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A Comparative Analysis for Video Watermarking Techniques

Garima Gupta[1*], V. K. Gupta[1] and Mahesh Chandra[2]

[1]Department of Electronics and Communication Engineering, Inderprastha Engineering College, Ghaziabad – 201010, Uttar Pradesh, India; garima1204@gmail.com
[2]Department of Electronics and Communication Engineering, Faculty of Engineering and Technology, BIT, Mesra, Ranchi - 835215, Jharkhand, India

Abstract

As now a day's data transmission is used widely. Data can be audio, video or text. A large data is present on the net today. Video data is mostly used now as it is much easier to understand. So, websites like you tube etc. are gaining more and more popularity. As a huge data is present on the net so there must be a sound security system for this data also. Owner of the data is putting his data on the net so that he may get revenue and popularity from it. But due to easy copy pasting hacking of data is also common. Any hacker can make a copy of data from his name and can transfer it ahead. Watermarking seems a copyright protection tool in this case. In this paper various methods of video watermarking are implemented in mat lab and a comparison in between different methods is made. Three methods are taken here – spatial domain, DWT domain, DCT domain. These methods are compared according to some common parameters.

Keywords: DCT, DWT, MSE, PSNR, Spatial Domain

1. Introduction

Watermarking is the process of hiding a message related to a digital signal (image, audio and video) within the digital signal itself.

Mainly watermarking system has two process namely embedding and extraction. Embedding is the process for hiding data (watermark) and extraction refers to get watermark back from embedded data. During embedding image to be hidden is inserted into the host image and this embedding is done with the help of secret key which is equivalent to the password and is known to the owner only. At the receiving end reverse process is applied and key is necessary again to extract the watermark from watermarked image. Applications of watermarking are Copyright protection, Authentication, Broadcast monitoring, Content labeling, Tamper detection, Digital fingerprinting.

Any watermarking scheme should have three main characteristics[2]: imperceptibility, robustness and security. Imperceptibility represents the invisibility of embedded watermark for the users of that video. Robustness refers to the ability of bearing various attacks either intentional or unintentional. Security is used in the watermarking scheme so that an unauthorized person cannot extract the watermarks without knowing the secret key. All these requirements ensures that a person extracting the watermark is able to get it unchanged even in the presence of attacks with full reliability.

Various watermark techniques have been proposed by many authors in the last several years[3,4]. Showed compressed domain watermarking with embedding and extraction.

2. Watermarking Schemes

Watermarking system contains broadly two types of schemes-spatial domain, transform domain. In transform domain either DCT or DWT method is used[5,6].

So, in this paper a comparison among spatial, DCT and DWT is shown based on parameters like PSNR, MSE.

* *Author for correspondence*

A. Spatial Domain

In spatial domain watermark is embedded directly into the pixel data whereas in transform domain image data is first converted into frequency like DCT, DWT. Steps followed for spatial domain is-

- Video to frame conversion
- Select any frame randomly
- Select watermark image
- Resizing of frame and watermark
- Divide watermark and frame both in bit planes.
- Shift bits of watermark image
- Embed watermark by adding shifted bits of watermark with the frame.

B. Discrete Cosine Transform (DCT)

This method converts the image in frequency domain and watermark is hidded in the coefficients of DCT. In this watermarking, the watermark can be introduced in the entire image or in non-overlapping blocks in the image[7]. A robust watermark is generally introduced in the perceptually significant portions of the visual signal because most compression techniques tend to degrade the perceptually insignificant portions of the image. Generally the DCT coefficients of high magnitude are considered perceptually significant.

- Video to frame conversion
- Select any frame randomly
- Select watermark image
- Resizing of frame and watermark
- Find R, G, B components of that frame
- Compute DCT of each one separately
- Select a coefficient for watermark strength
- Embed watermark by changing in coefficient value
- Find PSNR, SNR etc. after embedding
- Extraction

C. Discrete Wavelet Transform (DWT)

With this method we can overcome drawbacks of both time and frequency domain as well as time and frequency resolution problem is resolved. DWT is the method which decomposes the signal into 4 parts-LL, LH, HL, HH[9,10].

Here the work of Prachi V. Powar, S. S. Agrawal[10] is taken for the comparison purpose. They used the method-

- Video to frame conversion
- RGB frames to YUV frame conversion
- 2 DWT applied
- Watermark image is converted into vector form of ones and zeros.
- After this, vector sequence is further sub divided into n parts.
- After this, vector sequence is further sub divided into n parts. Then each part is embedded in the sub bands with strength x. The embedding equation is:

  M=M+ xW

  Where, x is the watermark embedding strength. In our calculation x is considered as 0.3,

  M is Max. Coefficient value
- IDWT is applied to get the watermarked frame.

3. Parameters Analyzed

In this paper all the three methods are compared according to the some parameters like- SNR, PSNR, MSE, NC.

Mean Square Error (MSE):

In the above equation, the MSE can be represented as follows:

In statistics, the mean squared error (MSE) measures the average of the squares of the errors, the difference between the watermarked image and original image.

$$MSE = \frac{1}{LM}\sum_{l=0}^{L-1}\sum_{m=0}^{M-1}\left|I^{*}(l,m) - I(l,m)\right| \quad (1)$$

Where $I(l,m)$ - Original image, $I^{*}(l,m)$ - Watermarked image

Peak Signal to Noise Ratio (PSNR):

The Peak Signal to Noise Ratio (PSNR) output value should be large for a good quality image, while the larger value of Mean Square Error indicates the poor quality image.

$$PSNR = 10\log_{10}\left(\frac{255^{2}}{MSE}\right) \quad (2)$$

4. Result and Discussion

Here results of three techniques has been compared on frame by frame bases. A video has been taken and randomly 6 frames from that video have been selected. All Spatial, DCT and DWT method has been applied on all the six frames and comparison is shown in tabular form.

4.1 Experimental Set Up and Simulation Results

The above techniques for Video Watermarking is implemented in a system having 3 GB RAM with 64 bit

operating system having i3 Processor using MATLAB 2013a.

4.2 Performance Evaluation after Video Watermarking

The performance of the video watermarked image frames will be evaluated by means of computing the Mean square error (MSE), Peak Signal to Noise Ratio (PSNR) values. The Peak Signal to Noise Ratio value should be greater for high quality images. Figure 1 shows the watermarked frame for all the 3 methods. Same frame is used for all the three. Result obtained after watermarking is shown here in Figure 1.

Figure 1. Watermarked frame for spatial domain, DCT Domain and DWT Domain.

Table 1. Peak Signal to Noise Ratio (PSNR) values obtained for the video frames after watermarking

Image Frames	Peak Signal to Noise Ratio (PSNR)		
	Spatial Domain	DCT Domain	DWT Domain
Frame1	27.9779009006053	106.306938724202	153.9329
Frame50	28.0107796771475	106.058282422675	153.9329
Frame100	28.0021674510289	107.177895674283	153.9329
Frame150	28.0644617992298	106.374076613415	153.9329
Frame200	27.9929641985147	106.608268929754	153.9329
Frame210	27.9279905003896	106.884331522983	153.9329

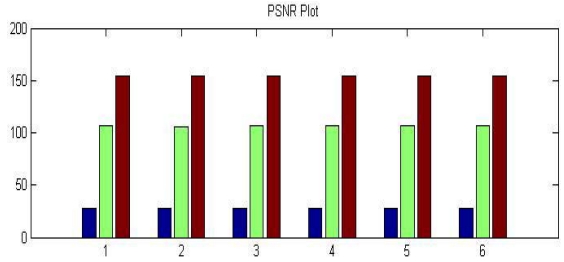

Figure 2. Graphical representation of Peak Signal to Noise Ratio (PSNR) on comparing Spatial domain, DCT domain and DWT domain video watermarking techniques.

Table 2. Mean square Error (MSE) values obtained for the video frames after watermarking

Image Frames	Mean square Error (MSE)		
	Spatial Domain	DCT Domain	DWT Domain
Frame1	103.583425925926	1.57118988037109	0.0134
Frame 50	102.802196296296	1.61074829101563	0.0134
Frame100	103.006259259259	1.44013595581055	0.0134
Frame150	101.539303703704	1.56067657470703	0.0134
Frame200	101.539303703704	1.52455139160156	0.0134
Frame210	104.780703703704	1.48303985595703	0.0134

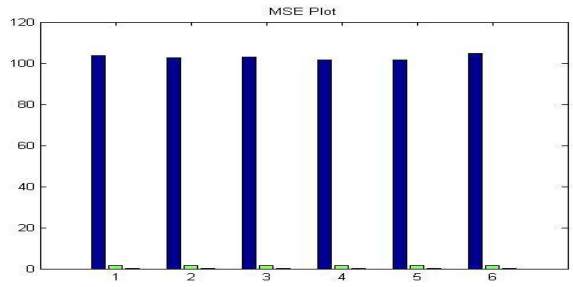

Figure 3. Graphical representation of Mean Square Error on comparing Spatial domain, DCT domain and DWT domain video watermarking techniques.

5. Discussion

Tabular representation shows the performance evaluated values obtained for three different types of methods. The Table 1 clearly shows the increased PSNR values for the DWT technique, reduced values for the DCT technique as compared to DWT and least PSNR value for spatial method. Moreover, Mean Square Error values are highest for spatial Domain and lowest for DWT. The tabulated values were represented in the form of graphical illustrations in Figures 1 and 2. From the graph, we could clearly understand the highest efficacy of DWT method.

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