Review of Video Watermarking Techniques

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Abstract

There has been a remarkable raise in the data exchange over web and the general use of digital media. The interest with reference to digital watermarking right through the last decade is certainly due to the increase in the need of copyright protection of digital data. Applications of video watermarking in copy control, broadcast monitoring, video authentication, fingerprinting, copyright protection etc is immensely rising. The major aspects of information hiding are security, capacity and robustness. Capacity deals with the amount of information that can be concealed. The ability of anyone detecting the information is robustness and refers to the resistance to modification of the cover content before concealed information is destroyed. Video watermarking algorithms normally prefers robustness. In a robust algorithm it is not possible to eliminate the watermark without precise degradation of the cover content. In this paper, features required to design a robust watermarked video for a valuable application. We review several algorithms, and introduce commonly used key technique. Aspire of this paper is to focus on the various domains of video watermarking techniques. The best part of the reviewed methods based on video watermarking highlight on the concept of robustness of the algorithm. Video Watermarking is a young and rapidly rising field in the area of multimedia. The aim of this paper is to focus on the various domains of video Watermarking techniques.

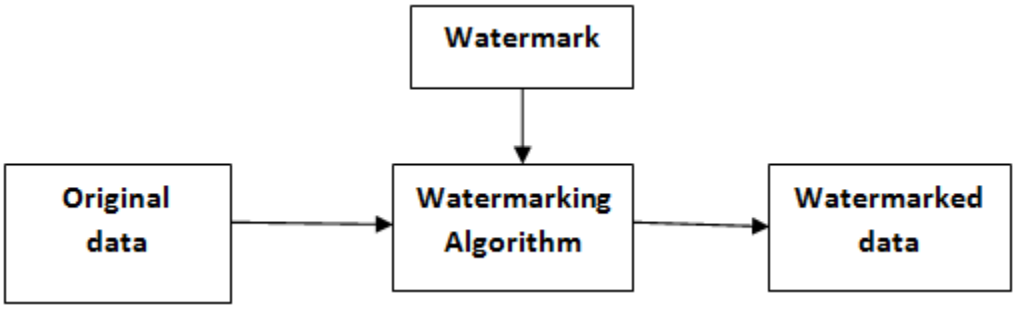
Keywords: Video Watermarking, Authentication, Robust, Techniques, DCT, DWT, PSNR, MSE.

I. INTRODUCTION

Watermarking can be described as a method for embedding information into another signal. In case of digital images, the embedded information can be either visible or hidden from the user. In this, we will concentrate on hidden Watermarks. Typical usage scenarios for watermarking are e.g. copyright protection and data authentication. One potential solution for claiming the ownership is to use electronic stamps or so-called watermarks, which are embedded into the images, and have the following features:

- Undeletable by hackers;
- Perceptually invisible, i.e., the watermark should not render visible artifact;
- Statistically undetectable;
- Resistant to lossy data compression, e.g., the Joint Photographic Experts Group (JPEG) compression;
- Resistant to image manipulation and processing operations,
  e.g., cut-and-paste, filtering, etc.

A. BLOCK DIAGRAM



II. METHODS OF WATERMARKING

There are two methods of performing watermarking, one in spatial domain, and the other in frequency domain. Each technique has its own advantage and disadvantage. The major disadvantage of spatial domain watermarking is that a common picture cropping operation may eliminate the watermark. Other than spatial domain watermarking, frequency domain approaches have also been proposed. In the spread spectrum communication technique is also used in multimedia watermarking. In most of the previous works the watermark is a symbol or a random number which comprises of a sequence of bits, and can only be

"detected" by employing the "detection theory." In the spatial domain, We can simply insert watermark into a host image by changing the gray levels of some pixels in the host image, but the inserted information may be easily detected using computer analysis. In the frequency domain. We can insert watermark into the coefficients of a transformed signal.

In frequency domain watermarking, Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and discrete wavelet transform (DWT) technique are used. In DCT technique the watermark is embedded into transform domain of host signal. The watermark is embedded by modifying the mid frequency coefficients so that the visibility of the image will not be affected. The Discrete Wavelet Transform (DWT) is widely applied to image watermarking applications because of its excellent spatial localization and multi-resolution properties. In general, most of the image energy is concentrated at the lower frequency sub-bands and therefore embedding watermarks in the low frequency sub-bands could increase robustness significantly, however, may degrade the image significantly. But we cannot embed too much data in the frequency domain because the quality of the host image will be distorted significantly. That is, the size of watermark should be smaller than the host image.

A. SPATIAL DOMAIN

Watermarking in spatial domain measured as a low and simple complexity method and usually is done in the luminance component and color component. However, there are some major limitations. Watermark optimization is not easy using only spatial analysis techniques. Different watermarking methods in the spatial domain are,

1) *Least significant bit modification (LSB)*

LSB technique is simple and straight-forward and uses the least significant bits to embed the watermark. This method provides high capacity. This technique is resistant against cropping while is fragile against noise addition, lossy compression and resetting the LSBs to 1. LSB technique can improve the security and prevent the third party from tracing the watermark.

2) *Correlation based techniques*

In correlation based method a noise which is randomly generated is added to the luminance of cover media pixels. The watermark strength can improve the robustness. The watermark regarded as detected when the correlation go above the threshold. In detection the key is needed as the side information to reconstruct the pseudo random noise. To obtain a high correlation the correct seed should be available.

B. FREQUENCY DOMAIN

1) *Discrete Cosine Transform (DCT)*

DCT is a classic and quite an important method for video watermarking. A lot of digital video watermarking algorithms embed the watermark into this domain. The usability of this transform is because that most of the video compression standards are based on DCT and some other related transforms. In this domain some DCT coefficients of the video are selected and divided into groups, and then the watermark bits are embedded by doing adjustment in each group.

2) *Discrete Wavelet Transform (DWT)*

DWT is a transform based on frequency domain. Figure 1 shown the distributions of the frequency are transformed in each step of DWT, where H represents High frequency, L represents Low frequency and subscript represents the number of layers of transforms. Sub graph LL represents the lower resolution approximation of the original video, while high-frequency and mid-frequency details sub graph LH, HL and HH represents vertical edge, horizontal edge and diagonal edge details. The process can be repeated to compute the multiple scale wavelet decomposition as shown in figure 2.

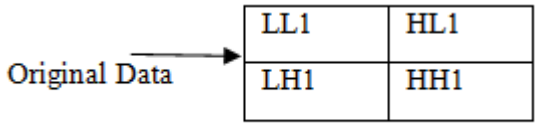


Fig. 1

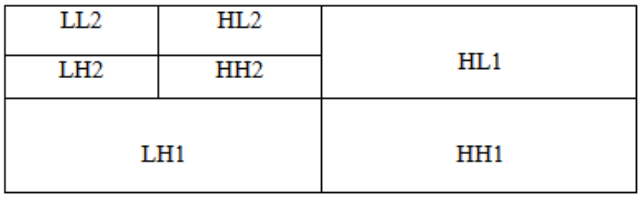
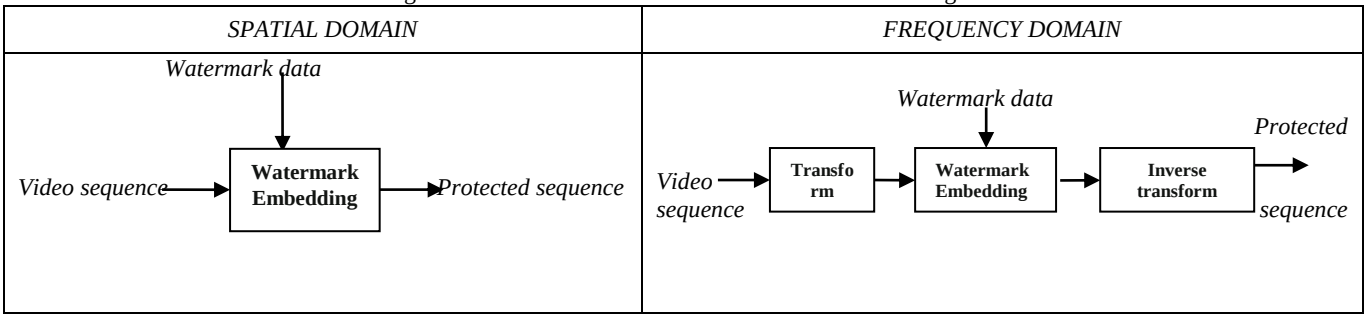


Fig. 2



The benefits of the spatial method are effortlessness and easiness for use. However, the watermark embedded in the spatial domain is easily cracked.	*In the transform domain, the watermark is dispersed throughout a video frame. This makes it more difficult to be removed. Furthermore, human perceptual behavior can be fully exploited in the transform domain. Therefore, better robustness and imperceptibility can be achieved using transform domain methods.*
Spatial domain techniques are easy to perceive	*Frequency domain techniques are not easy to perceive.*
It has the lack in providing adequate robustness and imperceptibility requirements.	*Better robustness and imperceptibility criteria*
It is easy to insert a watermark into a host image by changing the gray levels of some pixels	*watermark is inserted into coefficients obtained by using an image transform process*

III. ATTRIBUTES OF DIGITAL WATERMARKING SYSTEM

- Embedding Effectiveness: Embedding Effectiveness is not possible because of the requirement of perceptual similarity conflicts.
- Perceptual Similarity: Perceptual similarity is a measure that determines the similarity level between the original and watermarked image. Most commonly used image similarity index measure is PSNR (Peak Signal to Noise Ratio)

  PSNR=20log {max2/MSE}

  MSE= $1/XY \sum\sum [O(i,j)-W(i.j)]2$

  And limits are $0 \le i \le 1-X$ $0 \le j \le 1-Y$

  O is host data and W is watermark data. max = 255 for 8-bit gray scale image.
- Robustness: Robustness is the ability to detect the embedded watermark after common image processing operations like compression, filtering, geometric distortion etc. Robustness is application dependent and it is not necessary that all the applications require robustness against all the operations.
- Data Embedding Capacity: The number of bits, a watermarking scheme encodes within a cover work is referred to as data payload Increasing the watermark payload will affect the perceptual similarity (fidelity) of the system and vice versa.
- Blind and Informed Detection
- Computational Complexity

IV. ATTACKS IN VIDEO WATERMARKING

Attacks of video watermarking are frame averaging, statistical analysis, frame dropping, lossy compression, cropping and various signal processing and geometrical attacks. The attacks of video watermarking are divided into intentional attacks & unintentional attacks.

A. Intentional attacks:

The intentional watermark attack includes Single frame attacks like filtering attacks, contrast and color enhancement and noise adding attack. Statistical attacks like averaging attack and collision attack.

B. Unintentional attacks:

The unintentional attacks may be due to Degradations that can arise during lossy copying, or due to Compression of the video during re-encoding or because of Change of frame rate and Change of resolution.

V. CONCLUSION

In the paper we revised various video watermarking techniques in various domains. However many challenges have to be taken up. Robustness is a parameter that has to be well thought of some aggressive video processing may modify the watermark signal. New approaches are expected to come out and may merge existing approaches, For example cascading two powerful mathematical transforms, the Discrete Wavelet Transform (DWT) and the Singular Value Decomposition (SVD). The two transforms are different transform domain techniques and thus provide different, but complementary, levels of robustness against the same attack.

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