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Digital Video Watermarking with RGB Image Using DWT and SVD

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Abstract: Due to rise in multimedia technologies, it has become easy to manipulate any digital document. Video Watermarking is a technique which hides the digital information into video frames for increasing their security and protecting the video content from manipulation. In this paper, a video watermarking technique is proposed in which RGB watermark has been embedded into each frame of the digital video using DWT and SVD in transform domain. The encryption of each pixel of RGB watermark image with ASCII code of an alphabet is hidden in a host frame without any data compression. The experimental results indicate watermarked frames with good robustness and Imperceptibility.

Index Terms – **Digital Video watermarking, SVD, DWT, RBG Image**

I. INTRODUCTION

With the advent of the digital technology, digital multimedia (audio, video, image, text) being shared widespreadly has aroused concerns regarding the security of the data. Among the current technologies available watermarking technique provides the best solution for the protection of data which is robust and imperceptible [1]. Watermarking is used to protect ownership rights, copy control, copyright protection and integrity of data [2] [3]. Nowadays digital watermarking is used widely to protect the digital data and plays an important role in the in digital data security. [4] [5] Digital video watermarking is a technique in which digital code is embedded into digital multimedia (image, video, audio, text). [6] The process of digital watermarking comprises of three steps first is generation of watermark second is embedding of watermark and the last is extraction of watermark. The watermark that is being embedded is the information about the copy control, ownership etc. This watermark is embedded in the multimedia (audio, video, image, text) by various methods and as per the requirement, the watermark is extracted. The basic use of watermark is to identify the authorised User, check data Integrity and check the authenticity of the data.

Properties of watermarking

There are various properties of digital watermarking these are discussed as

Robustness: This is one of the important property of all the watermarking systems. There are many reasons by which watermark gets altered during transmission or due to attack by hackers so watermarking should be robust enough to withstand all the threats.

Watermark size: The size of the watermark should be minimum because if it is not limited then it will ultimately increase the size of the data to be transmitted.

Non-perceptibility: Watermark should not be visible to human eye, it should be only find out through special processing. The watermark should be embedded in such a way that it should not affect the quality of the data.

Security: To protect the copyright only the authorised users should detect, extract and modify the watermark.

Fidelity: When the watermark is added to image there is a possibility that it can affect the quality of original image. We must keep this thing in mind that the fidelity of the data should be maintained.

Types of techniques

Video watermarking techniques can be classified into two types based on the method of hiding the watermark. The two types are transform domain and spatial domain [7] [8] [9].

Spatial domain: In spatial domain, digital watermarking algorithm the watermark is embedded by changing the intensity values to ensure robustness against colour conversion. In spatial domain digital watermarking algorithm, raw data is directly embedded in the original data. However, nowadays most of the work is done in the transform domain, some examples of this type are LSB, Patchwork, Text mapping etc.

Frequency domain: This is also known as transform domain. The frequency domain techniques is widely used as compared to spatial domain techniques. In frequency domain, the watermark is embedded into the spectral coefficients of image. The various technologies of frequency transform are DWT, SVD and DCT. In this research paper SVD and DWT techniques are used for the video watermarking and these are discussed as below:

Discrete wavelet transform- DWT decomposes an image into frequency channel having constant bandwidth .DWT can be implemented at multistage and it decomposes n image into four sub-bands i,e LL, LH, HH, HL. The LL band is called approximation sub-band whereas

rest three LH, HH, HL are vertical, diagonal and horizontal sub-bands respectively. In DWT two filters are used to perform decomposition I,e L and H whereas H corresponds to the high pass filter and L corresponds to the low pass filter. LL is the high frequency whereas detail sub-bands are low frequency components. Decomposition of the video frame can be performed at different levels. DWT is widely used because it provides robustness as compared to the other techniques[10] [11]

Singular value decomposition: SVD is a technique that is implemented in the video watermarking. In SVD, a matrix is diagonalised and plays an important role in matrix calculations. In SVD, video frame is decomposed into the matrix form. If the frame is denoted by A and let A is p×q matrix having p=q then SVD for A=U×S×VT. Here S represents square diagonal matrices. U and V represents the orthogonal matrices. After SVD is applied, the singular values are modified to embed the watermark.

II Literature survey

The study of already research papers is considered the important factor for the new research or modification to the existing ones. Until now, a lot of research has been done on the digital watermarking where different techniques are used to perform the watermarking. In the beginning, the work on the digital watermarking started in spatial domain and later maximum research was performed in frequency domain because of its advantages over the spatial. [12] a research was performed about the digital watermarking in which different invisible techniques were implemented in both frequency domain as well as spatial domain and both these methods were combined to get the hybrid to get the better results. [13] Another robust technique was proposed in the wavelet domain, the watermark was embedded into third low-level frequency coefficients after the three level discrete wavelet and singular wavelet transform. [14][15] Proposed the digital colour video watermarking that was based on SVD and DWT and the result was the watermarked content was robust to many attacks like frame dropping etc. [16] The research on colour images was implemented which was aimed at retrieving of watermarked data and cover image from dual attacks like noise and rotation attacks. In this technique alpha bending, pseudo Zernike and median filtering were used to recover from dual attacks. [17] Video watermarking system for copyright protection based on moving parts and silence detection. Also different types of watermarking techniques were discussed in a review paper also a comparison was drawn between different watermarking techniques [18].A robust video watermarking scheme was proposed by using wavelet transform. In the process the video frames were converted to bitmap images and later transformed into wavelet domain. LSB was the embedding technique used [19].

III Proposed scheme:

Embedding process

STEP 1: Take a digital video as a host video.
STEP 2: Extract the number of frames from the video.
STEP 3: Choose first frame m x n of the video and apply DWT to decompose it into four sub-bands i.e. LL, HL, LH and HH.
STEP 4: Select the first band LL and apply SVD to obtain U, S and V component of that frame.
STEP 5: Similarly take a watermark RGB image of m x n and subtract all pixels with ASCII code of an alphabet for its encryption.
STEP 6: After encryption, apply DWT on this encrypted watermark image.
STEP 7: Use SVD on its selected LL sub-band for obtaining U2, S2 and V2 on components of red, green and blue.
STEP 8: Obtain S=S1+a×S2 for each component of frame.
STEP 9: Now, multiply U, S and V1 for obtaining R,G,B components of watermarked frame. Now concate these watermarked R, G,B components
STEP 10: Apply inverse DWT and reconstruct the frame.
STEP 11: Repeat steps from STEP 3 to 11 for each frame of digital video.
STEP 12: Reconstruct the watermarked video.

Extraction process

STEP 1: Take the watermarked video.
STEP 2: Extract the frames from the video.
STEP 3: Apply DWT on each frame.
STEP 4: Apply SVD to get Ui, Si and Vi for red, green and blue component for each watermarked frame.
STEP 5: Compute S = (Si-S1)/a.
STEP 6: Now, multiply U, S and V to get RGB component for watermark image.
STEP 7: Use inverse DWT after concating these components.
STEP 8: Reconstruct the watermark image after decryption it.

IV Results and Conclusion:

Original Frame:

Watermark RGB Image:

Watermarked Frame:

The PSNR has been calculated as below:

$$\textbf{PSNR:} \quad 10 \log_{10}\left(\frac{MAX^2}{MSE}\right)$$

Mean Square Error (MSE) between the host frame X and the watermarked Frame X' is defined as

$$MSE: \frac{1}{M \times N}\sum_{i=0}^{M-1}\sum_{i=0}^{N-1}\left(X(i,j) - \left(X'(i,j)\right)\right)$$

Video	PSNR	MSE
Video 1	45.8	0.498
Video 2	46.3	0.591
Video 3	46.0	0.467
Video 4	48.7	0.483
Video 5	45.2	0.528
Video 6	44.8	2.753
Video 7	47.5	0.446
Video 8	48.3	0.374
Video 9	46.0	0.477
Video 10	44.3	1.434

Conclusion

In this paper, a method is proposed which works on digital video to conceal the RGB watermark image for providing more protection of ownership of owner's digital video. This proposed method has been embedded RGB watermark into each frame of the digital video using DWT and SVD in transform domain. This provides good robustness and imperceptibility to digital video after embedding RGB watermark image. Each pixel of RGB watermark image is encrypted with ASCII code of an alphabet for hiding it in a host frame without any data compression. and extract after decryption with proposed method. Experimental results show watermarked images with good robustness and Imperceptibility.

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