A NOVEL RRW FRAMEWORK TO RESIST ACCIDENTAL ATTACKS

Farooq Shaik Mohammad[1], M. Ramana Reddy[2]

[1]Student, [2]Professor, Department of E.C.E, RGM Autonomous of college Engineering & Technology, Andhra Pradesh, India

faaruk.smd@gmail.com, ramana_2k5@rediffmail.com

Abstract

Robust reversible watermarking (RRW) methods are popular in multimedia for protecting copyright, while preserving intactness of host images and providing robustness against unintentional attacks. Robust reversible watermarking (RRW) is used to protect the copyrights and providing robustness against unintentional attacks. The past histogram rotation-based methods suffer from extremely poor invisibility for watermarked images and limited robustness in extracting watermarks from the watermarked images destroyed by unintentional attacks. This paper proposes a wavelet-domain statistical quantity histogram shifting and clustering (WSQH-SC) method and Enhanced pixel-wise masking (EPWM). This method embeds a new watermark image and extraction procedures by histogram shifting and clustering, which are important for improving robustness and reducing run-time complexity. It is possible reversibility and invisibility. By using WSQH-SC methods reversibility, invisibility of watermarks can be achieved. The experimental results show the comprehensive performance in terms of reversibility, robustness, invisibility, capacity and run-time complexity widely applicable to different kinds of images.

Keywords: *— Integer wavelet transform, k-means clustering, masking, robust reversible watermarking (RRW)*

---***---

1. INTRODUCTION

Reversible Watermarking (RW) methods [1] are used to embed watermarks [2], e.g., secret information [3], into digital media while preserving high intactness and good fidelity of host media. It plays an important role in protecting copyright and content of digital media for sensitive applications, e.g., medical and military images. The concept of reversible watermark firstly appeared in the patent owned by Eastman Kodak [4] Honsingex et al. [4] utilised a robust spatial additive watermark combined with modulo additions to achieve reversible data embedding. Goljan et al. [5] proposed a two cycles flipping permutation to assign a watermarking bit in each pixel group. Celik et al. [6] presented a high capacity, reversible data-embedding algorithm with low distortion by compressing quantization residues. Tian [7] presented a reversible data embedding approach based on expanding the pixel value difference between neighboring pixels, which will not overflow or underflow after expansion. Thodi and Rodrguez exploited the inherent correlation among the neighboring pixels in an image region using a predictor. Xuan et al. [8] embedded data into high-frequency coefficients of integer wavelet transforms with the commanding technique, and utilized histogram modification as a preprocessing step to prevent overflow or underflow caused by the modification of wavelet coefficients.

Reversible watermarking has found a huge surge of experimentation in its domain in the past decade as the need of recovering the original work image after extracting the watermark arises in various applications such as the law enforcement, medical and military image system, it is crucial to restore the original image without any distortions [9]. In traditional watermarking techniques, our main concern is to embed and recover the watermark with minimum loss. The quality of original work image we get after extraction is highly degraded and not restorable. But in applications like law enforcement, medical and military, in which superior quality of image is needed, we cannot use these algorithms. In medical images, some prerequisite information about the patient is watermarked in it while transmitting and at reception we need to have both, the original image and that information is to be recovered loss without. This type of result is achievable by making use of any reversible watermarking algorithm out of a pool of algorithms [10].

2. PROPOSED METHOD

The following steps are used to embed the watermark into image.

- Decompose image using 5/3 IWT and divide the sub-band HL into n non overlapping blocks with the size of h × w.
- Compute the mean of wavelet coefficients (MWC) histogram of all of the blocks and obtain Sk.
- Perform EPWM to compute the watermark strength
- For k = 1to m do
- 7 Embed the kth watermark bit bk with Sw
- k = Sk + βλbk ;
- End for

- Reconstruct the watermarked image I with inverse 5/3 IWT.

The block diagram of proposed method as shown in fig.1

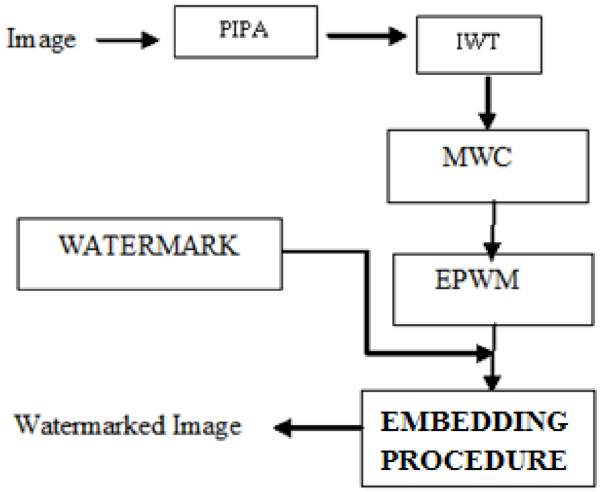

Fig.1. Block diagram of proposed method

2.1 Property Inspired Pixel Adjustment (PIPA)

In RRW, how to handle both overflow and underflow of pixels is important for reversibility. Xuan *et al*. [11] proposed a pixel adjustment strategy to tackle this problem. Unfortunately, it cannot be directly applied to wavelet domain because the adjustment scale related to wavelet transform is unknown. As a consequence, we develop PIPA to handle this problem. Firstly, PIPA deeply exploits the intrinsic relationship between wavelet coefficient and pixel changes. In particular, given a t-bit host image I with the size of $2M \times 2N$, the pixel adjustment is performed by

$$I'(i,j) = \begin{cases} I(i,j) - \eta & \text{if } I(i,j) > 2\hat{}t - 1 - \eta \\ I(i,j) + \eta & \text{if } I(i,j) < \eta \end{cases}$$

where $I(i,j)$ is the grayscale value of the pixel at (i,j) in the image I, $I(i,j)$ is the adjusted one ($1 \le i \le 2M$, $1 \le j \le 2N$), and $\eta > \lambda$ is the adjustment scale.

2.2 Integer Wavelet Transforms (IWT)

The wavelet transform transforms the image into a multi-scale representation with both spatial and frequency characteristics [12]. This allows for effective multi-scale image analysis with lower computational cost. Using the IWT, the texture image is decomposed into four sub images, as low-low, low-high, high-low and high-high sub-bands.

L1L1	L1L2	L1H1	L1H2
L2L1	L2L2	L2H1	L2H2
H1L1	H1L2	H1H1	H1H2
H2L1	H2L2	H2H1	H2H2

Fig.2. Image decomposition after a two level scaling for IWT

2.3 Means of Wavelet Coefficients (MWC) Histogram

It is designed in high-pass sub-bands of wavelet decomposition, to which HVS is less sensitive, leading to high invisibility of watermarked images and it has almost a zero-mean and Laplacian-like distribution based on the experimental study of wavelet high-pass sub-bands from 300 test images.

Considering a given host image I , we first decompose I using 2 level IWT to obtain the sub-band and then divide HL into n non overlapping blocks. Let S = (S1,..., Sk ,..., Sn) be the MWCs in the sub-band, then the MWC of the kth block, Sk ,is defined as

$$S_k = \frac{1}{(h-2)X(w-2)} \sum_{i=2}^{h-2} \sum_{j=2}^{w-2} P_k(i,j)$$

Where P (i, j) k represents the wavelet coefficient at (i, j) in the kth block

2.4 Embedded Pixel Wise Masking (EPWM)

It has been well acknowledged that a balance between invisibility and robustness is important for robust watermarking methods. Although many efforts have been made to design lossless embedding models, little progress has been made in this trade-off. Therefore, we develop EPWM to tackle this problem by utilizing the JND thresholds of wavelet coefficients to optimize watermark strength. To computed the watermark strength is as shown below

$$\lambda = \frac{\alpha}{M \times N} \sum_{i=1}^{1} \sum_{j=1}^{1} JND_{\rho}^{\omega}(i,j)$$

Where α is a global parameter and M × N is the sub-band size.

2.5 Embedded Procedure

We use the obtained JND thresholds to control watermark strength during the embedding process. To be specific, given the MWC of the kth block of interest, i.e., Sk the watermark embedding is given by

$$k = Sk + \beta\lambda bk$$

Here k is the obtained MWC after the kth watermark bit bk ∈ {0, 1} is embedded, β is a factor defined as

$$\beta = \left(S_k - S^*\right) \Big/ abs\left(S_k - S^*\right)$$

3. QUALITY MEASUREMENT

PSNR is most commonly used to measure the quality of reconstruction of lossy compression codecs. PSNR is most easily defined via the mean squared error (*MSE*). Given a noise-free $m\times n$ monochrome image *I* and its noisy approximation *K*, *MSE* is defined as:

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\left[I(i,j) - K(i,j)\right]^2$$

The PSNR is defined as:

$$PSNR = 10.\log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$

$$= 20.\log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

$$= 20.\log_{10}\left(MAX_I\right) - 10\log_{10}\left(MSE\right)$$

4. EXPERIMENTAL RESULTS

MSE = 174.2140
PSNR = 25.7200

Original Image

Fig 3 shows the original camera man image

Decomposed Image

Fig 4 shows the decomposed camera man image

EPWM

Fig 5 shows EPWM camera man image

Watermarked Image

Fig 6 shows the watermarked image

CONCLUSIONS

In this paper, we have developed a novel yet pragmatic framework for RRW. It includes carefully designed PIPA, SQH shifting and clustering, and EPWM, each of which handles a specific problem in RRW. PIPA preprocesses host images by adjusting the pixels into a reliable range for satisfactory reversibility. SQH shifting and clustering constructs new watermark embedding and extraction processes for good robustness and low run-time complexity. EPWM precisely estimates the local sensitivity of HVS and adaptively optimizes the watermark strength for a trade-off between robustness and invisibility. In future, we will combine the proposed framework with the local feature to further improve robustness.

REFERENCES

[1]. J. Fridrich, M. Goljan, and R. Du, "Lossless data embedding-new paradigm in digital watermarking," EURASIP J. Appl. Signal Process., vol. 2002, no. 1, pp. 185–196, Jan. 2002.
[2]. Z. Zhao, N. Yu, and X. Li, "A novel video watermarking scheme in compression domain based on fast motion estimation," in Proc. Int. Conf. Commun. Technol., vol. 2. 2003, pp. 1878–1882.
[3]. X. Li, "Watermarking in secure image retrieval," Pattern Recog. Lett., vol. 24, no. 14, pp. 2431–2434, Oct. 2003.
[4]. Honsinger, C.W., Jones, P., Rabbani, M., and Stoffel, J.C.: ‗Lossless recovery of an original image containing embedded data'. US patent no. 6278791, 2001
[5]. Goljan, M., Fridrich, J., and Du, R.: ‗Distortion-free data embedding for images'. 4th Information Hiding Workshop, LNCS, vol. 2137, (Springer-Verlag, New York, 2001, pp. 27–41.
[6]. Celik, M.U., Sharma, G., Tekalp, A.M., and Saber, E.: ‗Reversible data hiding'. Proc. ICIP, 2002, vol. 2, pp. 157–160
[7]. T ian, J.: ‗Reversible data embedding using a difference expansion', IEEE Trans. Circuits Syst. Video Technol., 2003, 13, (8), pp. 890–896.
[8]. Xuan, G.R., Yang, C.Y., Zhen, Y.Z., and Shi, Y.Q.: ‗Reversible data hiding using integer wavelet transform and companding technique'.Proc. IWDW, 2004.
[9]. J. T ian, ―Wavelet-based reversible watermarking for authentication,‖ in Security and Watermarking of Multimedia Contents IV—Proc. SPIE, E. J. Delp III and P. W. Wong, Eds., Jan. 2002, vol. 4675, pp. 679–690.
[10]. B. Macq, ― Lossless multi resolution transform for image authenticating watermarking,‖ in Proc. EUSIPCO, Sept. 2000, pp. 533–536.
[11]. G. Xuan, Y. Shi, P. Chai, X. Cui, Z. Ni, and X. Tong, "Optimum histogram pair based image lossless data embedding," in Proc. Digit Watermark., 2008, pp. 264–278.
[12]. D. Zou, Y. Shi, Z. Ni, and W. Su, "A semi-fragile lossless digital watermarking scheme based on integer wavelet transform," IEEE Trans. Circuits Syst. Video Technol., vol. 16, no. 10, pp. 1294–1300, Oct. 2006.

BIOGRAPHIES

FAROOQ SHAIK MOHAMMAD received B. Tech degree from SAFA Engineering College, B.Thandarpadu, Kurnool (dist), Andhra Pradesh in the year 2011 and currently pursing M. Tech in Digital Systems & Computer Electronics at RGM College of Engineering and Technology, Nandyal, Kurnool (dist), Andhra Pradesh. His areas of interest are research work in image processing.

Dr. M.RAMANAREDDY, presently working as professor in RGM College of Engineering and Technology (Autonomous), Nandyal, Kurnool(dist), AP, India. He was awarded a doctorate for his work in Signal Processing in 2010.He has 16 years of teaching experience and 8 years of industrial experience. He has Professional Memberships in MISTE, MIE, and FIETE. He guided 10 projects at master level.