# A Survay: Digital Video Watermarking

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**Abstract**— The information is in present in form of digital media. Digital watermarking was acquainted to provide the copy right protection and owners' authentication. A digital watermarking is secret information that is embedded inside an image. The digital watermarking for video an effective method to protect the video copyright. Digital video watermarking is the process embedding digital information into digital video sequence. In this paper, study the concept of digital video watermarking, properties, applications and some major digital video watermarking techniques.

**Index Terms**— Digital Video Watermarking, Discrete Wavelet Transform, Copyright Protection, Discrete Cosine Transform, Application, Transform Domain Watermarking.

## I. INTRODUCTION

Security and copyright protection are becoming important issues in multimedia (images, audio and video) applications and services. 'Digital watermarking' was introduced in 1993, when Tirkel presented two watermarking techniques to hide the watermark data in the multimedia (images, audio and video) [1]. The protection and enforcement of intellectual property rights for digital media has become an important issue [2]. Digital watermarking is that technology that provides and ensures security, data authentication and copyright protection to the digital media. Digital watermarking is the embedding of secret information (i.e. Watermark) into the digital media or multimedia such as image, audio and video. Many watermarking schemes have been proposed to hide copyright marks and other information in digital images, video, audio and other multimedia objects [3]. The watermark is embedded by modifying the transform coefficients of the frames of the video sequence. The most commonly used transforms are the Discrete Fourier Transform (DFT), the Discrete Cosine Transform (DCT), and the Discrete Wavelet Transform(DWT).

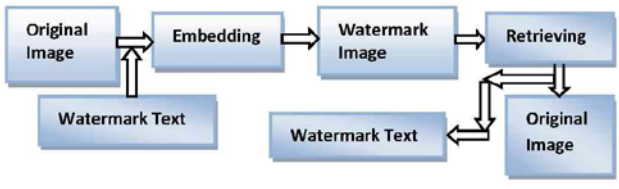


**Fig 1:- WATERMARKING METHOD**

## II. VIDEO WATERMARKING

### a) DIGITAL WATERMARKING

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 messages, control signals, transaction dates, information about the creators of the work, bi-level or gray level images, text or other digital data formats. In the literature large number of text [4]-[6], image [7]-[10], audio [11] and video [12]-[16] watermarking algorithms can be found. Fig 2 gives different types of watermarking methodologies.

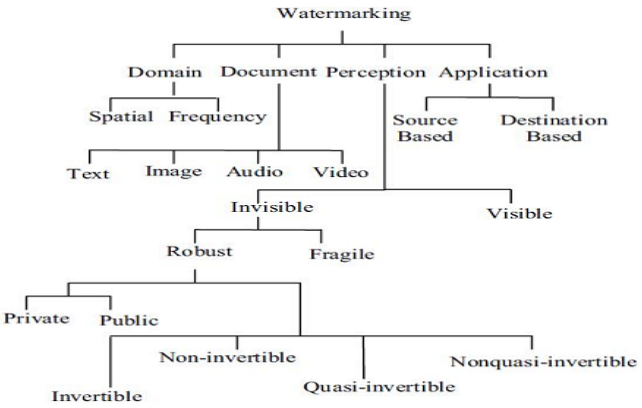


**Fig 2:- Different types of watermarking methodologies**

### b) DIGITAL VIDEO WATERMARKING

A complete digital watermarking system should include three basic parts [17]: watermark generation, watermark embedding and watermark extraction or detection. Watermark embedding algorithm uses the symmetric key or public key to make the watermark information embed into the original carrier to get concealed carrier. Watermark detection / extraction algorithm using the corresponding key vector from the hidden watermark is detected or recovered without the key. The attacker is very difficult to find and modify the hidden watermark vector. Block diagram of watermark embedding and extraction is shown in Figure 3:

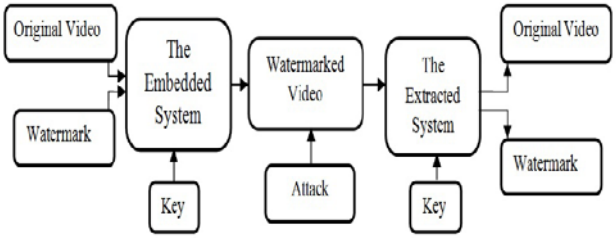


**Fig 3: - Block Diagram of a Digital Video Watermarking**

### c) DIGITAL VIDEO WATERMARKING FEATURES

The important terminologies to digital video watermarking are:

**Digital Video:** Video sequence is a collection of consecutive and equally time spaced still images.
**Payload:** It is the amount of information that can be stored in a watermark. An important concept regarding the video-watermarking payload is watermark granularity. Watermark granularity can be defined as how much data is required for embedding one unit of watermark information.
**Perceptibility:** video watermarking methodology is called imperceptible if humans cannot distinguish between the original video from the video with inserted watermark.
**Robustness:** Depending on the application, the digital watermarking technique can support different levels of robustness against changes made to the watermarked content. If digital watermarking is used for copying owner identification, then the watermark has to be robust against any modification.
**Security:** In watermarking the security is assured in the same way as in encryption. Though the algorithm of watermarking process is public, security depends on the choice of the key [18].

### d) APPLICATIONS OF VIDEO WATERMARKING

The following major applications of digital video watermarking are:

**Copyright protection:** Copyright protection is the very first targeted application for digital watermarking. In digital multimedia, watermarking is used as copyright protection to identify the copyright owner. [19]

**Video authentication:** Authentication means storing the signature into the header section, but the header field still be prone to tempering. So we can directly embed this type of authentication information directly as a watermark. [18]

**Broadcast monitoring of video sequences:** In television network different products are distributed over the channel. A broadcast observation system must be built in order to check the entire broadcasted channel. Watermark is used for this type of broadcast monitoring system by putting a unique watermark for each video to broadcast. [20]

**Copy control:** Watermarking system has the available technologies in which the information is secured into the header and it prevents from copying of that data. [21]

**Fingerprinting (Distribution):** Pay-per-view and Video-on-demand are two real-time applications of video streaming, in which digital watermarking is used to enforce a fingerprinting policy. The customer ID is embedded into the video as a watermark to track back any user breaking his license agreement. [22]

## III. DIGITAL VIDEO WATERMARKING TECHNIQUES

Watermark can be directly embedded in the raw video data or integrated during encoding process or implemented after compressing the video data. According to the working domains of watermark algorithms, video watermarking techniques are classified into different two domains: pixel domain or spatial domain and transform domain or frequency domain. [18] [20] [23] [21]

### SPREAD SPECTRUM (SS) VIDEO WATERMARKING TECHNIQUE:-

According to F. Hartung and B. Girod [24], each bit of watermark $a_j$, $a_j \in \{-1, +1\}$ a is spread over a large number of chips (cr) and modulated by a binary pseudo-noise sequence $p_i$, $p_i \in \{-1, +1\}$. The video and watermark are represented as vectors and scaled addition is carried out for watermark insertion. The retrieval of the watermark is carried out by high-pass filtering followed by correlation-based method. The robustness of the algorithm can be increased by increasing cr, $\sigma^2_p$ (variance of pseudo random sequence), or $\mu_\alpha$ (mean of locally adjustable amplitude factor). But increases in cr reduces the data rate of the scheme, where as increases in $\sigma^2_p$ or $\mu_\alpha$ results in perceptibility of the watermark.

### COLLUSION RESISTANT (CR) VIDEO WATERMARKING TECHNIQUE:-

According to K. Su, D. Kundur and D. Hatzinakos [25], this is a practical frame by frame video watermarking technique. Here a basic s× s watermark pattern is first created and this pattern is repeatedly embedded so that it is centred around a fixed number of selected points known as anchors in every video frame. The part of the video frame where the basic watermark is embedded is called the footprint. Anchor points are calculated using feature extraction algorithm. As the content of the video frames changes, so do the selected feature points. As a result of that watermark footprints evolves with the video. After generating these watermark frames with in a given host frame, spatial masking is applied on it to ensue robustness and imperceptibility criteria. Then the scaled watermark is embedded in the host data using addition.

### TRANSFORMED DOMAIN (TDC) VIDEO WATERMARKING TECHNIQUE:-

According to I. J. Cox, J. Kilian. F. T. Leighton and T. Shamoon [26], proposed and stressed on the importance of embedding the watermark into perceptually significant components to increase robustness against signal processing and lossy compression techniques. The watermark of length n was populated from a standard normal distribution apart from a binary PN sequence in order to enhance robustness. This method uses a non-blind approach for watermark detention. Detection is performed by transforming the original and test frame in the DCT domain and correlating the difference vector with the expected watermark pattern.

### GROUP OF FRAMES (GOF) VIDEO WATERMARKING TECHNIQUE:-

Watermarking algorithm based on group of frames (GOF) has few important benefits as they utilize temporal properties of the video. This consideration helps to maintain temporal imperceptibility.

### DISCRETE COSINE TRANSFORM (DCT) VIDEO WATERMARKING TECHNIQUE:-

According to Lu Jianfeng, Yang Zhenhua, Yang Fan, Li li [27], Discrete Cosine Transform (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.

### DISCRETE WAVELET TRANSFORM (DWT) VIDEO WATERMARKING TECHNIQUE:-

According to Lijing Zhang,Aihua Li [28], Discrete Wavelet Transform (DWT) is a transform based on frequency domain. Figure 4 shown the the distributions of the frequency is transformed in each step of DWT, where L represents Low frequency, H represents High frequency and subscript behind them 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 4.

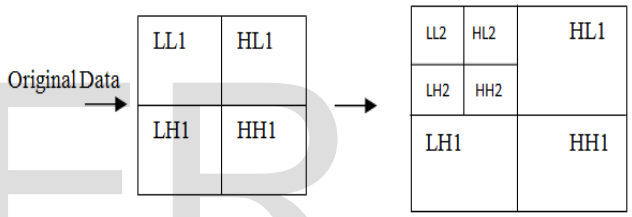


**Fig 4: - Frequency distribution after DWT**

## IV. COMPRESSION OF DIFFERENT VIDEO WATERMARKING TECHNIQUE:-

The comparative analysis of different video watermarking techniques in Table 1. We shall use the following terminology in the table: R: Robustness; Rl: Reliability; I: Imperceptibility; P: practicality; T: Time complexity; S: synchronization recovery. We shall denote the measure of goodness using the quantifiers Good (G), Acceptable (A), and Poor (P).

TABLE 1

| **Technique** | **R** | **RI** | **I** | **P** | **T** |
|---|---|---|---|---|---|
| **SS** | A | A | G | G | G |
| **CR** | G | G | G | P | P |
| **TDC** | G | G | G | A | A |
| **GOF** | G | A | G | A | G |
| **DCT** | G | A | P | A | A |
| **Technique** | **R** | **RI** | **I** | **P** | **T** |

| | | | | | |
|---|---|---|---|---|---|
| **DWT** | G | G | A | G | G |
| **DFT** | A | G | A | A | P |

## V. CONCLUSION

In this survey, we have presented a comprehensive survey of the existing techniques used for digital video watermarking. With the development of video compression standards, video watermarking technology develops from the first generation to second generation. We have reached the conclusion that compression terminologies are most important for digital video watermarking.

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