Open access Journal International Journal of Emerging Trends in Science and Technology
Impact Factor: 2.838 DOI: http://dx.doi.org/10.18535/ijetst/v3i06.17

Dual Transform Digital Watermarking

Author
Balasubramanya G S
Email: *balusubramanya.19947@gmail.com*

Abstract
The application of the dual watermarking techniques improves the robustness and imperceptibility of the watermarking technology. The proposed technique implanted on the double watermark in the hauler picture incorporates a dual watermark picture, a grey picture watermarking calculation. In an effort to balance both the imperceptibility and watermarking calculation, the paper breaks down the implanting point and procedure of transforming dominion calculations. The DC factor in the bearer picture is separated into pieces of DCT range and band on the grouping of DWT factor strategy. It utilizes the scrambling characteristics for the calculation to be enhanced adaptability in an embedded mode. The paper from the practical guideline, evaluation method, performance index, attach types, classification of computerized watermarking, and utilizations six angles were acquainted with the computerized watermarking innovation. Simulation of a computerized picture watermarking calculation based on DCT transform and Arnold change, security, robustness, and algorithms imperceptibility are dissected, analysing the calculation for embedding procedure.

Introduction

The development of digital watermarking technology has become one of the most important branches on information hiding. It has been awarded extensive attention by many foreign and domestic scholars and experts, gradually becoming a research point in the developing digital information field. Nowadays, with the development of the internet as the greatest information sharing and storage mechanisms, the application of the digital watermarking technology for the protection of copyright is on a rise and is of great significance in the industry [10]. A huge commercial value can be established in the industry with the creation and development of copyright protection tools and products. Within the industry, digital watermarking technology has emerged as one of the leading technology and innovation in the information hiding and protection sector, as a member of the efficient ways of digital application and patent protection. The industry has seen various developments and advancement in relation to information encryption and hiding through the application of digital watermarking technology.

The operation of the technology elaborates the fact that the digital watermark information does not have an effect on the value of the embedded covertly. Compelling watermarking has various necessities, the most vital of which are robust and imperceptibility. The robustness in characterised by the watermark being embedded in the watermarked frame whether the quality of the video frame is degraded or not [3]. While the imperceptibility property entails the perpetual transparency, where the quality of the underlying frames is neither degraded nor affected while embedding. The earliest development involved an algorithm proposed in a study undertaken in 1994 by Tirkel and Schyndel. The development was based on the spatial domain. The spatial domain procedures can be implemented easily, though, the application is not robust as compared to operations characterised by digital signal processing [7].

The current technology and research in the field are majorly built around the transform domain. The domain features an alteration of the values of spatial pixels of the host program in relation to the pre-determined transformation. Some of the commonly applied converts are the Singular Value Decomposition, DWT, Discrete Cosine Transform, and Fast Fourier Transform [8]. The domain watermarking procedures are more imperceptible and robust they diffuse the watermark into the video frame spatial domain, building a compact embedded watermark which is difficult to remove [4]. The paper analyses the principle of operation, performance, imperceptibility and robustness of digital watermarking based on the implementation through dual transform domain in conjunction with other transform domain techniques.

Overview

The working principle of the embedded digital watermark is comprised of various techniques characterised as modification rules are described as either multiplication rule or additive criteria. They provide a change in relation to the image content information.

The additive criteria:

$$P_w\ (x, y) = P\ (x, y) + k \times M(x, y)$$

The exponentiation rule:

$$P_w(x, y) = P(x, y) \times (1 + k \times M(x, y))$$

$P(x, y)$ represents the hauler picture, $P_w(x, y)$ representsthe watermarked picture and $k \times M(x, y)$ portrays the strength of the watermark embed with k being the strength factor.

The methods of evaluation being implemented currently in the sector are the metric methods based on the pixels and brightness values of the image [5]. The results obtained are not reliant on the subjective judgements since it compares and contrasts fairly the performance of the algorithms used.

Both the Arnolds and Discrete Cosine Transform (DCT) can be applied in watermarking. They rely on the Fourier transforms. Based on a two-dimensional matrix of MxN, the DCT can be modelled as

$$Y(u, v) = b(u)\, b(v) \sum_{i=1}^{M-1} \sum_{i=1}^{N-1} \cos \frac{(2i+1)\, u\, \pi}{2M} \cos \frac{(2i+1)\, v\, \pi}{2M}$$

The $Y(u, v)$ represents the transformation.

The watermarking is further generated through the combination of both the DCT and DWT transforms. The application of the Wavelet transformation is based on the separation of the frequencies and carrying out more effective analysis of the signal [1]. The DWT in a cardinal picture, identical to the picture of the column (row) for a single DWT for the picture and the row (column) for 1D wavelet transform disintegration. The decay is the core of pictures of various determination; the picture is decayed into various interstellar, various frequencies sub-pictures [9]. The digital image through a 2D DWT, the sub-picture results in four portions of equivalent size: high-rate diagonal part sub-pictures HH1, low-rate estimation sub chart LL1, high-rate element sub pictures of plane HL1, vertical high-rate part element sub-pictures LH1. The representational are shown in the figure.

Fig 1 showing the sub-images coordinates

High-frequency mental element sub pictures of HH in a digital image of the three sub - HH, HL and LH inclinations obtained through wavelet transform contain the original picture texture background and other subtle elements of the first picture [11]. Human visual recognition

responsiveness to the data is low, in it forms portion of the data in the watermark inserting processes that can accomplish improved intangibility. However, the part of the data in picture forming procedures are susceptible against obstruction, and thus, they cannot ensure the robustness of watermarking. On the other hand, the low-frequency estimation sub picture LL centralization of a whole fragment of the vitality of the original picture, in the picture preparing processes would not be aggravated. Therefore, the information obtained from the watermark implanted into the low-frequency estimation sub picture into getting better robustness [3]. However, the perception of the human being's visual is responsive to the portion of the data; accordingly, the watermark data straightforwardly in the area of the implanted procedures cannot ensure the watermark faintness.

The network is then expanded to a wavelet transformation of two levels. It comprises of the approximation image by the DCT factors, the carrier image based on the improved embedment instructions [2]. It follows an expansion algorithm based on the following a series of steps. Besides, the chosen DCT coefficients appropriate to the formula are selected in accordance. The coefficients relate to the illustrated below.

$$aver(\mathrm{r}) = \frac{1}{6}\left(\sum_{i=1}^{-1} F(\mathrm{r}, \mathrm{mid}+x) + \sum_{i=1}^{3} F(\mathrm{r}, \mathrm{mid}+y)\right)$$

$$\square(\mathrm{r}) = \mid \mathrm{F}(\mathrm{r}, \mathrm{high}) - \mathrm{aver}(\mathrm{r}) \mid$$

The watermark data series M(1, R) in accordance with the estimation of order rule, sub-portion of the image is embedded in the coefficients characterised by high frequencies. Also, the image is unruffled of the 2D array defined as f(x,y) with Y and X representing the positioning of the image using the 2D coordinate system. The f represents the image properties at the location (x,y) [11]. The representation of the image in 2D is done to aid in the reconstruction and wavelet decomposition of the image. The two-dimensional formula is

$$P_f \mathrm{f} = \mathrm{P}_{f+1}\mathrm{f} + \mathrm{f}\,\mathrm{D}_{f+1} + \mathrm{f}\,\mathrm{D}^2_{f+1} + \mathrm{f}\,\mathrm{D}^3_{f+1}$$

The two-dimensional wavelet disintegration and remodelling calculation are to utilize it, in the acknowledgment of the first for the one-dimensional wavelet change, and after that in the change taking into account the outcomes as a 1D wavelet change. In a practical presentation since the indication of the picture is within a constrained range, consideration has to be made on how to manage the limit issue [6]. The typical approach is the succession development and augmentation of the replication; it can diminish brought about by its margin incoherence at the margin of the revolution of moderate decomposition.

Furthermore, image scrambling is undertaken. It is defined as the definite values of a picture that do not change its pixels, so as to eradicate the spatial association, which cannot be identified visually. Also, it can arrive at a particular extent, protecting the image data without knowing the transformation of the original image and also the principle of applying the scrambling information [5].

Results

Through the comparison of the two DCT coefficients to the size of each picture, the selection should ensure that the alteration will not lead to severe deprivation of the carrier image. However, if it occurs, a choice is made on the DCT transformation coefficient algorithm of the image[7]. Furthermore, the selection is undertaken to analyse the image compression robustness. The pair of coefficients is thereby compared to develop the resultant waveform. The quantization of the watermarking image compression was undertaken portraying in an 8x8 block matrix.

(u,v)	1	2	3	4	5	6	7	8
1	10	11	10	26	24	40	51	61
2	12	11	14	19	26	58	60	55
3	14	13	16	24	40	57	69	56
4	14	17	22	24	51	87	80	62
5	18	22	37	56	68	109	103	77
6	24	35	55	68	81	104	113	92
7	49	64	78	87	103	121	122	101
8	72	92	95	98	112	100	103	97

Fig 2 showing the quantitative values of the image in a matrix

The proposed algorithms implemented tests for both the imperceptibility and robustness of resizing, sharpening, blurring, cropping, darkening, lightening, JPEG compression interpolation, frame swapping, and frame dropping.

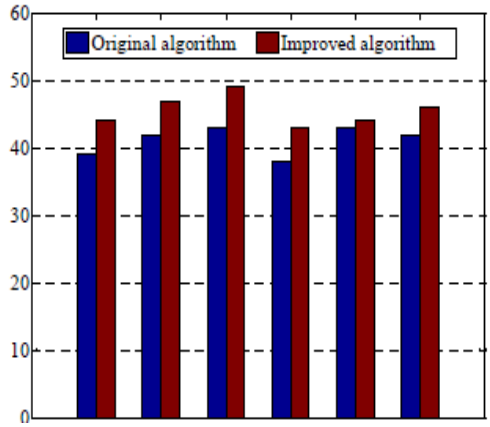

Fig 3 showing the performance of the various images used in the algorithms.

In the application of algorithms to the entire picture, DCT transforms before the hauler picture scrambling, making the DCT transformation. Then accomplished in the wake of inserting the watermark, the DCT transform picture is reverse scrambled to obtain the watermark image. The scrambling and its algorithm can be portrayed without carrier picture watermark identification detection correlation diagram, the abscissa of the random watermark succession seed [4]. Longitudinal coordinates for the watermark indicator yield esteem, and their use is analysed, in particular, the removal of the watermark in conjunction with the first watermark connection. As shown in the chart, picture scrambling, watermark arrangement of the pixels was inserted into the transporter picture, distinguished and contrasted with the haulier picture. Transform domain irregular arrangement is inserted a watermark, and it can incredibly improve the estimation of small arbitrary arrangement watermark detection.

Conclusion

The paper analyses the digital watermarking technology. The current algorithms being applied in the field are based on spatial and transform domain. The proposed algorithm is based on the duality concept applying the properties of the various developed formula. On an excellent picture watermarking calculation given discrete cosine change re-enactment, the re-enactment results demonstrate that the calculation is straightforward, simple to execute. Also, it has great security, robustness, and imperceptibility, and it has a place with the watermarking calculation for visually impaired extraction and has a specific down to earth esteem. The algorithms for DCT coefficients specifically transform the methodology has a few inadequacies; the paper proposes an enhanced calculation. The enhanced calculation is additionally given the DCT, yet the distinction to alter the nearby DCT factor to understand the watermark installing has a specific level of flexibility. At that point, the reproduction investigation of an excellent picture watermarking calculation is undertaken in relation to both the DCT and DWT transforms. For the weaknesses of the calculation, the paper introduces an excellent picture watermarking calculation taking into account DCT change and enhanced DWT transformation centred on essential innovation from its equalization watermark invisibility and robustness.

Reference

[1] N. M. Hasan, "Digital watermark algorithm," *Journal of Engineering and Development*, vol. 16, no. 3, pp. 287-296, 2012.

[2] M. Arnold, M. Schmucker and S. D. Wolthusen, Techniques and applications of digital watermarking and content protection, Boston: Artech House, 2003.

[3] M. Gupta, G. Singh and A. Gupta, "Design and Implementation of the Robust Watermarking Technique," *International Journal of Science, Engineering and Technology Research (IJSETR)*, vol. 5, no. 2, pp. 537-542, 2016.

[4] P. Gupta, "Cryptography based digital image watermarking algorithm," *International Journal of Scientific & Engineering Research*, vol. 3, no. 9, pp. 67-71, 12.

[5] M. Hirakawa, "A Study on Implementation and Service of Digital Watermark Technology Architecture," *Designing and Deploying RFID Applications*, pp. 290-305, 2011.

[6] M. Jiansheng, L. Sukang and T. Xiaomei, "Proceedings of the 2009 International Symposium on Web Information Systems and Applications," *A Digital Watermarking Algorithm Based On DCT and DWT*, pp. 104-107, 2009.

[7] H. H. Nasereddin, "DIGITAL WATERMARKING A TECHNOLOGY OVERVIEW," *IJRRAS*, vol. 6, no. 1, pp. 89-93, 2011.

[8] J. Seitz, Digital watermarking for digital media, Hershey, PA: Information Science Pub, 2005.

[9] Y. Q. Shi, H. J. Kim and F. Pérez-González, Digital forensics and watermarking, Berlin ; New York: Springer, 2012.

[10] F.-H. Wang, J.-S. Pan and L. C. Jain, Innovations in digital watermarking techniques, Berlin: Springer, 2009.

[11] Z. Yuefeng and L. Li, "DIGITAL IMAGE WATERMARKING ALGORITHMS," *INTERNATIONAL JOURNAL ON SMART SENSING AND INTELLIGENT SYSTEMS*, vol. 8, no. 1, pp. 199-219, 2015.