Hybrid Approach for Robust Digital Video Watermarking
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Abstract— With the growing popularity of internet and digital media, digital watermarking techniques have been developed to protect the copyright of multimedia objects such as text, audio, video, etc. So, we have proposed a hybrid video watermarking technique which takes the advantages of different transforms like DWT, DCT, SVD and Arnold Transform, which enhances more security and provides robustness to the watermark. In this paper method, video is divided into several groups of frames, and one of the frames is selected where watermark will be embedded. Before embedding watermark in a selected frame it will be pre-processed with Arnold Transform which will provide security to it. The selected plane of video frame are decomposed using DWT and high frequency band HH, middle frequency bands LH, HL are transformed with DCT. The DCT coefficients are SVD transformed which are embedded with corresponding transformed coefficients of watermarks along with Arnold Transform. The embedded watermark is extracted with inverse process of embedding. The proposed algorithm is tested with various video sequences using MATLAB 2013a. The distortion quality of original image and watermark is controlled by the Peak Signal to Noise Ratio, Signal to Noise Ratio and Mean square error of the watermarked frame with original frame.

Key words: Digital Watermarking, Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT), Singular Value Decomposition, Arnold Transform

I. INTRODUCTION

Nowadays, advances in digital multimedia like Internet video, wireless video, video phones, video conferencing and many others shows great interest in protecting the copyright ownership of multimedia. Digital watermarking is technique of hiding data in a multimedia object like image, audio and video [1]. Digital watermarking has been identified as a means to identify the owner and distribution path of digital data. The watermark is embedded and extracted as per the requirement [2]. The general framework of watermarking contains [6]: (1) embedding function which embeds the watermark in to the multimedia content (2) communication channel which then distributes the data to the concerned bodies. It is the place where the images are vulnerable to attacks. (3) Extraction function contains the extraction or detection algorithm to detect or extract the watermark as per requirements [6].

![Fig. 1: Basic Watermarking Model](image)

Digital video is a sequence or collection of consecutive still images. The amount of information that can be embedded in the video sequence is called payload. In reality, video watermarking techniques need to meet other challenges than that in image watermarking schemes such as large volume of inherently repeated sequence of data between frames [2]. The watermarking can be done either in spatial domain or transform domain. Spatial domain technique embeds the watermark by directly modifying the pixel values of the original data [2]. In transform domain technique, the watermark will be embedded by modifying the transform coefficients of the host data, for instance: discrete cosine transform (DCT), discrete wavelet transform (DWT), and singular value decomposition (SVD). In the transform domain the manipulation of watermark is more difficult than in spatial domain. This is due to the fact that when image is inverse transformed, watermark is distributed irregularly over the host image which makes the attacker difficult to read and modify [2].

In this paper a DWT – DCT – SVD with Arnold Transform based video watermarking technique has been used for embedding watermark. The defined methods combine the advantages of four transforms which can improve the imperceptibility, security, robustness very well.

The remainder of the paper is organized as follows:

In Section II, we briefly describe the background of Discrete Cosine Transform, Discrete Wavelet Transform and Singular Value Decomposition, Arnold Transform related to watermarking. Section III presents Literature Review, while the Summary of the proposed work is described in Section IV.

II. BACKGROUND REVIEW

Section II contains the jest of the frequency domain transform being used for watermarking. Discrete Wavelet Transform, Discrete Cosine Transform, Singular Value Decomposition and Arnold Transform are the methods that are elaborated in this section and worked on.

A. Discrete Wavelet Transform:

Discrete wavelet transform (DWT) of the image produces multi resolution representation of an image. The DWT analyses the signal at multiple resolution. DWT divides the image into high frequency quadrants and low frequency quadrants. The low frequency quadrant is again split into two more parts of high and low frequencies and this process is repeated until the signal has been entirely decomposed [8].

![Fig. 2: Two Level Decomposition [8]](image)

For the first stage decomposition by DWT the image is divided into its LL, LH, HL, and HH plane. The
low frequency coefficients are more robust to embed watermark because it contains more information of the original image. The reconstruct of the original image from the decomposed image is performed by IDWT [8].

B. Discrete Cosine Transform:
Discrete Cosine Transform (DCT) used for the signal processing. It transforms a signal from the spatial domain to the frequency domain. DCT watermarking is more robust as compared to the spatial domain watermarking techniques. The main steps which used in DCT [8]:

In DCT, for embedding the watermark information, we divide the image into different frequency bands. In Figure 2 FL denotes the lowest frequency component of the block, while FH denotes the higher frequency component and FM denotes the middle frequency component which is chosen as the embedding region which provides strong robustness [8].

![Discrete Cosine Transform Region](image)

**Fig. 3: Discrete Cosine Transform Region**[8]

C. Singular Value Decomposition:
The Singular Value decomposition yields the purpose of reduction of complexity by dividing the non-negative image (M) matrix into:

\[ M = U^*S^*V^T \]

Where, U and V are orthogonal matrices and S known as singular matrix is a diagonal matrix carrying non-negative singular values of matrix M.

The usage of singular values volumes to the robustness of the image, i.e. when any perturbation is added to the image large variations in the singular values do not occur [3].

D. Arnold Transform:
To confirm the security and improve the robustness of the proposed watermarking scheme, the watermark should be pre-processed before embedded into the original image. It is applied in original watermark [9].

III. EXISTING SYSTEM

Various combinations of these techniques i.e. SVD-DWT [3], DWT-SVD-Torus Automorphism [4], DWT-SVD & Multiple Level DCT [5], RDWT-DCT-SVD & Trigonometric Functions [6], DWT-SVD [7] have been proposed and worked upon it.

The watermark techniques proposed in [3] tried to resolve the issue of copyright protection. Here, the cover image is divided into four sub-bands using DWT and the singular value of the cover image is modified using SVD rather than on the DWT sub-bands which makes itself vulnerable to various attacks.

Now, the hybrid technique introduced in [4], uses blind image watermarking technique where watermark will be converted into binary data and then scrambling using torus Automorphism which provides better security. Now, DWT will be applied on host image, which divides into four sub-bands. Here, LL band is selected and block conversion is applied on it. After block conversion SVD is performed on each of these block which results in a three matrices U*S*V. Here, one watermark bit is embedded into one individual block and inverse DWT is performed to get watermarked image. The described methods are robust against different signal and non-signal processing attacks.

The large capacity watermark along with robustness to different attacks using hybrid transform is been introduced in [5]. Here, DWT is performed on host image and its low frequency sub-band is obtained. Then the block of size 8M×8M is obtained. The watermark which is to be introduced is scrambled using chaos encryption. The co-efficient matrix of the low frequency sub-band is partitioned. After that each block is done multiple-level DCT. As per the capacity of the embedded watermark, the appropriate DCT coefficients are selected in each block which forms new matrix and then new encrypted watermark is embedded in the singular value matrix of new matrix. The final watermark image is obtained by performing SVD, multiple level inverse DCT and inverse DWT.

To create a non-blind, robust, and reversible watermarking scheme a hybrid technique is proposed in [6]. Since RDWT is redundant in nature as well as shift invariance it has a potential to find out suitable areas to embed the watermark. Here, the whole image is divided into four sub-bands and HH sub-band is chosen since it provides transparency and reversibility. After selecting HH sub-band DCT is applied to both original and watermark image. To maintain the signal energy and close relating of original image and watermark image SVD is applied to DCT transformed images. Then modifying the singular values of original image and watermark image inverse DCT, inverse RDWT are performed to obtain watermarked image.

Digital image watermarking is performed in order to provide copyright protection using hybrid technique in YUV and RGB color spaces in [7]. Here, semi-blind watermarking technique is proposed where the color image is taken and the R, G and B color of it is separated. Convert it to Y, U, and V color model. Now, decompose the Y channel into four sub-bands using DWT. After that apply SVD to HH sub-bands and also compute the SVD of watermark image. To embed the watermark image modify the singular value of original image and watermark image and finally, apply IDWT to obtain watermarked image.

IV. CONCLUSION

According to the research survey, the method described in the existing paper does not provide much security. So, my proposed work will try to improve the security of watermark against various attacks such as cropping, rotation and blurring etc. along with image quality by using Arnold Transform with proposed hybrid methods.

REFERENCES


