Hybrid Approach based Video Watermarking Technique by using Scene Detection

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Abstract-This paper introduces a sturdy method for implementing a digital video-watermarking approach for copy protection. The method proposed in this paper is a combination of various techniques like wavelet transform , SVD and Scene Detection. The proposed design can be presented in four stages for better understanding. The initial major task is to find the exact position where frame should be inserted in the original video. DWT techniques is used up to three level and the LL band is used for the embedding purpose. After implementing the proposed algorithm and verifying the experimental results it is found that the designed algorithm is sturdy against various category of attacks like image processing, compression and geometrical attacks. The quality of the extracted watermark validates the sturdiness of designed algorithm.

Keywords – Watermarking, DWT, SVD, Scene Detection

1. Introduction

The term security is playing an important role nowadays in every sector of information technology .The growth of internet use has been rapidly increasing every day which leads to the security of multimedia content like audio, image, and video.The need of digital watermarking is based on the type of data which needs like copyright protection . This data is categorized as audio , video ,image and text

[1]. Many of the researchers use to apply watermarking on image data type ; however, video watermarking is the recently working area of researchers nowadays .Implementing the watermarking algorithms on image type of data , it is classified into two type implantation approach - spatial and frequency domains [2]. In the spatial domain watermark embedding schemes [3], the watermark data are inserted by modifying the pixel value of the gray level host image. For the motive of content authentication invisible watermarking is preferred [4]. The invisible approach can be further classified as a blind and non blind approach of watermarking method[5].The another implementation method for image watermarking is frequency domain . In this approach multimedia content is transformed into multiple frequency bands by using different wavelet tools. This type of transformation is reversible and the embedding process is implemented by modifying transformed coefficient values .Such type of methods are found sturdy against various attacks. The major method used to prevent copyright protection is watermarking. The copyright data may be in the form of video, text ,image and audio [6]. Watermarking may be visible or invisible. Information hiding can be done by using the concepts of cryptography and steganography. Cryptography is a mostly used concept for securing the media digital content over the internet .In Cryptography concept the message is encrypted before sending it to the receiver and after receiving the

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message receiver decrypt it using a secret key. The message cannot be accessed by unauthorized user without knowing the key . In steganography, the encryption process in not needed. In steganography the bits of media is hided into another media content which is called cover. Onlythe actual user can identify the hidden content from the cover using actual key . Digital watermarking is originated from the concepts of steganography. Steganography is not counted as a robust methods for the protection of digital data.

Hence Watermarking is best suitable for it.

2. Methodology Used

(a). Discrete Wavelet Transform

The first step is the transformation of spatial domain in transformed domain like DCT ,DWT ,DFT and many more. Using the wavelet transform is most likely used approach for the purpose of watermarking .Wavelets are the mathematical tool which is used to change the coordinate system as per the need .Another property of wavelet is that it has. The wavelet expansion coefficients represent a local component thereby making it easier to interpret. Wavelets are adjustable and hence can be designed to suit the individual applications. Its generation and calculation of DWT is well suited to the digital computer [7]. If an image is passed through the DWT function than it as a sum of the wavelets having different location and scale. DWT basically represent the image into high pass and low pass coefficients. In this the image is passed through the high and low filters.
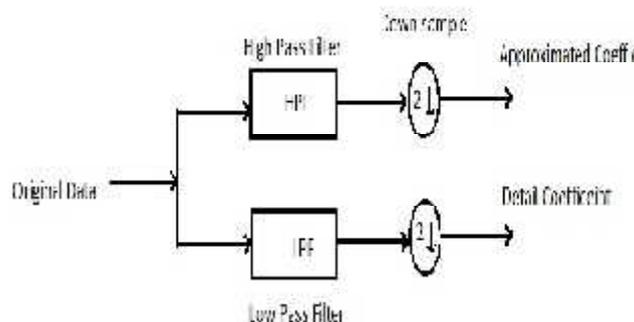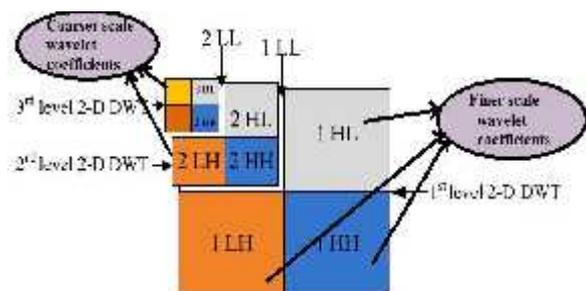

Fig 1. Block Diagram of 1-DWT

When the image is passed through the DWT than the analysis filter is used to separate the image into various frequency bands . The analysis filters separate the image into four sub bands LL,LH,HL HH. It is also called the first level of decomposition and it also represent the finer scale coefficients .This decomposition DWT can be done upto various level .2D-DWT shows that ,DWT is applied further on first level DWT and this will be applied on LL band of first level decomposition[9] . The various level of decomposition depends on the need of the application implementation . In most of the watermarking methods the decomposition is done up to 3 level.

Fig. 2 Three Level DWT(3D-DWT)

(b). Singular Value Decomposition(SVD)

SVD is a useful tool based on numerical analysis and it is used to decompose the image into three types of matrices .These three matrices contains an important information about an image .In these three matrices two matrix are called orthogonal matrix and one matrix is called diagonal matrix. The entries of diagonal matrix is called the singular values and these values represents the luminance property of an image. The orthogonal matrix denotes the horizontal and vertical details of an image[8].SVD technique decomposes a matrix A of size M x N into three matrices:

U, S and V according to the following equation,

A = U x S x VT

(c). Scene Change Detector

The important part of this paper is to design a mechanism which will detect the change of scene from a raw video. This is implemented by using successive estimation of statistical measures. Basically it is implemented by using a correlation between frames. Embedding the watermark in the same frame is not a good practice for video watermarking technique. Hence filtering the same frame reduces the complexity of the algorithm .This filtering method consist of histogram ,binary search and linear interpolation [10,11].An efficient watermarking system requires a well-designed watermark that most easily adapts the coverdata and must give a better robustness under the degradation of perceptual quality.

3. Proposed Algorithm

For the implementation of proposed algorithm we need an image as watermark and the cover video. The size of the watermark image is 256 x 256 . The proposed algorithm consist of two parts watermark embedding process and watermark extraction process.

(a). Watermark Embedding

Watermark embedding is done by using following steps-

(i) Convert the color watermark image into gray scale image.

(ii) Resize the watermark image into the size of 64 x 64.

(iii) After converting the cover video into frames use scene change detector algorithm to find out the frames those who are changed not similar to previous frames.

(iv) Convert the frames into RGB scale.

(v) .Now Decompose the scene changed frames by DWT tool which will give four sub bands LL,LH,HL and HH. All of the energy is contained in LL band.

(vi) Apply Level-2 DWT on LL band which will again give the four subband.

(vii) Now Apply the SVD method on Level-2 LL band and on Watermark image.

(viii) The watermark embedding is done by using following equation –

$$SVD_{WE}= SVD_V + SVD_W*\alpha$$

Where the α=0.05, SVD_V is the value of Cover video frame and SVD_W is the value of Watermark to be inserted .

(ix) Now Apply the inverse SVD tool on the frame .

(x) Apply the inverse DWT operation of 2 Level , this will result the final Watermarked frame of cover video.

(b). Watermark Extraction

Watermark extraction is the exact reverse process of Watermark Embedding . This process is used to proof the identity or copy right protection of multimedia content . For the extraction purpose we need watermarked video , cover video and the watermark to find out our embedded watermark . This extracted watermark will help to proof the identity of the owner of the multimedia content .

The proposed algorithm for Watermark Extraction is as follows-

(i). Convert the embedded video into the frames .

(ii).Apply scene-change detector algorithm using a successive estimation of statistical measure.

(iii). With help of RGB-to-Gray converter ,convert the frame into gray scale.

(iv). Resize the extracted frames into the size of 256x256.

(v) Apply the DWT tool on the scene changed frames which into four sub bands LL,LH,HL and HH.

(vi). Again apply DWT tool on LL band which we will call 2-Level DWT.

(vii). Now apply SVD tool on 2-Level LL band.

(viii). For the extraction of watermark from the above step apply the equation-

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SVD$_W$=(SVD$_{WE}$-SVD$_V$)/α

Where the α=0.05, SVD$_V$is the value of Cover video frame and SVD$_W$is the value of Watermark to be inserted and SVD$_{WE}$ is the value of Embedded video.

4. Experiment and Results

The proposed algorithm is implemented in MATLAB . For the experiment purpose mp4 format video is considered and the watermark image in JPG or TIF format is considered . The size of the watermark image is 256x256.

Fig 3(a). Cover Video

Fig 3(b). Watermark Image

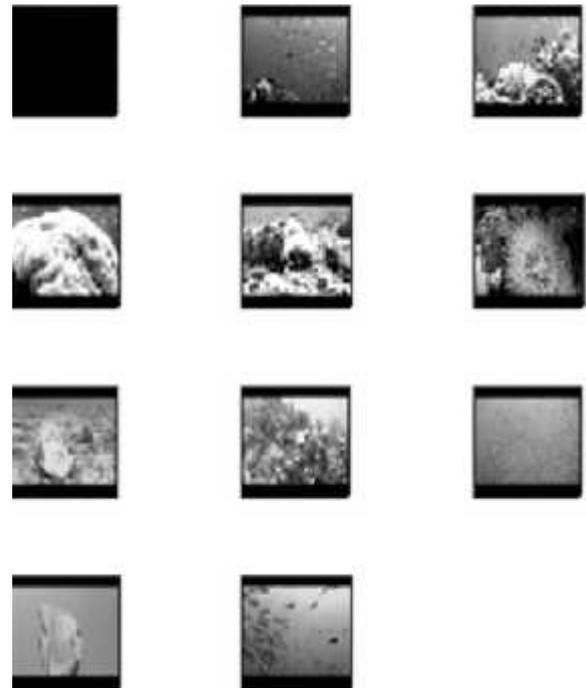Scene Change detector is applied on video which results the several frames shown in figure –

Fig 3(c)- Scene Change Frames

After applying the Watermark Embedding algorithm the result is Watermarked video which is shown in figure-

Fig 3(d)- Watermarked video

The performance measure of the proposed algorithm is done by using several components like PSNR,MSE, NC etc. Here in this paper we are using Normalized correlation for the measurement of the proposed video watermarking method. Various attacks are performed on the

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Embedded Watermark before extraction of Watermark and then NC is calculated . The category of these attacks are Image processing attack, JPEG compression and geometrical attacks. The analysis is shown in the form of table-

Table-1 Performance Measurement

S.No	Type of Attack	NC
1	Blurring	0.911
2	Salt and pepper noise	0.931
3	Sharpening	0.812
4	Gaussian noise	0.902
5	JPEG compression	0.951
6	Image Rotation	0.907
7.	Image Resizing	0.821

5. Conclusion

A robust video watermarking technique is proposed which is based on 2D-disrete wavelet transform using level-3decomposition is presented using Daubechies wavelets and Singular Value Decomposition (SVD) . Low frequency coefficients of wavelet (LL subband) are used for embedding the Watermark into cover video . This technique embeds an invisible watermark into the scene-changed video frame. The table shows the NC values of extracted watermark from the Watermarked video after applying various attacks. It is observed that NC values of the extracted watermark is at high range which shows that the proposed algorithm is robust against various attacks.

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