Restrict Piracy of Videos using DWT-SVD based Video Watermarking

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ABSTRACT
A video watermarking algorithm using the two techniques such as discrete wavelet transform (DWT) and Singular value decomposition (SVD) Based on the block selection procedure. Using the two watermarks to increase the level of authentication as we are using the watermarks is original watermark video and other is owner's finger print. Based on the sub-band selection scores the embedding process is done by using the watermark which are embedding in the cover video watermark. DWT-SVD based video watermarking is relatively a new technology that has been proposed to solve the problem of illegal manipulation and distribution of digital video for example movie piracy. To restrict it we use the process of embedding copyright information in video bit streams, observes various attacks and archive maximum probability to retrieve that information, the proposed technique is more robust to all the possible attacks that is proved from the simulation and experimental results.

Keywords
DWT, SVD, Authentication, Watermarking, Sub Band Selection Scores

1. INTRODUCTION
Digital watermarking is a new technology used for copyright protection or authentication of digital media. Digital watermarking was introduced at the end of the 20th century to provide means of enforcing copyright protection and security of digital data. Where, ownership information data called watermark is embedded into the digital media (image, audio, and video) without affecting its perceptual quality. In case of any dispute, the watermark data can be detected or extracted from the digital media and used as a proof of ownership. Inaudibility and robustness in contrast to attacks are the fundamental issues in digital watermarking techniques [1-2]. Recently, digital video watermarking has emerged as a significant field of interest [3]. Many digital watermarking schemes have been proposed for video. Most these schemes are based on the techniques of image watermarking, but video watermarking has some issues not present in image watermarking. This is because video sequences have some discriminate characteristics such as the temporal and inter-frame characteristics, which require specific approaches for video watermarking [4-7].

Video watermarking can do in spatial or transform domain. Spatial domain watermarking wherever embedding and detection of watermark are performed by directly manipulating the pixel intensity values of the video frame. Transform domain techniques, alter spatial pixel values of the host video allowing to a pre-determined transform and are more robust than spatial domain techniques since they scatter the watermark in the spatial domain of the video frame making it tough to eliminate the watermark through malicious attacks like cropping, scaling, rotations and geometrical attacks. The commonly used transform domain techniques are Discrete Fourier Transform (DFT), the Discrete Cosine Transform (DCT), and the Discrete Wavelet Transform (DWT). The frequency domain watermarking schemes are relatively more robust in lossy compression, noise addition, pixel removal, rescaling, rotation and cropping. It is almost impossible to distinguish subjectively which images are original, and which have been influenced by attack. Image validation techniques keep images free from malicious manipulation at each phase of transmission and storage.

2. RELATED WORK
In 2002, Wang, John F. Doherty, Robert E. Van Dyck proposed A Wavelet-Based Watermarking Algorithm for Ownership Verification of Digital Images in that they discussed a practical digital watermarking system for ownership verification requires. Besides perceptual invisibility and robustness, they claim that the private control of the watermark is also very important [1]. In Feb. 2005, Nicola Checcacci proposed watermarking of MPEG-4 Video Objects they stated that one of the key points of the MPEG-4 standard is the possibility to access and manipulate objects within a video Sequence [2]. In June 2010, Nakano-Miyatake stated that a public video watermarking algorithm, whose robustness depends on the embedding energy, which must be limited due to the degradation of video sequence caused by the same watermark signal.[3] . In 2010 Peng Cao proposed A DWT-DCT Based Blind Watermarking Algorithm for Copyright Protection they stated propose a blind watermarking algorithm combination of Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT).[4] In 2011,Celia Shahnaz and Shaikh Anowarul Fattah proposed A Basic Digital Watermarking Algorithm in Discrete Cosine transformation Domain they discussed some basic algorithms of digital watermarking technique using LSB (Least Significant Bit) and DCT (Discrete Cosine Transformation).[5] In Nov 2013, Baiying Lei and Ee-Leng Tan stated Robust SVD-Based Audio Watermarking Scheme with Differential Evolution Optimization they described that a robust audio watermarking scheme based on singular value decomposition (SVD) and differential evolution (DE) using dither modulation (DM) quantization algorithm is proposed. In Sept 2014,Andrew J. Lambert, and Mark Richard Pickering proposed Imperceptible and Robust Blind Video Watermarking Using Chrominance Embedding: A Set of Approaches in the DT CWT Domain in that they stated that extracts the watermark from any level(s) of the dual-tree complex wavelet transform depending on the resolution of the downscaled version of the watermarked frame rather than only from the embedding level to survive downscaling to an arbitrary resolution[6].

3. PROPOSED METHOD

The planned watermarking method is established on the combination of DWT and SVD.

3.1 DWT

The mathematical tool used for hierarchic decomposition of a picture is that the separate ripples remodel (DWT). DWT separate signal into low and high elements. The low frequency half is split once more into low and high frequency elements, whereas the high frequency elements have merely the sting part data. These high frequency elements will generally used for watermarking since the human eye is sensitive to smaller changes in edges. The 1-level DWT decomposes a picture into approximation elements and the careful elements. The approximation elements that is the lower resolution pictures represents as A11 and also the careful elements that is the horizontal, vertical and diagonal elements drawn by HL1, LH1 and HH1 severally. The two level of 2D-DWT is computed by applying DWT formula on the LL1 that more rotten the LL1 half in to four sub bands as LL2, HL2, LH2 and HH2. As a pair of level 2D-DWT method is shown within the fig.1

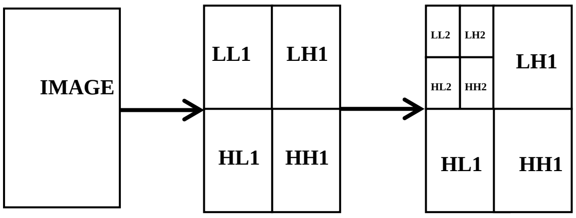

Fig 1: A 2 level 2D DWT

3.2 SVD

The singular price decomposition (SVD) involves the factoring of a true or complicated rectangular matrix with several applications in image process, signal process and statistics. The SVD (Singular price Decomposition) for an oblong matrix A is given as,

$$A = U\,S\,V^T \tag{1}$$

Where,

A - m×n matrix,

U, V - orthonormal matrices,

S – Diagonal matrix comprised of singular values of A.

3.3 Color Conversion

The YCbCr color area is wide utilized in digital video. in this the Y part represents brightness information, and therefore the parts CbCr is for color info, where as, the Cb part represents the blue and a reference price variations and therefore the chromium part represents the red and a reference price variations. The expression below shows the RGB to YCbCr color model,

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} + \begin{bmatrix} 65.481 & 128.553 & 24.966 \\ -37.797 & -74.203 & 112.00 \\ 112.00 & -93.786 & -18.214 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{2}$$

Again, for the transformation of YCbCr to RGB color model is given as,

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 0 & -0.344 & 1.77 \\ 1.103 & -0.714 & 0 \end{bmatrix} \begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} \tag{3}$$

3.4 Embedding Algorithm

Step 1: Convert Input cover Video And Watermark video into frames.

Step 2: Apply RGB to YCbCr Conversion on every cover video frame.

Step 3: Perform 2-level DWT on Y Element of every cover video frame.

Step 4: Perform sub band choice rule

Supported the below formula, the score Z_r is calculated as:

$$Z_r = \sum_p \sum_q |(X_r(p,q))| / M_r N_r \tag{4}$$

where, M_r and N_r correspond to dimensions of every constant matrix x_r of sub band x at level r. variations and therefore the chromium part represents the red and a reference price

Step 5: Choose sub bands with top two scores and named as subband1 and subband2.

Step 6: Embedding the Watermark video frame and the Finger print image in the sub bands which has highest score and the next highest scores respectively,

1. Divide the selected sub bands into blocks of size equal to the size of the watermark frame and fingerprint image respectively
2. Compute the score for each block using Step 4
3. Calculate block based SVD on the highest score block of the selected sub band as

$$A_1 = U_i S_i V^T{}_i \tag{5}$$

Where, α represents robustness factor

W1j represents j^th Watermark frame,

W2j represents Fingerprint image, where j=0 (means same fingerprint image)

4. Modify the singular values of the selected

Block of the sub bands with watermark frame and fingerprint image as follows, where, i represents one of the sub bands.

$$S'_i = S_i + \alpha W_{ij} \tag{6}$$

Where,

α Represents robustness factor

W1j represents j^th Watermark frame,

W2j represents Fingerprint image, where j=0 (means same fingerprint image)

Step 7: Reconstruction of modified

Subband DWT Coefficient using SVD

$$A_i = U_i S'_i V^T{}_i \quad \ldots (7)$$

Step 8: Obtain the watermarked frame using Inverse DWT.

3.5 Extraction Algorithm

Step 1: Convert Watermarked Video into frames

Step 2: Apply RGB to YCbCr Conversion on each frame

Step 3: Perform 2-level DWT on Y component of each Frame

Step 4: Repeat Step 4 and 5 of Embedding algorithm for Subband Selection and block selection.

Step 5: Calculate SVD on the selected block of each sub band.

Step 6: The extracted fingerprint image is compared with the original fingerprint image.

Step 7: If Step 6 is true, the extracted frame from Step 5 is an authenticated watermark else, unauthenticated watermark

4. SIMULATION AND RESULTS

4.1 Experimental Result

We can observe result for quality of watermarked videos with reference to various parameter and various attacks with various values of alpha.

SALT AND PEPPER NOISE

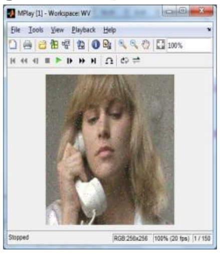

Figure 1(a): Salt and pepper noise

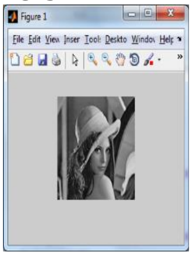

Figure 1(b): Secret image

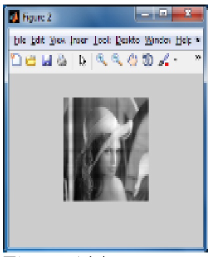

Figure 1(c): Extracetd secret image

CROPING ATTAC

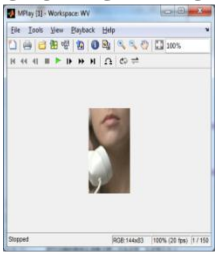

Figure 2(a): Cropping attack

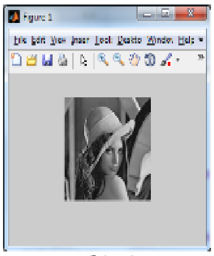

Figure 2(b): Secret image

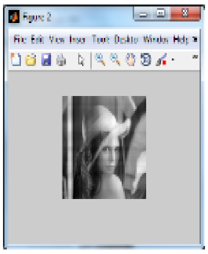

Figure 2(c): Extracetd secret image

SCALING ATTACK

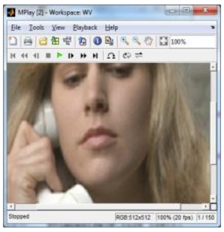

Figure 3(a): Scaling attack

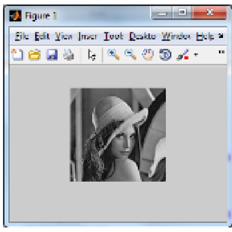

Figure 3(b): Secret image

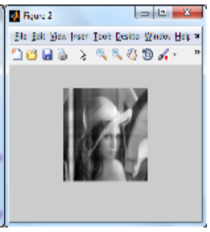

Figure 3(c): Extracetd secret image

ROTATION ATTACK

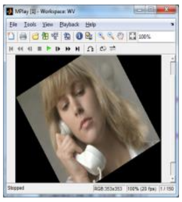

Figure 4(a): Rotation attack

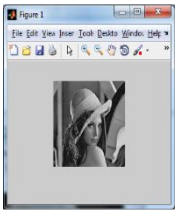

Figure 4(b): Secret image

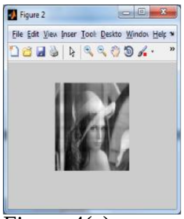

Figure 4(c): Extracetd secret image

NO ATTACK

Figure 5(a): No attack

Figure 5(b): Secret image

Figure 5(c): Extracetd secret image

4.2 Performance Parameter Result

From this analysis of performance parameter estimation of various attacks we can also find the best values of PSNR, MSE and NC for those attacks. Following tables shows that estimated value. According to simulation results we get highest value of PSNR ie 60.40 db obtained at no attack condition when alpha (α) =0.1, so this value gives most efficient and good results for our DWT-SVD based algorithm.

Table 1: Simulation Result for α=0.1

PARAMETER	MSE	PSNR	NC
Salt and pepper noise	0.08197	58.99	2.1163
Cropping attack	0.0709	59.62	1.7871
Scaling attack	0.0594	60.39	2.137
Rotation Attack	0.0711	49.61	1.5502
No attack	0.0594	60.40	2.141

Table 2: Simulation Result for α=0.2

PARAMETER	MSE	PSNR	NC
Salt and pepper noise	0.1420	56.6088	2.0669
Cropping attack	0.1411	56.6362	1.7463
Scaling attack	0.1187	57.3855	2.0875
Rotation Attack	0.7205	49.5548	1.5140
No attack	0.1188	57.3840	2.0877

Table 3: Simulation Result for α=0.3

PARAMETER	MSE	PSNR	NC
Salt and pepper noise	0.1972	55.18	2.023
Cropping attack	0.2055	55.00	1.711
Scaling attack	0.1768	55.68	2.044
Rotation Attack	0.7377	49.47	1.480
No attack	0.1769	55.63	2.049

Table 4: Simulation Result for α=0.4

PARAMETER	MSE	PSNR	NC
Salt and pepper noise	0.25	54.09	1.98
Cropping attack	0.2610	53.90	1.68
Scaling attack	0.2330	54.44	1.99

Rotation Attack	0.7412	49.38	1.45
No attack	0.23	54.43	2.02

Table 5: Simulation Result for α=0.5

PARAMETER	MSE	PSNR	NC
Salt and pepper noise	0.3104	53.21	1.9420
Cropping attack	0.3210	53.05	1.6571
Scaling attack	0.2903	53.50	1.9601
Rotation Attack	0.7610	49.28	1.4224
No attack	0.2904	53.49	1.9608

Table 6: Comparison with existing algorithms

PARAMETER	DCT Ref.4	DCT-DWT Ref.4	DWT-SVD Alpha=0.1
PSNR(db)	31.69	37.71	60.40

5. CONCLUSIONS

Comparing with the existing techniques the proposed method is robust in nature using for the high level of authentication which is based on the DWT and SVD process. From the approach of the simulation results ,using the proposed method which is robust in nature with the different attacks are of alike such as Noising attack: Salt and Pepper attack, image processing attack: Contrast Adjustment, geometrical attack: Rotation and Cropping. We also observed that parameter like PSNR,MSE and NC give their best value at no attack situation. In the embedding algorithm, we are embedding a cover video with different watermark frames and same finger prints in all the frames. As an extension and a future scope we can go for embedding the watermarks on the frame which doesn't have any motion by applying the motion estimation algorithms on the cover video, which may helps us in finding the location of embedding.

6. REFERENCES

[1] Yiwei Wang John F. Doherty and Robert E. Van Dyck, A Wavelet-Based Watermarking Algorithm for Ownership Verification of Digital Images, ieee transactions on image processing, vol. 11, no. 2, february 2002.

[2] Mauro Barni, Franco Bartolini and Nicola Checcacci Watermarking of MPEG-4 Video Objects, ieee transactions on multimedia, vol. 7, no. 1, february 2005

[3] R. Reyes, C. Cruz, M. Nakano-MiyatakeDigital Video Watermarking in DWT Domain Using Chaotic Mixtures, ieee latin america transactions, vol. 8, no. 3, june 2010.

[4] Liu Ping Feng, Liang Bin Zheng, Peng Cao, A DWT-DCT Based Blind watermarking Algorithm for Copyright Protection, 978-1-4244-5540-9/10/$26.00 ©2010 IEEE.

[5] Md. Asikuzzaman, , Md. Jahangir Alam, Andrew J. Lambert and Mark Richard Pickering, Approaches in the DT CWT Domain ieee transactions on information forensics and security, vol. 9, no. 9, september 2014.

[6] Andras Boho, Glenn Van Wallendael, Ann Dooms, Jan De Cock, Geert Braeckman, Peter Schelkens, Bart Preneel, and Rik Van de Walle,End-To-End Security for Video Distribution, IEEE signal processing magazine [97] march 2013.

[7] Glenn Van Wallendael, Student Member, IEEE, Andras Boho, Jan De Cock, Member, IEEE,Adrian Munteanu, Member, IEEE, Rik Van de Walle, Member, for High Efficiency Video Codingwith Video Adaptation Capabilities IEEE Transactions on Consumer Electronics, Vol. 59, No. 3, August 2013.

[8] Non-Blind Structure-Preserving Substitution watermarking of h.264/cavlc inter-frames ieee transactions on multimedia 5, august 2014 .

[9] Neha Agrawal and Anubha Gupta,"DCT Domain Message Embedding in Spread-Spectrum Steganography System", ieee data compression conference, 2009 .

[10] Lu CS, Liao HYM, Sze Cj. Structural digital signature for image authentication: an incidental distortion resistant scheme. In: Proceedings of the multimedia security workshop 8th ACM international conference on multimedia.2000.p.115-18.

[11] Lin CY, Chang SF. "A robust image authentication method surviving JPEG lossy compression". In: Proceedings of SPIE international conference on storage and retrieval of image/video database, vol.3312.1998.p.296-307.

[12] Lin ET, Podilchuk CI, Delp EJ."Detection of image alterations using semi-fragile watermarks". In: Proceedings of SPIE conference on security and watermarking of multimedia contents. 2000.p . 152-63

[13] C-H.Lee, and Y-K.Lee, "An Adaptive Digital Watermarking Technique for Copyright Protection," IEEE Trans. Consumer Electronics, vol.45, pp. 1 005-1015, Nov 1999.

[14] I.J.Cox, M.Miller and J.A.Bloom, Digital Watermarking, Morgan Kaufmann, 2002.

[15] C. T.Hsu, and J.L. Wu, "DCT-based watermarking for video", IEEE Trans. Consumer Electronics, vol. 44, pp. 206 – 216, Feb. 1998. [7] S. Mallat, "A theory for multi-resolution signal decomposition: The wavelet representation", IEEE Trans. Pattern Anal. And Machine Intel. vol. 11, no. 7, pp. 674- 693, July 1989.