Frame Based Digital Video Embedding Utilizing Non Sinusoidal Basis Function

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Abstract—Digital information rights is a great challenge in digital media and to reach this goal digital video watermarking technology is widely used. In this paper, we present digital video water marking using the collective approach of Discrete Wavelet transform and Principal Component Analysis. The embedding and extraction process are conceded out on approximation band (LL band) on given cover image. The retrieved result and analysis shows that the promiseable transparent watermarking can be achieved using the proposed approach.

Index Terms—Digital image watermarking, Discrete wavelet transform, Haar transform Principal component analysis.

I. INTRODUCTION

One of the prevalent technological events of the last two decades was the attack of digital media in an entire range of everyday aspect of life. Digital data can be efficiently stored with a very far above the ground quality, and it can be used very easily manipulate computers. Digital data can be transmitted in a fast and low-cost way through data communication networks without losing quality. Digital watermarks are pieces of information added to digital data (audio, video, or at rest images) that can be notice or extracted far in front to make an declaration about the data. This information can be textual data critic, copyright, etc., or it may be a picture. Secreted information is embedded by manipulate the fillings of the digital data allow someone to identify the originel proprietor, or in the case of the illegal replication bought material, the buyer complex. These digital watermarks go on intact under transmission/changes, allowing us to protect our exclusive human rights in digital form. A Watermarking is adding “rights” information in multimedia contents to prove the authenticity. This technique slight embeds a data digital code watermark, carry information about the copyright status of the work to be protected.

There are following two steps which involve in Digital watermarking technique;

1) An algorithm to embed small authentication information called watermark content on the mass content.
2) An algorithm to retrieve or extract the embedded watermark with less misrepresentation.

Based on their domain embedding, watermarking scheme can be classified either as Spatial Domain (The watermarking system directly alter the main data basics, like pixels in an Replica, to hide the watermark data) or Transformed Domain (the watermarking system alter the frequency transforms of data elements to hide the watermark data). The latter has proved to be more forceful than the spatial domain watermarking [1], [4]. To transfer an image to its frequency demonstration, one can use several reversible changes like Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), or Discrete Fourier Transform (DFT) [1]. Even though spatial domain based techniques cannot maintain most of the common attacks like compression, high pass or low pass based filtering, etc., researchers will close by the spatial domain techniques too [1], [4].

II. RELATED WORKS

Ondraj Slaciak and Radoslev Vargic proposed a watermarking scheme in which they offered a new promising method for acoustic watermarking working in wavelet domain. In this algorithm, to detect the watermark, the creative signal is not needed. The time and the scale plane are processed in the patchwork method mannar. Singular values of reference image . Wan-Chao Yang used the Public-Key Cryptography, Public-Key Infrastructure (PKI) and a watermark technique. They embed encryption watermarks in the LSB (least significant bit) of cover images. Hao Luo also proposed a watermarking scheme. It was for digital images. In their method, cover image was used as the watermark. It generate the watermark by half matching the image into a halftone image and then, next step is to permute the watermark and embed it in the LSB of the multitude image. Doo Gun Hong, Se Hyosung Park and Jehu Shin represented a paper in which statistical technique for audio watermarking is used. In this algo, to detect the watermark, the original signal and the security key is not needed. In this method, an extension of patchwork watermarking is presented which can detect the watermark. Huynh Kang, Koutarou Yamaguchi, Brian Kurkoski and Kazuhiko Yamaguchi presented a paper in which two improvements were planned which were applicable to audio watermarking .YU MENG and Dr. Bernard Tiddeman presented a paper in which own implementation of the SIFT algorithm is described and directions for future research. The main focus of the paper was on derive SIFT features from an image and then try to use these features to perform operations. Mina

A. Maker presented a paper in which she investigate the application of the SIFT(Scale-Invariant Feature Transform) to the problem of CD cover recognition The algorithm uses customized SIFT approach and the it matches key points between the inquiry image which was taken by camera phone and the original database of CD covers using this approach. Wenyu Chen and Yanli Zhao presented a paper in which they proposed an algorithm to solve the disadvantages of large computation and not met real time of the original one, which reduces the mismatching of SIFT algorithm.

Gaurav Bhatnagar proposed a new watermarking scheme which was based on SVD(singular value decomposition) and DWT(discrete wavelet transform) For watermark, they used a gray scale logo image and for watermark embedding, a reference sub-image is formed and they transformed the original image into wavelet domain, then the watermark was embedded into reference image by changing the singular values of reference image.

III. DIGITAL WATERMARKING

Digital watermarking is the placing of a signal, known as the watermark, into original video in an invisible manner. In other words watermark encodes information that can protect the video, typically identifying the holder (source) or the intended recipient (destination) of the video. The process of inserting the watermark introduces distortion, however, watermarking techniques use heuristics otherwise perceptual models to cover up the presence of the watermark embedded in the watermarked video. Ideally, watermarked and original video are perceptually in clear when displayed. The embedded watermark may be detected by using a watermark detector, which facilitates an application to react to the presence (or absence) of the watermark in a video. Video, watermarking

Techniques than have been proposed to images, audio, text, and other types of data to protect. A digital watermarking is a kind of marker secretly embedded in a noise-tolerant signal such as audio or image data. It usually is used to identify ownership of the copyright such signs. Digital watermarking is the technique of hiding information in a carrier signal the hide information, but should not have a controlling relationship to the carrier Signal. Generally, a digital watermark can be embedded into all forms of media. The most common medium audio, video and pictures. It's easy to add a scene digital watermark on a digital Signal, it just needs to add some data to the original signal. But do not make an invisible digital so easy as visible digital watermarking. Different medium has different data structure, so according to diverse medium, various algorithms are used to add digital watermarks in signal without changing the way which original signal looks like.

A. DISCRETE WAVELET TRANSFORM

DWT is the discrete variation of the wavelet transform. The foundations of DWT go back to 1976 when techniques to decompose discrete time signals were prepared. Similar work was done in the speech signal coding which was named as sub-band coding. In 1983, the sub-band of the same Techniques coding was developed which was named pyramid coding. After several improvements were made to these coding schemes which resulted in well-organized multi-resolution analysis schemes. Wavelet transform represents valid alternative to the cosine transform used in standard JPEG. The DWT of images is a transform based on the tree structure with D levels that can be implementing by using an appropriate bank of filters. Basically it is possible to follow two strategies that differ from each other essentially because of the criterion used to extract strings of image samples to be sophisticated by the bank of filters. Most image watermarking schemes operate either in the Discrete Cosine Transform (DCT) or the Discrete Wavelet Transform (DWT) domain

In numerical analysis and functional analysis, a discrete wavelet transform (DWT) wavelet is tested carefully, for which a wavelet transform. As with other wavelet transforms, Fourier transforms temporary solution but it is an important advantage: the frequency and location information (time, place) both capture. The Wavelet Series is just a sampled version of CWT and its calculation may consume significant amount of time and resources, depending on the resolution required. Discrete Wavelet Transform (DWT), which is based on sub-band coding, is found to produce a rapid calculation Wavelet Transform. It is easy to implement and reduces computation time and resources required.

1) Haar wavelets: The first DWT was made-up by the Hungrain mathematician Alfred Haar. For input represented by a list of numbers, the Haar wavelet transform may considered to simply pair up input values, the difference storing and passing totals.

The Haar basis functions can be represented as,

The k^{th} row of a $N \times N$ Haar Transformation Matrix can be calculated from $h_k(z)$, where $z = \frac{0}{N}, \frac{1}{N}, \frac{2}{N}\ \frac{3}{N} \ldots\ldots \frac{N-1}{N}$

$k = 0, 1, 2, 3 \ldots N - 1$, such that $N = 2^n$

The values of k can be formulated as $k = 2^p + q - 1$, where $0 \le p \le n - 1$ and $1 \le q \le 2^p$

$$h_0(z) = h_{00}(z) = \frac{1}{\sqrt{N}},\ z \in [0,1]$$

$$h_k(z) = h_{pq}(z) = \frac{1}{\sqrt{N}} \begin{cases} 2^{p/2} & (q-1)/2^p \le z < (q-0.5)/2^p \\ -2^{p/2} & (q-0.5) \le z < q/2^p \\ 0 & \text{otherwise},\ z \in [0,1] \end{cases}$$

Thus a 2×2 Haar matrix can be formulated as,

$$\frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

IV. PRINCIPAL COMPONENT ANALYSIS

Principal component analysis (PCA) is a mathematical process that uses an orthogonal transformation to convert a set of comments of possibly correlated variables into a set of values of uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. PCA is a method of identifying patterns in data, and expressing the data in such a way so as to highlight their similarities and differences. PCA plots the data into a new coordinate system where the data with maximum covariance are plotted together and is known as the first principal component. Similarly, there are the second and third principal components and so on. The first principal component has the maximum energy concentration.

The method is mostly used as a tool in examining data analysis and for making predictive models. PCA can be achieved by Eigen value decomposition of a data covariance (or correlation) matrix or singular value decomposition of a data matrix, usually after mean centering (and general or using Z- scores) the data matrix for each attribute. Results of a PCA are usually discussed in terms of factor score is sometimes called the component scores (transformed variable values corresponding to a specific data point), and loading (weight by which each standardized original variable should be multiplied to get the component score). PCA is the simplest of the true Eigen vector based multivariate study. The other main advantage of PCA is that once these patterns in the data have been identified, the data can be compressed by reducing number dimensions, without much loss of in sequence. Plots the data into a new coordinate system where the data with maximum covariance are plotted together and is known as the first principal component.

V. EMBEDDING PROCEDURE

The watermark or message image F (x, y) is embedded into the given cover image $I(x, y)$ to generate a watermarked frame $Z(x, y)$, by following the below detailed steps:-

1) Convert the $n \times n$ binary watermark logo into a vector $W = \{w_1, w_2, \ldots\ldots, w_{n\times n}\}$ of "0s" and "1s".
2) Divide the video into distinct frames of size $N \times N$.
3) Convert every frame from RGB to YUV color format.
4) Apply t-level DWT to the luminance (Y component) of each video frame to obtain four sub-bands LH, HL, LL and HH of sizes $\frac{N}{4t} \times \frac{N}{4t}$.
5) Divide the LL sub-bands into k non-overlapping sub-blocks each of dimension $n \times n$ the same size as Watermark image.
6) The watermark bits were embedded with forte α into each sub-block by first obtains the principal component score by PCA Algorithm. The embedding is carried out by $score^0_{(i)} = score_{(i)} + \alpha W$, where $score_{(i)}$ represents The principal component matrix of the i^{th} sub-block.
7) Apply inverse PCA on the upgraded PCA components ($score^0_{(i)}$) of the sub-blocks of the LL sub- bands to obtain the modified wavelet coefficients.
8) Apply inverse DWT to find the watermarked luminance component of frame. Then convert video frame back to its RGB components.

Over lapping distinct sub-block (size n×n), the PCA algorithm can be depict by following steps:-

1) Every sub-block is converted into a row vector D_i with n^2 elements ($i = 1, 2 \ldots k$).
2) Compute the $mean_i$ and $standard\, deviation_i$ of the elements of vector D_i .
3) Compute S_i according to the following equation $S_i = (D_i - mean_i)/(standard\, deviation_i)$, where S_i represents a focused, scaled version of D_i, of the same size as that of D_i.
4) Principal Component Analysis on (size $1 \times n^2$) to obtain the principal component coefficient matrix coef f (size $n^2 \times n^2$).
5) Calculate vector ith score as, $score_{(i)} = S_i \times coef\, f$, where, $score_{(i)}$ represents the principal component scores of the i^{th} sub-block.

VI. EXTRACTION PROCEDURE

The watermarked frame is transmitted over internet at the one end. It gets affected by Gaussian noise of communication channel. The attacks such as resizing, cropping, rotation, median filtering etc may detoriate the waterked image quality. At the intended user end the embedded watermark or message image can be extracted only by the use of original cover frame and encryption key α. The extraction process to be followed for extraction of watermark logo from recieved frame can be explained by following steps:-

1) Divide the watermarked (and possibly attacked) video into distinct frames and convert it from RGB to YUV format.
2) Choose the luminance (Y) component of a frame and apply the t-level DWT to decompose the Y components into the four sub-bands LL, HL , LH , and HH of size $\frac{N}{4t} \times \frac{N}{4t}$.
3) Divide the LL sub-band into $n \times n$ non overlapping sub-blocks.
4) Apply PCA to each block in the selected sub- band LL by using PCA Algorithm.
5) From the LL sub-band, the watermark bits are removed from the principal components of each sub-block as, $W^0_i = (score^0_{(i)} - score_{(i)})/\alpha$, where W^0_i is the watermark extracted from the i^{th} subblock.

VII. SIMULATION AND RESULT

VIII. CONCLUSION

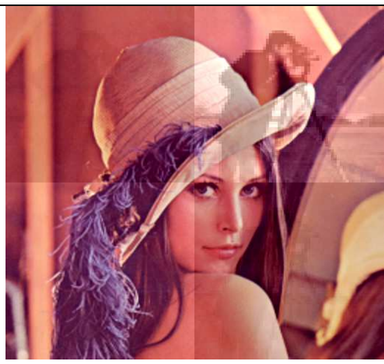
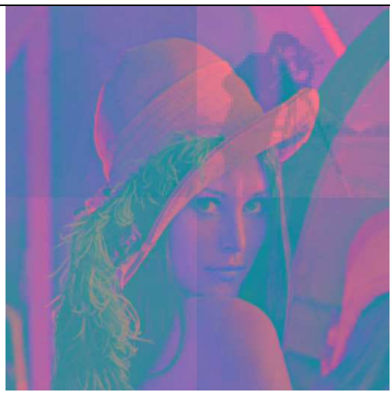
Digital watermarking technology is an developing field in computer science, cryptology, signal processing and commu nications. The watermarking research is more exciting as it needs collective concepts from all the fields along with Human

LL sub band coefficients are converted into a new coordinate set by calculating the principal components of each non Psycho visual analysis, Multimedia and Computer Graphics. The watermark may be of visible or invisible type and each has got its own applications. There are very few visible watermarking algorithms, so far. Out of the two visible watermarking algorithms proposed in this project, one is in spatial domain and the second is in DCT domain. To make the visible watermark visually pleasant, the mathematical models are developed taking the human visual system into consideration. The most significant application of visible watermarking is in Digital Libraries, where the owner wants to make the image available for research purpose but not for commercial use. There are few **fragile invisible algorithms** available in current literature even though it has got its own applications.

Results and Figures

Embedding Procedure:-

Result -1

Original Image	**Watermark Image**
	
Watermarked Images	
	
	

Extraction Procedure:-

Result -2

Original Image	**Watermark Image**
	
Watermarked Images	**Watermarked Images**
	
	

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