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Colour Image Watermarking Based On Wavelet and QR Decomposition

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ABSTRACT

We proposed new video watermarking algorithm on color video. The motivation of this implementation is to provide a recent watermarking trends and of the future research directions in color image and video watermarking. The proposed algorithm divides cover video frames into three color bands of red, green and blue. Then following operations are performed on all three channels of cover video frame separately. First, each colour band is divided into patches of small sizes then the entropy of each patch is calculated. At this step a threshold is found based on the average entropy of all patches and following is applied to all patches which have entropy lower than the threshold. Wavelet representations of each patch are given by applying a discrete wavelet transform. Then Singular value decomposition, orthogonal-triangular decomposition, and a chirp z-transform are used to embed a watermark on the cover image. Several signal processing attacks are applied on watermarked images in order to robustness of the algorithm. The Proposed algorithm is compared with one conventional state-of-art algorithms. Experimental results show superiority of the proposed algorithm compare with other algorithm in the area of image watermarking.

Keywords—Video processing, digital Video Watermarking, DWT, CZT, Entropy, SVD, QR.

I. INTRODUCTION

Due to the rapid growth of the role of social networks and communications in everyday lives, taking and sharing images frequently has become a widespread practice, where a remarkable division of modern movable phones and computers, as well as digital cameras, handle high resolution imaging. However, transferring the foregoing images from a device to another one may be seriously exposed to the risks of security, manipulation and copyright attacks, unless it has been carefully taken care of by embedding the data into the media contents through watermarking [1], [2], [3], [4], [5].

The illegal distribution of a digital movie is a common and significant threat to the film industry. With the advent of high-speed broadband Internet access, a pirated copy of a digital video can now be easily distributed to a global audience. A possible means of limiting this type of digital theft is digital video watermarking whereby additional information, called a watermark, is embedded in the host video. This watermark can be extracted at the decoder and used to determine whether the video content is watermarked. This paper presents a review of digital video watermarking techniques in which their applications, challenges and important properties are discussed, and categorizes them based on the domain in which they embed the watermark.

Watermarking provides a vital platform aiming at protecting multimedia materials from a variety of undesired operations and illegal interferences, such as distribution and manipulation, meaning that for a reliable performance, they need to generate seamless watermarks which could handle large volumes of data robustly and securely. The foregoing properties of watermarking schemes will be discussed in more details in what follows. One of the most important characteristics of a watermarking algorithm is the robustness of the resulting multimedia information against possible attacks made through image processing techniques.

Moreover, the watermark needs to be imperceptible, i.e. it should distort the data available in the original image. Furthermore, the data capacity is one of the main criteria in assessing the performance of a watermarking procedure, which stands for the largest amount of data that can be passed through the algorithm while preserving the visual appearance of the cover image. Last but not least, security of a watermarking technique is of paramount importance, as it denotes the resistance of the process against unauthorized detection, embedding or removal.

The studies reported on watermarking schemes in the literature heretofore [6], [7], [8], [9], [10] have categorized them into three major classes, namely, non-blind, semi-blind and blind. The underlying notion of the foregoing perception lies in the fact that in non-blind watermarking, both the original image and the watermark are required for embedding and extraction, whereas in semi-blind watermarking only the watermark image is needed, and in the blind variant, neither of them is necessary.

II.LITERATURE SURVEY

The appropriate background of literature and the concept of digital image watermarking are reviewed in this chapter. The copyright protection of multimedia content has become a critical issue now days due to easy copying, the latest developments in digital transmission and widespread of broadband networks and the internet. The transmission of information takes place in different forms and is used in many applications, where the communication must be done in secret form. Such secret communication techniques include the transfer of medical data, bank transfers, corporate communications, purchasing using bank cards, a large amount of information through emails and etc. Steganography, cryptography and watermarking are the different techniques used to perform secret communication.

Watermarks can be embedded within images by modifying these values, i.e. the transform domain coefficients. In case of spatial domain, simple watermarks could be embedded in the images by modifying the pixel values or the Least Significant Bit (LSB) values. However, more robust watermarks could be embedded in the transform domain of images by modifying the transform domain coefficients. In 1997 Cox et al. presented a paper "Secure Spread Spectrum Watermarking for Multimedia" , one of the most cited paper (cited 2985 times till April' 2008 as per Google Scholar search), and after that most of the research work is based on this work. Even though spatial domain based techniques cannot sustain most of the common attacks like compression, high pass or low pass filtering etc., researchers present spatial domain based schemes [1].

The present paper proposes a novel watermarking scheme specifically designed for high dynamic range (HDR) images. The employed embedding strategy is based on a decomposition of the original HDR representation into multiple low dynamic range (LDR) images by means of a bracketing process. After having inserted the selected watermark into each LDR component, the final output is generated by combining the available contributions into a single HDR object [2].

High dynamic range (HDR) images represent the future format for digital images since they allow accurate rendering of a wider range of luminance values. However, today special types of preprocessing, collectively known as tone-mapping (TM) operators, are needed to adapt HDR images to currently existing displays. Tone-mapped images, although of reduced dynamic range, have nonetheless high quality and hence retain some commercial value. In this paper, we propose a solution to the problem of HDR image watermarking, e.g., for copyright embedding, that should survive TM [3].

III.PROPOSED APPROACH

As we know video is nothing but frames of images, the work is similar to image processing. We focus on embedding a watermark into a colour Video and extracting it after applying several different attacks. This way, we consider all possible attacks and propose a non-blind colour video watermarking scheme. The embedding and extraction of a watermark video is done by a combination of characteristics of QR decomposition, Chirp Z-Transform (CZT), Discrete Wavelet Transform (DWT), and Singular Value Decomposition (SVD). a detail description of these steps of the proposed method are described in following. A. Embedding Watermark into Cover Video. The Watermark embedding step is explained in the following. Green (G) and blue (B) are extracted from the cover colored video. Then patches size of α × β are extracted from each colour channel of size of m×n, where α and β divide m and n respectively.

A. Embedding of Watermark

We will read video in X and extract the number of frames from video nf.From all 'nf' we will embed the data in some limited frame. With the help of loop we can get some limited number of frames. We can consider N = n β and M = m α. Then each patch can be described as in equation 1.

$$B_{mn} : n \epsilon \{1 \ldots\ldots N\}, m \epsilon \{1 \ldots . M\} \qquad (1)$$

For each patch, an entropy value (E) is calculated then a threshold value T is considered based on an average of all entropy values E of all patches. where T is founded by the following equation

$$T = \sum_{m=1}^{M} \sum_{n=1}^{N} \frac{E(B_{mn})}{m \times n} \qquad (2)$$

After finding the threshold, a two-level discrete wavelet transform (DWT) is applied on patches with a value of E less than T, in order to decompose them into four subbands of one Low frequency (ll) and three high frequency in vertical (LH) , horizontal and diagonal direction as given in equation (3).

$$LL_{mn} LH_{mn} HL_{mn} HH_{mn} = DWT(B_{mn}), \forall B_{mn} \epsilon \{B_{mn} < T\} \qquad (3)$$

In the next step a CZT of LLmn is calculated for all decomposed patchs as given in equation (4).

$$C_{mn} = CZT(LL_{mn}) \qquad (4)$$

A QR decomposition algorithm is applied in this step to matrix C mn from equation (4) to calculate diagonal matrix in the following equation.

$$[Q_{mn} R_{mn}] = QR(C_{mn})$$
$$D1_m = diag(R_{mn})$$
$$D_{mn} = Zeros(R_{mn})$$
$$D_{mm} = D1_m \qquad (5)$$

A SVD algorithm is applied to diagonal matrix Dmn in order to further decompose it as shown in equation (6).

$$[U_{mn} S_{mn} V_{mn}] = SVD(D_{mn}) \qquad (6)$$

On the other hand, the SVD algorithm is applied to a watermark image W in order to decompose it to three matrices of U1, S1 and V1. Modified upper-triangular matrix Rmn and Unitary matrix Qmn are combined as shown in following equation.

$$C_{2_{mn}} = Q_{mn} \times R_{mn} \qquad (7)$$

An inverse CZT of C2 mn is used to get watermarked LL sub band as illustrated in equation (8).

$$LL_{2_{mn}} = ICZT\left(C_{2_{mn}}\right) \qquad (8)$$

Then an inverse DWT is used to get watermarked image patch. Instead of using LLmn, a modified LL2mn is used as shown in equation (9).

$$I_{mn} = IDWT\left(LL_{2_{mn}} LH_{mn} HL_{mn} H\hbar_{mn}\right) \qquad (9)$$

Finally, modified version of patches with low entropy, high entropy patches and all three colour channels are combined in order to generate watermarked colour image.

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So,embedded patches will be combined and formed a video which is shown as embedded video.

B. Extraction of Watermark

Embedded video is used for data extraction. Embedded video with limited frames is applied for the data extraction. The extraction of Watermark is explained in the following. The first steps of watermark extraction are the same as the watermark embedding section. The steps from eqn 1 to equation 6 are used for watermark extraction as well. Singular values of cover image patches and the singular values of watermarked image patch are subtracted from each other then the singular values of the extracted watermark image is found bu a divination of the subtraction result and scaling factor γ, as shown in following equation

$$S_{1'_{mn}} = (s'_{mn} - S_{mn})/\gamma \qquad (10)$$

Then u1 and V1 are combined from watermark image with the singular values founded in above egn. in order to extract watermark for each patch as shown in equation (11).

$$W'_{1_{mn}} = U_1 \times s'_{mn} \times V_1^T \qquad (11)$$

Finally we will get the extracted frame and embedded data which we embedded as watermark.

IV.RESULTS

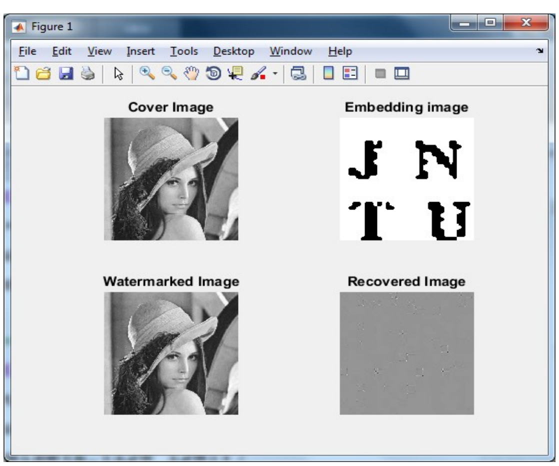

Fig1: (a) Cover image (b) Embedding Image (c) Watermarked Image (d) Recovered Image

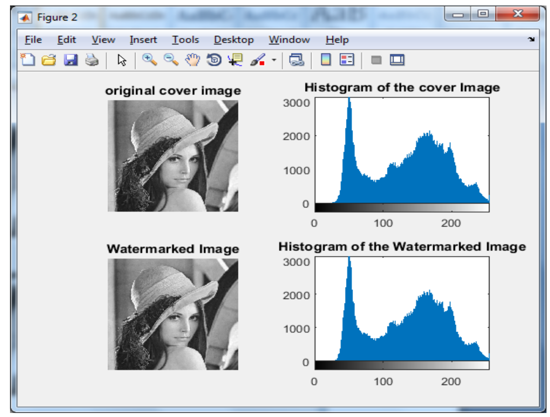

Fig2: (a) Original Cover Image (b) Histogram of the Cover Image (c) Watermarked Image (d) Histogram of Watermarked Image

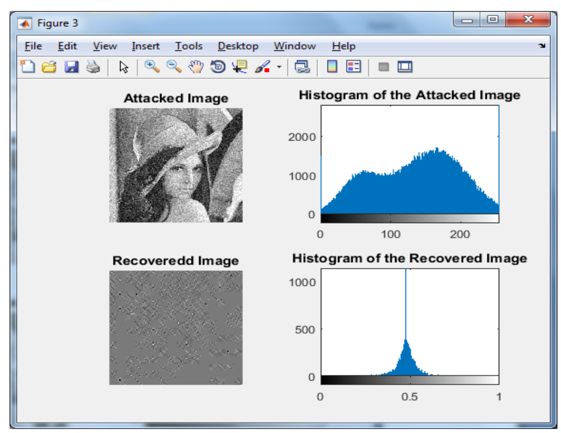

Fig3: (a) noise attacked image (b) Histogram of the Attacked Image (c) Recovered Image (d) Histogram of the Recovered Image

V.CONCLUSION

In this work, a novel video watermarking algorithm is proposed. The algorithm embeds a watermark into singular values of all three colour channel of cover video. At the First step, the cover video is branched into three colour channels of R, G, and B, and then each channel is divided into patches. Then a proper patch which has a low entropy is found in order to watermark embedding. Then these patches are decomposed into frequency channels by using DWT and further decomposed using CZT. Then orthogonal-triangular decomposition and Singular value decomposition are used to embed a watermark on the cover video. While going for the video watermarking first video is divided into number of frames. From that frames we selected some limited frames. The performance analysis is done with the help of both subjective as well as objective quality analysis. By both analyses our proposed video watermarking is more robust compared to state of art existing techniques.

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