Video Source tracking and copyright protection in video watermarking

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Abstract-**Due to extensive usage of internet, the exchange of data between users are also increasing rapidly. Security and copyright protection are becoming important issues in digital media applications and services. Owners of the digital products are troubled about illegal copying of their products. Digital watermarking throughout the last decade is improved due to the increase in the need for copyright protection. More specifically Creative Commons License (CCL) has been established as a expedient method to protect copyrights of user generated digital products .However, the lack of technical method to protect CCL causes illegal manipulations and sharing of CCL. This paper presents, embedding dual watermarking system which embeds both robust watermarks and semi-fragile watermarks for CCL protection and manipulation detection. A robust watermark is generated, in order to withstand frame drop and rescaling, which increases the overall robustness. Then the fragile watermark is embedded at DWT domain, robust watermarks are embedded at spatial domain.**

Keywords- **Copyright Protection, discrete wavelet transform, Creative common license,Watermarking**

I.INTRODUCTION

In the World Wide Web, it is thorny to manage the copyright exclusively, thus a wide-ranging and efficient approach is necessary for protecting the ownership. As a method of intellectual property protection, digital watermarks have recently stimulated significant interest and become a very active area of research. Videowatermarking overcomes a number of issues not present in imagewatermarking. Due to the large amount of data and inherent redundancies between frames, video signals are highly susceptible to piracy attacks, including frame averaging, frame dropping, frame swapping, statistical analysis.

The rapid stretch of digital media (audio, images and video) and the ease of their reproduction and distribution has created a call for copyright enforcement schemes in order to protect content creators and ownership. In recent years, digital watermarking has emerged as an valuable way to prevent users from violating copyrights. This concept is based on the insertion of information into the data in such a way that the added information is not perceptible yet resistant to (intentional or unintentional) alterations of the watermarked data.

Three factors must be considered in image or video watermarking:

Capacity - the amount of information that can be put in to the watermark and recovered without errors.

Robustness - the resistance of the watermark to alterations of the original content such as compression, cropping.

Visibility-how easily the watermark can be discemed by te user.

Multimedia data needs to be protected from unauthorized duplication and consumption from unauthorized disclosure, misuse and from unauthorized exploitation Encryption watermarking are two groups of complementary technologies that have been identified by content providers to protect multimedia data.Watermark embedding and detection are sometimes considered to be analogous to encryption and decryption. Watermarking is the process of embedding data in to a multimedia element such as image audio or video. Given a cover image I, and a watermark W, the transformation produces the watermarked image. Each detection transformation is defined with a detection algorithm. Embedding multiple watermarks in a transform domain using the coefficients in several frequency bands drastically increases the overall robustness of a watermarking scheme.

In the online world of the internet many people do not want to impose the full restrictions of copyright, and so an alternative method of protection was developed called the creative common giving some protection but not all of the

rights granted by the full copyright law. Whether or not to claim copyright protection is a matter of personal preference.

In making this decision we need to be adequately informed of the consequences of choosing to maintain a copyright claim as opposed to claimed a less restrictive level of protection.The levels of protection modify the strict requirements of copyright law, but provide a level of protection that is suitable for your personal work to be used in the online world.By using CCL, content-creators specify several copyrights on their works. CCL comprises a selection of four basic conditions: Attribution, Non-commercial, No Derivative Works, and Share alike. Table I shows the meaning and abbreviation of four basic licence conditions. In general, six combinations shown in Table I are used in practice.

In applications such as owner identification, copy control and device control the most important properties of a watermarking system are perceptual transparency, robustness, security, high data capacity and unambiguousness.

Table 1

FOUR BASIC CONDITIONS OF CCL(TOP) WITH SIX AVAILABLE COMBINATIONS(BOTTOM)

Abbreviation	Meaning
BY	Attribution
NC	Non-Commercial
ND	No Derivative Works
SA	Share-alike

Abbreviation	Meaning
CC BY	Attribution
CC BY-SA	Attribution Share-alike
CC BY-ND	Attribution No Derivative
CC BY-NC	Attribution Non-Commercial
CC BY-NC-SA	Attribution Non-Commercial Share alike
CC BY-NC-ND	Attribution Non-Commercial No derivative works

DISCRETE WAVELET TRANSFORM (DWT)

The Discrete Wavelet Transform (DWT) is used in a wide variety of signal processing applications. 2-D discrete wavelet transform (DWT) decomposes an image or a video frame into sub-images,3 details and 1 approximation. The 2-D DWT is an application of the 1-D DWT in both the horizontal and the vertical directions. DWT separates the frequency band of an image into a lower resolution approximation sub-band (LL) as well as horizontal (HL), vertical (LH) and diagonal (HH) detail components.

Watermark is embedded in low frequencies obtained by Wavelet decomposition which increases the robustness. So that resultant watermark video become susceptible to different attacks that have low pass characteristics like filtering , lossy compression and geometric distortions.

In this paper, we propose a dual watermarking scheme which embeds robust watermarks in spatial domain, and semi-fragile watermarks in DWT domain. Semi fragile watermarks inform manipulations on the video such as rescaling, clipping, frame rate changing, logo insertion, and cropping, while robust watermarks inform the information of content-creators and CCL after those manipulations.

II. WATERMARK EMBEDDING

The robustwatermarks are embedded into spatial domain of video frames and the semi-fragile watermarks are embedded into DWT domain of video frames.

A. Robust watermark design

Robust watermarks carrying the information of content creators and CCL are designed as follows. Random number generator with private key generates mX n, 2-D basic pattern W_b. To enhance robustness, the basic pattern W_b is enlarged k times where k is calculated by dividing frame height by static length l. Then we tiling the enlarged basic pattern i times to horizontally, j times vertically to generate the final pattern W_r. By embedding different patterns into frames for each time interval T_r seconds, we can embed message bits into a target video.

B. Semi-fragile watermark design

Semi-fragile watermarks detecting manipulation on target videos are designed as follows. In this method, block Bi is generated by dividing frames into N_w times horizontally and N_h times vertically. Each block Bi contains semi-fragile watermark W_f which follows Gaussian distribution with zero mean and unit variance. Each W_f is generated from random number generator using private key made by the following three factors. as follows:

$$K(K_1,K_2,K_3) = K_1 + (K_2 \text{ X } 10^3) + K_3$$

The first factor K1 is a spatial index of the block Bi and the second factor K2 is a temporal index of the frame which contains the block Bi. The average time per frame is the last factor K3 and the private key K is computed with scaling factor to avoid duplication.

C. Watermark Embedding

We embed a robust watermark and semi-fragile watermark into different domains to minimize interference between two watermarks. To improve the imperceptibility of robust watermarks, we apply perceptual masking after embedding robust watermarks into the video frames. The perceptual masking consists of noise visibility function (NVF) masking, motion masking, and luminance masking. An NVF masking filter, M, is computed as follows:

$$M_n(i,j)=S_{0+}(S_1-S_0).NVF(i,j)$$

where S_o is the maximum value of the masking filter, Sj is the minimum value of the masking filter, and NVF is a measurement of the noise in the frame. A motion masking filter M_m ,and a luminance masking filter, M_l ,uses the characteristics of HVS, which is insensitive to noise and brightness changes when a scene has more motion orbrighter or darker regions. After perceptual masking, a robust watermarked frame, X_r, can be expressed as

$$X_{r=}X+(W_r.M_n.M_m.M_l)$$

where X is the original target of the video frame. Each dot product indicates a pixel-wise product.

Semi-fragile watermark is embedded in to video frames by following the steps:

1. Video is divided into frames .RGB frames are converted to YUV frames.

2. 4-DWT is applied on it.

3. RGB watermark image is converted into a vector P= {p1, p2… p32x32} of zeros and ones.

4. This vector P is again divided into n parts. Then each part is embedded into each of the corresponding LL and HH sub bands. The watermark pixels are embedded with strength x into the maximum coefficient M_i of each PC block Y_i. The embedding equation is:

$$M_i=M_i+ X_w$$

Where, x is the watermark embedding strength.

5. Inverse DWT is applied to obtain the watermarked luminance component of the frame. Finally watermarked frame is reconstructed and watermarked video is obtained.

III. WATERMARK DETECTION

This section provides an overview of watermark detection process to decode a message and determine whether the video has been manipulated or not.

A. Detecting robust watermark

To extract a message, we use an adaptive Wiener filter as a noise reduction filter because robust watermarks were embedded into a frame as a noise .The estimated watermark W'_r can be extracted by

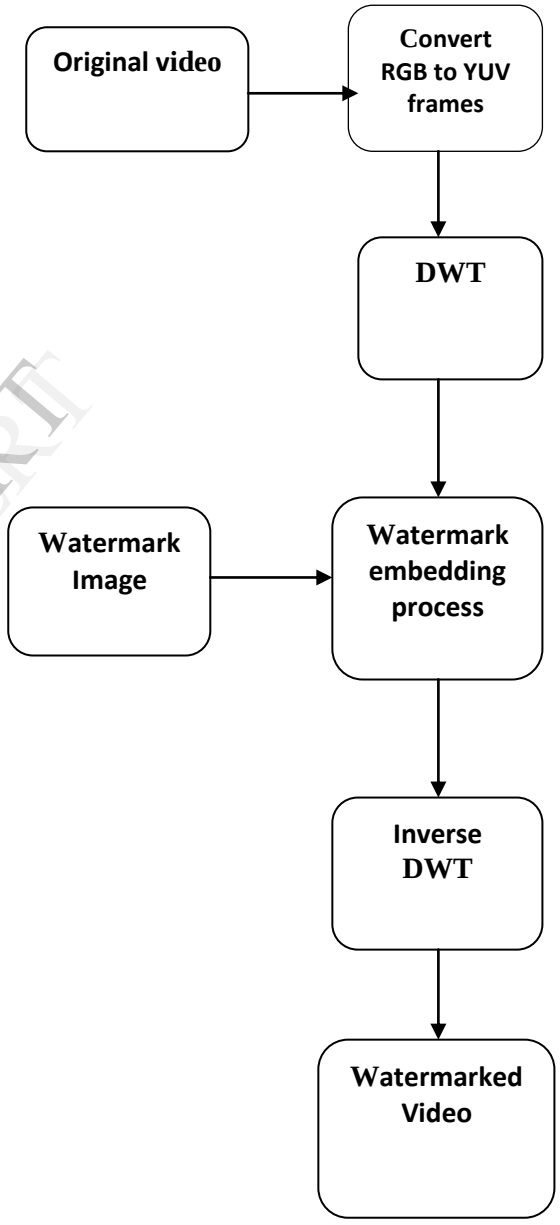

Fig-1: Watermark embedding process

$$W'_r(i,j)=X(I,j)-X'(i,j)$$

where X is a target frame, X' is a frame with the adaptive wiener filter, X(i; j) is a pixel value of X, and X'(i,j) is a pixel value of X'. A denoised frame X' can be calculated as follows:

$$X'(i,j)=\mu(i,j)+\frac{\sigma^2(i,j)-S^2}{\sigma^2(i,j)}.((X(i,j)-\mu(i,j))$$

where S^2 is the approximated mean of local variance of X , μ(i; j) is the local mean of X, and σ(i; j) is the local variance of X. W'r is calculated by accumulating the estimated watermark patterns for t_r seconds and normalizing the accumulated watermark patterns.
Where, W_r is the reference watermark for the target frame. Embedded robust watermarks are successfully detected when Z is larger than threshold Tr defined by:

$$T_r=\mu_z+\alpha_z\sigma_z$$

whereμ_z is the mean of Z, σ_z the standard deviation of Z, and α_z is the controlling factor of false positive error.To extract messages from robust watermarks, normalized cross correlation(NCC) Z is computed as follows:

$$Z = \frac{IFFT(FFT(W'r).FFT(Wr)*)}{|W'r|.|Wr|}$$

B.Detecting Semi Fragile watermark

1. Watermarked video is converted into frames. Each RGB frame is converted to YUV representation.

2. DWT is applied. LL and HH sub-bands divided into nxn non-overlapping blocks.

3. Following equation is used to extract watermark

$$W = \frac{Mi'-Mi}{X}$$

4. The extracted watermark is compared with the original watermark as follows:

$$NC = \frac{\Sigma i \Sigma j W(i,j)W'(i,j)}{\Sigma i \Sigma j W(i,j)}$$

Where, NC is the normalized correlation. NC value is 1 when the watermark and the extracted watermark are identical and zero if the two are different from each other

We decide that a target frame has been manipulated when more than Pf percentages of blocks in the target frame have been manipulated. We decide whether a target video has been manipulated by following steps:

Step 1 : Detect semi-fragile watermark Wf from frame group. Go to step 2.

Step 2 : If more than P global percentages of frames in frame group are manipulated, we decide that target video has been manipulated. If not, go to step 3.

Step 3 : If more than P partial percentages of blocks in frame group with same spatial index are manipulated, we decide that target video has been manipulated. If not, go to step 4.

Step 4 : We decide the target video has not been manipulated.

IV. RESULTS AND DISCUSSION

Above algorithm is applied to a sample video sequence using binary watermark logo. The original sampled frame and its corresponding watermarked frame are shown in Fig. Watermarked frame appears visually identical to the original.

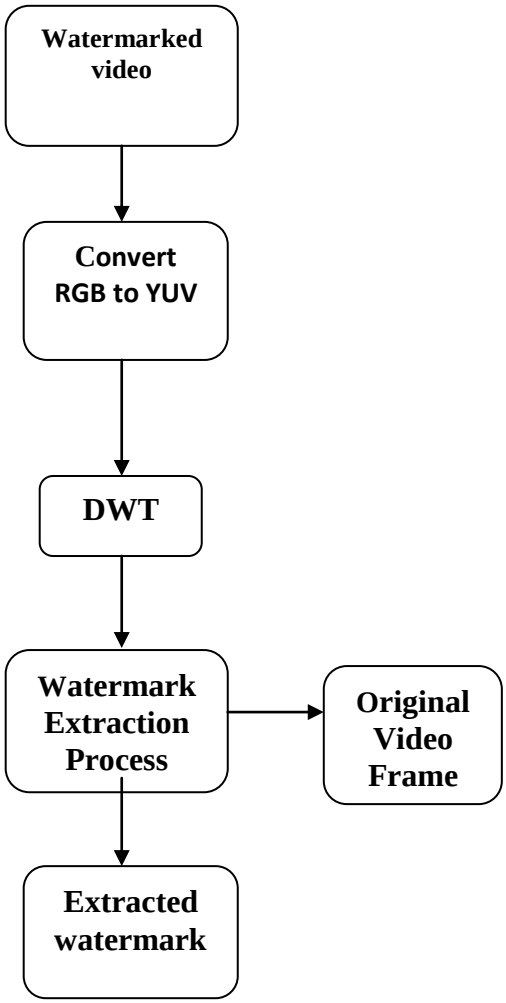

Fig 2: watermark extraction process

The performance of algorithm can be measured in terms of its imperceptibility and robustness against the possible attacks. Watermarked frame is subjected to a variety of attacks such as Gamma correction, Contrast adjustment, Histogram equalization etc. In case of geometric attacks scheme is tested against Frame resizing, Frame rotation, Frame cropping.

To evaluate the performance of any watermarking system, Peak Signal to Noise Ratio (PSNR) is used as a general measure of the visual quality of the watermarking system.

PSNR: The Peak-Signal-To-Noise Ratio (PSNR) is used to measure deviation of the watermarked and attacked frames from the original video frames and is defined as:

$$PSNR=10\log_{10} 255^2/MSE$$

Fig-3: Original Video

Fig-4: Watermark Image

Fig-5: Watermarked Video

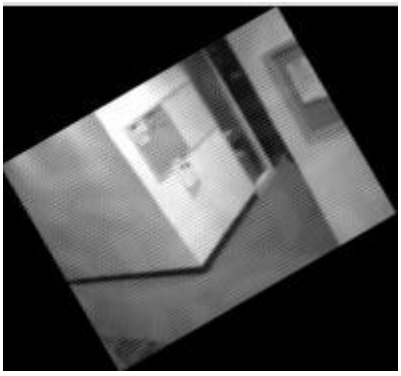

Fig-6: Video frame after rotation by 180 degrees

Fig-7: Video frame after resizing

Fig-8: Video frame after gamma correction

V. CONCLUSION

Now a days network and multimedia develop rapidly, video watermarking as a kind of digital works copyright protection and information security protection technology has great potential,also plays an important role.Here the implementation of digital video watermarking scheme based on DWT is proposed. Due to multi resolution characteristics of DWT, this scheme is robust against several attacks. This algorithm makes the video copyright protection effect that is largely improved and it can effectively enhance the robustness of the video stream .This algorithm embedding the binary watermark in the low LL sub band helps in increasing the robustness of the embedding procedure without much degradation in the video quality.

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