A Survey of Robust Digital Image Watermarking, Its Algorithm and Applications

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Abstract - From the past several years, people are keen interested on internet. Internet does not only provide information but also used for sharing documents i.e. audio, images and video. Incursion of digital data is very complicated and can be monitored easily by anyone by using medium of internet. So in order to get protection from these attacks, different intellectual rules have been originated nearly fifty years ago. This hence helps in the origination of digital watermarking. Digital watermark is applied to the images. Digital watermarking is used to prevent data against the unlawful dissemination of images, audio and video. The technique is very magnificent for protecting the image from unauthorized. In this paper, we desire to present a review of digital watermark and its methods and applications. The purpose of this watermarking is to be protected from copyright infringement and to provide authentication. This paper explains digital watermarking algorithm based on discrete wavelet transform. And the blind detection technique use invisible watermark for verifying the image. Hence, it is more efficient than the semi- blind and non-blind detection.

Keywords - Image, Digital Watermarking, Discrete Wavelet Transform, Matlab.

I. INTRODUCTION

Internet is a massive public spider web of computer connection. With the universal expanding usage of internet, transmission of multimedia data has been increased. It can be defined as the endless ocean of information internet is a fabulous information highway, the whole globe is connected with the flow of internet. The internet is used in every stretch of the earth where it is accessible. In other words, the internet revolution is molding society into a different type of person It has become effortless routine nowadays. But due to lack of security images can be easily replicated and scattered without the owner's knowledge. To cope up with this issue, digital watermark came into existence and have been proposed for protecting and authenticating the images.

An image may also be explained as two- dimensional functions ,f(x,y) where function x and y are spatial correlative and the amplitude (magnitude) of 'f ' at any pair of counterparts (x,y) is known as the intensity or gray-level of the given image as that mark. Digital image is an image that is processed by electronic devices. pixel is the term which is used to denote the elements of digital image Watermark is an identifiable image or a pattern that appears slightly lighter in the image when light directed towards it and from many years it has been represented and symbolized in currencies and cheque watermark is the most effective way to protect your photos 'copyright from unauthorized, or watermark provide the indelible protection for your image files. it is classified into visible watermark and invisible watermark .visible watermark is visible in the image and in the form of text or logo which clearly recognize the owner of the image. This has major drawbacks that it is not similar to the original image thus it is easy to detect and decreases the quality of an image. Invisible watermark is also termed as digital watermark which cannot be seen by the naked eye. Digital watermarking is the approach that helps an individual to enclose concealed copyright notices also it embed other verification information to digital media. The message defines information similar to the signal or its creator and it is a collection of bits. It can also be defined as a multi-resolution based technique. The name comes manually from the visible watermarks imprinted on the document that identify its directed manufacturer. Digital image watermark can be described as the method of embedding marks or label that is unobtrusive in digital content. The message contains the embedded marks that are generally not visible but can be later extracted or detected. It processes the image into definite structure and resists image redundancy and also the compression of lossy data. It is intended to be embedded into the digital media permanently but at the same time it should not modify the content of data and also it should be impossible for the attacker to read and remove it. Digital watermarks have been broadly and successfully deployed in billions of media objects across a wide range of applications. The structure of digital watermark consists of embedding unit, detection, and extraction unit. Steganography and Cryptography are terms related to it but has different objectives. Steganography is the process of hiding secret message within the original image by replacing last two rightmost bits of each byte of image with two bits of secret message or image. Where in cryptography a data is used to store and transmit in a particular form so that only those for whom it is intended can read and process it often

associated with plaintext(readable) into ciphertext(non-readable). In this paper digital image watermarking scheme with blind detection algorithm is proposed. There are basically two categories in which watermark techniques fall as per to the domain of watermark insertion, -spatial domain methods and transform domain methods. Spatial domain includes least significant bit insertion method, but it has a disadvantage that it may be effortlessly demolished by lossy compression. Whereas in transform domain include discrete cosine transform, discrete wavelet transform, fast Fourier transform etc. This is more robust than the former against cropping, filtering, compression and noise attack etc. This paper focused on an algorithm of digital watermarking based on discrete wavelet transform. Wavelets are a powerful tool in image processing that has been used to compress images to a greater extent. It is used to represent images in various resolutions. Rather than Discrete Cosine transform and Discrete Fourier transform, wavelet transform can correctly model hvs. And thus it makes watermark more robust. Watermark algorithm can be classified as blind, semi-blind and non-blind which depend on the use of original image during the detection process and watermark is extracted from the watermarked image during extraction process. Then, this watermark will be used for verifying the original image.

II. LITERATURE REVIEW

Mauro Barni et al [1] proposed " A DCT-domain system for robust image watermarking". They worked on the new watermarking algorithm for digital image. They presented the method which embeds a pseudo-random sequence of a real number in the set of dct coefficients. After embedding process, watermark cannot be seen by the human eye that is invisible and without resorting the original image the watermark can be extracted reliably. Experimental result shows that the watermark is robust against noise, filtering, and jpeg compression.

Santa agreste et al [2] proposed an algorithm called wm2.0 was used and it works on both-watermark embedding and watermark detection process as well. First the watermark signal and selected dwt component are chosen in the embedding process then watermark was embedded in dwt coefficient and watermark detection concerned with resynchronization

Pao ta yu et al[3] proposed "Digital watermarking based on neural networks for color images". It stated that the watermark which is an invisible hide into a color image and then efficiently collaborates neural networks for learning the attributes of the embedded watermark which is associated to the watermarked image. Since the neural network is flexible and has the adaptive capabilities which entirely regain the watermark from the watermarked image. Results illustrate that the technique possesses robustness against the attacks.

Chih wei tang and hsueh ming hang et al[4] proposed "A feature-based robust digital image watermarking scheme". In this they proposed a robust digital image watermarking scheme which merge normalization and feature extraction of image. They select feature extraction method known as Mexican Hat Wavelet Scale Interaction. The extracted feature point can be protected and survive if attacks occur. When watermark signal is applied to the normalized image, the detection task can be more untangled. Hence, the simulation result shows that it can survive even after cropping, rotation, Gaussian filtering and jpeg compression.

Sha wang proposed et al [5] proposed" An Image Quality Evaluation Method Based on Digital Watermarking". This paper present image quality evaluation method based on digital watermarking which can precisely estimate image quality with reference to the classical objective metrics like peak signal to noise ratio, weighted PSNR without using the original image. Watermark was first embedded into the dwt coefficient of the original image, and for the image the vulnerability of watermark was adjusted. To estimate image quality the degradation of watermark which is extracted from the watermarked image can be used. The experimental result demonstrated that the estimated and calculated measures of image quality are of highly correlated.

A blind image watermarking method that embeds a watermark into the original image depends on dwt and singular value decomposition. Watermark is extracted from the watermarked image without the need of the original/cover image. And hence proved that the technique was very useful and robust against any attacks including signal and non-signal. A block based blind image watermarking proposed by kakkirala et al [6].

Zheng xiong bo et al [7] proposed a blind watermarking based on dwt. Wavelet coefficients of the image is used and they are categorized into several classes after that watermark is embedded into these some coefficients. While extracting the watermark, an original image is not needed. Thus, it called as blind watermarking algorithm. The experimental result shows that this is extremely robust algorithm against noise and jpeg compression.

Based on stationary wavelet transform blind watermarking proposed. The proposed method merges the watermark image and the low-frequency swt component's information without altering the information of an original image. Key

is used for extracting the watermark. The result shows that it doesn't degrade the quality of image [8].

Zhi yong meng et al [9] proposed"joint dwt-dct transformation on digital image. The algorithm combines the visual characteristics of dwt low-frequency sub-image and the potential of dct to detach correlation between dwt coefficients. It proposed real-time blind watermark algorithm. The watermark is embedded into dct low-frequency coefficient for robust watermark and hence the result presented that the technique is more effective and can be prevented from attacks.

Xingyang huang et al [10] proposed" An Image Digital Watermarking based on DWT in Invariant Wavelet Domain". This paper proposed an improved invariant wavelet which is better than the bilinear interpolation.

Blind detection used for security of images. In the wavelet domain of an image, watermarks which are in the form of binary are embedded by using discrete wavelet packet transform. Experimental result explains that the proposed method is robust to several attacks [11].

Qing Liu et al [12] presented grayscale image watermarking technique. The technique involves embedding and extraction process. First the watermark is embedded into the image then it is organized by spread spectrum technology. As per the characteristics of the original image, the location of embedded watermark is adjusted automatically then the watermark is extracted blindly without the need of information of the original image. Experimental result makes it more secure and highly robust against noise, jpeg compression, filtering.

III. WATERMARKING ALGORITHM

3.1 Wavelet Transform

As discrete cosine transform requires much effort to implement and are computationally much costly. And it proved weak against any attacks. Dwt has been recognized in various applications of signal processing along with the image watermarking as it delivers both frequency domain and spatial domain of an image. It is a mathematical tool for decomposing the images into levels. Discrete wavelet transforms (DWT) are applied to discrete data sets and produce discrete outputs It is used to represent images in various resolutions and provide reconstruction of decomposed image. When image is proceeded through filters either low pass or high pass, the image is decomposed into sub-bands of dissimilar resolutions. This decomposition is done by dwt and at different levels of dwt.

At level 1, it decomposes image into four non-overlapping sub-bands i.e. LL, LH, HL, HH, where LL, LH, HL, HH represents approximate sub-band, vertical sub-band, horizontal sub-band, diagonal sub-band. And LL is low-frequency element and the other three are high-frequency component. Decompose the LL sub-band in order to get the next level of decomposition. And this continues till a final scale is achieved. It is computationally efficient and is useful to embed and detect watermark at lower resolution.

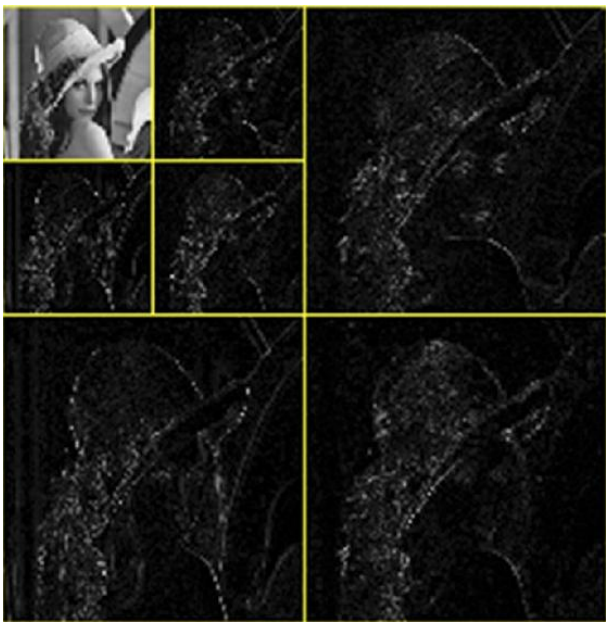

Fig Two-dimensional decomposition process using DWT

Chih chin lal et al [13] presented a watermarking scheme using discrete wavelet transform (dwt) and singular value decomposition (Svd). The watermark is embedded in the singular values element of the DWT sub-band of the original image. the technique was found to have a less error.

A digital watermarking based on wavelet domain proposed by Salama A et al [14]. They implemented watermark in the dwt third band component of an image. The technique is tested and thus found robust against attacks.

For copyright protection, the algorithm was proposed to embed the watermark and then to detect and extract later for verification. They implemented algorithm using Matlab 7.x.[15].

3.2 Watermark Principle

There are basically two types of watermarks which can be embedded in an original image.

3.2.1 Pseudo-random Gaussian sequence:

This watermark is a sequence of numbers containing equal number of 1 and -1. It is considered as a zero mean with one variation watermark.

3.2.2Gray-scale image watermark:

This is also known as binary image. This algorithm rather embeds data like logo, text or any binary string into an image than embedding 1's and -1's.

Both these methods are used to detect original data. Since we are embedding meaningful information in an image thus we will work on gray scale image watermark.

IV. APPLICATIONS OF DIGITAL WATERMARKING

In this section, we present the use of watermark in various applications.

1. Copyright protection:

The aim is to enable the other group or the unauthorized sector from claiming the copyright with designated and embedded information that recognize the copyright owner from the world of digital media it detaches the use of unfriendly user from being copyrighted of a document which nourishes watermarking, it demands the absolute and rightful ownership

2. Owner identification:

It is used to identify the owner of the image. Invisible watermark is added in the image to protect from modifying the image. now a day's software are used to remove the copyright registration symbol mark and then to modify the image. thus invisible watermark is used to solve this problem**.**

3. Labeling*:*

The hidden message could also contain labels that allow, for example annotate images or audio. Of course, the annotation may also be included in a separate file, but with watermarking it results more difficult to destroy or lose this label, since it becomes closely tied to the object that annotates. This is especially useful in medical applications since it prevents dangerous errors.

4. Broadcast monitoring:

Confirming the content which is supposed to be transmitted. Like, commercial advertisements can be monitored by their watermarks to assure timing.

5. Tamper detection:

For tamper detection, fragile watermarks are used. Fragile watermark breaks very easily on modifying the image. If the watermark is destroyed, it specifies the existence of tampering and thus that content cannot be trusted.

6. Trustworthy digital camera:

This embed watermark into each photographs it capture. This provides authentication. It has been used by professional photographers as a proof of identity**.**

V. CONCLUSION

In this paper, we have reviewed digital watermarking technique and algorithm. In the literature so many algorithms of watermarking are reviewed that present advantages using wavelet transform. In addition to, blind detection is applied to the method. The use of discrete wavelet transform and blind method saves time and are more efficient than the other. With these, an introduction to digital image watermarking, watermark principle and its applications have also been presented. Watermarking schemes is widely used in today's world. It's like a relief to the people for protecting images from unauthorized. The watermark will be designed to exist even after many attacks.

REFERENCES

[1] Mauro Barni, Franco Bartolini, Vito Cappellini, "A DCT-domain system for robust image watermarking" in signal processing,Elsevier, 66 (1998) 357—372.

[2] Santa Agrestea, Guido Andalorob, Daniela Prestipinob, Luigia Puccio "An image adaptive, wavelet-based watermarking of digital images" in Journal of Computational and Applied Mathematics 210 (2007) 13 – 21, Elsevier, Received 19 September 2005; received in revised form 30 May 2006.

[3] Pao-Ta Yu*, Hung-Hsu Tsai, Jyh-Shyan Lin "Digital watermarking based on neural networks for color images". Elsevier, Signal Processing 81 (2001) 663-671.

[4] Chih-Wei Tang ; Dept. of Electron. Eng., Nat. Chiao-Tung Univ., Hsinchu, Taiwan ; Hsueh-Ming Hang. Signal Processing, IEEE Transactions on (Volume:51 , Issue: 4, April 2003 .

[5] Sha Wang ; Sch. of Inf. Technol. & Eng., Ottawa Univ., Ont. ; Dong Zheng ; Jiying Zhao ; Wa James Tam IEEE Volume:17 Issue:1,Browse Journals & Magazines .

[6] Kakkirala, K.R. ; TCS Innovation Labs., TATA Consultancy Services, Hyderabad, India ; Chalamala, S.R. "Block based robust blind image watermarking using discrete wavelet transform ". Signal Processing & its Applications (CSPA), 2014 IEEE 10th International Colloquium on 7-9 march 2014.

[7] Zheng Xiong-bo ; Sch. of Sci., Harbin Eng. Univ., Harbin, China ; Zhang Xiao-wei ; Sun Ming-jian "A blind digital

watermarking algorithm based on wavelet transform". Computer Science and Automation Engineering (CSAE), 2011 IEEE International Conference on (Volume:4).

[8] Nagarjuna, P.V. ; PDPM Indian Inst. of Inf. Technol., Electron. & Commun. Eng., Jabalpur, India ; Ranjeet, K." Robust blind digital image watermarking scheme based on stationary wavelet transform". IEEE, Contemporary Computing (IC3), 2013 Sixth International Conference on 8-10 Aug. 2013.

[9] Zhi-Yong Meng ; Inst. of Inf. Sci. & Engineerning, Hebei Univ. of Sci. & Technol., Shijiazhuang, China ; Ping-Ping Yu ; Guo-Qing Yu "copyright protection for digital image based on joint dwt-dct transformation", in IEEE Wavelet Analysis and Pattern Recognition (ICWAPR), 2012 International Conference on 15-17 july 2012.

[10] Xinyang Huang ; NanHua Univ., Hengyang ; Yang Luo ; Minsheng Tan ; Dazheng Lin "A Image Digital Watermarking based on DWT in Invariant Wavelet Domain" in Image and Graphics, 2007. ICIG 2007. Fourth International Conference on 22-24 August 2007.

[11I Kuan Kong ; Dept. of Comput. & Inf. Sci., Univ. of Macau, Macao ; Chi-Man-Pun "Digital image watermarking with blind detection for copyright verification".

[12] Qing Liu ; Sch. of Phys. & Inf. Sci., Tianshui Normal Univ., Tianshui, China ; Jun Ying "Grayscale Image Digital Watermarking Technology Based on Wavelet Analysis". Electrical & Electronics Engineering (EEESYM), 2012 IEEE Symposium on 24-27 june 2012.

[13] Chih chin lal et al presented a watermarking sceheme using discrete wavelet transform (dwt) and singular value decomposition (Svd).

[14] Salama, A. ; Electr. Eng. Dept., Port Said Univ., Port Said, Egypt ; Atta, R. ; Rizk, R. ; Wanes, F."A robust digital image watermarking technique based on wavelet transform"in System Engineering and Technology (ICSET), 2011 IEEE International Conference on 27-28 June 2011.

[15] Chandra, M. ; I.M.S, Ghaziabad, India ; Pandey, S. ; Chaudhary, R."Digital watermarking techniques for protecting digital images" in Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference on (Volume:7) 226-233.