Enhancement of Robustness of Color Video Watermarking using 2D-DWT

Archana Srivastava
IT System & Network Security
Gujarat Technological University
Ahmedabad, India
sri.archies@gmail.com

Abstract— **In this paper we propose an effective, robust and imperceptible video watermarking algorithm by applying DWT (Discrete Wavelet transform) on video frames. The video frames will be first decomposed using DWT and the binary watermark will be embedded in the wavelet coefficients. The experimental results demonstrate that the propose algorithm can produce watermarked contents in good visual quality and is robust to typical video operations.DWT is used to embed the invisible watermark and Peak Signal to Noise Ratio (PSNR) will be calculated to measure efficiency of this method.**

Keywords-Video Watermarking, DWT (Discrete Wavelet Transform), PSNR (Peak-to-Signal-Ratio)

I. INTRODUCTION

Digital video watermarking is the process to embedding a digital code into digital video sequences. Digital video is nothing but a sequence of consecutive still images. In recent few years the applications based on video like, pay-per-view, video-on-demand, video broadcasting are becomes more and more popular, so the requirement of a secure video distribution increases [1].

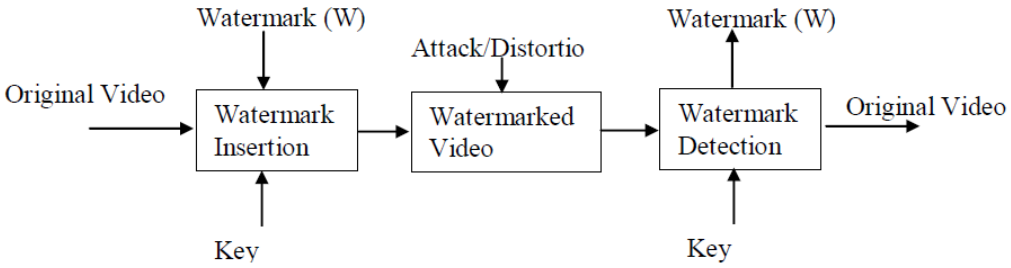


Figure 1 Block diagram of Video Watermarking

The complete process of digital video watermarking is described into four steps (same as digital image watermarking): Watermark insertion or embedding, Watermark transmission or distribution through a channel, Watermark extraction or detection and Watermark decision, as shown in Figure 1.

Watermark embedding algorithm embedded a watermark into original video using a Key, which may be either public or symmetric key. Then the watermarked video transmitted over the channel. At the receiver side, watermark detection/ extraction algorithm used to detect a watermark. In last step, watermark decision, watermarking system analyzes the extracted data

For digital video watermark some most important characteristics or properties of watermarking process are required. Such as, Robustness, Imperceptibility, Unambiguous, Loyalty, Computational Cost, Interoperability, CBR (Constant Bit Rate), Random detection and Blind detection scheme.

II. KEY FRAME DETECTION

For video watermarking we considered here Computer related video for analysis, because of the complexities of scene change itself. In this video, frame sequences have certain properties like some frame sequence are either same or having some difference between them. Now to consider all the frames for computations is insufficient. So we propose a key frame detection approach for minimizing the computation time which is necessary as the amount of data is huge. Suppose we consider the sequence of frame, for same frame sequence denote S and different frame sequence denote D [2].

Ex: SSSSDSSSDSSS

For such sequence of frame there would be a spike in HHD (Hue- Histogram Difference) plot with rising edge at frame 203 and at frame 204. We have to consider only the rising edges to decide on key and non key frames. As shown in Figure 2. Frames with spikes are considered as key frames.

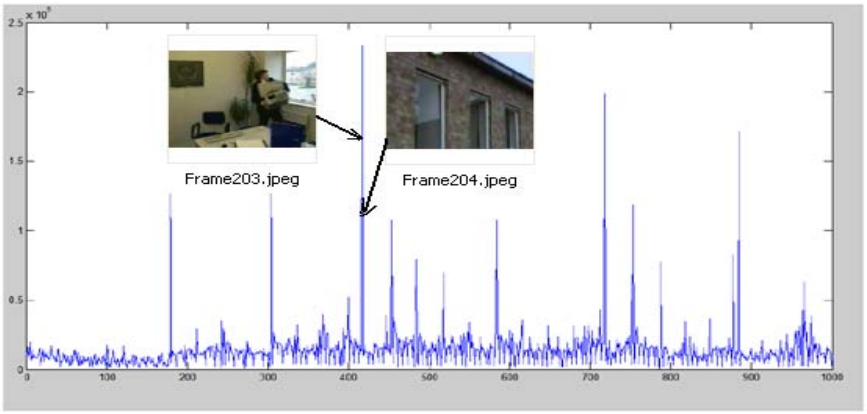


Figure 2 Hue-Histogram Difference graph for key frame detection with two different consecutive frames having maximum difference.

III. WATERMARKING EMBEDDING AND EXTRACTION USING 2D-DWT

1. First of all convert the video in to frames and then frame to image.
2. Decompose each image in to three RGB color components.
3. Apply 2-level DWT to each component of each video frame and watermark image to obtain four sub-bands LL, LH, HL and HH of size N x N.
4. The watermark bits are embedded with strength α into each sub-band. The embedding is carried out as Equation 1.

$$WI_{i,j} = I_{i,j} + \alpha * WM \quad (1)$$

Where WI represents the watermarked video

I represent frame sequences of original video

And WM represents watermark.

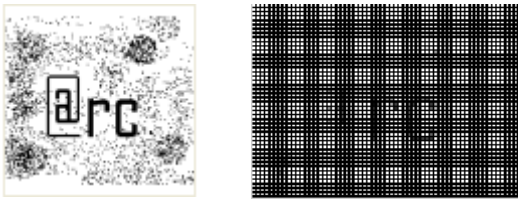
5. Apply inverse DWT to obtain the watermark. Then convert the video frame back to its RGB components.

IV. EXPERIMENTAL RESULTS

The proposed algorithm is applied to a sample video sequence 'Computer.avi' of 14 seconds using watermark logo. The watermark embedding into key frames of size 240 * 180 pixels of jpeg format. The watermark key is a grayscale image. The watermark is embedded into each component of frame. Figure 3 and 4 show the original and the watermarked video frames respectively. Figure 5(a) is the embedded watermark and Figure 5(b) is the difference of original and watermarked images. The performance of the algorithm has been measured in terms of its imperceptibility and robustness against the possible attacks like noise addition, filtering, geometric attacks etc.

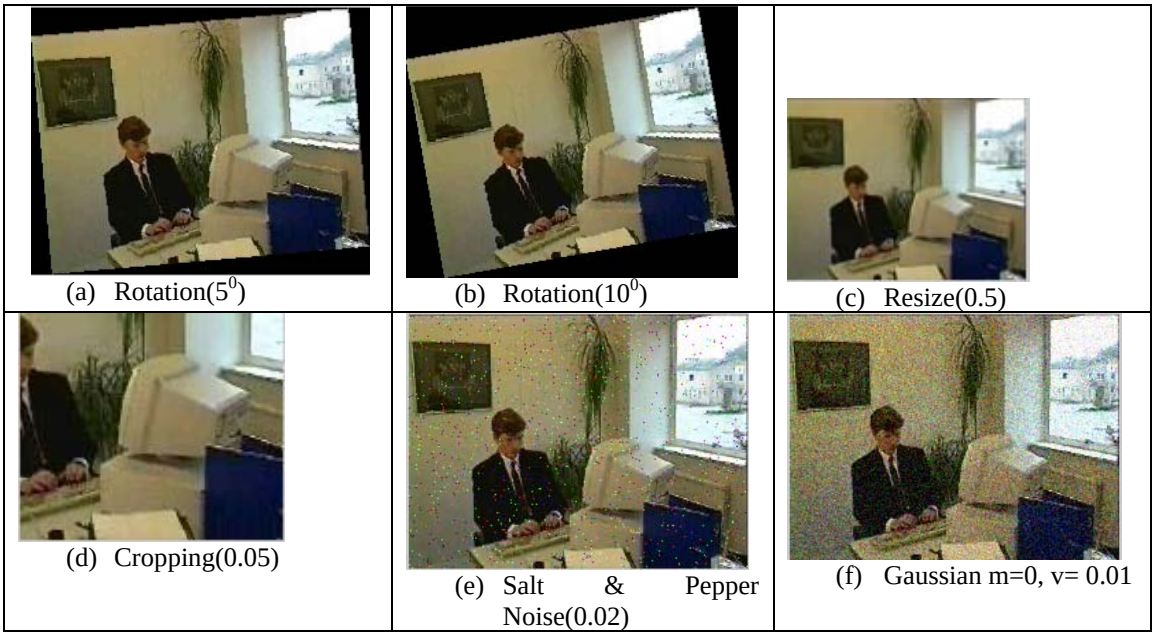
Figure 3 Key frames from video

Figure 4 Watermarked Video frames



(a) (b)

Figure 5.(a) Extracted Watermark (b) Difference between Original and Watermarked Frames



(a) Rotation(5^0) (b) Rotation(10^0) (c) Resize(0.5)

(d) Cropping(0.05) (e) Salt & Pepper Noise(0.02) (f) Gaussian m=0, v= 0.01

Figure 6 Attacks on watermarked Images

Table 1 Comparison between PSNR values in dB obtained after different attacks using different algorithms

Attacks	[3]	[4]	Proposed Method
Rotation(5)	28.8256	12.87	36.675
Rotation(10)	-		27.57
Resize	41.4628	21.66	40.14
Cropping	28.3373	10.90(on both sides)	30.89
Salt & Pepper Noise	24.4592	-	27.33(0.02)
Gaussian Noise	31.1564	30.14(m=0,v=0.001)	32.17(m=0, v= 0.01)

Table 2 Parameters to compare test video sequence

Video Test Sequence	[5]	[6]	[7]	[8]	Proposed Method
Size	352×240	240 x 352	240 x 352.	352x288	240X180
Frame rate	29.9		29,	100	25
Length	-	351 frames	32 frames	4 seconds	14 seconds
PSNR(in dB)	40.17	48.1308	53.2672	36.821	47.5446

V. CONCLUSION

The research proposes key frame detection based video watermarking scheme using 2D-DWT. The process of comprehensive video watermarking scheme, including watermark preprocessing, video preprocessing, watermark embedding, and watermark detection, is described in detail. Experiments are conducted to demonstrate that our scheme is robust against attacks by frame dropping, frame averaging, and the robustness against the image processing attacks is tested and compared with various proposed methods.

VI. FUTURE WORK

The future work can be extended as to implement DWT algorithm for the scene change detection for embedding the watermark. So, watermark is embedded into motion scene frames. Also, we can implement DWT with SVD or PCA algorithms to increase the robustness and effectiveness of the video.

REFERENCES

[1] S.V.Patel and A.R.Yadav, "Invisible Digital Video Watermarking Using 4-level DWT", National Conference on Recent Trends in Engineering & Technology, May 2011

[2] S. T. Dhagdi, P.R. Deshmukh, "Keyframe Based Video Summarization Using Automatic Threshold & Edge Matching Rate", International Journal of Scientific and Research Publications, Volume 2, Issue 7, July 2012

[3] S.Sinha, P.Bardhan, S.Pramanick, A.Jagatramka, "Digital Video Watermarking using Discrete Wavelet Transform and Principal Component Analysis", International Journal of Wisdom Based Computing, Vol. 1 (2), pp. 7-12,August 2011

[4] Dr. E Elbasi, "Robust Mpeg Video Watermarking In Wavelet Domain", Araştırma Makalesi / Research Article, Trakya Univ J Sci, 8(2): 87-93, 2007

[5] Sadik. A.M .Al-Taweel, P. Sumari, "Digital Video Watermarking in the Discrete Wavelet Transform Domain", Sixth International Conference on Computer Graphics, Imaging and Visualization, IEEE, 2009

[6] L. Rajab, T. Al-Khatib, and A. Al-Haj , "Hybrid DWT-SVD Video Watermark", pp.588-592 IEEE, 2008

[7] S. Ali Rathorel, S.A.M. Gilanil, A. Mumtaz, T. Jameell, A. Sayyed, "Enhancing Invisibility and Robustness of DWT based Video Watermarking scheme forCopyright Protection" , International Conference on Information and Emerging Technologies, pp.1-5, ICIET 2007 , Karachi

[8] A.Essaouabi and F.regragui, "A Wavelet-Based Digital Watermarking for Video", International Journal of Computer Science and Information Security, Vol. 6, No.1, pp 29-33, 2009