Effective Video Watermarking Technique Using Binary Tree Structure with Feature Point Extraction

Ms.S.Ponni@Sathya[#1], Dr.S.Ramakrishnan*[2], V.Roopa[3], A.Sonia[4]

[#]Assistant Professor, [*]Professor, Department of Information Technology, Dr. Mahalingam College of Engineering and Technology, Pollachi, Coimbatore, India

***Abstract* — An effective video watermarking for video copy right protection helps to avoid piracy of videos. The video is read and it is splitted into the frames and they are arranged in the binary tree structure according to the number of frames in the video. The root frames are selected with the help of secret key generated by dedicated cryptographic algorithm to extract feature points. The feature points of frame and frame-patch of different users is taken and it is extracted by using Harris feature point extraction. With the help of these feature points, the embedding and extracting regions are identified. Then the watermark content is embedded in Discrete Wavelet Transform (DWT) domain. In the extraction process, we synchronize the embedded region from the deformed video by using feature point matching method. The watermark synchronization process is performed to get the robust watermarking locations before watermark embedding and extraction is performed. Then rotation, scaling, translations are performed and the values are measured.*

Keywo***rds***— *Harris features, Video watermarking, Feature point matching, DWT.*

I. Introduction

Due to high speed computer networks and the rapid development of the Internet and the World Wide Web the usage of multimedia data has been increased. The way, in which digital content is transmitted across the web led to unlimited duplicate copies, therefore to maintain the ownership of data becomes difficult. Digital watermarking is a promising technique used for copy control, identification and traitor tracing. In digital watermarking, the watermark content is embedded into a video without affecting the quality but that can be detected using the dedicated algorithm. A watermark is a digital data embedded into the multimedia objects like image, audio and video. Video watermarking is used to provide authentication for the video data by embedding digital data into video sequence. Digital multimedia plays an important role in applications such as news reporting, intelligence content gathering, criminal investigation, security surveillance and health care. However, this reliability could no longer be granted since users can easily manipulate, modify, or forge the digital content without causing noticeable traces using low cost and easy-to-use digital multimedia editing software. Therefore, digital multimedia authentication has become an important issue.

Different related works are performed by various authors for video watermarking are:

Hongyuan Chen [3] proposed a robust video watermarking algorithm based on singular value decomposition and slope-based embedding technique. In this paper, the proposed algorithm is characterized by four key features - a robust feature obtained by singular value decomposition is selected to embed the watermark, a novel slope-based embedding technique is developed to embed a one-bit watermark into several successive blocks in the temporal direction, thus enhancing the robustness against global attacks, an embedding location selection method is used to give priority to blocks with small variations that can also enhance the visual quality of the watermarked video, a temporal synchronization method is introduced to effectively withstand temporal synchronization attacks.

Osama S. Faragallah [14] proposed an efficient video watermarking based on singular value decomposition in the discrete wavelet transform domain. This paper presents an efficient, robust, and unrevealed video watermarking technique based on singular value decomposition (SVD) performed in the Discrete Wavelet Transform (DWT) domain. In this, DWT-based SVD video watermarking method is characterized by two improvements: (1) a cascade of two powerful mathematical transforms; the Discrete Wavelet Transform (DWT)-based SVD using additive method, and (2) an error correction code is applied and embeds the watermark with spatial and temporal redundancy.

Majid Masoumi et.al [13] proposed a Blind Video Watermarking Scheme Based on 3D Discrete Wavelet Transform. In this paper a novel digital

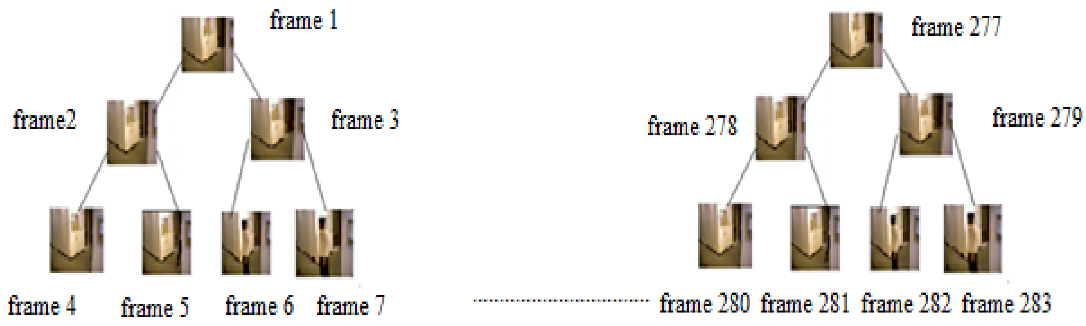

Fig 1: Representation of frames in tree structure

Watermarking method for video based on multi-resolution wavelet decomposition is proposed. The core idea in this technique is to implement scene change analysis to embed the watermark into DWT coefficients of detected motion scene frames. The resulting watermarking scheme can be used for public watermarking applications, where the original video is not available for watermark extraction.

Divjot Kaur Thind [4] proposed A Semi Blind DWT-SVD Video Watermarking. Digital watermarking was introduced due to rapid advancement of networked multimedia systems. This technology is first used for images but now they have been developed for other multimedia objects such as audio, video etc. In this paper a digital video watermarking scheme is proposed which combines Discrete wavelet transform (DWT) and Singular Value Decomposition (SVD) in which watermarking is done in the high frequency sub band and then various attacks have been done. Tests have been undergone to check the proposed idea for robustness and imperceptibility.

Nisreen I. Yassin et al. [5] proposed A Block Based Video Watermarking Scheme Using Wavelet Transform and Principle Component Analysis. In this paper, a digital video watermarking is introduced, where a binary watermark image is embedded into the video frames. Each video frame is decomposed into sub-images using 2 level discrete wavelet transform then the Principle Component Analysis (PCA) transformation is applied for each block in the two bands LL and HH. Experimental results show high imperceptibility where there is no such difference between the watermarked video frames and the original frames. In this scheme shows high robustness against several attacks such as JPEG coding, Gaussian noise addition, histogram equalization, gamma correction, and contrast adjustment.

II. PROPOSED METHODOLOGY

A. Tree structure representation

The original video is splitted into frames. We proposed a novel method to store the frames as a tree like structure. A binary tree is a structure in which each node has at most two children at their root, which are referred to as the left child and the right child. The binary trees are generated according to the number of frames in the video. The frames are arranged up to the level n=3 and this input video there are 283 frames are subdivided into 40 sub trees. Therefore the frames are selected based on the root, left and right frames in the video with the generation of secret key using dedicated cryptographic algorithm.

B. Feature point selection

The root element of each tree is selected to apply the Harris feature point extraction algorithm. The feature is an interesting part of an image or frame. It can be used to detect the corner points of selected frame. The features point selection is used to differentiate the frame from its neighbouring points and this method can be possible to match it uniquely with the corresponding point in another frame. Therefore, the neighbourhood of a feature can explicitly be different from the neighbourhood points obtained from the video frames.

C. Discrete wavelet transform

Discrete wavelet transforms (DWT) are enhanced to discrete the data sets and produces the discrete outputs. Discrete wavelet transforms map data from the time domain to the wavelet domain. The discrete wavelet transform (DWT) is an implementation for the discrete set of the wavelet scales and translations. This transform decomposes the signal into orthogonal set of wavelets. Discrete wavelet transform can be used for fast de-noising of a noisy signal. Then the original image is decomposed into 4 frequency sets that is one low-frequency (LL) and three high-frequency (LH, HL, HH) sets. Here in this image only LL single level component DWT transformation is performed on the image for embedding and extraction process.

LL	HL
LH	HH

Fig 2 : One level DWT image

D. Feature point matching

In order to synchronize the embedding region and extracting region, we have to find the common local features between the deformed video and the original video. By using the Harris feature point matching, we find that we can detect the matched feature for recovering the deformed video. The corner points are matched with the randomly generated secret key frame number and the frame patch of different users. Thus the features points are matched according to the corner point detection by using Harris feature point matching method.

E. Embedding algorithm for watermarking

Our Embedding method for watermarking is done by the following steps:

Step 1: Extract one frame R from the original video I according to the secret key generation in the tree structure and extract the Harris feature points of frame R and frame-patch P.

Step 2: Then, those feature points are matched using the Harris feature point matching with each other to find the region for embedding.

Step 3: Convert the RGB frame of the matched region to YCbCr color space in the frame.

Step 4: Transform Y-component of the frame into Discrete Wavelet Transform (DWT).

Step 5: Embedding $T(a,b) \in \{0, 1\}$, $1 \leq a,b \leq N$ to Y-component in the frequency domain, where $N \times N$ is the size of the watermark content. T(a,b)is converted into an array $T_l(c) = T(a,b)$, $c = a + b\,N$, $1 \leq a,b \leq N$.

One bit $T_l(k)$ is embedded into the DWT coefficient in the frequency domain.

Step 6: Compute the inverse DWT to obtain the modified Y-component and compose it with the Cb and Cr components.

Step 7: Convert the modified YCbCr frame to obtain the modified RGB frame.

Repeat Step 1 to Step 7 for all the frames in video, we can obtain the watermarked video.

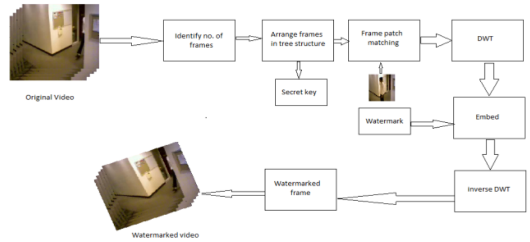

Fig 3: Block diagram for watermark embedding process

F. Extraction algorithm for watermarking

Fig. 3 describes how to extract the embedded content from the watermarked video by using Harris feature points matching in the frame-patch. This procedure consists of the following steps.

Step 1: Extract one frame R from the watermarked video T by the secret generation from the tree structure and extract the Harris feature points of it. Next, the feature points of frame-patch P is used to match with those of frame R and detect the embedded region.

Step 2: Based on matched feature points, the rotation, the scaling, and the translation parameters of the deformed video are calculated. Then, the deformed video is restored.

Step 3: Convert the RGB frame of the matched region to YCbCr color space.

Step 4: Transform the Y-component to a frequency domain using DWT.

Step 5: Here, the embedded content $T_l(c)$ can be extracted from the matched region.

Repeat Step 1 to Step 5 for all the frames in video, we can get all watermark content from the watermarked video.

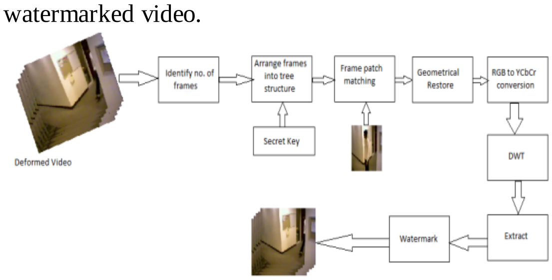

Fig 4: Block diagram for watermark extraction process

III RESULTS AND DISCUSSIONS

In this paper, we used the vipmen.avi as the input video. It consists of 283 frames and the each frame size is 561X 425 pixels. The input fame patch is also shown in the figure 6. It consists of 237X1 corner points in each frame. The size of the frame patch is 57.3KB.

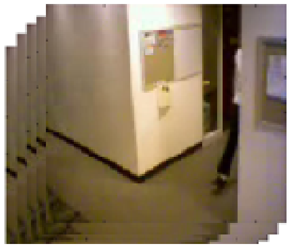

Fig 5: Input video : vipmen.avi
Size : 283 frames

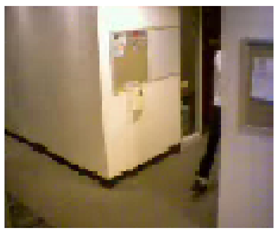

Fig 6: Input frame patch
Size: 57.3 KB

The quality of the watermarked video can be determined by the Peak Signal to Noise Ratio (PSNR).

Peak Signal to Noise Ratio

Peak Signal-to-Noise ratio, often abbreviated as PSNR, is termed as the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. Since many signals had dynamic range, it is expressed in terms of the logarithmic decibel scale. PSNR is commonly used to measure the quality of reconstruction for the lossy compression codes (e.g., for video compression). The signal here is the original content, and the noise is the error introduced by compression. PSNR is an approximation to human perception of reconstruction quality. Although a higher PSNR generally indicates that it is the reconstruction is of higher quality of the video.

Therefore the PSNR value of watermarked video is expressed as:

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

Result comparison

The following table shows the result comparison of PSNR values of different authors and the value of proposed method.

Table I: PSNR Value and Author name of various methods

Author name / Attacks	Divjot Kaur Thind	Sanjana Sinha	Hongyuan Chen & Yuesheng Zhu	Nisreen I. Yassin	Osama S. Faragallah	Proposed method
Gaussian Noise	33.2908	31.1564	33.45	29.807	36.69	37.79
Poisson Noise	35.6241	32.09	35.00	22.88	27.48	36.02
Salt and pepper noise	32.3132	24.4592	30.06	32.06	34.33	40.25
Gamma correction	36.8717	24.56	19.59	15.26	33.42	37.21
Rotation and cropping	38.2881	28.8256	15.88	15.88	38.09	40.32
Compression	32.56	33.45	34.55	41.48	33.41	42.35

IV CONCLUSION

In this paper, we have employed the Harris feature point extraction to develop video watermarking and the frame selection using secret key generation of dedicated cryptographic algorithm to achieve robustness. By using the proposed method, the frame selection is easy to match with the frame patch of different user. In this we can solve three challenges. First, we have proposed the frame-patch matching technique using the Harris feature point extraction for synchronizing the embedded and extraction regions in the watermarking video. Second, by introducing the Harris feature point extraction, we can say that the local feature is more robust and it can help our method to restore the deformed video. Finally, based on the advantage of our method, we can provide the ways to trace the illegal redistribution and to judge the legal users when the problem of digital property dispute happens. There are still some issues left for future work. For instance, we want to reduce the computation cost to apply our method for real time video watermarking. For this issue, we have to reduce the cost of matching process, e.g by performing the generation of secret key for frame selection from the binary tree structure.

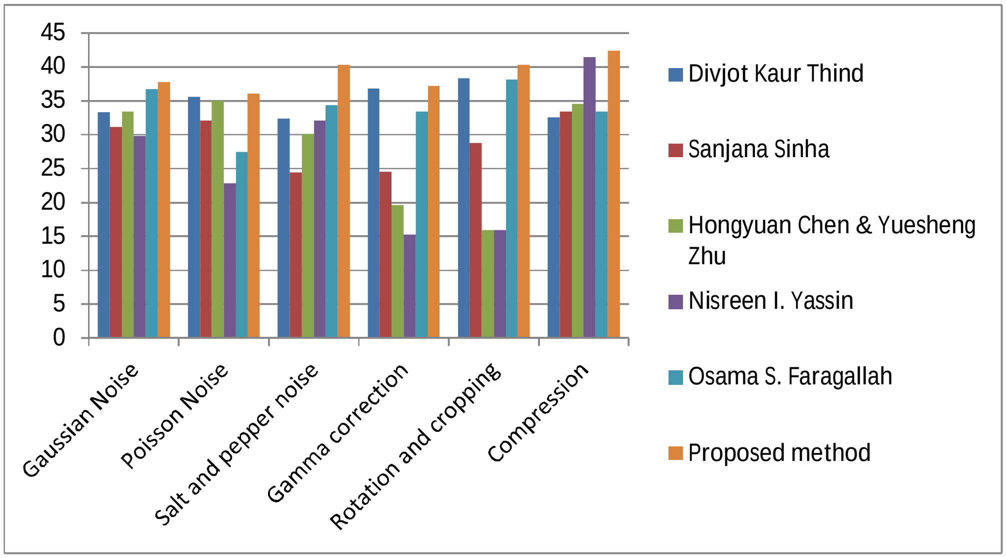

Fig 7: Graphical representation of PSNR values

In this paper, we also have focused on the high robustness of the video against geometrical attacks, video processing attacks, compression attacks and temporal attacks.

ACKNOWLEDGEMENT

We would like to thank the professors for their support and guidance to implement video watermarking technique with feature extraction.

REFERENCES

[1] Marwen Hasnaoui, Mihai Mitrea. Multi- symbol QIM video watermarking. Signal Processing: Image Communication 29 (2014)107–127.

[2] Nasrin M.Makbol, Bee EeKhoo. A new robust and secure digital video watermarking scheme based on the integer wavelet transform and singular value decomposition. Digital Signal Processing 33 (2014).

[3] Hongyuan Chen & Yuesheng Zhu A robust video watermarking algorithm based on singular value decomposition and slope-based embedding technique.

[4] Divjot Kaur Thind et.al. A Semi Blind DWT-SVD Video Watermarking. International Conference on Content and Communication Technologies (ICICT 2014).

[5] Nisreen I. Yassin et.al A Block Based Video Watermarking Scheme Using Wavelet Transform and Principle Component Analysis IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 1, No 3, January 2012.

[6] Sanjana Sinha, Prajnat Bardhan, Swarnali Pramanick, Ankul Jagatramka, Dipak K. Kole, Aruna Chakraborty. Digital Video Watermarking using Discrete Wavelet Transform and Principal Component Analysis. International Journal of Wisdom Based Computing, Vol. 1 (2), August 2011.

[7] Hamid Shojanazeri Video Watermarking Techniques for Copyright protection and Content Authentication ISSN 2150-7988 Volume 5 (2013).

[8] Mahesh Sanghavi, Archana M. Rajurkar, Rajeev Mathur and Kainjan S. Kotecha. Fibonacci Series based Watermark Embedding in a Video. International Journal of Computer Applications (0975 – 8887):2013(ICRTET'2013).

[9] Yanjiao Shia,b, Miao Qia, Yugen Yia, Ming Zhanga, Jun Kong. Object based dual watermarking for video authentication. Optik 124 (2013) 3827– 3834.

[10] R.V.Raviteja, K. Vijaya Kumar, K. Venu Gopal, A New And Secure Video Watermarking Method Based On ECC With HWD And NMF. International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 11, November – 2013.ISSN: 2278-0181.

[11] Manoj Kumar1 and Arnold Hensman. Robust Digital Video Watermarking using Reversible Data Hiding and Visual Cryptography. ISSC 2013, LYIT Letterkenny, June 20-21

[12] Majid Masoumi and Shervin Amiri A Blind Video Watermarking Scheme Based on 3D Discrete Wavelet Transform. International Journal of Innovation, Management and Technology, Vol. 3, No. 4, August 2012.

[13] Osama S. Faragallah, Efficient Video Watermarking based on singular value decomposition in the discrete wavelet transform domain,Electr Comm.(Elsevier) 2012;AEUE-50941.

[14] Satyanarayana Murty,Venkatesh K, Rajesh kumar P; A Semi Blind Video watermarking using Hybrid Transforms for copyright Protection; International Journal of Computer Applications(0975-8887) 2012;Volume51 No.9.

[15] N. Leelavathy, E. V. Prasad and S. Srinivas Kumar. A Scene Based Video Watermarking in Discrete Multiwavelet Domain. International Journal of multidisciplinary sciences and engineering, vol. 3, no. 7, July 2012.

[16] Survey on Digital Video Watermarking , Volume 1, No. 2, April 2012 ISSN – 2278-1080 The International Journal of Computer.

[17] Sarada Sreepada, Venkateswara Prasad Evani"A Novel Copyright Protection Model through IDWT", International Journal of Engineering Trends and Technology (IJETT), V27(3),129-132 September 2015. ISSN:2231-5381.