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Video Water Marking using Discrete Wavelet Transform

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Abstract: Video watermarking has been widely used in ownership protection, authentication, and content integrity confirmation of intellectual property in digital form. We are proposing a novel video watermarking scheme operating in the discrete wavelet transform is presented. Specifically the input video sequence is partitioned into number of frames for the embedding process. The grayscale image is sliced into bit planes for analyzing the each bit of the image. The sliced bit plane images are permuted and each permuted watermark images are embedded into each frame of the segmented shots with the aid of the watermark embedding. Then the recovery of the watermark is achieved with the help of the watermark extraction. Current scheme allows algorithm design, evaluation, experimentation and robustness.

Keywords: Copyright Protection, Discrete Wavelet Transform, Video Watermarking.

I. INTRODUCTION

Watermarking can be described as the process of embedding data into multimedia images, audios and videos [2, 3]. Modern digital watermarking methods concentrate on image and video copyright protection [4]. According to the technique employed to hide the watermark information bits in the host video, watermarking methods can be classified into two major types; they are spatial domain watermarking and transform-domain watermarking. Spatial-domain watermarking methods embed and detect watermark by modifying the spatial pixels values (luminance, chrominance, color space) of the entire video frame [5]. On the other hand spatial pixel values of the host video are modified according to a pre-determined transform by the transform-domain techniques. Transforms such as Discrete Cosine Transform (DCT), and the Discrete Wavelet Transform (DWT), are predominantly used [6].

II. EARLY WORKS

A robust scheme for digital video watermarking based on scrambling & then embedding the watermark into different parts of the source video according to its scene change. Proposed algorithm is robust against the various attacks like dropping of frame, averaging and collusion. The work is started with a comprehensive investigation of modern watermarking technologies, and perceived that none of the standing arrangements is proficient of resisting all the attacks. Hence, we propose the notion of embedding different fragments of a lone watermark into dissimilar scenes of a video. A novel video watermarking system operating in the three-dimensional wavelet transform is here presented. Specifically the video sequence is partitioned into spatial-temporal units and the single shots are projected onto the 3D wavelet domain. First a gray- scale watermark image is decomposed into a series of bit planes that are preprocessed with a random location matrix. After that the preprocessed bit planes are adaptively spread spectrum and added in 3D wavelet coefficients of the video shot. In present work, an efficient video watermarking technique using discrete wavelet transform to protect the copyright protection of digital video is presented. A watermarking procedure is introduced to embed a grayscale image into the digital video. Initially, the input video sequence is segmented into shots using well known shot segmentation technique. The segmented video shots are partitioned into limited number of frames for the embedding process. The grayscale image is utilized as a watermark to embed into the digital video sequence.

Initially, the grayscale image is sliced into bit planes. Subsequently, the sliced bit plane images are permuted to enhance the security of the watermark image. The permuted images are embedded into each frame of the segmented shots with the aid of the watermark embedding process. Subsequently, the recovery of the watermark is achieved with the help of the watermark extraction process. The results obtained from the experimentation shows that the proposed video watermarking techniques provide better results with higher visual quality. The organization of the paper is as follows: The proposed efficient video watermarking technique using discrete wavelet transform is detailed in Section III. The experimental results and discussion is provided in Section IV. Finally, the conclusions are summed up in Section V.

III. PROPOSED METHODOLOGY FOR VIDEO WATERMARKING

The proposed video watermarking scheme consists of two stages:

A. Watermark Embedding process
B. Watermark Extraction process

A. Watermark Embedding Process

Before embedding watermark pixels into the input video sequences, the following process should carried out to enhance the security of the hiding information as well as to improve the efficiency of our proposed approach. The process includes.

1. Shot segmentation of video sequences

The original input video sequence is first segmented into non-overlapping units, called shots that depict different actions. Each shot is characterized by no significant changes in its content which is determined by the background and the objects present in the scene. Here, proposed method uses Discrete Cosine Transform and correlation measure to identify the number of frames involved in each shot.

2. Bit plane slicing of grayscale image

Bit-Plane Slicing is a technique in which the image is sliced at different planes. Instead of highlighting gray level images, highlighting the contribution made to total image appearance by specific bits might be desired.

3. Pixel permutation

After the bit plane slicing process, the sliced images are allowed to permute each pixel value to enhance the security of the hiding information.

4. Decomposition of image using DWT

Wavelets are functions defined over a finite interval and having an average value of zero. The basic idea of the wavelet transform is to represent any arbitrary function as a superposition of a set of such wavelets or basis functions. The fig.1 shows the watermarking embedding process as shown below.

a. Watermark Embedding Algorithm

Step 1: Segment the original input video sequence into number shots using shot segmentation technique. Then identify the number of frames involved in each segmented shots for embedding purpose.

Step 2: Grayscale image. Slice the grayscale watermark image into sliced images using bit plane slicing.

Step 3: Permute the sliced images using pixel permutation technique to obtain the permuted grayscale image.

Step 4: Decompose the components of each partitioned frame into four sub-bands such as HH, HL, LH and LL with the aid of the DWT to attain the transformed frames.

Step 5: Choose the low frequency sub-bands (HL, LH) from the transformed frames to embed the permuted.

Step 6: Find the similarity matrix of the permuted image to embed into the chosen sub-bands. The upper part of the similarity matrix is embedded into the HL sub-band and the lower part of the similarity matrix into the LH sub-band.

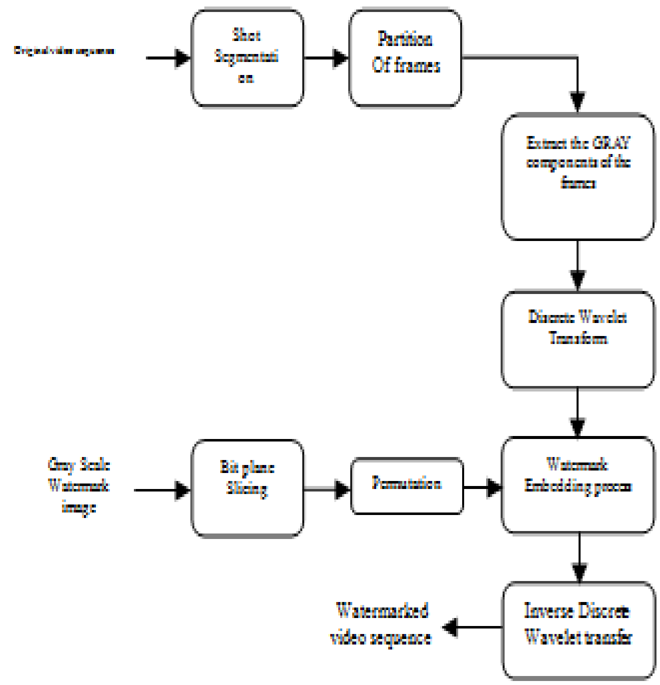

Fig.1. Watermark embedding process.

Step 7: The HL and LH sub-bands used to embed the permuted watermark image are divided into four parts as per the similarity matrix. The lower part embedding part of the similarity matrix of the HL and LH bands is chosen for embedding the two similar parts of the watermark image.

Step 8: In the HL sub-band, the upper part of the similarity matrix is embedded with the following steps:

Calculate the mean value and the maximum value mean (Up), max (E_p) of the chosen embedding part E_p.

$$mean(E_p) = \sum_{i=1}^{n} E_p(i) \quad \textbf{(1)}$$

Step 9: Embed the watermark pixels 0 or 1 in a zigzag manner in the chosen embedding part, since the watermark is the grayscale image.

Step 10: In the HL sub-band, the upper part of the similarity matrix is embedded with the following steps:

Calculate the mean value and the maximum value mean (Up), max (E_p) of the chosen embedding part E_p.

Step 11: Divide all the embedded frames with the embedding strength to enhance the quality of the image.

Step 12: Map the modified sub-bands into its original position and apply the inverse discrete wavelet transform to attain the watermarked video sequence.

b. Watermark Extraction process

The fig.2 shows the watermarking extraction process as shown below.

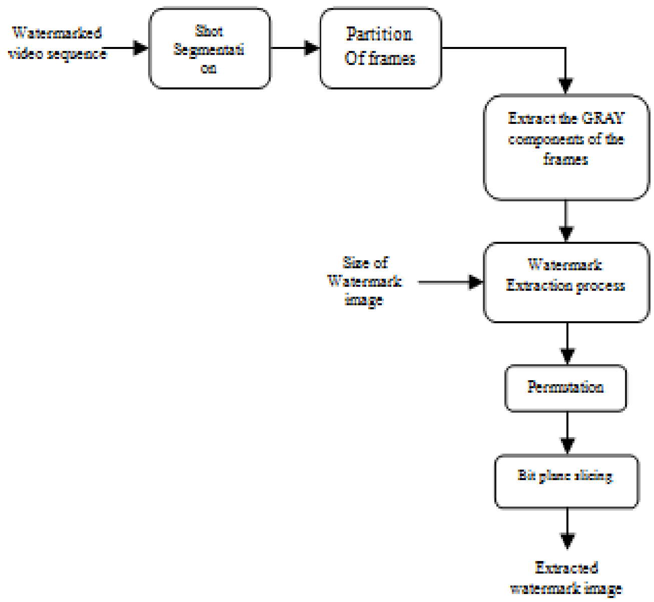

Fig.2. Watermark Extraction process.

B. Watermark Extraction Algorithm

Step 1: Extract the components of all the partitioned frames for extracting Segment the watermarked video sequence into a number of non-overlapping shot using the shot segmentation technique. Then, identify the number of frames involved in each segmented shots for the extraction process.

Step 2: Extract the components of all the partitioned frames for extracting the embedded watermark pixels.

Step 3: Decompose the components of the frames with the aid of the discrete wavelet transform into four sub-bands HH, HL, LH and LL.

Step 4: Select the low frequency sub-bands (HL, LH) from the transformed frames to extract the watermark grayscale image.

Step 5: Extract the watermark pixels from the embedding part in a zigzag manner from the HL and the LH sub-bands with the aid of the following steps. If the embedded pixel value is greater than the mean pixel value, then the extracted pixel value is one. If it is lesser, then the extracted pixel is zero.

Step 5: Extract the watermark pixels from the embedding part in a zigzag manner from the HL and the LH sub-bands with the aid of the following steps. If the embedded pixel value is greater than the mean pixel value, then the extracted pixel value is one. If it is lesser, then the extracted pixel is zero.

$$W_I[i',j'] = \begin{cases} 1, E_p(i) > mean(E_p) \\ 0 \end{cases} \quad \textbf{(2)}$$

Step 6: Form the matrix with the size of the watermark image and the extracted pixels are placed in it to attain the watermark image.

Step 7: Obtain the watermark image W [i', j'] I by applying the reverse process of permutation and bit plane slicing.

IV. EXPERIMENTAL RESULTS

The experimental results of the proposed digital video watermarking scheme using discrete wavelet transform are presented. The water marked image is sliced into 8 bit planes and the watermarked video sequences possess superior Peak Signal to Noise Ratio (PSNR) and visual quality for grayscale watermark images as shown in Fig.3.

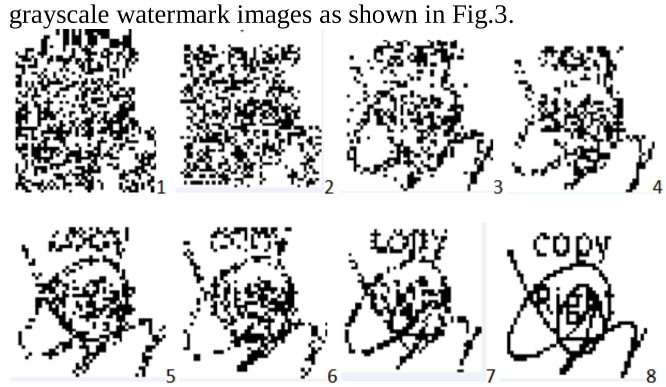

Fig.3. Grayscale watermark images.

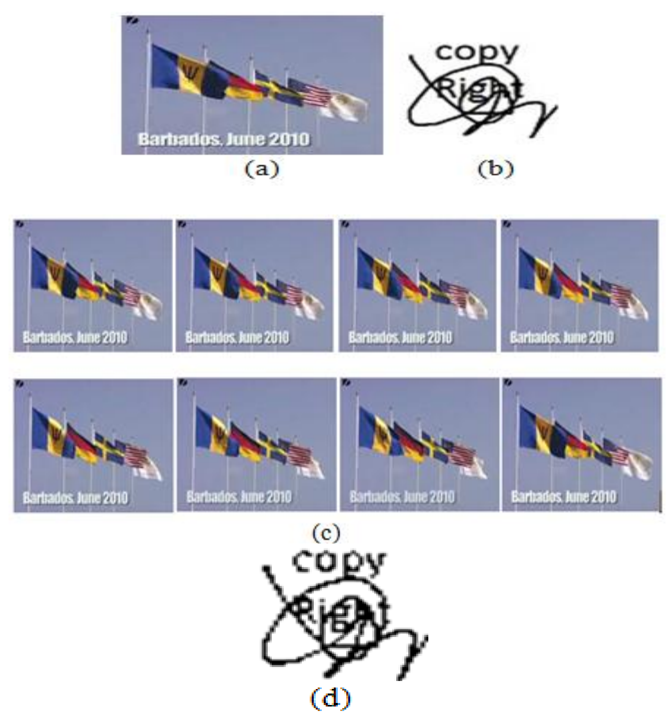

Fig.4. (a) Input polo video sequence, (b) Watermark image, (c) frames of polo Watermarked video, (d) Extracted watermark image.

The output acquired from the proposed video watermarking scheme has been evaluated by PSNR and NC (Normalized Correlation).The current scheme is evaluated by a video sample such as polo. Fig.4 shows the original input polo video sequence, watermark image, watermarked video sequence and the extracted watermark image.

A. Evaluation Results

To prove the effectiveness of the proposed scheme the results are compared with the existing method [8]. Table 1 shows the PSNR values with different frame number for the polo video sequence.

TABLE I: PSNR Values with Different Frame Number (PSNR in db)

Video sequence	Frames	Embedding Strength = 1	Embedding Strength = 5	Embedding Strength = 10	
		PSNR(db)	PSNR(db)	PSNR(db)	
		100	30.27	26.98	26.11

V. CONCLUSION

This paper proposes a novel scheme for video watermarking. In the present investigation an efficient video watermarking scheme using DWT to protect the copyright of digital video sequence is demonstrated. This is attaining by watermark embedding and watermark extraction process. Experimental results proved that the proposed scheme is efficient by means of imperceptibility and robustness.

VI. REFERENCES

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