IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 10, October 2016

Digital Video Watermarking Using DWT and SVD Techniques

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Abstract: Video watermarking is well known as the process of embedding copyright information in video bit streams. It had been proposed in recent years to solve the problem of illegal manipulation and distribution of digital video. In this study, an effective, robust and imperceptible video watermarking algorithm was proposed for copyright protection. This algorithm was based on a cascade of two powerful mathematical transforms; Discrete Wavelets Transform (DWT) and Singular Value Decomposition (SVD). Two different transform domain techniques showed high level of complementary and different levels of robustness against the same attack will be achieved through their combination.

Keywords: Authentication, DWT, Robust Techniques, SVD, Video Watermarking.

I. INTRODUCTION

Digital watermark is a pattern of bits inserted into a digital audio, video or image that identifies the copyright and authenticates information. The goal of watermark technique is to embed the secret information seamlessly hidden within into original message, which is robust against attacks. The use of digital video applications such as video-conferencing, digital television, digital cinema, distance learning, videophone, and video-on-demand has grown very rapidly over the last few years. Today it is much easier for the digital data owners to transfer multimedia data over the internet, and hence the data could be perfectly duplicated and rapidly redistributed on a large scale.

Hence, copyright protection has become more important. Digital watermarking is an efficient way to protect the copyright of multimedia data even after its transmission. Watermarking refers to the process of inserting a hidden structure, called a watermark, into a multimedia data that carries either, the owner's information or the receiver of the original data object. Broadcast monitoring, replica control, tracing of transaction, and protection of copyright these are the applications of watermarking. Robustness, invisibility and security are the three most important properties that need to be satisfied for such applications. Video watermarking approaches can be classified into two main categories based on the method of hiding watermark bits in the host video.

The two categories are: Transform domain technique and spatial domain technique. In spatial domain watermarking embedding and detection of watermark are carried out by directly calculating the pixel intensity values of the frame of video. On the other side, Transform domain techniques, alter values of spatial pixel of the host video according to a pre-determined transform and are more robust than spatial domain techniques since they disperse the watermark in the spatial domain of the video frame making it difficult to remove the watermark through malicious attacks like rotation, scaling, cropping, and geometrical attacks. The most frequently used transform domain techniques are Discrete Fourier Transform (DFT), the Discrete Cosine Transform (DCT), and the Discrete Wavelet Transform (DWT).

In this paper, we propose an imperceptible and robust video watermarking algorithm based on Discrete Wavelet Transform (DWT) and Singular value decomposition. DWT is more computationally efficient than other transform methods like DFT and DCT. Due to its excellent spatio-frequency localization properties. The DWT is used to identify areas in the host video frame where a watermark can be embedded imperceptibly.

II. DIGITAL VIDEO WATERMARKING

A digital watermark is a model or digital signal introduce into a digital document such as text, multimedia or graphics and carries information distinctive to the copyright owner. Some watermarking methods have been forwarded for video data. In this a method is proposed in which video sequence is assumed as a three dimensional signal with two dimensional in space and one dimensional in time. Among the delivered techniques in recent years, the ones based on the Discrete Wavelet Transform (DWT) are gaining more reputation due to their outstanding spatial localization, frequency spread and multi-resolution features. Video watermarking involves embedding cryptographic information determines from frames of digital video. Usually, a user viewing the video cannot remember a difference between the original, marked video and the unmarked video, but a watermark extraction application can read the watermark and it can obtain the embedded information. Watermark is the part of the video,

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Vol. 5, Issue 10, October 2016

rather than part of the file format. In video file format this technology works individually.

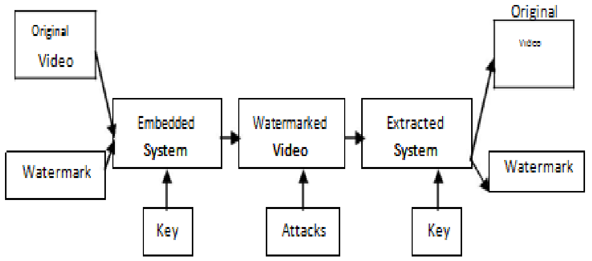

Fig.1. Block diagram of digital video watermarking

III. VIDEO WATERMARKING TECHNIQUES

Video watermarking introduces some issues not present in image watermarking. Due to large amounts of data and inherent redundancy between frames, video signals are highly susceptible to pirate attacks, including frame averaging, frame dropping, frame swapping, statistical analysis, etc. Applying a fixed image watermark to each frame in the video leads to problems of maintaining statistical and perceptual invisibility. Applying independent watermarks to each frame is also a problem. Regions in each video frame with little or no motion remain the same frame after frame.

The watermarking techniques found in the literature can mostly be grouped into six main categories which are now reviewed.

A. Spatial Domain Watermarking

Spatial Domain (SD) or spread-spectrum techniques refer to a method of watermark embedding and extraction that is performed in the spatial domain, without the need to apply mathematical transforms on the original content. The watermarks are usually encoded to form a noise-like sequence and then added to the original content, while extraction is usually performed with a correlation-based receiver. Since no mathematical transforms are required, these techniques are relatively computationally efficient. This is advantageous in real-time applications or where resources available for embedding are limited.

B. Discrete Fourier Transform Watermarking

Discrete Fourier Transform (DFT) techniques take advantage of properties of the DFT to gain robustness against attacks such as spatial and temporal shifts. In order to embed the watermark a DFT is performed on the original content after which the watermark is embedded by modifying elements in the frequency domain. After the watermark is embedded, an inverse DFT is performed to obtain the watermarked content.

C. Singular Value Decomposition Watermarking

The Singular Value Decomposition (SVD) is a technique that can be used in image compression techniques, but can also be applied to watermarking. The SVD is performed, after which the singular values are usually modified to embed the watermark. A pseudo-inverse SVD is then applied to obtain the original content. The SVD can be used on its own for watermarking, but is also often used in hybrid techniques such as which combines the SVD and the discrete cosine transform. The SVD is relatively computationally complex, but by applying it in hybrid techniques it may not be necessary to perform an SVD on the entire image, lowering the computational complexity.

D. Discrete Wavelet Transform Watermarking

In this watermarking scheme, the watermark is decomposed into different parts and embedded in the corresponding frames of different scenes in the video. As identical watermark is used within each motionless scene and independent watermarks are used for successive different scenes, the proposed method is robust against the attack of frame dropping, averaging, swapping, and lossy compression.Video is divided into different scenes by scene change detection and each frame is transformed to wavelet domain before watermark is embedded. And the watermark needs to be preprocessed, being cropped crop into different parts.

E. Discrete Wavelet Transform

This watermark scheme is based on 4 levels Discrete Wavelet Transform (DWT). All frames in the video are normalized to 256 X 256 pixel size. Normalization will be perform in both insertion and detection phase; this can make the watermark to be robust to resizing of the video frame.

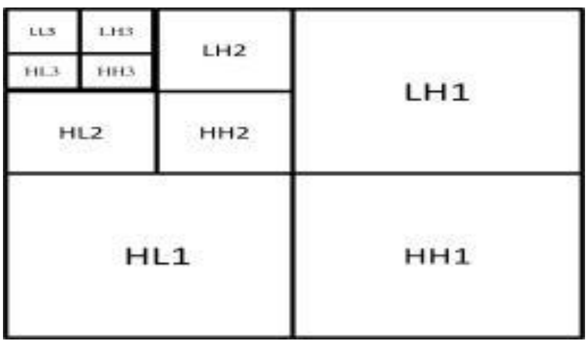

Fig.2. Discrete wavelet transform

The scheme is robust against format conversions because the watermark is inserted before compression. Otherwise, the drawback of the techniques is that, since the code is directly embedded into the compressed stream such as mpeg-4, the copyright information is lost if the video file is converted to a different compression standard, such as mpeg-2.

F. Discrete Cosine Transform Watermarking

Discrete Cosine Transform (DCT) techniques are often used to watermark compressed video streams. DCT coefficients in video streams can be modified without having to first uncompress the video or compress it again after watermarking.

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IV. PROPOSED SYSTEM

The proposed system is used for copyright protection and the watermark is added to the video signal that carries information about sender and receivers of the delivered video and attacks are given to check whether watermark is attacked or not. For embedding and extracting the watermark we are using a DWT-SVD watermarking algorithms consist of two procedures, the first embeds the watermark into the original video clip, while the other extracts it form the watermarked version of the clip.

A. Watermark Embedding Procedure Algorithm
Step 1: Divide the video clip into video frames.
Step 2: Process the frames of each video scene using DWT and SVD as described in steps 3-10.

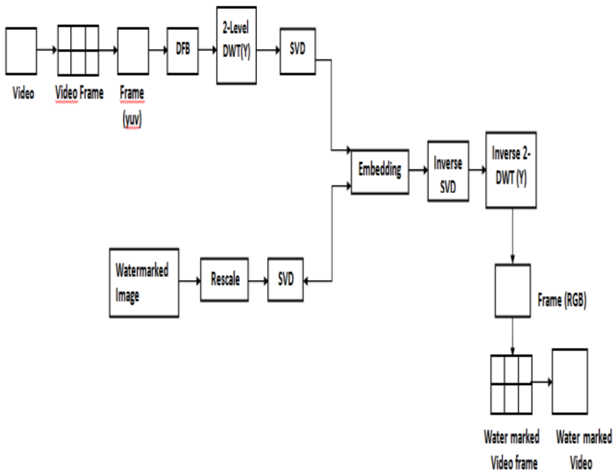

Fig.2. DWT-SVD watermark embedding procedure

Step 3: Convert every video frame F from RGB to YUV color matrix format. Y = 0.2989 * R + 0.5866 * G + 0.1145 * B U= -0.1687*R-0.3312*G+0.5*B V = 0.5 * R - 0.4183 * G - 0.0816 * B
Step 4: Perform directional filter bank decomposition on luminance part of the frame
Step5: Compute the 2-level DWT for the Y (Luminance) matrix in each frame F. This operation generates seven DWT sub-bands Each sub-band is a matrix of DWT coefficients at a specific resolution.
Step 6: Apply the SVD operator on the HL2 sub-band in each frame. The SVD operator decomposes the sub-band's coefficient matrix into three independent matrices
Step 7: Rescale the watermark image so that the size of the watermark will match the size of the HL2 sub-band which will be used for embedding.
Step 8: Embed the binary bits of watermark WVsi intoSHL2 by substituting the watermark bit Wi with the LSB (Least significant Bit) bit of SHL2 (i, i)
Step 9: Apply the inverse SVD operator on the modified SHL2' matrix to get a modified coefficient matrix HL2'.
Step 10: Apply the inverse DWT on the modified coefficient matrix HL2' . This operation produces the final watermarked Video frame F'.
Step 11: Convert the video frames F' from YUV to RGB color matrix.
Step 12: Reconstruct frames into the final watermarked Video scene Vsi'.
Step 13: Reconstruct watermarked scenes to get the final watermarked Video clip
Step 14. Repeat the steps for all frames in the video
Step 15. Independent watermarks are embedded in frame of different scenes. The watermarked signal is then transmitted or stored, usually transmitted to another person. If this person makes a modification, this is called an attack.

B. Watermark extraction procedure Algorithm
This is an algorithm which is applied to attacked signal to attempt to extract the watermark from it. If the signal was unmodified during transmission, then the watermark is still present and it can be extracted. In this extraction algorithm it should be able to correctly produce the watermark, even if the modifications were strong.

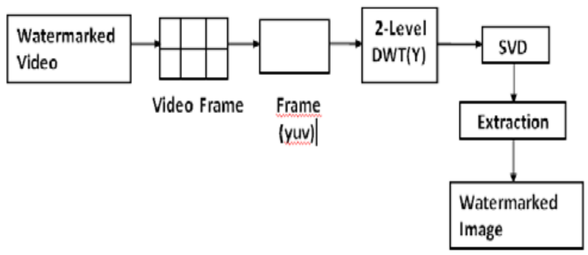

Fig.3. DWT-SVD watermark extraction procedure

Step 1: Divide the watermarked Video clip V 'into Watermarked frames.
Step 2: Process the watermarked frames of each watermarked video scene using DWT and SVD as described in steps 3 ~ 6.
Step 3: Convert the video frame F' from RGB color matrix to YUV. Y = 0.2989 * R + 0.5866 * G + 0.1145 * B U= -0.1687*R-0.3312*G+0.5*B V = 0.5 * R - 0.4183 * G - 0.0816 * B
Step 4: Compute the 2-level DWT for the frame F'. Let the seven sub-bands produced after this process be: [wLL1, wLL2, wHL2, wLH2, wHH2, wLH1, wHH1]
Step 5: Apply the SVD operator on the wHL2 sub-band. The SVD operator decomposes the sub-band's coefficient matrix into three independent matrices: wHL2 = UwHL2 SwHL2 VwHL2.
Step 6: Extract the embedded watermark from the diagonal matrix SwHL2 as follows: WVsi (i) = LSB (SHL2 (i, i))
Step 7: Construct the image watermark WVsi by cascading all watermark bits extracted from all frames.
Step 8: Repeat the same procedure for all video frames.

V. RESULT AND DISCUSSION

We are using three images from the frame sequence of digital video.

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Fig. 4. First frame

Fig. 5. Second frame

Fig.6. Third frame

A. Watermark embedding

In this process we embed the watermark to the fifth image in frame sequence.

Original cover image

Watermark image

Watermarked Image

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B. Watermark recovery

Watermarked image

Extracted Watermark

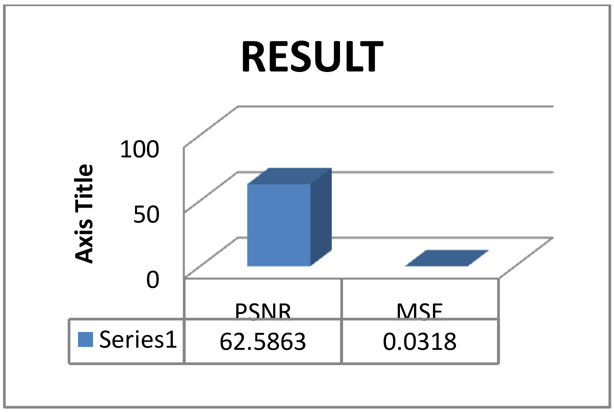

Fig. 7. MSE and PSNR values comparison

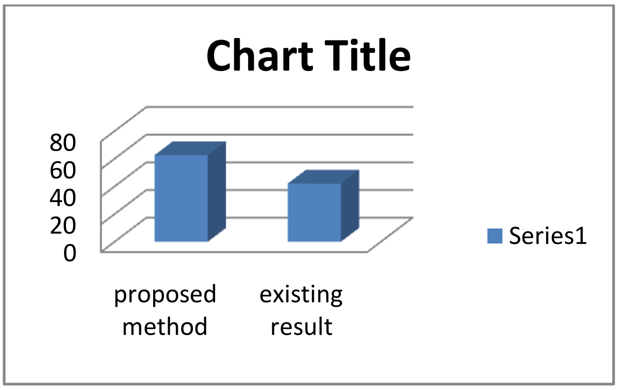

Fig. 8. Comparison chart on the basis of Peak signal to noise ratio.

VI. CONCLUSION

Video watermarking using wavelet transform is very secure watermarking technique .for image compression single value decomposition method used in the existing search papers. The existing techniques give peak signal to noise ratio 42 approx. For further enhancement in video watermarking (db10) daubechies based watermarking technique is used in proposed work and reduced single value decomposition method is used to get high level of compression. Proposed method peak signal ratio is 64.28.

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