Digital Video Watermarking Using Dwt and Pca

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ABSTRACT

Due to the extensive use of digital media applications, copyright protection and multimedia security has gained tremendous importance. Digital Watermarking may be a technology used for the copyright protection of digital applications. During this paper, a comprehensive approach for watermarking digital video is introduced, and a hybrid digital video watermarking scheme based on Discrete Wavelet Transform (DWT) and Principal Component Analysis (PCA). PCA helps in reducing correlation among the wavelet coefficients obtained from wavelet decomposition of each video frame thereby dispersing the watermark bits into the uncorrelated coefficients. The video frames are first decompose using DWT and also the binary watermark is embedded in the principal components of the low frequency wavelet coefficients. An imperceptible high bit rate watermark embedded is robust against various attacks that will be carried out on the watermarked video, like filtering, geometric attacks and contrast adjustment.

KEYWORDS : *BinaryWatermark.; Digital Video, Principal Component Analysis, Discrete Wavelet Transform , Inverse DWT , Inverse PCA*

I. INTRODUCTION

The use of digital multimedia system content is increased large amount of data is transfer and distributed [1] easily. Copying of digital media has become comparatively easy. These products can be transmitted and redistributed easily without any authentication. So there is need for copyright protection of multimedia data[2]. Digital watermarking is the process of hiding digital information in a carrier signal. Information is nothing but name of creator, status, recipient, etc. Watermarking can be done for different types of digital data where copyright needs to be protected. Digital watermarks are used to verify the authenticity of the carrier signal. It is prominently used for tracing copyright violations. Like traditional watermarks, digital watermarks are only perceptible under certain conditions, i.e. after using some algorithm. A watermark is a digital code permanently embedded into cover content, in case of this system, into a video sequence.Applications of watermarking are copying prevention, broadcast monitoring, authentication and data hiding. The watermarking technique is used for data hiding. The main aspects of information hiding are capacity, security and robustness[4-6]. Amount of information that can be hidden is capacity. Detecting the information correctly is security and robustness refers to the resistance to modification of the cover content. Video watermarking algorithms usually prefers robustness. A robust algorithm it is not possible to remove the watermark without rigorous degradation of the cover content.

Video watermarking approaches will be classified in to two main classes based on the method of hiding watermark bits in the host video. The two classes are: Spatial domain watermarking wherever embedding and detection of watermark are performed by directly manipulating the pixel intensity values of the video frame. Transform domain techniques[8-9], on the totally different hand, alter spatial pixel values of the host video according to a pre-determined transform and are more robust than spatial domain techniques since they disperse the watermark in the spatial domain of the video frame making it tough to remove the watermark through malicious attacks like cropping, scaling, rotations and geometrical attacks. The commonly used transform domain techniques are Discrete Fourier Transform (DFT), the Discrete Cosine Transform (DCT), and the Discrete Wavelet Transform (DWT) [8-9].

II. WATERMARKING SCHEME

Several researches concentrated on using DWT because of its multi resolution characteristics. PCA has been used in different ways in image and video watermarking methods. For implementation of robust video watermarking scheme following transforms are used.

Discrete Wavelet Transform (DWT)

Principle Component Analysis (PCA)

DWT is used to implement a simple watermarking scheme. The 2-D discrete wavelet transforms (DWT) decomposes the image into sub-images. The approximation look like the original, only on the 1/4 scale. The 2-D DWT is an application of the 1-D DWT in both the horizontal and also the vertical directions. The DWT decompose an image into a lower resolution approximation image (LL) as well as horizontal (HL), vertical (LH) and diagonal (HH) detail components.Due to its excellent spatial-frequency localization properties DWT is very suitable to identify areas in the host video frame where a watermark can be embedded imperceptibly. Embedding the watermark in low frequencies obtained by wavelet decomposition increases the robustness with respect to attacks that have low pass characteristics like lossy compression, filtering, and geometric distortions.

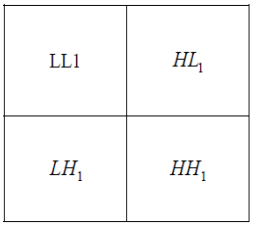

Figure a: Standard DWT decomposition

PCA is a method of identifying patterns in data, and expressing the data in such a way so as to highlight their similarities and differences. PCA produces linear combinations of the original variables to generate the axes, also known as principal components, or PCs. PCA transform is used to embed the watermark in each colour channel of each frame of video. The main advantage of this approach is that the same or multi-watermark can be embedded into the three colour channels of the image in order to increase the robustness of the watermark.

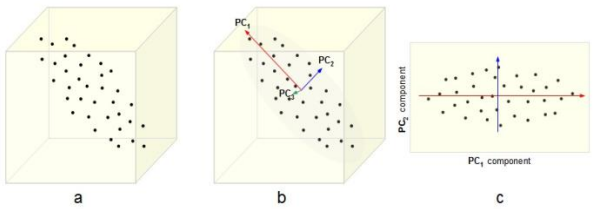

Figure b Principal components

III. WATERMARK EMBEDDING PROCESS

Here first video is divided into frames. Then luminance component of each frame is chosen and DWT is applied to it which results into different sub bands. These bands are again divided into different blocks on which PCA is applied. For each block covariance matrix is calculated. Then each block is transforms into PCA components. watermark image is taken. This vector W is divided into four parts p1, p2, p3, and p4. Then each part is embedded into each of the corresponding sub bands. Inverse PCA is applied on the modified sub bands to obtain the modified wavelet block. By applying the inverse DWT watermarked luminance component of the frames are obtained. Finally by reconstructing the watermarked frame watermarked video is obtained.

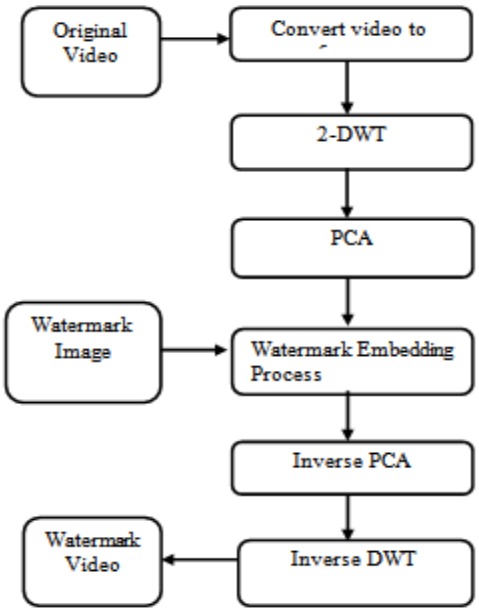

Figure c Flowchart of watermark embedding process

IV. WATERMARK EXTRACTING PROCESS

Here first video is divided into frames, RGB frame is converted into YUV frames. Then luminance component of each frame is chosen and DWT is applied to it which results into different sub bands. These bands are again divided into different blocks on which PCA is applied. For each block covariance matrix is calculated. Then each block is transforms into PCA components. On the other hand RGB watermark image is converted into binary image. This binary image is converted into a vector of zeros and ones. This vector W is divided into four parts p1, p2, p3, and p4. Then each part is embedded into each of the corresponding sub bands. Inverse PCA is applied on the modified sub bands to obtain the modified wavelet block. By applying the inverse DWT watermarked luminance component of the frames are obtained. Finally by reconstructing the RGB watermarked frame watermarked video is obtained.

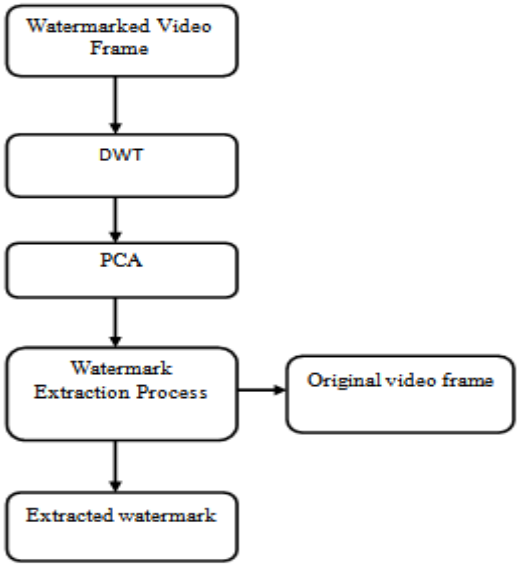

Figure d Flowchart of watermark extraction process

V. CONCLUSION

The watermark is embedded into the maximum coefficient of the PCA block so we get high imperceptibility where there is no noticeable difference between the watermarked video frames and the original frames. Due to multi resolution characteristics of DWT this scheme is robust against several attacks. It will not affect original quality of video.

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