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Review on Comparative Analysis of Different Video Watermarking Techniques with DWT-SVD-DCT

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ABSTRACT: Rapid growth in last few years in the image watermarking among various techniques like DWT, DCT, and SVD found to be significant regarding robustness, imperceptibility, data payload etc. Hybrid technology like DWT-SVD, DCT-SVD, DWT-DCT-SVD techniques for image watermarking used to give better tradeoff between performance, robustness and data payload. In this paper survey on available video watermarking techniques is performed, also feasibility study on watermarking techniques meeting application specific criteria for various types of attacks and perform survey on comparative analysis of DWT-SVD-DCT watermarking algorithm based on robustness and computational complexity.

Keywords: DWT-DCT, DCT-SVD, DWT-DCT, SVD.

I. INTRODUCTION

The usage of High speed computer networks, the Internet and the World Wide Web for communication and information sharing leads to increase in size of internet. Due to this the volume of multimedia data (images, text, video/audio) also increasing Extensive and easy accesses to multimedia contents and possibility to make unlimited copy without loss of considerable fidelity have motivated the need for digital rights management [1]. Digital watermarking is a technology that can serve copyright protection to multimedia information or multimedia data. Various digital watermarking schemes have been proposed in digital images video, audio and other multimedia objects. Digital watermarking means embedding the secret information in the form of watermark into the digital multimedia objects such that it can be detected or extracted later in order to make an assertion about the object. The purpose of watermarking is to embed information imperceptibly, robustly with having high data payload. In the host data parameters in digital watermarking are: data payload, fidelity and robustness [2]. Digital watermarking has been widely used for still images but now they are also used for other multimedia objects such as audio and videos Digital video watermarking is the process of embedding and extracting watermark from the videos. There are many algorithms of video watermarking some based on the group of continuous still images and some are based on temporal dimension.

II. Video Watermarking

Watermarking techniques can be applied in two domains: Spatial domain and transform domain. Spatial values which changes the intensity values (Luminance, Chrominance and color space) on overall video frames.[3]Previously watermarking techniques were based on spatial domain example least significant bits (LSBs). This method is easy and simple however they are not robust against common digital signal processing operations such as video compression. Frequency domain technology embeds watermark in the transform of the signal. The main strength of frequency domain techniques is addressing the restrictions of spatial methods, moreover special features to represent an alternative view of a signal. The main drawback with frequency domain refers to high computational requirement. Three techniques in frequency domain are namely Discrete Cosine Transform, Discrete Wavelet Transform, Discrete Fourier Transform, Singular value decomposition

III. Techniques of Video Watermarking

A. Singular Value Decomposition: The SVD is popular linear numerical technique used to solve mathematical problem that provides tool for analysis of matrices. [2] It is an effective way for extracting algebraic features from an image. It was first introduced by Beltramiand Jordan in 1870 for square matrices and then Eckart and Young in 1936 extended to rectangular matrices provided its application in image processing and watermarking.[3][4]

The SVD of an image has good stability even when there is a small disruption. In order to get high imperceptibility, robustness and payload, two algorithms of SVD are used which are based on algebraic transform of singular value decomposition.

1. In first algorithm watermark bit information are embedded in the SVD-transform video in a diagonal wise fashion.[5]The diagonal wise algorithm achieved better robustness result.
2. In second algorithm bits are embedded in a block-wise fashion, block-wise algorithm gave higher data payload rate The SVD belongs to orthogonal transform which decompose the given matrix into three matrices of same size. To decompose the matrix using SVD technique it need not be a square matrix. Let us denote the image as matrix A. The SVD decomposition of matrix A is given using

$$A = USV^T$$

U and V are matrices such that UU^T =I, VV^T= I, where I is U = V, U matrix Scaled left singular values and V matrix is called right singular values. Each of s specifies the luminance of an image layer while the corresponding pair of singular vector specifies the geometry of the image layer The decomposition of matrix A is obtained using SVD (A) = U S V^T =S such that all the elements in main diagonal are in decreasing order like S1= S2= Sn where S is the diagonal matrix having all positive singular values in its main diagonal of A. Number of nonzero values the rank of the matrix These positive singular values can be used to embed watermark. The order of singular matrix is same as A, and hence the resultant matrix is also square. Hence images of equal size can be taken as cover object.

B. Discrete Cosine Transform: The most popular and classic domain for image processing is that of the Discrete Cosine Transfer. In block-based DCT transform image is segmented in three frequency sub-bands: Low frequency sub-band, mid-frequency sub-band and high frequency sub-band. It is much easier to embed watermarking information into the middle frequency bands of an image. DCT transformation is based on two facts:

1. In first fact the most of the signal energy lies at the low frequency sub band which contains the most significant visual part of the image.
2. In second fact the high frequency component of the image are usually removed through compression and noise attacks.

In DCT domain we can have a 2-D watermark signal W, which is embedded in the middle band frequency of 8 x 8 DCT block. The 8 x 8 DCT coefficients F (u, v) are modulated according to the following equation denotes the middle band frequency coefficients, the gain factor, and the spatial domain location of an 8x8 pixel block in image coefficients in the corresponding 8 x 8 DCT block.

$$I_{W_{x,y}} = \begin{cases} I_{x,y}(u,y) + k * W_{x,y}(u,v) & if\ (u,v) \in F_M \\ I_{x,y}(u,v) & if\ else \end{cases}$$

Here FM denotes the middle band frequency coefficients, k the gain factor, (x, y) the spatial domain location of an 8×8 pixel block in image I and (u, v) the DCT coefficients in the corresponding 8 × 8 DCT block. Imperceptibility, data payload and robustness are the important requirements of and efficient watermarking scheme.

Compare to DCT, SVD based watermarking scheme has high imperceptibility and also withstands certain attacks, but not resistant to attacks like rotation, sharpening etc. Disadvantage of SVD is that it has only limited capacity. The limitation of SVD led to the development of new scheme that club the properties of DCT and SVD.This hybrid algorithm proves to be better than ordinary DCT based watermarking and ordinary SVD based watermarking scheme

C. Discrete Wavelet Transform: DWT is Multiscale approximation (MSA) mathematical tool for decomposing an image. [12].DWT is a time domain localized analysis method.[15] It differentiate time in high frequency and frequency in low frequency part of DWT transformed signal. An image is considered as two dimensional signals which are passed through various orthogonal filters like daubechies, QMFs etc which are high and low pass filters decompose into various sub bands having different resolutions.

These sub-bands are LL, LH, HL, HH which are horizontal, vertical and diagonal details as shown in fig a. This is known as first level wavelet decomposition of an image. It can be further decompose in to second level of decomposition. It is carried out on first

level LL sub band of the image which results in another level of decomposition. Watermark is embedded in high frequency sub bands because the details like sharpness, edges etc of an image are present in high frequency sub bands (LH, HL and HH) to avoid degradation of host video and make it invisible.

Cons of embedding watermark in high frequency sub band may reduce robustness. In order to get best tradeoff between performance and robustness, watermark is embedded into LH and HL sub bands. It improves the robustness and increases the capacity of embedding data. Several algorithms has been proposed on using DWT-SVD.First time SVD based algorithm using DWT was presented by Genic and Ahmet Eskicioglu(2004).[16]

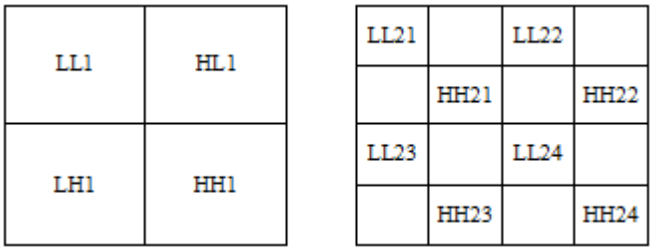

Fig a. Decomposition of image into various sub bands using DWT.

As compare to DWT-SVD, SVD-DCT scheme has enormous capacity because embedding can be perform in all the sub bands.[17]It was found that watermark to be resisted to all types of attacks except achieve good imperceptibility and rotation. Disadvantage is that the embedding and recovery are time consuming process because the zigzag scanning to map the coefficient into four quadrants based on the frequency. Alternatively if we apply DWT we get four frequency sub bands directly. So the time consumption will be greatly reduced. [18] Also, SVD is a very convenient tool for watermarking in the DWT domain.

IV. Hybrid Technique

DWT-DCT-SVD: This method satisfies all the requirements of watermarking scheme such as imperceptibility or fidelity, robustness and good capacity. Also, this method is robust against different kind attacks likes rotation and sharpening. In this algorithm the properties of SVD and DWT are clubbed. In this method the wavelet coefficients of the host image are utilizes to embed the watermark. Any of the three high frequency sub bands of wavelet coefficients can be used to watermark the image. The DCT coefficients of the wavelet coefficients are calculated and singular values decomposed. The singular values of the host image and watermark are added to form the modified singular values of the watermarked image. Then the inverse DCT transform is applied followed by the inverse DWT [22]. Fig b. shows the embedding and extraction technique for DWT-DCT-SVD based video watermarking.

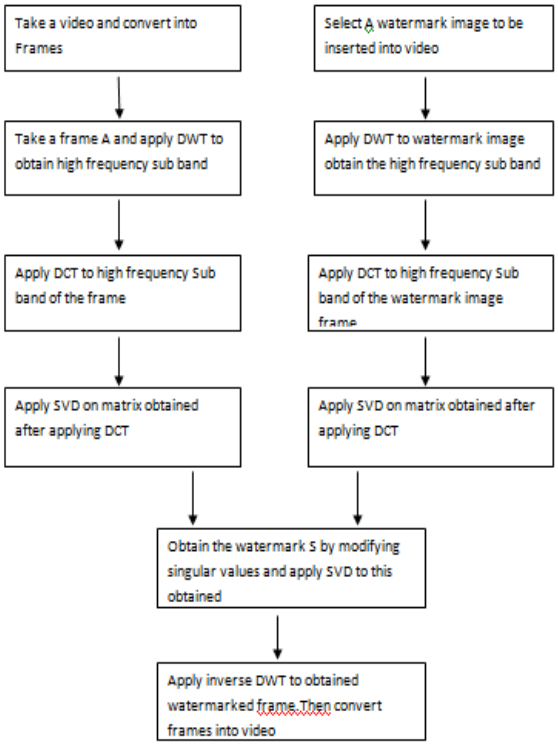

Fig b. Video watermarking using Hybrid technique DWT-DCT-SVD.

Conclusion

The technique based on DCT-SVD is very time consuming but it offers better capacity and imperceptibility. Technique DWT-SVD is found to be similar to the DCT-SVD scheme except that the process was fast. The DWT-SVD-DCT found to satisfy all the necessary requirements of an best watermarking scheme such as imperceptibility, fidelity, robustness and high data payload. Also, this method is robust against different kinds of mentioned attacks. DWT-DCT-SVD method can be used for authentication and data hiding purposes. The future work includes the extension of this technique to other various attacks and formats of videos.

REFERENCES:

[1]F. Hartung and M. Kutter, "Multimedia watermarking techniques",Proceedings of the IEEE, vol. 87, no. 7, July 1999.
[2]V.Santhi and Dr.Arunkumar Thangavelu,"DWT-SVD Combined Full Band Robust Watermarking Technique for Color Images in YUV Color Space", International Journal of Computer Theory and Engineering,Vol.1,No. 4,October 2009.
[3]Majumder, Swanirbhar and Swarnalipi, Sujata and Sarkar,Soubhik and Sarkar, Subir Kumar, "A Novel Watermarking using Multiresolution SVD", matrix, vol.1, December 2012, pp.1.
[4]Divjot Kaur Thind1 and Sonika Jindal2, A Semi Blind DWT-SVD Video Watermarking Under Attacks, International Conference on Communication, Computing & Systems (ICCCS–2014)
[5]V.Santhi and Dr. Arunkumar Thangavelu," International Journal of Computer Theory and Engineering, Vol. 1, No. 4, October2009"[6]Liu Quan, AI Qingsong "A combination of DCT based and SVD based watermarking, ICSP proceedings of IEEE International conference on signal processing, pp. 873-876, 2004.
[7]H. Andrews and C. Patterson, "Singular Value decompositions and Digital Image Processing," IEEE Trans. on Acoustics, Speech,and Signal Processing, vol. 24, no. 1, pp. 26-53, Feb. 1976.
[8]Ke-feng he, et al , "Watermarking for images using the HVS and SVD in the wavelet domain" Proceedings of IEEE International Conference on Mechatronics and Automation, pp.2352- 2356,
2006.
[9]I.J Cox, J. Kalian, F.T. Leighton, and T.Shamoon, "Securespread spectrum watermarking for multimedia" in IEEE Transactionson Image Processing, vol.6, no.12, Dec.1997, pp:1673-1687.
[10]Seitz J., Digital watermarking For Digital Media, Information Science Publishing ,United States of America, May 2005.
[11]F.Hurtang and M.Kuttar," Multimedia Watermarking Techniques" ",Proceedings of the IEEE, vol. 87, no. 7, July 1999.
[12]Aditi Agarwal et al," International Journal of Computer Science and Information Technologies", Vol. 2 (4), 2011.

[13]Nisreen I. Yassin1, Nancy M. Salem2, and Mohamed I. El Adawy3, IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 1, No 3, January 2012

[14]H. Olkkonen, "Discrete wavelet transforms – algorithms and applications", InTech, August 2011.

[15]Kaur, Ramandeep and Jindal, Sonika, "Semi-blind Image Watermarking Using High Frequency Band Based on DWTSVD",Emerging Trends in Engineering and Technology (ICETET), 2013 6th International Conference on, pp. 19—24.

[16] Faragallah, Osama S, "Efficient video watermarking based on singular value decomposition in the discrete wavelet transform domain", AEU-International Journal of Electronics and Communications, Elsevier, 2013, pp.189-196, vol 67.

[17]Sumit Kumar Prajapati,Amit Naik,Anjulata Yadav"Robust Digital Watermarking Using DWT-DCT-SVD"International Journal of Engineering Research and Application",Vol.2,Issue 3,May-June 2012.

[18]Ganic,E.,Eskicioglu,A.M.,"Robust digital watermarking:Robust DWT SVD domain image watermarking:embedding datain all frequencies",Proceedings of the 2004 multimedia and security workshop on Multimedia and Security,September2004,pp.166–174.

[19]J. J. K. O Ruanaidh, F. M. Boland, O. Sinnen,"Watermarking Digital Images for Copyright Protection",IEE 1995.

[20] Mohamed A. Suhail , Mohamed S. Obaidet , "Digital Watermarking based DCT and JPEG Model", International Journal of Computer Applications ,Volume 3, June 2010.

[21]Heena Shaikh *et al*, International Journal of Computer Science and Mobile Computing Vol.2 Issue. 3, March- 2013,pg. 137-143

[22]J. Cox, M. L. Miller, J. A. Bloom, "Digital Watermarking",.

[23] Rathod Jigisha D (July 2013). A hybrid DWT-SVD Method for Digital Video Watermarking.International Journal of Advanced Research in Computer and Communication Engineering, Vol. 2, pp. 2771-2775.

[24] V.Santhi (2009). DWT-SVD Combined Full Band Robust Watermarking Technique for Color Image in YUV Color Space.International Journal of Computer Theory and Engineering, Vol.1, pp.424-429.

[25] A Mansouri (2009). SVD-based Digital Image Watermarking using Complex Wavelet Transform. Sadhana,Vol. 34,Part 3, pp. 393-406

.[26] Akshaya Kumar Gupta (2012). A Robust and Secure Watermarking Scheme Based on Singular Values Replacement. Sadhana, Vol.37, Part 4, pp. 425-440.

[27] Pooja Malhotra (2013). A DWT-SVD based Watermarking Technique for Digital Images. International Journal of Computational Engineering Research. Vol. 3, Issue 6, pp. 1-5