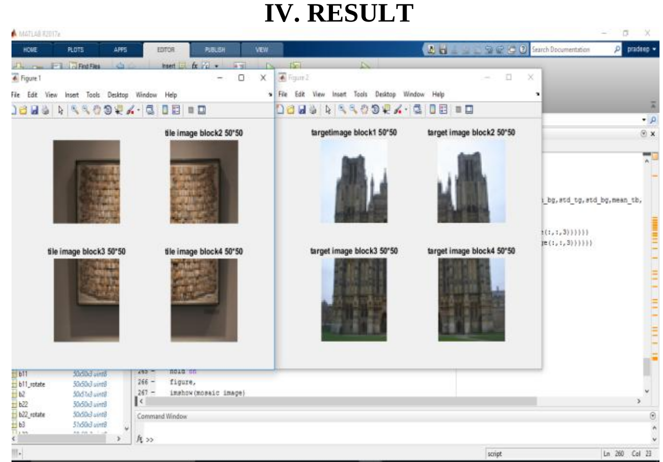

Fig4. Transmitter part.

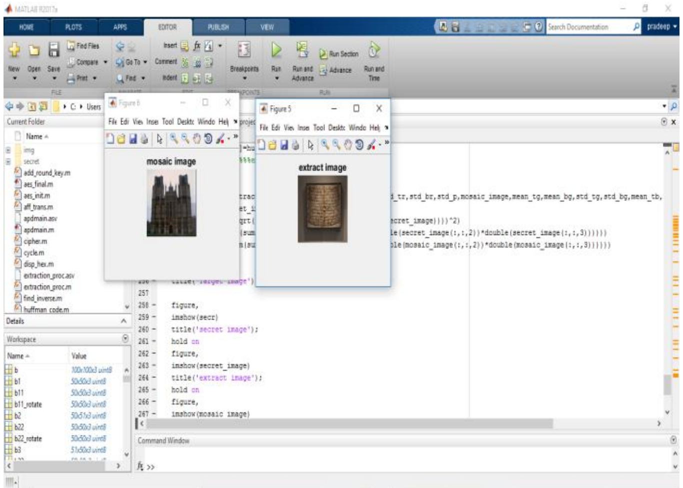

Fig5. Receiver part.

V. CONCLUSION

In this thesis, presented a new watermarking scheme robust to affine transformation along with DT-CWT. Through experiments, the algorithm shows strong robustness to rotation, scaling, and aspect ratio attack. The algorithm also shows robustness to general affine and DT-CWT geometric to some degree. An efficient and enhanced algorithm is designed and implemented with at-most data set.

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