Digital Video Watermarking

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Introduction

Protection of intellectual property has a history as long as publishing itself. The rise of “new’ media in the form of electronic dissemination, digital libraries, electronic commerce and many others has generated calls for document protection through placement of electronic seals, preferably but no necessarily, invisible. Recent efforts in digital watermarking have been mostly confined to still imagery. We intend to extend this to videos. These techniques plan a unique code either as a spatial or spectral signature in the video which can later be recovered.

Problem statement

A **watermark** is hidden information within a digital signal (such as image, video, audio…) and is integrated into the content of host signal itself, and requires no additional file header or conversion of data format.

Our aim is to watermark a given digital video without any degeneration in the quality of the image considering the HVS (Human Visual System). Providing that a certain HVS threshold is not exceeded, the modified (watermarked) video will be undistinguishable to the human eye compared with the original with optimal manipulations on the video.

Motivation/Background

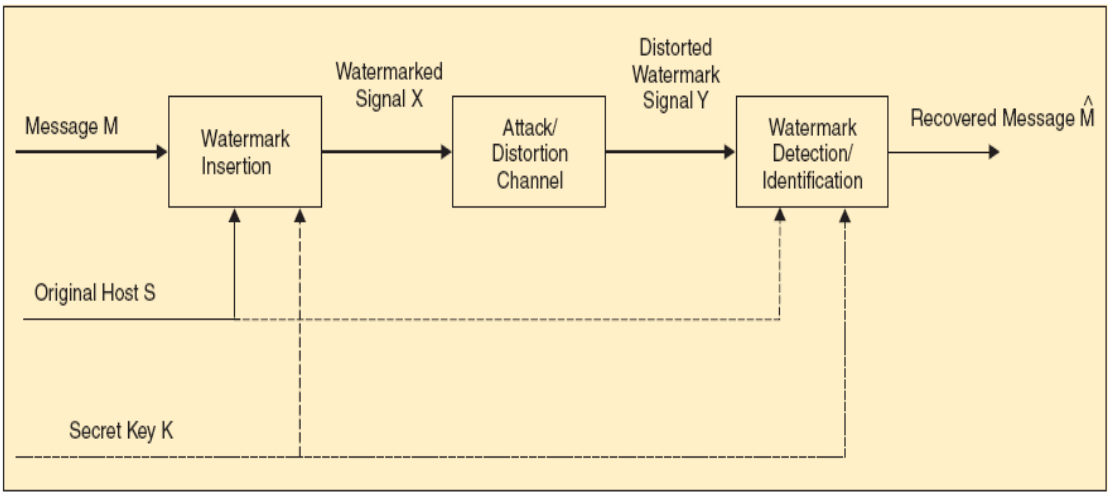
Computers are becoming more and more integrated via the network; the distribution of digital media is becoming faster, easier, and requiring less effort to make exact copies. Besides, the characteristics of digitization bring significant changes in copyright issues, such as:

1. Ease of replication,
2. Ease of transmission
3. Plasticity of digital media

These create an urgent need to intellectual property protection on the digitally recorded information.

Unfortunately, the ease with which end users can produce digital copies, which maintain the perfect quality of the original, has become a serious piracy issue for multimedia content developers and a growing concern for TV broadcasters. Digital video watermarking uses the inherent properties of digital

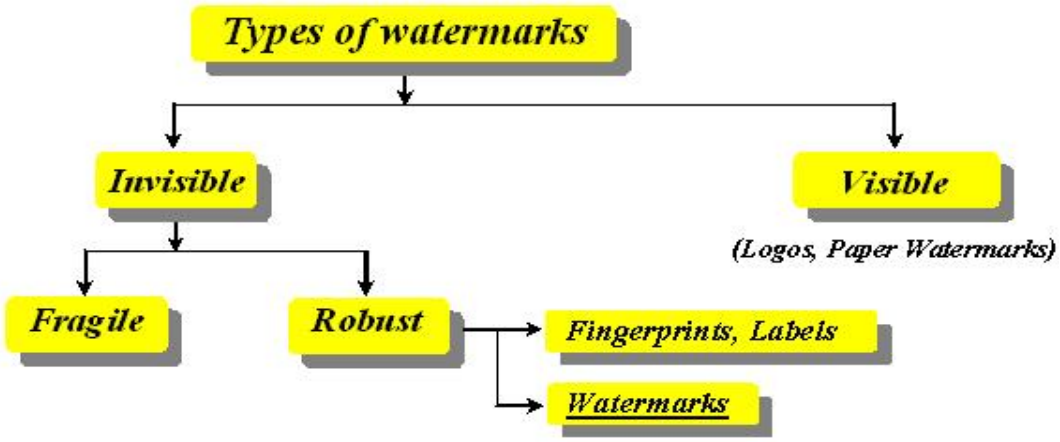
images, with the limitations of human vision to insert invisible data into digital video to provide copyright protection. The watermark tracks pirated copies, prevents illegal copying and authenticates digital data. Digital watermarking is the process of conveying information by imperceptibly embedding it into the digital media. The purpose of embedding such information depends on the application and the needs of the owner/user of the digital media.



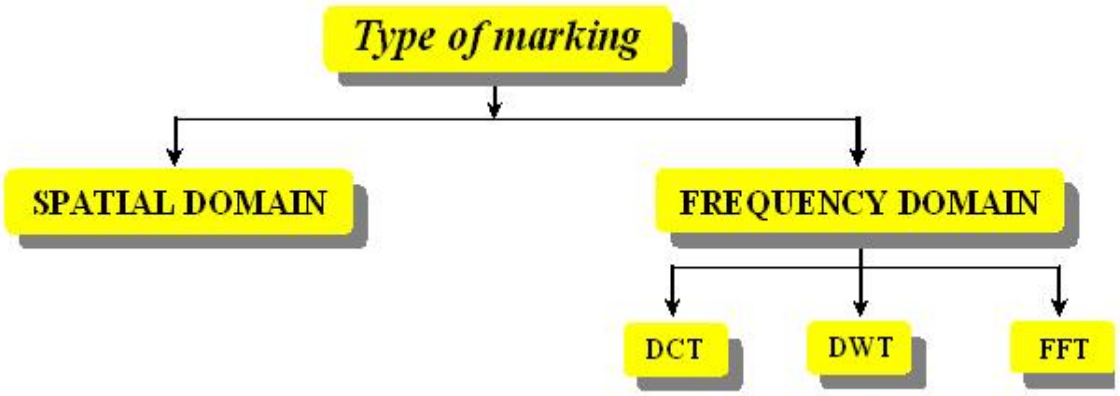
▲ *1. Block diagram of a watermarking system.*

Classification of Watermarking

Excluding the obvious case of visible watermarks, we can classify the watermarks as FRAGILE or ROBUST. The fragile watermark is used for detecting even the smallest alteration of an image, while the robust one is specially designed to withstand a wide range of “attacks”, which basically are trying to remove the watermark, but without destroying the image/video.

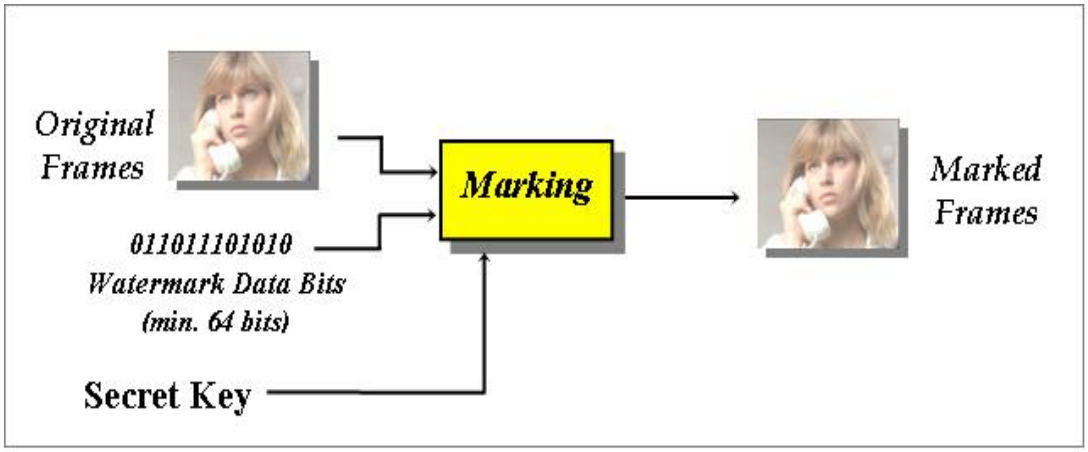


- Next we would see the types of marking. Watermarking can be done by
  - Changing directly the values of the pixels, in the spatial domain.
  - Inserting the watermark in the frequency domain, using one of the well known transforms: FFT, DCT or DWT.
  - Using fractals.



The easiest (simplest) way to watermark an image/video, is to change directly the values of the pixels, in the spatial domain. A more advanced way to do it, is to insert the watermark in the frequency domain, using one of the well known transforms: FFT, DCT or DWT. Other techniques are possible as well, like using fractals for example.

The watermark embedding can be done uniformly (or in some other empirical manner), which doesn't account for the HVS properties (this is called non-perceptual marking). Or, the watermarking embedding can use some HVS models in order to optimize the embedding. Depending on the HVS model used, the perceptual marking can be video independent (basic HVS model) or preferably video dependent (advanced HVS model).



Watermark Embedding

Applications

The main application of digital watermarking is in copyright protection. The owner of the image/video adds a watermark to his material before it is distributed. Possible applications are:

- Robust identification of digital content.
- Broadcast monitoring of video sequences (digital TV)
- Advertisement verification
- Monitoring applications including forensic tracking of distributed video content.
- DVD protection and access control (Mastering: Adding copyright notices as proof of original ownership)
- Distribution (fingerprinting): Adding copyright notices and identifying recipients; tracing the source of illegal copies
- Remote control and triggering. Adding information that will allow triggering or control of devices in a broadcast chain.