Watermarking Technique Based on Wavelet Transform for Color Image

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***Abstract*— A good quality watermarking scheme should have maximum PSNR, ideally Correlation Factor equals to 1and should have maximum watermark information hiding capacity. In this paper,copyright protection is proposed for a new colour image watermarking scheme. It is based on embedding multiple watermark bits into the luminance component or the blue component of a colour image in discrete wavelet domain. The intend scheme uses image normalization technique to reduce the effect of synchronization errors caused by geometric attacks. The extraction process does not require the original image. The scrambled watermark is embedded in middle frequency sub band. The security levels are increased by generating PN sequence which is depending on periodicity of watermark image. The image scrambling is applied by using Arnold Transform. The decomposition is done with the help of 'Haar' which is simple, symmetric and orthogonal wavelet and the direct weighting factor is used in watermark embedding and extraction process. The scheme results in exact recovery of watermark with standard database images of size 512x512, giving Correlation Factor equals to 1. The PSNR with weighting factor 0.02 is up to 48.51 dBs. The presented scheme is non blind and embeds binary watermark of 64x64 size.**

IndexTerms— **Watermarking, color image, Wavelet domain, normalization, Geometric attacks, Discrete Wavelet Transform, Scrambling, Color space.**

I. INTRODUCTION

Digital image watermarking provides copyright protection to image by hiding appropriate information in original image to declare rightful ownership Robustness, Perceptual transparency, capacity and Blind watermarking are four essential factors to determine quality of watermarking scheme. In spatial domain, watermark is embedded by directly modifying pixel values of cover image. Least Significant Bit insertion is example of spatial domain watermarking. These algorithms are simple in implementation. But problems with such algorithms are: Low watermark information hiding capacity, Less PSNR, Less Correlation between original and extracted watermark and less security, hence anybody can detect such algorithms. The Frequency domain the watermarking inserted into transformed coefficients of image giving more information hiding capacity and more robustness against watermarking attacks because information can be spread out to entire image.The original image for declaring ownership is protected by using Digital image watermarking. The excellence level of watermarking scheme is determined from four essential factors: Robustness, Perceptual transparency, capacity and Blind watermarking. In spatial domain, watermark is embedded directly by modifying pixel values of cover image. Example:Least Significant Bit insertion. The algorithm can be detected by anyone due to Less PSNR, Less Correlation between original image and extracted image, Low watermark information hiding capacity and extracted watermark and less security. The Frequency domain watermarking inserted into transformed coefficients of image gives more information about hiding ability and more robustness against watermarking attacks because information can be spread out to entire image. Digital Colour Image Watermarking is essential in Digital age which is implemented here giving robustness

II. SURVEY

In spatial domain, LSB based watermarking is the straightforward method, But simple LSB based watermarking and LSB based watermarking with pseudo random generator are not secured methods. Calculation of wavelet coefficients in CWT at every possible scale involves huge amount of work and it generates a lot of data.

Reconstruction of signal carries high redundant information due to the attractive features of Discrete Wavelet Transform, researches have been focused on DWT. Wang Hongjun, Li Na have proposed a DWT method in which watermark was embedded in middle frequency coefficient using α as flexing factor with $\alpha = \beta\ |m|$,where m is mean value of all coefficients watermarking embedded. But this method doesn't provide enough security. The proposed method using DWT was extended to enhance the security of algorithm by using Arnold's Transform pre-treatment for watermark. But this method can be extended only to improve PSNR and security levels. An Integer Wavelet Transform with Bit Plane complexity Segmentation is used for more data hiding capacity and for colour images. But this method needs separate processing for R, G and B components of colour image and it is time consuming method. As given in DWT, host image is decomposed into 3 levels recursively where Level 1 gives 4 sub bands. In level 2, each sub band of level 1 is divided to 4 sub bands to give total 16 sub bands. Finally, each sub band of level 2 is again divided into 4 sub bands each to give total 64 sub bands.

Then ‘Generic algorithm’ was applied to provide perceptual transparency and robustness; and find the best sub band for watermark embedding. This process is too lengthy and time consuming. The common problem faced with DCT watermarking is block based scaling of watermark image that changes the scaling factors block by block and results in visual discontinuity. As given in J. Cox et. al had presented ‘Spread spectrum based watermarking schemes’ and Chris Shoemaker has developed CDMA based Spread spectrum watermarking with one scale DWT and got PSNR between 35-40 db for various attacks. As given in, Harsh Varma et.al tested CDMA based watermarking scheme with spatial domain and frequency domain with DCT as well as DWT. But these algorithms have low information hiding capacity.

A. RGB AND YUV COLOR SPACES

The RGB colour space is converted into YUV Colour space and then Watermark is embedded into V Component of YUV colour space. Initially colour image is read and R, G, B components of original Cover Image are separated. Then they are converted into YUV colour Space using following equations.

$$Y=0.299*R+0.587*G+0.114*B \quad (1)$$
$$U=-0.147*R-0.289*G+0.436*B \quad (2)$$
$$V=0.615*R-0.515*G-0.100*B \quad (3)$$

After embedding the watermark using DWT, YUV colour space is converted back into RGB colour space using following equations.

$$R=Y+1.140*V \quad (4)$$
$$G=Y-0.395*V-0.581*U \quad (5)$$
$$B=Y+2.032*U \quad (6)$$

B. DISCRETE WAVELET TRANSFORM (DWT)

The researcher has focused DWT for watermarking as DWT is very identical to theoretical model of Human Visual System (HVS). ISO has improved and hypothesis for image compression standard JPEG2000 is substituted by DWT for DCT. DWT offers multi-resolution representation of an image and gives precisely reconstruction of decomposed image. Discrete wavelet can be represented as an Image itself is considered as two dimensional signals. When image is passed through series of low pass and high pass filters, DWT decomposes the image into sub bands of different resolutions. Decompositions can be done at different DWT levels. At level 1, DWT decomposes image into four non overlapping multi-resolution sub bands: LLx (Approximate sub band), HLx (Horizontal sub band), LHx (Vertical sub band) and HHx(Diagonal Sub band). Here, LLx is low frequency component whereas HLx, LHx and HHx are high frequency components. the sub band LL1 is further processed until final N scale to obtain next coarser scale of wavelet coefficients after level 1. When N is reached, we have 3N+1 sub bands with LLx and HLx, LHx, HHx where x ranges from 1 to N. Three level image Embedding watermark in low frequency coefficients can increase robustness in significant manner but maximum energy of natural images is concentrated in approximate (LLx) sub band. Hence modification in this low frequency sub band will cause intense and unsatisfactory image degradation. Hence watermark is not embedded in LLx sub band.
The good areas for watermark embedding can yield effective with high frequency sub bands (HLx, LHx and HHx), because human naked eyes are not sensitive to these sub bands.
But HHx sub band is excluded as contains edges and textures of the image.Most of the watermarking algorithms have been failed to achieve perceptual transparency and robustness simultaneously because these two conflicting requirements with each other. The rest options are HLx and LHx. But Human Visual System (HVS) is more sensitive in horizontal than vertical. Hence Watermarking done in HLx region.

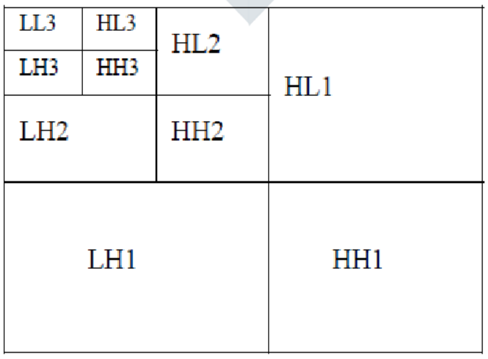

Fig1. Three Level Image Decomposition

III. PROPOSED WATERMARKING METHODOLOGY

The block diagram of watermarking scheme shown in Fig. 2 provides an overview of the proposed watermarking scheme. First, the blue component in R (Red), G (Green), and B (Blue) or the Luminance (Y) component in Y (Luminance), I (Hue), and Q (Saturation) colour models is obtained from the original image for embedding the watermark; second, circular image is obtained from(Y) component or blue component; then the normalized rotation is performed on the circular image. As a result, the detection process can be reduced at watermark synchronization problem. Next, a square sub image is procured from the normalized circular image and decomposed in L-decomposition levels using DWT. The watermark is embedded at the highest level of the wavelet decomposition not including the coarsest LL-subband. After embedding watermark bits, L-level inverse wavelet transform is applied. Finally, for the watermarked normalized circular image and the watermarked image is reconstructed by the inverse rotation normalization.

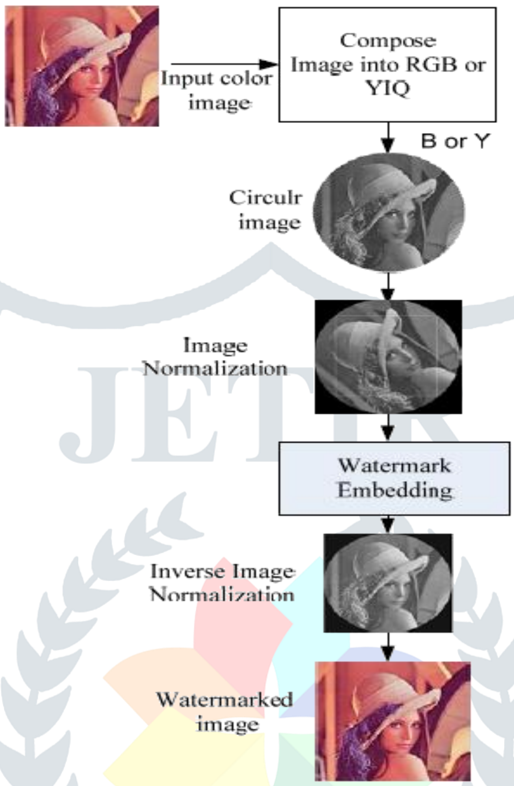

Fig2. Watermark Scheme.

B. Watermark Embedding Method

The block diagram of the watermarking embedding is shown in Fig.3.The algorithm for embedding watermark in LL3 coefficients of the host image Y channel is described as follows:
Step 1: Generate YCbCr channels converting from RGB channels of a host image W.
Step 2: Decompose the Y channel into a 3-level wavelet pyramid structure with 10 DWT sub bands. The coarsest sub band LL3 is taken as the target sub band for embedding watermarks.
Step 3: Prevent the signs of selection coefficients in a matrix sign.
Step 4: Quantize faultless values of selection coefficients.
Step 5: Scramble watermark W1 by Arnold transform algorithm for key times.
Step 6: Embedding watermark W1. For security, imperceptibility and robustness, the watermark W is embedded in LSB that has smallest quantization errors. Step 7: Effect the embedded coefficients from matrix sign. Step 8: Regenerate RGB channels of host image W from Y Cb Cr channels.
Step 9: A watermarked image W' is then generated by inverse DWT with all changed and unchanged DWT coefficients.
Step10: Save the key times of Arnold transformation, indexes of changed selection coefficients, and index of the embedded sub band as the authenticated key.

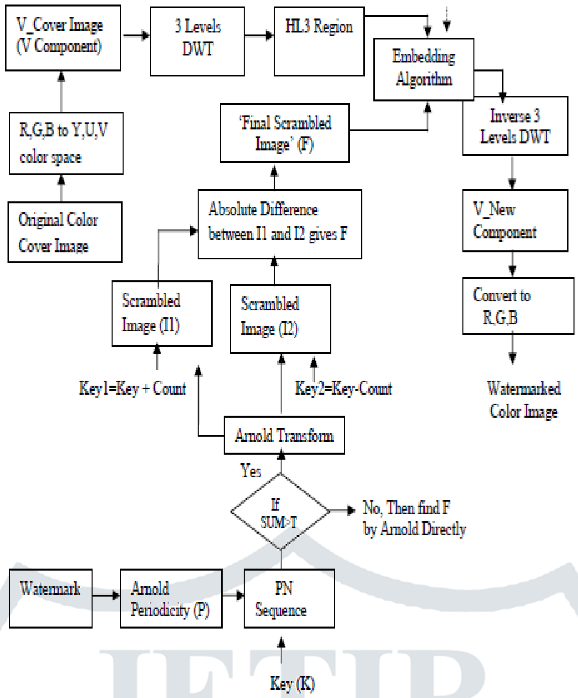

Fig3.Watermark Embedding Process

C. Watermark Extraction Method

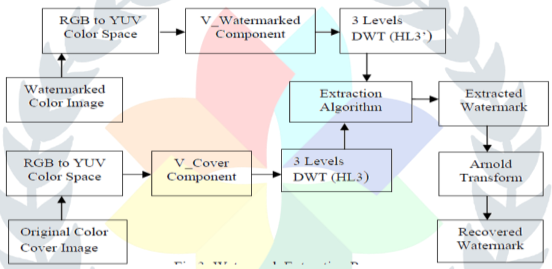

Fig. 4 Watermark Extraction Process

The watermark extraction method as shown in fig.4. The embedded watermark can be extracted using the stored authenticated key after wavelet decomposition of the watermarked image.
The extracting process is described as follows:
Step 1: YCbCr channels are generated form the RGB channels of the watermarked images.
Step 2: Decompose the Y channel into 10 DWT sub-bands. Step 3: Re-fetch the stored authenticated key.
Step 4: Quantize absolute values of LL3 sub-band.
Step 5: Extract least significant bit of re-fetched key.
Step 6: re-scrambling watermark by inverse Arnold transform for key times.
Extraction Formulae:
Value (i,j)= {abs(HL3(i,j),HL3)/K1}
If Value (i,j)<Theshold Value
Then Extracted_watermark (i,j)=0
Otherwise Extracted_watermark (i,j)=1

I. EXPERIMENTAL RESULTS

The experiments were organized in two phases. The first phase evaluated the watermark Imperceptibility and the second evaluated the robustness of the watermark against various attacks including signal processing and geometric attacks.

Image	RGB model	YIQ model
Lena	48.33	42.13
Peppers	44.67	39.66
Baboon	40.04	35.29
Lake	42.84	38.44
House	46.04	40.32

Opera	44.14	41.39
Water	41.80	37.39

Table 1: PSNR between watermarked image and the original image (dB)

CONCLUSION

The paper presents a robust colour image watermarking scheme, which is designed to be robust both geometric attacks and signal processing. Image normalization technique is used to overcome the synchronization errors caused by rotation attack. The original image is not required at detection. The watermark is embedded into the image luminance in YIQ model and in the blue channel in RGB model by modifying the two largest values of DWT coefficients in the selected blocks. Each bit of the watermark is embedded into three different locations of wavelet bands. It has been demonstrated that the proposed scheme succeeds in making the watermark perceptually invisible and under most of the commonly used attacks; the proposed scheme is robust. The results demonstrate that more robustness can be achieved when the watermark is embedded into the luminance channel than the blue channel of an image.

REFERENCES

[1] Ibrahim AlsonosiNasir, Member, IAENG, Ahmed b. bdurrman," A Robust Color Image Watermarking Scheme Based on Image Normalization", Proceedings of the World Congress on Engineering 2013 Vol III, WCE 2013, July 3 - 5, 2013, London, U.K.

[2] AtefehElahian, Mehdi Khalili, ShahriarBaradaranShokouhi,"Improved Robust DWT-Watermarking in YCbCrColor Space", ISSN: 2249-1945 AtefehElahian et al, GJCAT, Vol 1 (3), 2011, 300-304

[3] B.L.Gunjal, R.R.Manthalkar, "Discrete Wavelet Transform Based Strongly Robust Watermarking Scheme for Information Hiding in Digital Images", Third International Conference- Emerging Trends in Engineering and Technology,19-21 Nov 2010 , Goa, India, ISBN 978-0-7695-4246-1, http://doi.ieeecomputersociety.org/10.1109/ICETET.2010.12.

[4] Voloshynovskiy. S. S. Pereira and T. Pun. 2001. "Attacks on Digital watermarks: classification, Estimation-Based attacks and Benchmarks", Comm, Magazine. 39(8):118-126.

[5] Ahmad Nilchi1, AyoubTaher," A New Robust Digital Image Watermarking Technique based on the Discrete Cosine Transform and Neural Network", pp:1 – 7, April 2008.

[6] M.S. Hsieh, and D.C. Tseng, "Hiding digital watermarks using multi-resolution Wavelet transform",IEEETransactionson industrial electronics, vol:48, No:5, pp:875-882, Oct, 2001.

[7] H. Guo, and N. Georganas, "Multi-resolution Image Watermarking Scheme in the Spectrum Domain,"Proceeding of IEEE Canadian Conference on Electrical and Computer Engineering, pp. 873-878, May, 2002.

[8] Wang, S. and Y. Lin, "Wavelet Tree Quantization for Copyright Protection Watermarking," IEEE Trans. Image Processing, vol. 13, no. 2, pp: 154-164, 2004.

[9] P. S. Huang, C. S. Chiang, C. P. Chang, and T. M. Tu, "Robust spatial watermarking technique for colour images via direct saturation adjustment," IEE Proceedings -Vision, Image and Signal Processing, vol. 152 (5), pp. 561-574, 2005.

[10] S. Roy and E.C. Chang, Watermarking color histogram, in proc. Int. Conf. Image Process, pp.2191-2194, 2004

[11] Baisa L. Gunjal,WAVELET BASED COLOR IMAGE WATERMARKING SCHEME GIVING HIGH ROBUSTNESS AND EXACTCORELATION", International Journal of Emerging Trends in Engineering and Technology (IJETET),Vol. I No. 1, 2011, ISSN 2248-95