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Highly Secured and Distortionless Video Watermarking using DCT and DWT Transforms

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ABSTRACT: "Watermarking" is the process of computer-aided information hiding in a carrier signal. Digital watermarks may be used to verify the authenticity or integrity of the carrier signal. In video watermarking, the watermark can be added either to uncompressed data or compressed video streams. Practical video storage and distribution systems store and transmit the video sequences in compressed format, such as using a video on demand (VoD) service to avoid the process of fully decoding and encoding. Most video watermarking applications require the watermark to be embedded and detected in real time. Video watermarking scheme should be robust to geometric distortions, including rotation with cropping, scaling, aspect ratio change, frame dropping, and swapping. Both the Real-time performance and resistance to geometric distortions are important requirements. Discrete Wavelet Transform is invariant to rotation, scaling, and other geometric distortions and Discrete Cosine Transform coefficients Which are subsequently used to construct one-level DWT. This reduces the computational cost and meet the real-time requirement. An additional encryption and decryption keys were used to enhance the security without affecting the quality of video is proposed.

Keywords: Watermarking , Discrete Cosine Transform, Discrete Wavelet Transform, Geometric distortions, encryption, decryption.

I.INTRODUCTION

Watermarking is a protecting technique which protects (claims) the author's property right for images by some hidden watermarks. According to the domain where watermarks or confidential data are embedded, both categories can be further classified as the time domain methods and the frequency domain methods.

For spatial domain watermarking methods , the processing is applied on the image pixel values directly. The watermark is embedded in image by modifying the pixel values. The advantage of this type of watermarking is easy and computationally fast. The disadvantage is its low ability to bear some signal processing or noises.

For frequency domain methods , the first step is to transform the image data into frequency domain coefficients by some mathematical tools (e.g. FFT, DCT, or DWT). Then, according to the different data characteristics generated by these transforms, embed the watermark into the coefficients in frequency domain. After the watermarked coefficients are transformed back to spatial domain, the entire embedding procedure is completed. The advantage of this type of watermarking is the high ability to face some signal processing or noises.

II.RELATED WORKS

In video watermarking, the watermark can be added either to uncompressed data or compressed video streams. Practical video storage and distribution systems store and transmit the video sequences in compressed format, such as using a video on demand (VoD) service system. In these cases, the watermark should be embedded into the compressed video data to avoid the process of fully decoding and encoding[1].

It is not necessary to fully decode a compressed video stream both in the embedding and extracting processes. . The method also presents an inexpensive spatiotemporal analysis that selects the appropriate sub macro blocks for embedding, increasing watermark robustness while reducing its impact on visual quality. [2].

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A real time video watermarking algorithm based on the singular value decomposition (SVD) was presented. The embedding procedure combines the DCT and SVD. The SVD is applied on the low frequency AC coefficients of block DCT of the frame then the relation of neighbor coefficients of those middle frequency bands in the singular values is modified[3].

The robust watermark into video streaming according to the differential energy theory was proposed. The region should embed watermarks according to the relationship between the energy adjustable threshold and their differential energy[4].

Unlike still image, video watermarking technology must meet the real-time requirements. Differential Number Watermarking (DNW) was used. The label bits are embedded in a pattern of number differences between two sub regions by selectively removing high frequency components[5].

The real-time requirement of video watermarking and proposes a new improved DEW based algorithm was addressed. Two measures to improve the DEW algorithm's performance are using the ratio of energy difference to total energy R_D to replace energy difference D as pattern to embed label bits and the selection of embedding other is that cut-off index. The improved algorithm performs better on watermark's visual quality impact, capacity and robustness than the original DEW algorithm[6].

Digital video data distribution through the internet is becoming more common. These materials need to be protected to avoid copyright infringement issues. Differential Energy Watermarking (DEW) algorithm is used for the low bit-rate operation[7].

The differential energy watermarking (DEW) algorithm for JPEG/MPEG streams was proposed. The DEW algorithm embeds label bits by selectively discarding high frequency discrete cosine transform (DCT) coefficients in certain image regions[8].

III.EXISTING METHOD

A. Discrete Wavelet Transform

DWT , is any wavelet transform for which the wavelets are discretely sampled. Wavelets can be used to extract informations from many different kinds of data including audio and images.The transform generates subband LL,LH,HL,HH each with one forth. Here most of the energy are concentrated in LL, which represents the Low-resolution version of the original image.Among the various types of wavelet transform Haar transform is used.

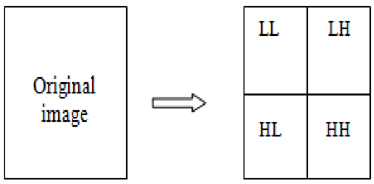

Fig.1 DWT Operation

1) Haar Wavelet:

Haar-DWT, the simplest DWT . A 2-dimensional Haar-DWT consists of two operations: One is the horizontal operation and the other is the vertical one.

Step 1: At first, scan the pixels from left to right in horizontal direction. Then, perform the addition and subtraction operations on neighboring pixels. Store the sum on the left and the difference on the right. The process is repeated until the rows are processed. The pixel sums represent the low frequency part while the pixel differences represent the high frequency part of the original image.

Step 2: Secondly, scan the pixels from top to bottom in vertical direction.

Perform the addition and subtraction operations on neighboring pixels and then store the sum on the top and the difference on the bottom. The process is repeated until the columns are processed.

Finally we will obtain4 sub-bands denoted as LL, HL, LH, and HH respectively. The LL sub-band is the low frequency portion and hence looks very similar to the original image.

B. Discrete Cosine Transform

DCT has been widely deployed by modern video coding standards, for example, MPEG, JVT etc. Like other transforms, the Discrete Cosine Transform (DCT) attempts to de correlate the image data. After de correlation each transform coefficient can be encoded independently without losing compression efficiency.

1) The One-Dimensional DCT:

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The most common DCT definition of a 1-D sequence of length N is

$$C(u) = \propto (u) \sum_{x=0}^{N-1} \cos\left[\frac{\pi(2x+1)u}{2N}\right]$$

For u=0,1…..N-1.
Similarly, the Inverse transformation is given by ,

$$f(x) = \sum_{u=0}^{N-1} \alpha(u)C(u)\cos\left[\frac{\pi(2x+1)u}{2N}\right]$$

For x=0,1…N-1.
In both of these equations $\alpha(u)$ is defined by

$$\alpha(u) = \begin{cases} \sqrt{1}/N for u = 0 \\ \sqrt{2}/N for u \neq 0 \end{cases}$$

If u=0, the first transform coefficient is the average value of the sample sequence and this value is referred to as the DC Coefficient. All other transform coefficients are called the AC Coefficient .The plot of $\sum_{x=0}^{N-1} \cos\left[\frac{\pi(2x+1)u}{2N}\right]$ for N=8 with u=0, gives constant DC value, whereas, all other waveforms (u= 1, 2,… , 7) give waveforms at progressively increasing frequencies . These waveforms are called the cosine basis function.

2) The Two Dimensional DCT:

To obtain the efficacy of DCT on images two-dimensional DCT is important. The 2-D DCT is a direct extension of the 1-D case.
It is given by,

$$C(u,v) = \alpha(u)\alpha(v) \sum_{x=0}^{N-1}\sum_{y=0}^{N-1} f(x,y)\cos\left[\frac{\pi(2x+1)u}{2N}\right]\cos\left[\frac{\pi(2y+1)u}{2N}\right]$$

The inverse transform is given by,

$$f(x,y) = \sum_{u=0}^{N-1}\sum_{v=0}^{N-1} \alpha(u)\alpha(v)\cos\left[\frac{\pi(2x+1)u}{2N}\right]\cos\left[\frac{\pi(2y+1)u}{2N}\right]$$

B. Watermarking Schemes

1) Watermarking Embedding:

Fig.2 shows the watermark-embedding process. In one video sequence, continuous frames are chosen to form a basic carrier unit for watermark embedding, which we call the watermark minimal sequence (WMS). For each frame in oneWMS, we compute the DWT coefficients directly from the block DCTs.

Then, we embed the watermark into the histogram bits calculated from the low-frequency sub band of the DWT domain. The watermark W is divided into F equal-sized segments, each of which is embedded into the histogram shape of one frame in each WMS, in order. The steps of the embedding process are as follows.

Step 1. For each WMS, we calculate the one -level DWT coefficient matrix of every frame from the block DCTs.

Step 2. We compute the histogram shape in the DWT domain and acquire the number of coefficients in each bit.

Step 3. We embed each watermark bit into two neighboring bits by reassigning the number of coefficients in the two bits. These bits include $g_q(j)$ and $g_q(j + 1)$ coefficients, respectively.

We control the relative relation of the two bits in order to embed one bit of information:

$$\begin{cases} g_{q(j)}/g_{q(j+1)} \geq T, if\ w_i = 1 \\ g_{q(j+1)}/g_{q(j)} \geq T, if\ w_i = 0 \end{cases}$$

where T is a threshold that controls the number of modified coefficients. We select the threshold by considering the watermark robustness performance and the distortion.

Afterward, we embed one bit in two consecutive bins. First, we consider the case when w_i is 1. If $g_q(j)/g_q(j + 1) \geq T$, no operation is needed.

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Vol. 2, Issue 4, April 2013

Otherwise, if $g_q(j)/g_q(j + 1) < T$, some randomly selected coefficients will be moved to E1 from E2, satisfying ${g_{q(j)}}/{g_{q(j+1)}} \geq T$. We repeat this procedure until watermark bits are embedded in the corresponding frame in one WMS.

Step 4. The modified differences of all DWT coefficients are inversely transformed to the modified differences of block DCT coefficients , followed by adding them to the original block DCT coefficients to generate the new watermarked frame. This process can reduce computational cost and lower complexity because most of the modified differences of all DWT coefficients are zero.

Step 5.Low bits watermark can be embedded into one WMS by repeating steps 2 through 4.

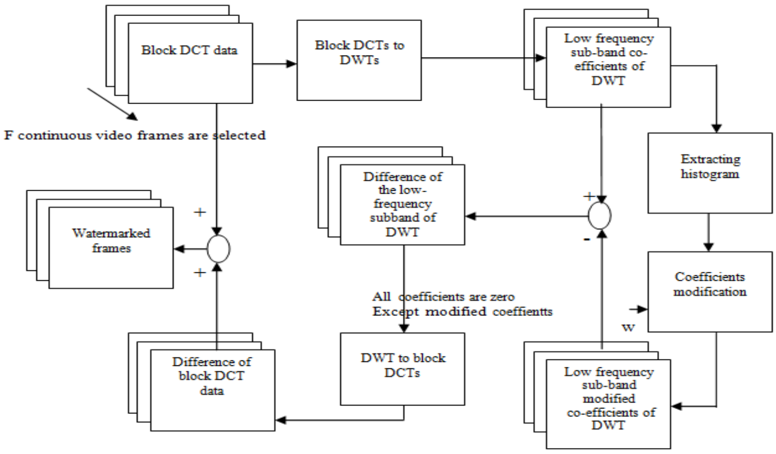

Fig.2 Watermarking Embedding Process

2) Watermark Detection:

The watermark detection does not need to re-encode the frames into compressed data. Compressed video data can also be easily and quickly decoded by employing some codec or decoding chips. Therefore, we could perform the watermark detection after decoding the video data.

Fig.3 shows the watermark-detection process. The detection process involves four steps.

Step 1 : We choose contiguous frames as one WMS with a sliding window. In each WMS, we calculate the one-level DWT coefficient matrix R^W of every frame by the Haar wavelet transform in the spatial domain.

Step 2 : As in the watermark-embedding process, we compute the low frequency sub band coefficients of the DWT domain of each frame in one WMS and generate the histogram with equal-sized bins.

Step 3 : The number of coefficients in two consecutive bins are $g_{q(j)}$ and $g_{q(j+1)}$.We can extract the hidden bit by comparing their values:

$$W_i^e = \begin{cases} 1 \; if \; {g_{q(j)}}/{g_{q(j+1)}} \geq 1 \\ 0 \quad otherwise \end{cases}$$

We can extract watermark bits from the corresponding frame in the WMS by repeating this process.

Step 4 : By repeating steps 2 through 3, we can extract the Lw-bits watermark from all frames in the WMS. The extracted watermark sequence is denoted as $W^e = \{W_i^e | i = 1,2, \ldots .. L_w\}$. We can then decide the robustness by comparing it with the original watermark sequence W.

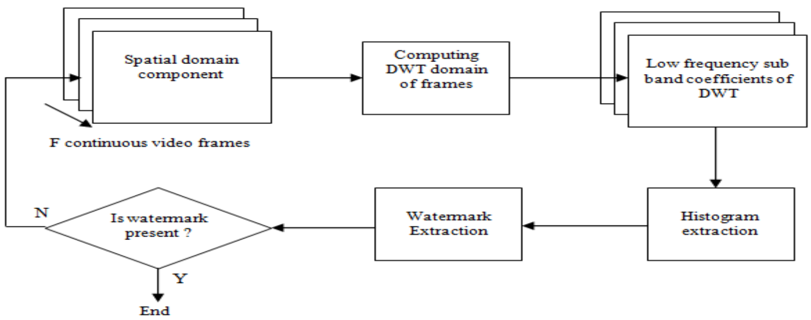

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Fig.3 Watermarking detection process

IV.PROPOSED METHODOLOGY

We present a scheme which involve the secured video watermarking scheme. The secured video watermarking process involves the additional encryption and decryption scheme additional to the watermarking embedding and detecting process. This scheme provides the highly secured watermarking technique.

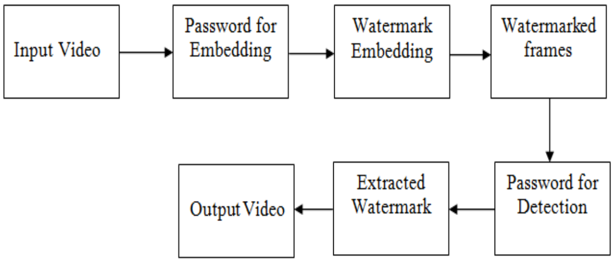

Fig.4. Proposed Block Diagram

V.RESULTS AND DISCUSSIONS

The whole watermark embedding process includes partial decoding, which consists of variable length decoding and de quantization, the inter transformation between the DWT coefficients and block DCTs, coefficient modification, and partial encoding.

we achieved robustness using the invariance of the histogram shape of the low-frequency sub band coefficients of the one level DWT domain. The watermark embedding is designed by modulating the relative relations of each two successive bins in the number of low-frequency DWT coefficients.

The simulation results were obtained using MATLAB 7.10.The simulation results were obtained upto the embedding and detecting process. The continuous video sequence were converted into frames and then the embedding and detecting processes were simulated and is shown in the fig.

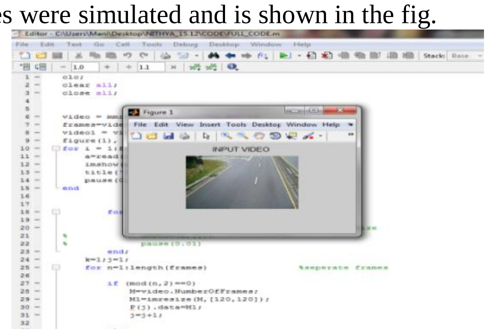

Fig.5. Input Video

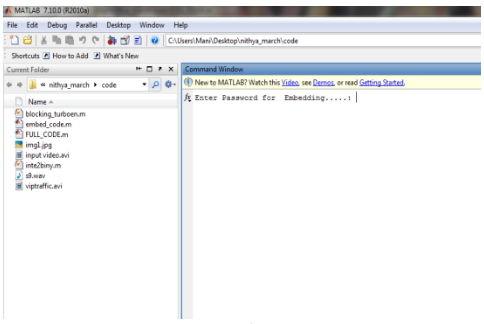

Fig.6.Password for embedding

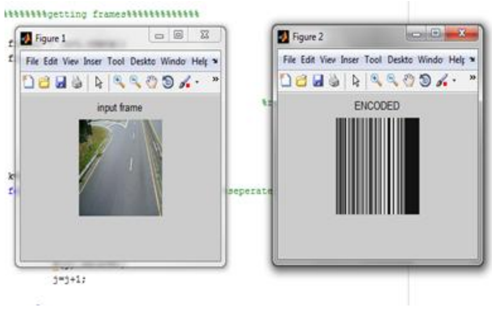

Fig.7. Encoded output

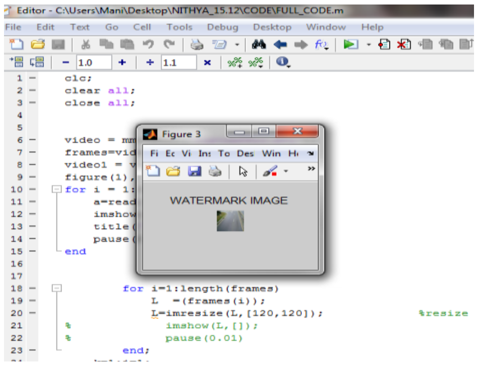

Fig.8.Watermarked Image

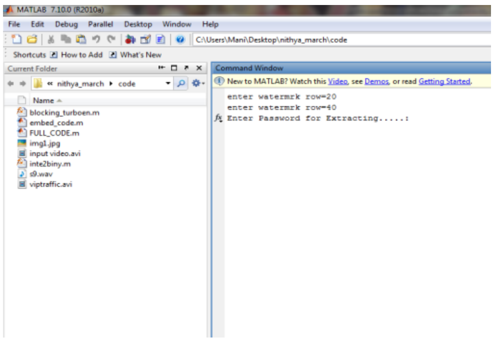

Fig.9.Decryption for detection

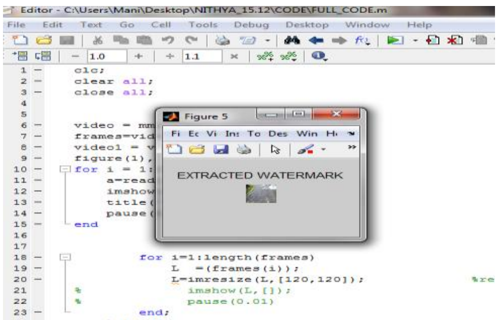

Fig.10.Extracted Watermark

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VI.CONCLUSION AND FUTURE WORKS

In this paper the real time video watermarking with high security and high robustness is proposed. The future work includes the watermarking with further time reduction.

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BIOGRAPHY

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