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Survey on Digital Video Watermarking Techniques

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Abstract: With the advancements of Internet along with the increasing probability of multimedia has spawned a number of copyright issues. One of the main most important areas that this growth has feed is digital watermarking. Digital watermarking is a technique of hiding a message similar to a digital signals in different forms such an image, song, video within the signal itself. In this paper we present survey on digital video Watermarking techniques for better performance, robustness and discuss the various important factors used in watermarking, attributes and application area where watermarking technique needs to be used. Also survey of latest work is done in digital video watermarking field.

Keywords: Types of watermarking, Applications, Watermarking techniques

I. INTRODUCTION

Digital Watermarking is a technique is used to secure multimedia data that transfer over the internet. Digital Watermarking is a technique to embed copyright information into a digital multimedia data such as image, audio, video etc. Digital watermarking is the process by which a discrete data stream called a watermark is hidden within a multimedia signal by moving imperceptible changes on the signal. In many proposed techniques this procedure imposes the use of a secret key which must be used to successfully embed and extract the watermark.

Watermarking has gained very high interest in applications involving the security of multimedia signals. One major energetic force for research in this area is the need for effective copyright protection scenarios for digital imagery, sound and video. In similar an application a serial number is watermarked into the signal to protect to mark ownership. It is conventional that an attacker will attempt to remove the watermark by intentionally modifying the watermarked signal.

Thus, we must endeavor to embed the mark such that it is difficult to remove (without the use of the key) unless the marked signal is significantly distorted. In digital watermarking a host signal is transformed to a watermark domain in which adaptations are imposed on the domain coefficients to embed the watermark. The adjusted coefficients are then inverse transformed to produce the marked signal1. Our proposed work to improved robust watermarking is applicable to the general class of watermarking methods with the following basic properties: The watermark data stream consists of some binary elements. The host signal (which refers to the original multimedia signal before watermarking) is not applicable or exploited for watermark extraction. The entire watermark is regularly embedded right through the signal and each reproduction of the watermark is situated in a distinct localized region of the watermark domain.

II. TYPES OF DIGITAL WATERMARKING

Watermarks and watermarking techniques can be divided into various categories in various ways. The watermarks can be applied in spatial domain. An alternative to spatial domain watermarking is frequency domain watermarking.

It has been pointed out that the frequency domain methods are more robust than the spatial domain techniques. Watermarking techniques can be divided into four categories according to the type of document to be watermarked as follows.

Watermarking techniques can be divided into four categories according to the type of document to be watermarked as follows.

- Image Watermarking
- Video Watermarking
- Audio Watermarking
- Text Watermarking

According to the human perception, the digital watermarks can be dividing into three different types as follows.

- Visible watermark
- Invisible-Robust watermark
- Invisible-Fragile watermark
- Dual watermark

Watermarking is the process of inserting secret information (watermark) into digital multimedia (images, audio and video) by taking into account the limitations of the human perception system. Digital watermarking is the process of embedding digital code into digital multimedia (images, audio and video sequence). The embedded information or watermark can be a serial number or random number sequence, ownership identifiers, copyright

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messages, control signals, transaction dates, information about the creators of the work, bi-level or gray level images, text or other digital data formats.

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

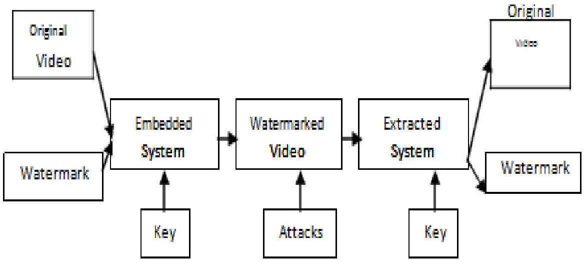

Fig.1. Block diagram of digital video watermarking

IV.NEED FOR VIDEO WATERMARKING

Any image watermarking techniques can be extended to watermark video meets some demanding in reality video and motionless region real-time requirement susceptible to pirate attacks. Watermark directly embed in the raw video data and integrated in the encoding process. After compressing the video data processing it can be implemented.

One of the main objective of a watermark is to protect the owner's copyright. However, for many existing watermarking schemes, an attacker can easily confuse one by manipulating the watermarked image (or video, audio) and claim that he or she is the legitimate owner. Some watermarking schemes require the original image (or video chip) to perform watermark verification. Video Watermarking can help to find a misappropriating person, prove ownership, Broadcast Monitoring, Protect copyright of a data etc.

V. VIDEO WATERMARKING APPLICATIONS

A. Transaction Tracking

Transaction tracking is used to track how content was distributed through a system or transmitted between multiple points. A unique identifier is embedded into the media at the time of playback, which can later be extracted. In the case of illegal distribution of the content, it should ideally be possible to identify the source from where the distribution occurred, possibly identifying the misappropriating party.

B. Broadcast Monitoring

Broadcast monitoring enables broadcasters or content owners to track or verify the transmission of media in a broadcast system. The watermarks can automatically be extracted to verify if a commercial has successfully been aired or whether a certain segment of material was used in a broadcast. The content is usually watermarked by the content owner, while detection can be done by a monitoring site in the broadcast chain or a third party at the receiving end.

C. Copy Control

Copy control aims to disable the duplication of copyrighted material on devices equipped with special watermark detectors. The watermark is used to indicate copy control information, such as copy_never, copy_once or copy_freely. By implementing watermark extraction and embedding in devices, the user can be allowed or denied permission to duplicate content.

D. Content Authentication

Content authentication is a method that attempts to ensure the integrity of media by detecting attempted tampering of the original content. At creation, the content is usually watermarked with a semi-fragile watermark, which is designed to be affected by signal transformations. Tampering with the content should destroy or alter this semi-fragile watermark, which could then be used to determine that the content is not authentic.

E. Ownership Identification

In this application, watermarks can be used to identify the rightful owner or creator of content [34]. After the original content was watermarked, disputed ownership can be resolved by extracting the original watermark. Resolving rightful ownership can, however, be challenging as pirates may also embed their own watermark, in which case it can be difficult to determine which is the original watermark. This is known as an ownership deadlock problem.

F. Fingerprinting

This category is only included for clarity, as there exist at least two definitions of fingerprinting, each with specific characteristics and applications. The first definition of media fingerprinting is “the art, or algorithm, of identifying component characteristics of a source and then reducing it into a fingerprint that can uniquely identify it.” These techniques do not add any additional information to the media, but rather generates a compact signature based on the unique properties of the content.

VI. 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 [3], 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 pre-processed, 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.

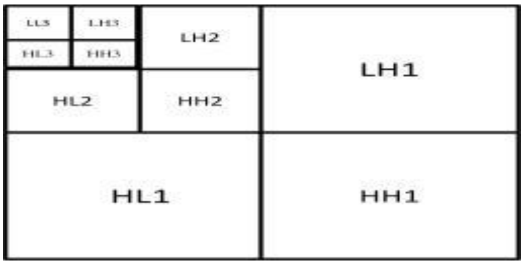

Fig.2. Discrete wavelet transform

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.

VII. RELATED WORK

Gayyer 2006, study that spatial watermarking can also be applied using color separation, in which the watermark appears in only one of the color bands. This renders the watermark visibly subtle such that it is difficult to detect under regular viewing, though, the mark appears immediately when the colors are separated for printing. The document useless for the printer unless the watermark can be removed from the color band. This approach is used commercially for journalists to inspect digital pictures, photo- stock house before unmark versions. Behal et. al 2012, presents the gap in Frequency domain and Spatial-domain methods, frequency-domain methods are more widely applied than spatial domain. The intent is to embed the watermarks in the spectral coefficients of the image. The most commonly used transforms are the

Discrete Cosine Transform (DCT), Discrete Fourier Transform (DFT), Discrete Wavelet Transform (DWT), the reason for watermarking in the frequency domain is that the characteristics of the human visual system (HVS) are better captured by the spectral coefficients. Chang et. al 2005, described that DCT (Discrete consine transform) like a Fourier Transform, it represents data in terms of frequency space rather than an amplitude space. This is useful because that corresponds more to the way humans perceive light, so that the part that are not perceived can be identified and thrown away. DCT based watermarking techniques are robust compared to spatial domain techniques. Such algorithms are robust against simple image processing operations like low pass filtering, brightness and contrast adjustment, blurring etc. However, they are difficult to implement and are computationally more expensive. At the same time they are weak against geometric attacks like rotation, scaling, cropping etc. DCT domain watermarking can be classified into Global DCT watermarking and Block based DCT watermarking. Embedding in the perceptually significant portion of the image has its own advantages because most compression schemes remove the perceptually insignificant portion of the image. Harrison et. al 2008, described that the basic idea of DCT in image process is to multi-differentiated decompose the image into sub-image of different spatial domain and independent frequencies. Szczypiński et. al 2001, described that discrete wavelet transform derived features used for digital image texture analysis. Wavelets appear to be a suitable tool for this task, because they allow analysis of images at various levels of resolution.

Delaigle, 2002 study the main features of human visual system (HVS) to be translated into watermarking technology and highlights the need for dedicated inputs from the human vision community and not to provide a thorough description of the HVS. In a synthetic way and from an engineering perspective, HVS features on which the designer of a watermarking algorithm can rely, i.e. its sensitivity and masking capabilities. Ahmad et. al 2010 suggested absolute values of DCT coefficients that are divided into an arbitrary number of segments and the energy of each segment is calculated. Watermarks are then embedded into the selected peaks of the highest energy segment. Watermarks are extracted by performing the inverse operation of watermark embedding process. Simulation results indicate that our proposed watermarking method is highly robust against various kinds of attacks such as noise addition, cropping, re-sampling, re-quantization, MP3 compression, and echo, and achieves similarity values ranging from 13 to 32. In addition, our proposed method shows SNR (signal-to-noise ratio) values ranging from 13 dB to 24 dB. Manaf et. al 2011 presented watermarking embedded in frequency domain using DWT or DCT can affect the imperceptibility and robustness of watermarking, this paper studies the effect of embedding domain on the imperceptibility and robustness in genetic watermarking. Results of watermark image quality and attacks based on peak signal-to-noise ratio (PSNR) numerical correlation (NC) is analyzed through the paper sections, the DWT results showed more robustness high imperceptibility than DCT in watermarking based on GA. Khanna et. al 2013 presented digital image watermarking is used for copyright protection of digital information, with the widespread of internet; the intellectual properties are accessible and manipulated easily. It demanded to have different ways to protect data. Digital watermarking provides a viable and promising solution. In this paper, we have described about the three different watermarking techniques (LSB, DCT, DWT) along with the various performance parameters required to evaluate the best technique out of them. This can help us to propose and implement new technique to achieve maximum robustness against various attacks.

VIII. CONCLUSION AND FUTURE WORK

In this paper we surveyed the current literature on digital video watermarking. We classified watermarking technique based on the transform domain in which the watermark is embedded. We also tried to classify the digital watermarking in all the known aspects. Future scope of the video watermarking is very broad. Video watermarking avoids video piracy in broadcast video monitoring. Previously using SVD watermarking is done which is less efficient but recently DWT & DCT techniques are used which will increase the robustness of the system.

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