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A NOVEL IMAGE WATERMARKING IN CONTOURLET DOMAIN USING SINGULAR VALUE DECOMPOSITION

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ABSTRACT

Digital Watermarking has been utilized to provide an essential secure technology for digital data. The basic idea involves hiding information imperceptibly into the digital content. There are lot of algorithms are found for digital image watermarking to ensure copyright protection. Digital video Watermarking is an extension of this concept. In this paper, a new watermarking scheme that can greatly improve the existing watermarking technology has been proposed. A multi resolution image representation named Discrete Wavelet Transform and factorization methods such as Singular Value decomposition are used here to perform video based watermarking. Video Watermarking is implemented by dividing input video into group of frames and one of the frames is selected to embed the watermark using DWT technique and IDWT technique is used for decryption. The performance of the proposed scheme is measured using PSNR and MSE values.

Keywords: DWT, SVD, Watermarking, IDWT

INTRODUCTION

Due to the advancements in multimedia like audio / video sharing and conferencing, everyone has the need to protect the copyright ownership of their own data. Digital Watermarking is a technique of concealment of data within digital files. Watermarking is related to the fact that a secret message is being sent, as well as concealing the contents of the message. It has become a highly prioritized topic for the researchers to discover new technique for the protection of data.

A Watermarking process consists of mainly three distinct steps which are (1)embedding of secret data into original multimedia content (2) attacks such as trying to remove the original watermark through modification (3)extraction mechanism includes algorithm to extract data as needed. We have mainly two types of classification of Watermarking. First type of classification of watermarking is based on domain type 1) Spatial 2) Frequency .In Spatial domain, the secret information is embedded in to LSB of the original host image without any changes .In frequency domain, the secret data is embedded into the transform coefficients using transformation techniques such as DCT (Discrete Cosine Transform), DWT (Discrete Wavelet Transform) and FFT (Fast Fourier Transform).

Video Watermarking is an extension of image watermarking concept which mainly serves the following purposes 1)Prove ownership 2)Broadcast Monitoring 3)Trace the video dissemination. It is a kind of technique to hide data like image, audio, text into video sequences. This paper proposes a scheme using DWT, IDWT and SVD techniques to watermark the video in order to secure it. Video Watermarking techniques are classified based on Spatial domain, Frequency domain and MPEG Coding structure based Spatial domain technique hide the watermark by changing the pixel values of the host image for enhancing the robustness of watermarking mechanism, Frequency domain techniques are used where the watermark will be embedded into frequency domain instead of spatial domain.

1. REVIEW OF RELATED WORK

I. J. Cox et al [1] discussed about a methodology for digital watermarking that may be generalized to audio, video, and multimedia data. Gaussian vector which is imperceptibly inserted in a spread-spectrum-like fashion into the most crucial spectral components of the data. The capability of prohibiting potential users from querying the image for ownership and copyright information may be desirable but appears difficult to achieve with the same level of tamper resistance.

C. Song et al [2] proposed a technique using a region-adaptive approach to further improve upon criteria like robustness. It Embeds parts of the watermark images into selected regions in the host image. The technique utilizes dual watermarking technologies. The

drawbacks are it cannot detect tampering on a district of the digital image.

A. B. Watson et al [3] provide mathematical formulae to compute a perceptually lossless quantization matrix. The method treats each DCT coefficient as an approximation to the local response of a visual "channel. At present, it is admittedly only a conjecture that this scale relates in a direct way to perceived visual quality

A. Cheddad et al [4] proposed a solution to this digital document forgery problem through a 1D hash algorithm coupled with 2D iFFT (irreversible Fast Fourier Transform) to encrypt digital documents in the 2D spatial domain. The drawback is tackling the problem of image compression has to be found.

Based on quaternion Fourier transform and least squares support vector machine (LS-SVM), X.-y. Wang [5] proposed a robust blind color image watermarking in quaternion Fourier transform domain, which has good visual quality. Firstly, the original color image is divided into color image blocks. Later, the fast quaternion Fourier transform is carried out on the image block. The drawback of this scheme is related to computation time for LS-SVM training and pseudo-Zernike moments computation.

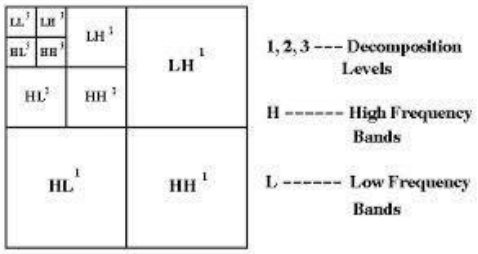
2. PRELIMINARIES

I. SVD(Singular Value Decomposition)

SVD act as mathematical tool for the matrix analysis. It is a method to extract algebraic image features or representations. The SVD matrix constructed for a digital image is highly stable. When a small change happens to the image, Singular values do not vary largely. This feature of SVD helps in embedding the watermark into this matrix without large variation. Using SVD based watermarking; the singular values of the matrix are changed by introducing the singular values of the selected watermark.

II. DWT(Discrete Wavelet Transform)

DWT converts discrete time signal to a discrete wavelet representation. It is a mathematical multi resolution transform tool used for the decomposition of an image. An image is represented as 2 dimensional digital signals which when passed through high and low pass filters decompose into many sub bands having varying resolutions. HH indicates diagonal high frequency band, LH indicates horizontal high frequency band, and HL represents vertical high frequency band and LL the low frequency band. DWT decomposes an image into four components which are LL, LH, HL and HH. .A multi resolution approximation can be obtained with perfect reconstruction using DWT.



a) Contourlet Transform

Contourlet Transform is a multi directional method of two dimensional images. This multi resolution transform is made up of mainly decomposition on by Laplasse Pyramid and directional filter. In the proposed scheme it is used for image separation into RGB planes.

b) Existing System

The existing system provides the security and copyright ownership of the digital images by utilizing the characteristics of the watermark micrograph to construct the association rules .It embeds the rules into the host image, rather than the bit streams of the watermarks commonly used in digital watermarking.
It uses DWT and SVD techniques for image watermarking. The proposed system is an extension of this concept - video marking.

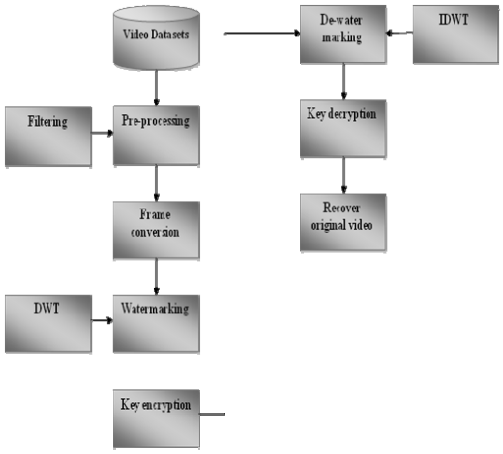
c) Proposed System

Fig 1. Represents the proposed system for video watermarking. In the proposed scheme the following techniques are used for visible video Watermarking. This scheme is based mainly on DWT and SVD techniques. The input video is divided into selected frames. The selected frame is divided into 8 X 8 square wavelet by using DWT technique The watermark image is also selected and splitted into 8 x 8 square wavelets by means of DWT technique .The SVD is then applied to the watermark image which has Red, Green and Blue planes .Then the Watermark image is embedded into the original selected frame by modifying the scaling factors with the singular values of the watermark .The extraction process is the reverse of embedding procedure using Inverse Discrete Wavelet Transform to extract the watermark image from the input video.

Watermarking Embedding Procedure

The Steps for embedding the watermark into the input digital video are given as follows

a) The input sample video is divided into selected frames
b) Select the frame and Watermark image
c) Apply DWT transform on both selected frame and the watermark image and divide into four quadrants.
d) Apply SVD on the LL sub band of both selected frame and the watermark image
e) Apply the watermarking algorithm on the two images and generates the resulting watermarked image.



Watermarking Extraction Procedure

a) In this process to shuffle the every pixel of each color to recover bits by bit.
b) IDWT (Inverse discrete wavelets transform) is applied to recover input frame and watermark image.
c) Finally the original frame is obtained.

III. SVD (Singular Value Decomposition)

The difference of two pixels in the cover image is calculated. The number of bits to be embedded into these two pixels is determined by their absolute difference and a pre-defined range table. Since pixel pairs with larger difference are often located in complex regions, SVD embeds more data into pixel pairs with larger differences. The partitioning and difference calculation steps were same as original SVD. The range table was controlled by user into lower division and higher division. If the pixel difference of a block was under higher level then original SVD was used for embedding otherwise 3 bit LSB substitution was employed. This method improved image quality.

PSNR peak-signal-noise-ratio for the distorted watermark image is measured to compare the occurrence of distortion in the extracted image to that of the original video while image processing attacks are performed.

$$PSNR(db) = 10log_{10}\frac{(Max\,1)^2}{MSE}$$

PSNR value is calculated by the following formula

Where I is the maximum possible pixel value of image.

$$MSE = \frac{[\Sigma_{i=1}^{M}\Sigma_{j=1}^{N}[f(i,j) - f'(i,j)]^2]}{M \times N}$$

Mean Square Error (MSE) is calculated by the following formula

f(i,j) and f‟(i,j) are the original and watermarked image respectively of size M×N.

3. RESULTS AND DISCUSSIONS

On implementing the above proposed Watermarking scheme, the following are the results through which the quality of embedding and extracting can be evaluated.

Figure1

Figure1 shows the embedding process in video watermarking. Steps to simulate the above process are

1. Select the input sample video in .wmv format. ->Video is divided into a group of frames.
2. User is asked to select a frame from the given folder
3. DWT is applied to the selected frame and shown in GUI.
4. User is asked to select the watermark image to be embedded for security purpose.
5. DWT is applied to both watermark and original video frame.
6. Watermarked image is shown in GUI
7. User is asked to provide the secret encryption code.
8. If proper validation occurs, extraction process is started.

Figure2

Figure2 shows the extraction process in video watermarking. Steps to simulate the above process are

1. IDWT is applied to Watermarked image
2. Decryption is performed
3. Original video and Watermark image is extracted and shown in GUI.
4. Performance measures such as PSNR (peak-signal-noise-ratio) and MSE (mean square error) are calculated.

The performance results of both existing and proposed watermarking scheme are shown below. PSNR and MSE values of both image and video based watermarking can be compared. Higher the PSNR value the more capacity and robustness.

Different Watermarks	MSE	PSNR (db)	Type of Watermarking
	1.75676	40.3514	Image
	2.13167	40.2514	Image
	1.98957	40.2433	Image
	3.72334	47.9831	Video
	3.91859	47.9132	Video

4. CONCLUSION AND FUTURE WORK

In the proposed scheme, a novel video based Watermarking scheme has been implemented which combines SVD along with the DWT .Extraction and Embedding of Watermark on the input video has been successfully implemented using MATLAB. The performance measures are formulated by the calculation of PSNR and MSE values. Higher the value of PSNR more the efficiency and capacity of Watermarking. Many more systematic experiments and algorithms are needed to enhance the video Watermarking process. Video Watermarking in this scheme considers only a single image for watermarking. Further experiments can be done on multiple images watermarking in video based scheme.

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