Video Watermarking
Using DWT Based Scheme

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***Abstract*— In this paper, a new watermarking algorithm on video frame is proposed. The proposed algorithm divides a cover image frame into three color bands of red, green and blue. Then the following tasks are done on all three channels separately. First, Each color 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. A wavelet representation of each patch is 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 video frame. Several signal processing attacks are applied on watermarked video in order to robustness of the algorithm.**

***Keywords*—digital Image Watermarking, DWT, CZT, Entropy, SVD, QR.**

INTRODUCTION

With the latest evolution in the field of science and Technology, there has been an exponential growth in the usage of Internet. As a result, the sharing of digital content (audio, video, image, text) has become much easy. Hence, we need to prevent the unauthorized distribution and sharing of digital content. Watermarking is one process in which we embed or insert data into the original content i.e., we hide the digital information in the carrier signal and the advantage with watermarking is that the hidden data and the original need not to be related. We can embed or insert a text file into the audio by using necessary conversion parameters and we can embed an image into audio by converting the pixels into gray scale and then to binary and we can embed an image into host image. Digital Watermarking is one of the appealing methods to protect the copyright and unauthorized access to the content. Such type of watermarking can be applied to images, audio, videos etc. These watermarks should not alter the quality of content and it should be robust to the various attacks and distortion. There are alternate mechanisms like using the header of a digital file to store meta-information. However, for inserting visible marks in images & video and for adding information about audio in audio clip etc. the digital watermarking technique is appealing, since it provides following main features. The watermarks do not create visible artifacts in still images, alter the bit rate of video or introduce audible frequencies in audio signals. The watermarks should not get degraded or destroyed as a result of unintentional or malicious signal and geometric distortions like analog-to digital conversion, digital-to-analog conversion, cropping, re-sampling, rotation, dithering, quantization, scaling and compression of the content.

I. LITERATURE SURVEY

The appropriate background of literature and the concept of digital video 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 [18]. 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.

Hyun Park, Sung Hyun Lee and Y. S. Moon [4] proposed an adaptive blind video watermarking method using video characteristics based on human visual system (HVS) in three-dimensional discrete cosine transform (3D-DCT) domain. In order to optimize the weight factors for watermarking, we classify the patterns of 3D-DCT cubes and the types of video segments by using the texture and motion information of 3D-DCT cubes. Then we embed an optimal watermark into the mid-range coefficients of 3D-DCT cubes by using the trained optimal weight factors. Experimental results showed that the proposed method achieves better performance in terms of invisibility and robustness than the previous method under the various possible attacks such as MPEG compression, frame dropping, frame insertion and frame swapping to experimental videos.

Sanjana Sinha, Prajnat Bardhan [17] proposed 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 decomposed using DWT and the binary watermark is embedded in the principal components of the low frequency wavelet coefficients. The imperceptible high bit rate watermark embedded is robust against various attacks that can be carried out on the watermarked video, such as filtering, contrast adjustment, noise addition and geometric attacks. But video frames can be subject to scene change analysis to embed an independent watermark in the sequence of frames forming a scene, and repeating this procedure for all the scenes within a video.

Wenhai Kong,Bian Yang, Di Wu and Xiamu Niu [16] proposed a new blind video watermarking algorithm based on the Singular Value Decomposition. The watermarks can be detected without the original video or any other information of the original singular values. Experiments show that the algorithm bears desirable robustness on MPEG-2 compression, median filtering, small rescaling, and rotation, the books are sequenced properly. etc. we can improve the algorithm to gain better performance against other attacks like rotation, cropping, etc. Moreover, it does not need any information in the detection process while other algorithms need the information of singular values. In our future work, we will improve the algorithm to gain better performance against other attacks like rotation, cropping.

The cooperative work process and the automation work flow of the no man keeping watch library which takes the robot as its centre and uses the internet of things technology are firstly introduced in this paper. A new data format of the RFID electronic label for books is designed, and the robustness of positioning of the manipulator is improved by the information fusion of the RFID label source and the CCD sensor source installed on the manipulator. A position method named THREE STEPS by the combination of fuzzy position, area position and accurate position is advanced, and the complex books positioning and grasping question is transformed into the world coordinate solving question of some point on the objective book. The fuzzy CMAC (cerebella model articulation controller) neuron network is adapted to realize the non-line relationship of fusion feature and manipulator position. And direct vision servo control architecture is used when designing the manipulator position system. The experiment result has proved this method can help the manipulator realize the accurate position and rapid catching.

G. Anbarjafari, M. Agoyi, L. Laur, and P. Rasti [11] This paper describes a digital watermarking scheme based on fractal codification for 8-bit gray scale images; it replaces range blocks by modified blocks according to the watermark bit being embedded. The main contribution of this work is a decrease in the distortion generated by the watermark embedding in the carrier image compared to the reference scheme based on fractal codification; in addition, the scheme achieves a better robustness against JPEG attacks, a decrease at 13.2 dB in distortion and up to 50% improvement in Bit Correct Ratio (BCR). The scheme relies on the selection of interest points, local searching regions and embedding regions to be successful. Finally, this document presents a comparison of the results obtained with the proposed scheme and other schemes inspired by the fractal codification.

This article proposed a watermarking scheme that owes its success to the adjustment of the watermark magnitude factor S to the standard deviation of the range block R. This improves the imperceptibility of the watermark avoiding block artifacts. Moreover, this scheme hides the watermark in different regions of the image, which increases robustness.

Also, we can conclude that local search regions assure a better correspondence between blocks, which diminishes perceptibility of the embedded watermark and increases BCR of the scheme. In addition, limiting the search of blocks in a determined area, increases embedding and extraction processes speed. A disadvantage of the utilization of embedding regions is that the scheme may lose synchronization of the regions in a geometric attack, an adaptive disposition of blocks can be used to reach robustness against them. In the utilization of triangular patterns in watermarking is proposed. A further improvement against JPEG attacks may be gained by the use of similarities in the DCT coefficients.

SCOPE OF THE PAPER

This paper aims to design a better video watermarking algorithm which is more robust and immune to signal processing attacks. The watermark is embedded in the lowest frequency sub band obtained from applying dwt and further operations like CZT, SVD, QR decomposition IDWT, IFFT, so very least or no amount of data is lost in this process.

PROPOSED METHODOLOGY

The input video is first partitioned into frames. The number of frames to be selected for watermarking depends on the user. We can embed the watermark in any frame.

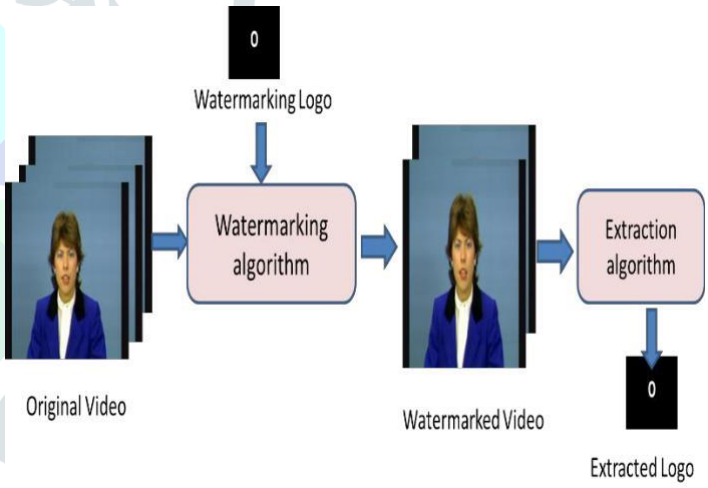

Fig 1: concept of video watermarking

After we have selected the frames, we will divide the frames into Red(R), Green(G), Blue(B) color planes respectively. After dividing the frames into three color planes we will further divide each color plane into patches of size m*n. We can change the values of m*n according to our needs. After dividing into patches, we will now calculate the Entropy (the average information present) of each patch using inbuilt MATLAB function. After calculating the Entropy of each patch, we will now determine Threshold based on the average Entropy. Since we know the value of the Threshold now, we can embed the watermark logo only in those patches whose Entropy is less than the threshold as it contains least amount of information.

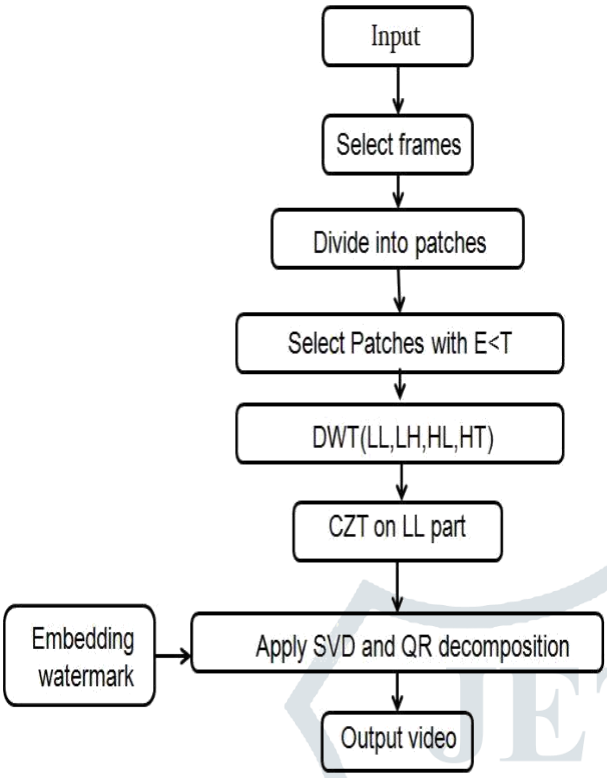

Fig 2: block diagram

For the patches with Entropy less than the Threshold we are applying 2 level DWT (Discrete Wavelet Transform is used to decompose the input image into sub bands of different resolutions that are low, middle and high frequency bands. The mean value of the filter is the low frequency coefficient while wavelet coefficients are the high frequency coefficients) and decomposing the patch into 4 frequency sub bands (LL, LH, HL, HH). We will be applying Chirp Z Transform (The chirp Z-transform (CZT) is useful in evaluating the Z-transform along contours other than the unit circle.

The chirp Z-transform, or CZT, computes the Z-transform along spiral contours in the *z*-plane for an input sequence. Unlike the DFT, the CZT is not constrained to operate along the unit circle) on the low frequency sub band. QR decomposition (The QR decomposition (also called the QR factorization) of a matrix is a decomposition of the matrix into an orthogonal matrix and a triangular matrix. A QR decomposition of a real square matrix A is a decomposition of A as A = QR, where Q is an orthogonal matrix (i.e. QTQ = I) and R is an upper triangular matrix. If A is nonsingular, then this factorization is unique) is applied in the next step, SVD is applied in the next step to further decompose it.

SVD gives three matrices S, V, U where U and V are Orthogonal matrices and S is diagonal matrix whose values are nothing but the square root of eigen values. On the other hand, the SVD algorithm is applied to a watermark image *W* in order to decompose it to three matrices of U_1, S_1 and V_1. modified upper-triangular matrix R_{mn} and Unitary matrix Q_{mn} are combined.

An inverse FFT of C_{2mn} is used to get watermarked *LL* sub band. Then an inverse DWT is used to get watermarked image patch. Instead of using LL_{mn}, a modified LL_{2mn} is used. Finally, modified version of patches with low entropy, high entropy patches and all three color channels are combined in order to generate watermarked color frames.

We follow the same steps for extraction process as well. We repeat the same steps till the SVD process. Singular values of the color frame and the singular values of the watermarked image are subtracted to get the singular values of the extracted watermarked image.

V EXPERIMENTAL RESULT

After selecting the input video and watermarking logo, give the MATLAB a few seconds to load the video and the watermarked video is available and we have plotted the cover frame, the watermarked logo and the cover frame after embedding watermark and the extracted watermark. As shown in the output the quality of the extracted watermark is high. The video selected for watermarking is a basic video and the watermarking image selected is the logo. Several signal processing attacks are selected in order to apply on the cover image which is watermarked with a watermark image. Various images are used as watermark and results are shown below.

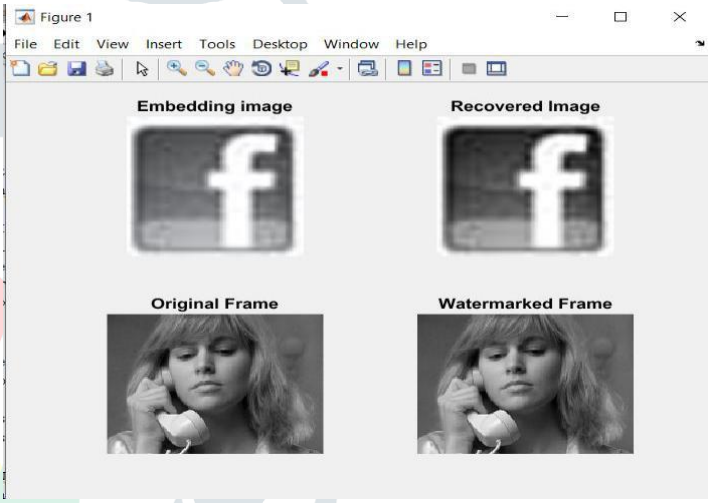

Fig 3 : sample 1

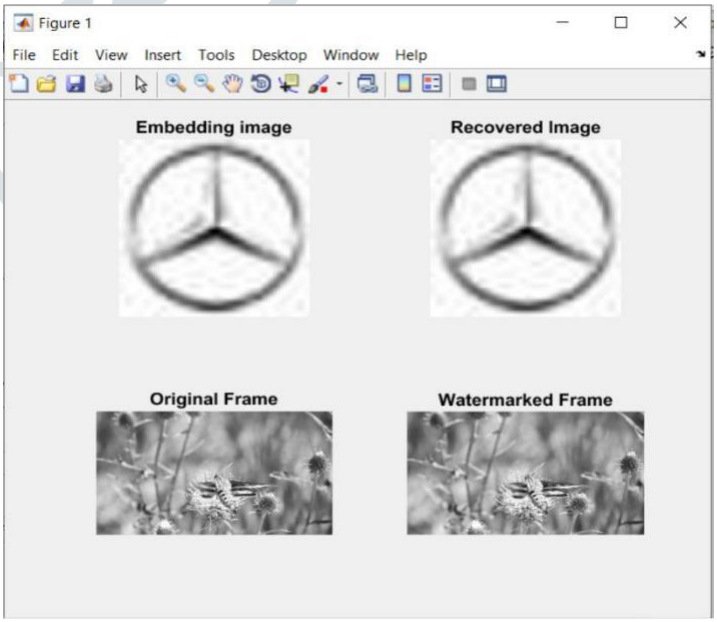

Fig 4: sample 2

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