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A Singular Value Decomposition and Wavelet Based Robust Watermarking Scheme

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---ABSTRACT---

This paper presents a robust watermarking technique using discrete wavelet transform and Singular Value Decomposition. In proposed method the blue channel of the color host image is selected for embedding watermark because it is more resistant to changes compared to red and green channels, for embedding watermark singular values are used. In this the watermark is embedded into singular values of the host image. They embedded the singular values of the watermark image into the singular values of the host image. The blue channel is decomposed into n levels using discrete wavelet transform because this is an invertible transform and has the property of exact reconstruction and smoothness. This method is shown to be robust against many signal processing operations as well as geometrical attacks.

KEY WORDS**:** *Attacks, Copyright Protection, Digital Image Watermarking, Discrete Wavelets Transform, Robust Watermarking, Singular Value Decomposition*.

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I . INTRODUCTION

With the growth of the Internet and the immediate availability of computing resources to everyone, "digitized property" can be reproduced and instantaneously distributed without loss of quality at basically no cost. Until now, intellectual property and value has always been bound to some physical container that could not be easily duplicated, there by guaranteeing that the creator benefits from his work. Clearly, there is business like the music or photography industry that cannot adopt this paradigm since they trade basic content and therefore have to stick with traditional copyright enforcement to guarantee income. As audio, video and other works become available in digital form, it may be that the ease with which perfect copies can be made will lead to large-scale unauthorized copying which will undermine the music, film, book and software publishing industries. The rapid evolution of digital technology makes the development of reliable and robust schemes for protecting digital still images, audio and video from piracy a matter of urgency. The use of digitally formatted image and video information is rapidly increasing with the development of multimedia broadcasting, network databases and electronic publishing. This evolution provides many advantages such as easy, fast and inexpensive duplication of products. However, it also increases the potential for unauthorized distribution of such information, and significantly increases the problems associated with enforcing
Copyright protection.

II . 2D DISCRETE WAVELET TRANSFORM

The 2D DWT is computed by performing low-pass and high pass filtering of the image pixels as shown in Figure 1. In this figure, the low-pass and high-pass filters are denoted by h (n) and g (n), respectively. This figure depicts the one level of the 2D DWT decomposition. At each level, the high-pass filter generates detailed image pixel information, while the low-pass filter produces the coarse approximations of the input image. At the end of each low-pass and high-pass filtering, the outputs are down-sampled by two (↓ 2). In order to compute 2D DWT, 1D DWT is applied twice in both horizontal and vertical dimension. In other words, a 2D DWT can be performed by first performing a 1D DWT on each row, which is referred to as horizontal filtering, of the image followed by a 1D DWT on each column, which is called vertical filtering as shown in figure 1.

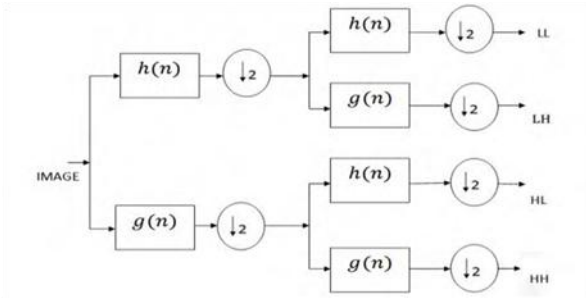

Fig.1. One level 2D DWT decomposition of an input image using filtering approach

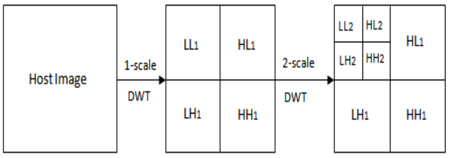

Fig.2. Two level 2D Wavelet based transforms

The higher level sub bands are more significant than the lower level sub bands. They contain most of the energy coefficients so embedded in higher level sub bands is providing more robustness. On the other hand lower level sub bands have minor energy coefficients so watermark in these sub bands are defenseless to attacks. The higher level approximation sub band (LL2 sub band) is not suitable for embedding a watermark since it is a low-frequency band that contains important information about an image and easily causes image distortions. In second level, embedding a watermark in the diagonal sub band (HH2 sub band) is also not suitable, since the sub band can easily be eliminated, for example by lossy compression as it has minor energy coefficient. So the middle frequency sub bands (Vertical & Horizontal) of higher level are the best choice for embedding. Further the LH2 sub band has more significant coefficients than the HL2 sub band.

III PERFORMANCE EVALUATION

Peak Signal-to-Noise Ratio (PSNR): It is the ratio between the maximum possible power of a signal and the power of corrupting noise the affects the fidelity of its representation. It is the most easily defined via the Mean Squared Error (MSE) which for two m x n images I and K where one of the images is considered as a noisy approximation of the other. MSE and PSNR can be estimated below equations.

$$\mathrm{MSE} = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n}[I(i,j) - K(i,j)]^2 \quad \ldots(1)$$

$$\mathrm{PSNR} = 10.\log_{10}\left(\frac{MAX^2}{MSE}\right) \quad \ldots\ldots\ldots (2)$$

IV PROPOSED WATERMARKING METHOD

In embedding process, first separate the R, G & B channels of the color image and the blue channel is selected for the embedding because this channel is more resistant to changes compared to red and green channels and the human eye is less sensitive to the blue channel, a perceptually invisible watermark embedded in the blue channel can contain more energy than a perceptually invisible watermark embedded in the luminance channel of a color image. The blue channel is decomposed into n-level using discrete wavelet transform

Let select a bmp image of size 128 x 128 as watermark and convert it into a 1-D vector, for embedding watermark bit 0 & 1 in mid frequency sub bands of higher level decomposition of the channel. Finally reconstruct the watermarked image using inverse discrete wavelet transform. Now calculate the Mean Squared Error & Peak Signal to Noise Ratio between original host image and watermarked image to evaluate the perceptual Similarity between these two images by using equation 1 & 2.

In extraction process the end user separates the R, G & B channels of the watermarked image. The blue channel is decomposed into n-level using discrete wavelet transform.

V SINGULAR VALUE DECOMPOSITION

SVD is a Mathematical tool used to analyze matrices. In this a square matrix is decomposed into three matrices of same size. A real matrix A of size NxN can be decomposed into a product of three matrices.

$$A= USV^T$$

Where U and V are left singular and right singulars vectors of A and S is diagonal matrix.

For calculating singular values, we need to find DET of the matrix, Eigen values, Eigen vectors and inverse transform after that we can get the singular values. SVD is having so many properties like Orthogonal matrices, Scaling property, The Stability of singular values, Rotation and translation invariance.

VI EXPERIMENTAL RESULTS

Baby.jpg color image of size 256X256 is selected as a host and *best.bmp* bitmap image of size 128X128 is chosen as a watermark. Figure 3 shows the original host image & l-Level decomposed blue channel using discrete wavelet transform. In Figure 4 host image, watermark, watermarked and extracted watermark on the receiver side is shown.

Fig.3. Original host image & decomposed blue channel using wavelet transform

Fig.4. Original host image, original watermark, watermarked image and extracted watermark

Fig.5 shows watermarked image at a different embedding factors for

(a) α =0.1, MSE=0.0023,PSNR=74.4430.
(b) α =0.5, MSE= 0.0224, PSNR=64.6298.
(c) α =0.01, MSE= 2.3376, PSNR=94.4430.

The performance of the proposed method is tested by applying different geometric and image processing attacks, such as salt and pepper noise, Random noise, Rotation, Additive Gaussian noise, Gamma, Blurring and Motion Blurring attack.

Table1. Shows the different attacks performed in this paper.

Attack	PSNR
Blurring	78.6082
Salt & Pepper	78.4430
Random Noise	76.5514
AWGN	78.3875
Motion blurring	74.4430
Rotation	76.5514
Gamma	94.4430

VII. CONCLUSION

In this paper a new robust watermarking technique for copyright protection has been proposed. We applied the singular value decomposition along with the Discrete Wavelet Transform. Since the technique utilizes the properties of both DWT and SVD the proposed technique is more robust against different attacks. The innovation of this paper is that the security of the algorithm is increased with the on the watermark image. The robustness of the technique is justified by giving analysis of the effect of attacks and still we are able to get good visual quality of the embedded watermark. The performance of the proposed method is tested by applying different geometric and image processing attacks, such as salt and pepper noise, Random noise, Rotation, Additive Gaussian noise, Blurring and Motion Blurring attack. The proposed method, with stands for all these attacks.

Future Scope:

The watermark embedding scheme can be extended to include encrypted watermarks. Watermark extraction algorithm can be extracted to perform watermark validation automatically. Suitable feature extraction & matching techniques have to be explored. In case of the progressive image transmission the schemes for optimizing the data for each phase needs to be studied. The phase wise data compression & decompression schemes need to be evaluated.

REFERENCES

[1] C.Venkata Narsimhulu and K.Satya Prasad, "A hybrid watermarking scheme using contourlet transform and singular value decomposition", IJCSNS International Journal of Network security, VOL.10 No.9, September 2010.

[2] Ibrahim Nasir, Ying Weng and Jianmin Jiang, "New Robust Watermarking Scheme for color image in spatial Domain", University of Bradford, UK.

[3] Gonzalez, F.P., and J.R., Hernandez, 1998. "A tutorial on digital Watermarking", Tech. Rep., University of Vigo, Spain.

[4] J. J. K. Ó Ruanaidh, W. J. Dowling, and F. M. Boland, "Watermarking digital images for copyright protection," *Proceedings of the IEEE, Vision, Image and Signal Processing*, vol. 143, pp. 250–256, Aug. 1996.

[5] R. B. Wolfgang and E. J. Delp, "A watermark for digital images," in *Proc. 1996 Int. Conference on Image Processing*, Lausanne, Switzerland, Sept. 1996, vol. 3, pp. 219–222.

[6] S. Kay and E. Izquierdo, "Robust content based image watermarking," in *Proc. Workshop on Image Analysis for Multimedia Interactive Services, WIAMIS' 2001*, Tampere, Finland, May 2001.

[7] I. J. Cox, J. Kilian, F. T. Leighton, and T. Shamoon, "Secure spread spectrum watermarking for multimedia," *IEEE Trans. Image Processing*, vol. 6, pp. 1673–1687, Dec. 1997.