A Survey on Different Video Watermarking Techniques

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Abstract —In last few decades there has beenrapidgrowthin video coding technology. There has been numerous new technology introduced in this field. In this paper we survey on different video watermarking techniques and there advantages and drawbacks

IndexTerms—digital video, digital video watermarking

I. INTRODUCTION

The way of distribution of digital data have been radically revolutionized and reformed with help of high speed computer network and World Wide Web. The purpose of the watermarking technology is to easy access to multimedia content and to make unlimited copy without loss of considerable fidelity have motivated the need for digital rights management. Basically video watermarking solves the problem of illegal manipulation and other type of frauds and attacks. Video watermarking involves cryptographic information derived from frames of digital video onto the video itself. Rather than part of file format of DRM system, watermarking works independently of the video file format or codec .This watermarking algorithm optimizes for three separate factors:

1. *Robustness*: The dexterity of the watermark to contend attempts by an attacker to ravish it by transfigure the size, rotation, quality, or other aspects of the video.
2. *Security*: The dexterity of the watermark to contend attempts by anattacker to expel it or transfigure it via cryptanalysis, without modifying the video itself.
3. *Perceptual fidelity*: the perceived visual quality of the marked video compared to the original, unmarked video.

A huge numberof watermarking schemeshavebeenproposedtohidecopyright marksandother informationindigital images, video, audio andothermultimediaobjects[1,andreferencestherein]

A watermark is digital data embedded in multimedia objects such that the watermark can be detected or extracted at later times in order to make an assertion about the object. the main purpose of digital watermark is to embed information imperceptibility and robustly in the host data typically the watermark contains information about the origin , ownership, destination, copy control, transaction etc. potential application of digital watermarking include transaction tracking, copy control, authentication and legacy system enhancement and database linking etc. [2]

Growing popularity of video based applications such as Internet multimedia,wireless video,personal video recorders, video-on-demand, set-top box, video phone and video conferencing havea demand formuchhighercompressiontomeetbandwidthcriteriaandbestvideoquality as possible. Different videoEncoderDecoders(CODECs) haveevolved to meet the current requirementsof video application based products

II. VIDEO WATERMARKING

A: Digitalwatermarking:

Digital water marking is also known as water mark insert ionor watermark embedding,representsthe method of interpose information into multimedia data also called original media or cover mediae.g. text,audio,image,video.

The inserted information orwatermark canbeaserialnumber orrandom number sequence, ownershipidentifiers, copyrightmessages, control signals, transaction dates, information about the creators ofthe work, bi-level or graylevel images, textor otherdigitaldataformats.

B: Watermarking Requirements

The tradeoff between the watermarking requirements can make the effectiveness of each approach. The relative importance of each requirement is somewhat application dependent. Several of the requirements may be correlated whereby an improvement in one requirement may somewhat lead to the deterioration or improvement of the other. In copyright protection the need to retrieve watermark (independent form the image) focus on robustness among the requirements for this application, but in authentication the criteria changes as the goal is to discriminate between malicious and no malicious attacks and localization of tampered area.

A. *Fidelity*: An effective watermarking system should meet a high level fidelity as one the main requirements of watermarking. The distortion made through the watermark embedding should not exceed from a certain level that viewer can make sense.

B. *Robustness:* Generally an ideal robust video watermarking system is resistant against any malicious attacks such as watermark removal using signal processing methods and frame dropping while it must tolerate normal distortion and noises. For example noise can be added to a video during the transmission over a public network, a good watermarking system is capable of watermark detection regardless to noise distortion. To improve the robustness of a watermark, perceptually significant portions of a signal are suitable locations for watermark embedding .The level of watermarking robustnessdepends to the video application. A proposed approach forvideo authentication does not need to provide a high levelof robustness. Video authentication schemes exploit fragiletechniques to detect the tampering in a video

C. Use of the Key: The improvement of security by using a secret key is involved with cryptography techniques which enhance the robustness of the watermarking algorithm.

D. Speed: Withdevelopment of high speed hardware's and computingtechnologies, speed became as a least requirement is awatermarking system. Basically this requirement points to lightweight and non-complex watermarking algorithms whichare ideal for low cost micro-controllers.

E. Capacity: Capacity refers to a maximum number of bits are allowed to embed in a cover media. In video watermarking capacity is not high priority requirement due to the nature of cover object which is big size. The size of the watermark depends on application which determines the type of watermark data and embedding policy.

F. *Statistical Imperceptibility*: Along with fidelity of a watermarking system which make the watermark invisible for the viewer, it should
be statistically imperceptible too. It means an statistical analysis should not be able to reveal the watermark.

G. Low Error Probability: This requirement implies an ideal situation for watermark detection. An ideal watermarking system should detect the watermark accurately with the minimum probability of failing in detection, false-negative, false-positive and detection of non-exist watermark.

H. Real-time Detector Complexity: For real time applications such as video on demand a low complexity algorithm should be adopted. The process of detection and extraction should be light weight to can respond in an appropriate time.

III. VIDEO WATERMARKING TECHNIQUES

Apparently any image watermarking technique can be prolongedto watermark videos, but in reality video watermarking techniques needtomeetotherchallenges than thatinimagewatermarking schemessuchaslargevolumeof inherentlyredundantdatabetweenframes,the unbalance betweenthe motionandmotionlessregions,real-time requirements in the video broadcasting etc. . Watermarked video

sequences are very muchSusceptible to pirate attacks such as frame averaging, frame swapping, statistical analysis, digital analog (AD/DA) conversion and loss compressions.
Video watermarking application can be grouped as security related like copy control, fingerprinting, ownership identification, taper resistance etc. or value added applications like legacy system enhancement, database linking[1], video
tagging, digital video broadcast monitoring , media bridge etc.

Apart from robustness, reliability, imperceptibility, practicality, video watermarking algorithms should also address issues such as localized
Detectionreal time algorithm complexity, synchronization recovery, effects of floating point representation, power dissipation.
According to working domain, video watermarking techniques are classified in pixel domain the watermark is embedded
in the source video by simple addition or bit replacement of selected pixel positions. The advantage of using pixel domain technique are that they are conceptually simple to understand and the time complexity of these techniques are low which favors real time implementations . but these techniques lacks in providing adequate robustness and imperceptibility requirements.

In transform domain methods, the host signal is transformed into different domain and watermark is embedded in selective coefficients. Commonly used transform methodologies are discrete cosine transformation (DCT) and discrete wavelet transformation (DWT). Detection is generally performed by the transforming the received signal into appropriate domain and searching for the watermarking patterns or attributed. The main advantage of the transformed domain properties. For example working in the frequency domain enable us to apply more better robustness and imperceptibility criteria.
Commutative encrypted &watermarking in video compression video: This scheme is proposed to implement commutative video encryption and watermarking during advanced video coding process. In H.264/AVC compression, the intra-prediction mode, motion vector difference and discrete cosine transform (DCT) coefficients'signs are encrypted, while DCT coefficients' amplitudes are watermarked adaptively. To avoid that the watermarking operation affects the decryption operation, a traditional watermarking algorithm is modified. The encryption and watermarking operations are commutative. Thus, the watermark can be extracted from the encrypted videos, and the encrypted videos can be re-watermarked. This scheme embeds the watermark without exposing video content's confidentiality, and provides a solution for signal processing in encrypted domain. Additionally, it increases the operation efficiency, since the encrypted video can be watermarked without decryption. These properties make the scheme a good choice for secure media transmission or distribution

A content adaptive digital watermarking scheme in H.264/AVC compressed video:
A digital video watermarking scheme under the framework of H.264/AVC is proposed in this technique. The watermark signal is embedded into quantization indices of intra-coded slices to ensure both the effectiveness of watermarking and the compact size of video data. The luminance masking of Watson's visual model is employed to guarantee the imperceptibility of watermark signal. The coding procedure of H.264/AVC is taken into account in the design of watermarking procedures to achieve efficiency.

A real time video watermarking using adjacent luminance blocks correlation based compresses domain:
Based on the strong correlation of adjacent luminance blocks, a video watermarking algorithm based on the correlation of adjacent luminance blocks in the MPEG-4 video coding standard bit-stream. In the algorithm, the watermark is embedded in the DCT coefficients of I frames and P frames. This algorithm adopts the re-embedding and optimal retrieving strategy to guarantee the synchronization between embedding and retrieving watermark, and improve the robustness of watermarking. This algorithm has obvious low complexity, high watermark payload and the strong robustness against re-encoding, multiple re-encoding and deleting.

Table. 1 survey on video watermarking techniques

Technique	Approach	Characteristic
Commutative encryption &watermarking in video compression video	The coding procedure of H.264/AVC and DCT	No decryption is needed
A content adaptive digital watermarking scheme in H.264/AVC compressed video	The coding procedure of H.264/AVC	Bit rate control is introduced
A real time video watermarking using adjacent luminance blocks correlation based compresses domain	Watermark is embedded in the DCT coeffients of I frames &P frames	Bit rate control is introduced. Distortion of visual quality
A compressed video watermarking scheme with temporal synchronization	Temporal synchronization	Bit rate control is introduced imperceptible watermarking
Adaptive secure watermarking scheme for images in spatial domain using Fresnel transforms	Spatial domain	Does not need host image during the extraction process
Digital video watermarking in the discrete wavelet domain	DWT	High perceptual invisibility
Drift compensation in compressed video reversible watermarking	Lossless drift compensation	Bit rate control is introduced. distortion of visual quality,
SVD based watermarking scheme in complex wavelet domain for color video	Lossless drift compensation	High level of security geometric manipulations
Spatial self-synchronizing video watermarking techniques	Spatial domain	Robust to compound geometric attacks &has low complexity. Does not need the step foe synchronization
Robust watermarking of H.264 – encoded video: extension to svc	Scalable video coding method	Blind watermark detection in the full and low resolution decoded video & bit rate saving.
Dual watermarking in video using discrete wavelet transform	DWT	Forensic analysis for combating media piracy
Robust video transmission using reversible watermarking technique	H.264/AVC	Lossless watermark and suitable for real time wire applications.

A compressed video watermarking scheme with temporal synchronization:
As an effective technology for copyright protection, digital watermarking has been applied in videos. Temporal synchronization is an important aspect for video watermarking. If synchronization is lost, the detector may fail in extracting the correct watermark. A temporal synchronous compressed MPEG-4 video watermarking scheme. This scheme utilizes DCT direct current coefficients to divide video into several scenes. Watermarks are embedded according to features of scenes. Bit rate control is introduced to ensure that watermark embedding does not increase the size of video. Drift compensation is employed to counteract the visual distortion in P-frames and B-frames caused by watermark embedding. Visual masking is exploited to enhance the invisibility of watermark. This scheme has satisfactory ability in resisting the temporal synchronization attacks of frame deleting and frame inserting, therefore achieving well robustness.

Adaptive secure watermarking scheme for images in spatial domain using Fresneltransforms:
A new adaptive blind watermarking scheme with the watermarks encrypted by Fresnel transform in spatial domain is presented. By utilizing fuzzy c-means clustering (FCM) technique and human visual system (HVS),

the watermark can be adaptively embedded according to block classification. To keep imperceptibility and robustness, a novel iterative embedding algorithm is adopted to change the to-be-embedded pixel-values. This scheme provides good robustness to withstand different kinds of common attacks.

Digital video watermarking in the discrete wavelet domain
One of the significant problems in video watermarking is the Geometric attacks. The DWT (discrete wavelet transform) domain is used for proposed a novel algorithm to place invisible watermark in a video frame based on a three-level DWT using Haar filter. This algorithm is robust against JPEG compression, geometric attacks such as Downscaling, Cropping, and Rotation. It is also robust against Image processing attacks such as low pass filtering (LPF), Median filtering, and Weiner filtering. Furthermore, the algorithm is robust against Noiseattacks such as Gaussian noise, Salt and Pepper attacks. The embedded data rate is high and robust. The experimental results show that the embedded watermark is robust and invisible. The watermark was successfully extracted from the video after various attacks.

Drift compensation in compressed video reversible watermarking:
In most reversible compressed video watermarking schemes, there is a particular problem that the distortion of image quality will be spread and accumulated. In this technique it is
analyzed that problem of distortion drift caused by reversible watermarking in compressed video, and then a lossless drift compensation scheme for compressed video is proposed. The results of this technique shows that the lossless drift compensation method we propose in this paper will significantly improve the visual quality of embedded compressed video, while allowing recovering the standard encoded video exactly. In addition, the lossless drift compensation approach does not depend on the specific embedding and extraction of reversible watermark, and it also can be used in the video reversible watermarking based on other compression standards such as H.264.

SVD based watermarking scheme in complex wavelet domain for color video:
SVD-based watermarking scheme in complex wavelet domain for color video. Video watermarking is well known as the process of embedding copyright information in video bit streams. It has 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 is proposed. This algorithm was based on a cascade of two powerful mathematical transforms; the 2-level dual tree complex wavelet transforms (DT-CWT) and singular value decomposition (SVD). This hybrid technique shows high level of security and different levels of robustness against attacks. This algorithm was tested for imperceptibility and robustness and excellent results were obtained.

Spatial self-synchronizing video watermarking techniques:
There are various traditional video watermarking schemes robust to geometrical transformations. Most of them use synchronizing techniques or invariant transforms to resist geometric distortions. However, these algorithms are time-consuming or not resilient to mixed geometrical distortions. This video watermarking method that is robust to compound geometrical attacks and has low complexity. This method embeds a reference pattern and a watermark pattern into the temporal axis of a video during each pre-defined frame interval. Even if the marked video is geometrically distorted, both the reference pattern and watermark one are always in sync. Thus, we can simply detect the watermark without additional synchronization step.

Robust watermarking of H.264 – encoded video: extension to svc
A framework for robust watermarking of H.264-encoded video to scalable video coding (SVC) as defined in Annex G of the standard. Watermark embedding in the base resolution layer of the video is inadequate to protect the decoded video of higher resolution. This complication is mitigated by a proposed up sampling technique of the base layer watermark signal when encoding the enhancement layer. This technique manifest blind watermark detection in the full- and low-resolution decoded video and, surprisingly, can report bit rate savings when extending the base layer watermark to the enhancement layer.

Dual watermarking in video using discrete wavelet transforms:
This technique gives the invisible watermarking which is performed by using Discrete Wavelet Transform. To get the invisible watermarking the alternate pixel value of the host video is replaced by the pixel value of watermark video/image. This type of watermarking provides a means of forensic analysis for combating media piracy. Video watermarking provides robustness to geometric attack such as rotation, cropping, contract altercation, time editing without compromising the security of the watermark.

Robust video transmission using reversible watermarking technique:
This scheme presents a novel error-resilient strategy which employs a reversible watermarking technique to protect the H.264/AVC video content. This scheme adopts reversible watermarking to embed an error detection code word within every Macro block (MB). The watermark is then extracted at the decoder and used to detect the corrupted MBs to be concealed. This scheme further manages to recover the original video content after watermark extraction, thus providing no loss in video quality. The simulation results demonstrate that the proposed approach provides a substantial gain of up to 2.6 dB in Peak Signal-to-Noise Ratio (PSNR) relative to the standard with a minimal increase in complexity.

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