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A Digital Watermarking System for Video Authentication Using DMT

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ABSTRACT

The paper presents multi-wavelet based on in-visible water marking. In the past, DMT technique has less copyright protection, content authentication and produce poor quality. The proposed method is solved referred problems. In this paper, firstly apply the multi wavelet to improve image resolution at LL sub band. Secondly, embedded the important data (watermark image) into host multimedia, and it can be used in digital right management, authentication and data hiding. The result shows that the watermark scheme has strong robustness, and can embed much more data. By using DMT to improve quality of watermarking system.

Keywords: DWT, SVD, DMT, PSNR, MSE

I. INTRODUCTION

Digital video watermarking is one of the most popular approaches considered as a tool for providing the copyright protection of digital video. This technique is based on direct embedding of additional information into the digital video. Theoretically, there should be no perceptible difference between the watermarked image and the original one. In addition, the watermark should be easily extractable, but reliable and robust against image compression or common image processing. By extracting the embedding information, the image ownership can be verified or even an illegal copy source can be traced. Digital watermark technique is widely applied to tampering detection, authenticity and/or ownership protection of digital images, audio, video or even texts.

1.1 VIDEO WATERMARKING

Watermarking digital video introduces some issues that generally do not have a counterpart in images and audio. Due to large amount of data and inherent redundancy between frames, video signals are highly susceptible to pirate attacks including frame dropping, frame averaging, statistical analysis, etc. Many of these attacks can be accomplished with little damage to the video signals. However, the watermark may be adversely affected. Applying an identical watermark to each frame in the video leads to problems of maintaining statistical invisibility. Furthermore, such an approach is necessarily video independent, as the watermark is fixed. Applying independent watermark to each frame is also poses a problem. Regions in each video frame with little motion remain the same frame after frame. Motionless regions in successive video frames may be statistically compared or averaged to remove independent watermarks. To increase the robustness of the scheme, an audio watermark is included. The error detecting codes of a video watermark is embedded as an audio watermark, which can refine the retrieved watermark during watermark detection.

II. BACKGROUND STUDY

Watermarking is the process that embeds data called a watermark or digital signature or tag or label into a multimedia object such that watermark can be **detected** or **extracted** later to make an assertion about the object. The object may be an **image** or **audio** or **video**. A simple example of a digital watermark would be a visible "seal" placed over an image to identify the copyright. However the watermark might contain additional information including the identity of the purchaser of a particular copy of the material.

In general, any watermarking scheme (algorithm) consists of three parts: [3]
- The watermark
- The encoder (marking insertion algorithm**)**
-The decoder and comparator (verification or extraction or detection algorithm)

Each owner has a unique watermark or an owner can also put different watermarks in different objects the marking algorithm incorporates the watermark into the object. The verification algorithm authenticates the object determining both the owner and the integrity of the object.

A. *Characteristics of Watermarking Schemes*

An effective watermarking scheme should have the following characteristics [4]:

1. Imperceptibility: In terms of watermarking, imperceptibility means that after inserting the watermark data, cover medium should not alter much. In other words, the presence of the watermark data should not affect the cover medium being protected.

2. Robustness: Robustness of the watermark data means that the watermark data should not be destroyed if someone performs the common manipulations as well as malicious attacks.

3. Fragility: Fragility means that the watermark data is altered or disturbed up to a certain extent when someone performs the common manipulations & malicious attacks. Some application areas like temper detection may require a fragile watermark to know that some tempering is done with his work. Some application may require semi-fragility too.

4. Resilient to common signal processing: The watermark should be retrievable even if common signal processing operations are applied to the watermarked cover medium data.

5. Resilient to common geometric distortions (image and video data): Watermarks in image and video data should also be immune from geometric image operations such as rotation, translation, cropping and scaling. This property is not required for audio watermarking.

6. Robust to subterfuge attacks (collusion and forgery): In addition, the watermark should be robust to collusion attack. Multiple individuals, who possess a watermarked copy of the data, may collude their watermark copies to destroy the watermark presence and can generate a duplicate of the original copy.

7. Unambiguousness: Retrieval of the watermark should unambiguously identify the owner. Furthermore, the accuracy of owner identification should not degrade much in the case of an attack. The Unzign and Stirmark [8] have shown remarkable success in removing data embedded by commercially available programs. Watermarking of watermarked image (re-watermarking) is also a major threat.

III. MUL TI-WAVELET TRANSFORM

The study of the Multiwavelets as an extension of scalar wavelets has received considerable attention from the wavelet research communities both in theoretical development as well as for applications such as signal compression and denoising in the recent years. The major limitation of the singular wavelet functions is their time-frequency localization property. Multiwavelets have two or more scaling and wavelet functions. The multi-wavelet has several remarkable properties like orthogonality, short support, symmetry, and high degree of vanishing moments. Some of the applications of the MultiWavelet transform include image compression, watermark processing, and image pattern recognition and so on. The multiscaling function is defined from the set of scaling functions as

$$\Phi(t) = [\Phi1(t)\ \Phi2(t)\ \ldots..\Phi r(t)]^T \quad (3.1)$$

Similarly the multiwavelet function is defined from the set of wavelet functions as

$$\Psi(t) = [\Psi1(t)\ \Psi2(t)\ \ldots.\Psi r(t)]^T \quad (3.2)$$

where r > 1 is an integer. When r = 1, is called a scalar wavelet or simply wavelet. When r =2, is called a multiwavelet. In the GHM multiwavelet, the wavelet functions are orthogonal and both the scaling and wavelet functions are symmetric. The multiwavelet two scale equations must satisfy the two scale equation of the wavelet equation:

$$\Phi(t)=\sum_{k=0}^{m-1} G\Phi(2t-k) \quad (3.3)$$

$$\Psi(t)=\sum_{k=0}^{m=1} H\Phi(2t-k) \quad (3.4)$$

The pair {GK,Hd is called a multi wavelet filter bank. GK is called a matrix low pass filter and HK is called a matrix high pass filter. They are rxr matrices for each integer k, and m is the number of scaling coefficients. In the MWT, input signal needs to be fust vectorized, namely pre-processing (which is a crucial point also known as multiwavelet initialization or prefiltering). Prefiltering process generate multiple (vector) streams from a given scalar source stream and results in the initial expansion coefficients . The nature of the components of the multiscaling functions should be taken into account for constructing an efficient filter.

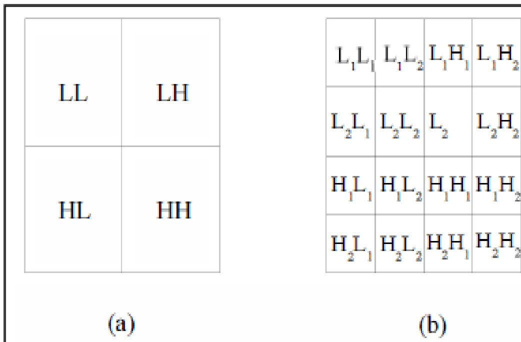

Fig. 1. Image subband after a single level decomposition, for (a) scalar wavelets and (b) multiwavelets

In the case of scalar wavelet, during a single level of decomposition the 2-D image is decomposed into four blocks corresponding to the sub bands in the representing either

lowpass or highpass filtering in both dimensions. These subbands are illustrated in Figure l (a). The multi wavelets have r scaling functions and the multiwavelets used here have 2 channels (r=2), so that there will be two sets of wavelet and scaling coefficients. Since the multiple iterations over lowpass data are desired, the scaling and wavelet coefficients of the two channels are stored together. In this case, 4 subband images obtained from the single level decomposition of 2-D image are once again decomposed into 16 more subband images and they can be divided into 4 blocks. For example, LH subband obtained from single level decomposition of 2-D image is again decomposed into LIHI. L,H2, LzH, and LzHz. L,H, corresponds to the data from the
fust channel high pass filter in the horizontal direction and the fust channel low pass filter in the vertical direction. A multiwavelet system can simultaneously provide perfect reconstruction while preserving length (orthogonality), good performance at the boundaries (via linear-phase symmetry), and a high order of approximation (vanishing moments) compared to the scalar wavelets.

IV. PROPOSED METHOD

Hybrid DMT-SVD method for digital video watermarking

In this hybrid method of watermarking, we use Singular Value Decomposition (SVD) and Discrete MultiWavelet Transform. In this proposed method of embedding the watermarking in video, first load the original video and watermark image. Get information about video's cover object and watermarked image. And adjust the co-efficient (alpha) value and take the first frame of video. Now Apply Single level (DMT) discrete 2-D Multiwavelet transforms. After that resize the watermark image and apply SVD on the video frames. After that all frames convert in video format and saved it in hard disk.

The embedding algorithm of DMT-SVD is described as,

1. Load original video and watermark image. And adjust alpha value for result.

2. Read the watermarked image in double. And take information about first frame of video and double it.

3. Apply DMT2 as [CA,CH,CV,CD] = DMT2(X, 'wname') computes the approximation coefficients matrix CA and details coefficients matrices CH, CV, CD, obtained by a wavelet decomposition of the input matrix X. 'wname' is a string containing the wavelet name.

4. After that again resize watermarked image as per size of the co-efficient and apply SVD.

5. Than After convert all frames in to matlab movies format.

6. Matlab movie format converted in avi format and save in hard disk.

This proposed method of extraction algorithm used. First we read the watermarked video and get information about it. Take any one of the frame from the watermarked video and apply DMT as per embedding algorithm. Now use SVD, and resize the S1 and get new values of SVD matrix. After that getting new watermark values and display recovered message.

The extracting algorithm of DMT-SVD is described as,
1. Load watermarked video.
2. Take any one of the frame from the watermarked video, double it and apply dmt.
3. Use switch case for SVD"s value.
4. Getting new values of S1 and get new value of matrix.
5. After that get new value of watermark = (matrix-S1)/alpha.
6. Display recovered watermarked image.

EMBEDDING PROCESS

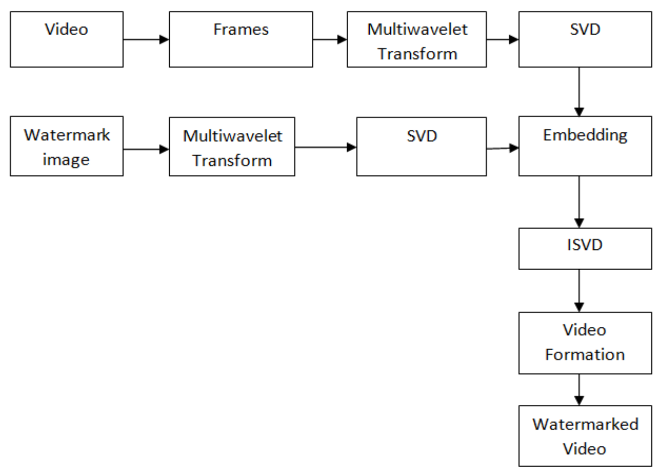

Fig.2 Embedding process

EXTRACTING PROCESS

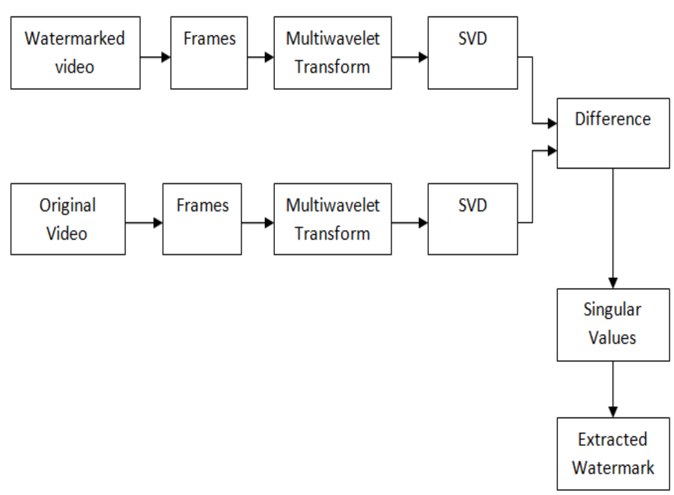

Fig. 3 Extracting Process

V. EXPERIMENTAL RESULTS

In this proposed watermarking algorithm host image Bird of size 512x512 is used as shown in Fig.4. Watermark image taken cameraman of size 256x256 shown in Fig.5.

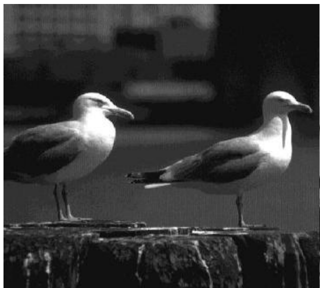

Fig. 4 Host image bird. Fig. 5 watermark

The proposed watermarking algorithm is simulated using MATLAB R12a. The proposed watermarking algorithm is tested for the various host and watermark images. Here the results are given for Bird image only. To evaluate the performance of the proposed method, evaluation metrics used are PSNR (Peak Signal to Noise Ratio) and MSE(Mean Square Error). PSNR is widely used to measure imperceptibility between the original image and watermarked image. PSNR is defined by the eqn. (5.1). The similarity between the original watermark and extracted watermark from the attacked image is evaluated by using MSE given by the eqn. (5.2).

$$PSNR=20\log \frac{255}{RMSE} \quad (5.1)$$

here 255 represents the maximum value of luminance and the root mean square error (RMSE) is defined as:

$$RMSE=\sqrt{1}.\left(\frac{1}{N.M}\sum_{i=1}^{N}\sum_{j=1}^{M}[g(i,j)-f(i,j)]^2\right) \quad (5.2)$$

PSNR:

Here we calculate PSNR ratio, the peak signal-to-noise ratio (PSNR) is the ratio between a signal's maximum power and the power of the signal's noise. PSNR to measure the quality of reconstructed images that have been compressed. Each picture element (pixel) has a color value that can change when an image is compressed and then uncompressed. Signals can have a wide dynamic range, so PSNR is usually expressed in decibels, which is a logarithmic scale. We can see comparison in Table no.1

TABLE NO.I

Comparison between PSNR values of watermarked video

DWT Method PSNR_wat	20.35 db
DMT Method PSNR_wat	24.31 db

In Table no.1, we calculate PSNR ratio of watermark video and conclude DMT method is more efficient than DWT method.

Here, we get some snapshot of embedded video frame, original watermark and recovered watermark, Here, we see snapshot of comparison between embedding video frame of video of demo_video.avi, original watermark and recovered watermark of different image in below table. We conclude that original watermark and recovered watermark is approximating same.

Snapshot of embedding video frame of demo video.avi, Original watermark and recovered watermark of cameraman.tif

VI. CONCLUSION

A proposed approach of digital video watermarking based on hybrid concept of DMT and SVD. This method can be used for authentication and data hiding purposes. The DWT based method is very time consuming though it offers better capacity and imperceptibility. A Hybrid DMT-SVD method is found to be better than DWT method. The new method was found to satisfy all the requisites of an ideal video watermarking scheme such as imperceptibility, robustness and fast processing time.

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