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Research Paper

Minimization of Effect of Cropping On Watermarked Images Using Bpnn and Dfis Methods

Engineering

KEYWORDS : watermarking; robust; back propagation neural network; dynamic fuzzy inference system; cropping.

Dr.Nallagarla Ramamurthy	Professor of ECE, G.Pullaiah college of Engg.& Technology, Kurnool, India
G.Ramarao	Associate Professor, Dept. of. ECE, G.Pullaiah College of Eng. & Technology, Kurnool, India

ABSTRACT

the copyright protection of multimedia content became a critical issue now a days due to the internet does not use secure links and thus information in transmission is vulnerable to interception. In this paper, two techniques are proposed for information hiding. The first method is the robust digital image watermarking scheme using back propagation neural network in discrete wavelet transform domain. The second method is the robust digital image watermarking scheme using quantization and dynamic fuzzy inference system. Both the methods are robust to cropping attack

INTRODUCTION

Different watermarking techniques have been developed in spatial and transform domain methods, however, in recent years; the watermarking techniques based on transform domain are developed to provide better robustness and imperceptibility [1].Digital Image watermarking techniques classified as private, semi private and public watermarking techniques. In private watermarking technique the knowledge of cover image and secret key required to recover the embedded watermark from the watermarked image. In semi-private or semi blind watermarking technique both the secrete key and the watermark required to extract the inserted watermark. In blind or public watermarking technique only the secrete key is enough to extract the watermark [2]. Private watermarking techniques have high robustness than the other two techniques. But the drawback of private watermarking techniques is that they require original information to extract the watermark [3]. Some important disciplines of information hiding are cryptography, steganography and watermarking. While cryptography is about protecting the content of the text messages, steganography is about concealing their very existence. Watermarking is about hiding multimedia content in other multimedia data. Watermarking and cryptography are closely related, but cryptography scrambles the image so that it cannot be understood. Similar to steganography, watermarking is about hiding information in other image, but difference is that watermark must be somewhat resilience against attempts to remove it. The approach of information hiding can be extended to protect the copyright of multimedia content.

Yonghong Chen and Jiancong Chen [9] presented "a blind image watermarking scheme that embeds watermark messages at different wavelet blocks based on the training of BPNN in wavelet domain". He Xu, Chang Shujuan [10] presented "an adaptive image watermarking algorithm which is based on synthetic human visual system characteristic and associative memory function of neural network". N.Chenthalir Indra et al, [11] proposed "a system SBS-SOM a neural network algorithm was trained to generate digital watermark values from the image". Chen Yongqinang et al [5] presented "a DWT domain image watermarking scheme, where genetic algorithm is used to select the wavelet coefficients to embed watermarking bits into the cover image". Samesh Oueslati, et al. [13] presented "an adaptive image watermarking scheme based on Full Counter Propagation Neural Network". NICOLAS et al [14] proposed "a novel approach to neural network watermarking for uncompressed video in the wavelet domain". Pao-Ta.Yu et al [17] developed "watermarking techniques, integrating both color image processing and cryptography, to achieve content protection and authentication for color images". The efficiency of any watermarking method is mainly based on the performance metrics like Signal to Noise Ratio and Correlation Coefficient.

In this paper, the neural network and fuzzy logic are implemented to perform image watermarking in discrete wavelet transform domain. The discrete wavelet transform alone does not provide better robustness and imperceptibility. Back Propagation Neural Network (BPNN) has good nonlinear approximation ability, which makes it very useful in image processing applications. The BPNN is used to embed and extract the watermark, where the training process is completed before embedding watermark. Dynamic Fuzzy Expert System also known as The Dynamic Fuzzy Inference System (DFIS) is a computing framework which is widely accepted based on the well-known concepts of fuzzy set theory, fuzzy reasoning and fuzzy if-then rules. In this work Mamdani type DFIS is modeled using biorthogonal wavelets to improve watermark robustness and imperceptibility. The dynamic fuzzy inference system is recognized as a powerful tool based on fuzzy mapping operations without using extensive mathematical operations. The performance of the methods tested against cropping attack in detail.

I. DIGITAL IMAGE WATERMARKING USING BPNN

A. Back Propagation Neural Network (BPNN)

Back propagation neural network has good non-linear approximation where the relationship between cover image wavelet coefficients and watermarked image wavelet coefficients is established by adjusting the weights between the layers. Just like human beings, the neural networks learn by experience and the learning process depends on learning rate. The empirical formula to determine the number of hidden nodes (4) is

$$n_h=(om+em+d_h)^{1/2}\ldots\ldots\ldots(1)$$

Where 'n_h' is number of hidden nodes,
'm' is number of input nodes
'o' is number of output nodes,
'e & d_h' are the parameters to be determined

The following posterior formula (13) is used to determine the nodes in layers

$$n_h= (om+1.6799m+0.9298)^{1/2}\ldots\ldots(2)$$

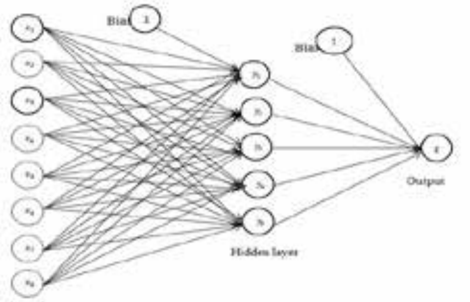

Figure: Back Propagation Neural Network

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In this paper ,m=8,o=1, n_h≈4.8, taking n_h=5,there are three layers in the neural network; there are '8' nodes in input layer, '5' nodes in hidden layer and '1' node in output layer.

B. Watermark Embedding using BPNN

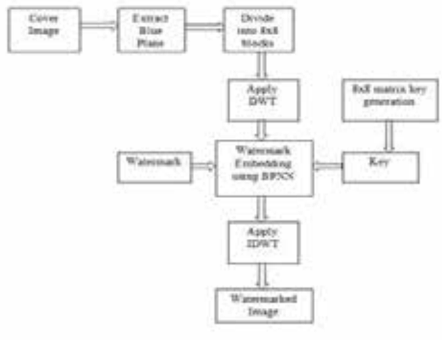

Figure: Watermark Embedding using BPNN

Compute fourth level DWT on the Blue plane of the cover image to get the frequency sub band coefficients {HH_1, HL_1, LH_1, {HH_2, HL_2, LH_2, {HH_3, HL_3, LH_3, {HH_4, HL_4, LH_4, LL_4}}}}.Apply the DWT coefficients to BPNN to perform quantization and then get the output BPNN(round($T_{(g+key)/Q)}$);

II. DIGITAL IMAGE WATERMARKING USING DFIS

A. Dynamic Fuzzy Inference System(DFIS)

The Dynamic Fuzzy Expert System also known as Dynamic Fuzzy Inference System (DFIS) is the framework computed based on the popular concepts of fuzzy reasoning, fuzzy set theory and fuzzy if- then rules [5]. The DFIS is recognized as a powerful tool to perform simple and powerful fuzzy operations to perform mapping operations from a given set of inputs to another set of outputs without the extensive use of mathematical concepts.

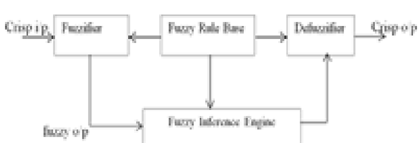

Figure: Dynamic Fuzzy Inference System

B. Watermark Embedding using DFIS

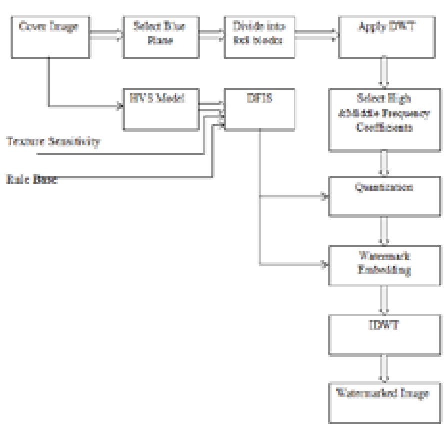

Figure: Watermark Embedding using DFIS

Apply the DWT coefficients to DFIS to perform quantization and then get the output DFIS(round($T_{(g+key)/Q)}$);

Where

$T_{(g+key)}$ is the selected cover image coefficient to embed the watermark, and Q is quantization value. Embed the watermark using the following equation

$$T'_{(g+key)} = DFIS\left(round\left(\frac{T_{(g+key)}}{Q}\right)\right) + X_g \quad ....(3)$$

Where

$T'_{(g+key)}$ is the watermarked image coefficient and

X_g is the random watermark sequence.

III. EXPERIMENTAL RESULTS

A Lena color image of 512x512 size is used as the cover image and grey scale bitmap of size 64x64 is selected as the watermark. The following formula is used to calculate the Peak Signal to Noise Ratio of the watermarked image

$$PSNR = 10\log_{10}\left(\frac{R*R}{MSE}\right) \quad .....(4)$$

Where R is the maximum fluctuation in input image=511;

MSE is Mean Square Error (13), given by

$$MSE = \sum_{p=1}^{r}\sum_{q=1}^{c}\frac{[F(p,q)-F'(p,q)]^2}{rc} \quad ....(5)$$

Where r = number of rows in the digital image

c = number of columns in the digital image

$F(p,q)$ and $F'(p,q)$ represent blue plane of cover image and watermarked image.

The similarity between the original watermark $W(x,y)$and the extracted watermark $W'(x,y)$ is calculated using the formula(13).

$$NC = \frac{\sum_x\sum_y W(x,y)*W'(x,y)}{\sum_x\sum_y W(x,y)*W(x,y)} \quad .....(6)$$

The robustness of the watermarked image is tested against cropping attack.

A. Variation of MSE, PSNR and NC in BPNN Method for Cropping Attacks

10% and 20% cropped images and the corresponding extracted watermarks are shown in figure (4.1). 30% and 40% cropped images and the corresponding extracted watermarks are shown in figure (4.2). 50% and 60% cropped images and the corresponding extracted watermarks are shown in figure (4.3).

Figure (4.1): 10% Cropped Image (a), Extracted Watermark (b), 20% Cropped Image (c) and Extracted Watermark (d).

Figure (4.2): 30% Cropped Image (a), Extracted Watermark (b), 40% Cropped Image (c) and Extracted Watermark (d).

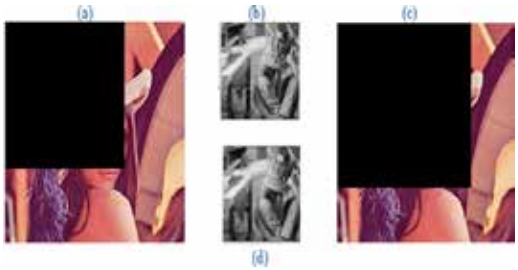

Figure (4.3): 50% Cropped Image (a), Extracted Watermark (b), 60% Cropped Image (c) and Extracted Watermark (d).

Sl.No	Cropping (%)	MSE	PSNR	NC
1	0	0.8850	54.6992	0.9989
2	10	924	24.5107	0.9847
3	20	2568	20.0728	0.9746
4	30	3181	19.1426	0.9454
5	40	4259	17.8753	0.9397
6	50	5532	16.7395	0.9219
7	60	6868	15.8000	0.9073

Table (4.1): Variation of MSE, PSNR and NC in BPNN for Cropping

B. Variation of MSE, PSNR and NC in DFIS Method for Cropping Attacks

In DFIS method, variation of MSE, PSNR and for 10%,20%,30%,40%,50% and 60% Cropping are shown in table(4.2).

Sl.No	Cropping (%)	MSE	PSNR	NC
1	0	18.6179	35.4315	0.9969
2	10	372	28.4651	0.9839
3	20	1433	22.6063	0.9754
5	30	4272	17.8623	0.9588
6	40	5042	17.1424	0.9408
7	50	5542	16.7319	0.9362
8	60	7749	15.2590	0.9289

Table (4.2): Variation of MSE, PSNR and NC in DFIS for Cropping

C. Comparison of Cropping Attacks

For cropping attack, BPNN and DFIS methods providing better PSNR and NC than Yanhong method as showed in table (4.3) and charts (4.1) and (4.2).

Sl.No	Method	Cropping	MSE	PSNR	NC
1	Yanhong	Irregular	-	11.3672	0.8912
2	BPNN	10%	924	24.5107	0.9847
3	DFIS	10%	372	28.4651	0.9839

Table (4.3): Comparison of MSE, PSNR and NC of Cropping attacks for different methods.

Chart (4.1): Comparison of PSNR of Cropping Attacks for different Methods.

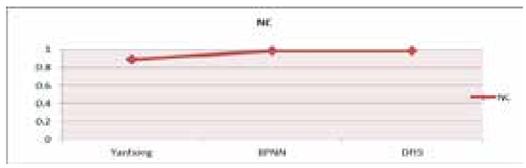

Chart (4.2): Comparison of PSNR of Cropping Attacks for different Methods.

CONCLUSIONS&FUTURE WORK

The BPNN and DFIS image watermarking methods are powerful and resourceful tools in copyright protection systems. The proposed algorithms are developed based on Back Propagation Neural Network and Dynamic Fuzzy logic systems. These algorithms based on neurofuzzy can be designed for achieving better robustness. The BPNN and DFIS methods are developed in DWT domain using biorthogonal wavelets. These algorithms can also be developed using other wavelets like complex wavelet, Morphological wavelet and Non-tensor wavelet.

REFERENCES

1. G.Fahmy, M.F.Fahmy, and U.Mohammed"Nonblind and Quasiblind Natural Preserve Watermarking" Hindawi Publishing Corporation, EURASIP Journal on Advances in Signal Processing, Volume 2010, Article ID 452548, 13 pages.
2. Y.H.C. Wu and C.-C. Chang, "A novel digital image watermarking scheme based on the vector quantization technique," Computers & Security, vol. 24, pp. 460–471, 2005.
3. Nallagarla Ramamurthy and Dr.S.Varadarajan, "Robust Digital Image Watermarking Scheme with Neural Network and Fuzzy Logic Approach", International Journal of Emerging Technology and Advanced Engineering Volume 2, Issue9, 2012, pp.555-562.
4. Samesh Oueslati, et al, " Adaptive Image Watermarking Scheme based on Neural Network", international Journal of Engineering Science and Technology, Vol. 3, No. 1, Jan 2011, pp. 748-756.
5. Nizar Sakr, Nicholas.Georganas, and Jiying Zhao, "Copyright Protection of Image Learning Objects using Wavelet based Watermarking and Fuzzy", I2LOR2006, 9-11, November, 2006.
6. Y.Wang and A. Pearmain, "Blind image data hiding based on self- reference," Pattern Recognition Letters, vol. 25, no. 15, pp.1681–1689,2004.
7. P. H. W. Wong, O. C. Au, and Y. M. Yeung, "A novel blind multiple watermarking technique for images," IEEE Transactions on Circuits and Systems for Video

Volume : 5 | Issue : 5 | May 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

Technology, vol.13, no. 8, pp. 813–830, 2003.
8. Chen Yongqinang, Zhang Yanqing, and Peng Lihua, " A DWT Domain Image Watermarking Scheme Using Genetic Algorithm and Synergetic Neural Network", Academy Publisher,2009, pp. 298-301.
9. Nagaraj. V, Dharwadkar, B.B.Amberker, "An Efficient non blind watermarking scheme for color images using discrete wavelet transformation", International journal of computer applications, Vol. 2, No.3, May 2010, pp 60-66.
10. Yanhong Zhang, "Blind Watermark Algorithm Based on HVS and RBF Neural Network in DWT Domain", WSEAS TRANSACTIONS on COMPUTERS, Issue 1, Volume 8, January 2009, pp. 174-183.
11. K. Yoga Lakshmi and R. Kanchana, "Blind watermarking scheme for digital images", International journal of technology and Engineering systems- Jan-March 2011, Vol. 2, No. 3, pp 276-282.
12. Yonghong Chen and jiancong Chen, "A Novel Blind Watermarking Scheme Based on Neural Networks for Image", 2010 IEEE Transactions, pp. 548-552.
13. He Xu, Chang Shujuan, "An Adaptive Image Watermarking Algorithm based on Neural Network", IEEE Computer Society, 2011, 4th International Conference on Intelligent Computation Technology and automation, pp. 408-411.
14. N.Chenthalir Indra and Dr. E. Ramraj, "Fine Facet Digital Watermark (FFDW) Mining from the Color Image Using Neural Networks", International Journal of Advanced Computer Science and Applications, special Issue on Image Processing and Analysis, pp. 70-74.
15. Baisa L.Gunjal and R.RManthalkar, "An Overview of Transform Domain Robust Digital Image Watermarking Algorithms", Journal of Engineering trends in computing and information sciences, Vol. 2, No. 1, 2010-2011, pp. 37-42.
16. Maher EL` ARBI, Chokri BEN AMAR and Henri NICOLAS, "Video watermarking based on Neural Networks", 2006 IEEE transactions, pp.1577-1580.
17. Summrina Kanwal Wajid, M. Arfan Jaffar, et al, "Robust and Imperceptible Image Watermarking using Full Counter propagation Neural Networks", 2009 International Conference on Machine Learning and Computing, IPCSIT Vol. 3 (2011), pp. 385-391.
18. Cheng-Ri Piao, Seunghwa Beack, Dong-Min Woo, and Seung-Soo Han, " A Blind Watermarking algorithm Based on HVS and RBF Neural Network for Digital Image", Springer-Verlag Berlin Heidellberg 2006, pp. 493-496.
19. Pao-Ta Yu, Hung-Hsu Tsai, and Jyh-Shyan Lin, "Digital Watermarking Based On neural networks for color images", signal Processing 81 (2001), pp. 663-671.
20. Nallagarla Ramamurthy and S.Varadrrajan, "Robust Digital Image Watermarking using Quantization and Back propagation Neural Network" ,Contemporary Engineering Sciences, Vol.5,2012,No.3, pp. 137-147.
21. Jean Francois Delaigle, "Protection of Intellectual Property of Images by Perceptual Watermarking", Ph.D. thesis submitted for the degree of Doctor of Applied Sciences, Universite Catholique de Louvain, Belgique.
22. Wu Bo XiaoMing Cui Chao Zhang, "Realization of Digital Image Watermarking Encryption Algorithm Using Fractional Fourier Transform", 2011 IEEE Transactions on 6th International Forum on Strategic Technology, pp.822-825.
23. Li Chunhua and Fu Li, "Adaptive Image Watermarking Based on Biorthogonal Wavelet Transform" 2011 IEEE Transactions, pp. 978-982.
24. Divyakant T. Meva & Amit D .Kothari, " Adoption of Neural Network Approach in Steganography and Digital Watermarking for Covert Communication and Copyright Protection", International journal of Information Technology and Knowledge Management, July-December2011, Volume 4, No. 2, pp. 527-529.
25. Vaishali.S.Jabade, Dr.Sachin R.Gengaje "Literature Review of Wavelet based Digital Image Watermarking Techniques", International Journal of Computer Applications, Vol.31, No.1, October2011.
26. Bibi Isac and V. Santhi, " A Study on Digital Image and Video Watermarking Schemes using Neural Networks", International Journal of Computer Applications, Vol. 12, No. 9, January 2011, pp. 1-6.
27. N.Provos, P.Honeyman, "Hide and Seek: An Introduction to Steganography", IEEE Security& Privacy, May/June 2003, pp.32-34.
28. R.Chandramouli, and N.Memon, " Analysis of LSB based Image Steganography Techniques", Proc. Of the Int. Conf. on Image Processing, Vol.3, Oct.2001,pp. 1019-1022.
29. N.G.Kingsbury et al., "The Dual Tree Complex Transforms: A new Efficient Tool for Image Restoration and Enhancement," Journal of Applied and Computational Harmonic Analysis, Vol.10, 2001, pp.243-253.
30. Ali AL-Haj et al., "Combined DWT-DCT digital Image Watermarking", Journal of Computer Science, Vol. 3,2007,pp.740-746.
31. K.Ramani, Dr.E.V.Prasad and Dr.S.Varadarajan "Enhanced Information Hiding through Integer, Discrete and Complex Wavelet Transforms", Ph.D. thesis submitted for the degree of Doctor of Computer Science, Jawaharlal Nehru Technological University College of Engineering, Kakinada, India.