Live Video Watermarking Using LabVIEW

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Abstract

The use of digital media applications, and copyright protection has obtained tremendous importance. Digital Watermarking is a technology used for the copyright protection of digital applications. A comprehensive approach for watermarking digital video is introduced. Hybrid digital video watermarking scheme based on Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT) has been proposed. Discrete Cosine Transform (DCT) with Principal Component Analysis (PCA) helps in reducing correlation among the wavelet coefficients. Wavelet decomposition of each video frame is done thereby dispersing the watermark bits into the uncorrelated coefficients. The video frames are first decomposed using DWT. The binary watermark is embedded in the low frequency wavelet coefficients. The imperceptible high bit rate watermark embedded is robust against various attacks that can be carried out on the watermarked video, such as filtering, contrast adjustment, noise addition and geometric attacks.

Key Words: Video watermarking, DWT, DCT, PCA.
1. Introduction

The rapid growth of Internet and networks technique, multimedia data transforming and sharing is common in today’s world. Multimedia data is easily copied and modified, so necessity for Copyright protection is increasing. Digital Watermarking has been proposed as technique for Copyright protection of multimedia data. The process of Digital Watermarking involves embedding and extraction of watermarked data in order to provide security. The embedding method must leave the original data perceptually un-changed, yet should impose modifications which can be detected by using an appropriate extraction algorithm. The digital content could be any data that the user likes to protect. The watermark is mainly used to authenticate the owner to ensure copyright protection.

Digital watermarking refers to embedding of watermarks into a digital content. However a technique named DWT method for digital video watermarking is divided in two parts; they are Embedding watermark and Extracting watermark. This presents a new image encryption algorithm, which can improve the security of image during transmission more effectively. As a result, it’s important for creators and distributors to protect their copyright and ownership of their digital media. In this background, watermarking technique is an effective method to solve the problem, and it has been widely used in the copyright protection. Now the digital video watermarking technique has become the focus of the theoretical research and practical application. Many schemes have achieved good results both in security and robustness. However, some practical technical problems have not been a better solution. Many schemes are at the cost of complex theory and large computational quantity in order to obtain a better robust scheme, which is difficult to meet the real-time requirement, such as the broadcast monitoring, digital television system, etc.

2. Proposed System

The proposed system is mainly constructed to protect the data when transmitted through a public network and ensure the authentication of both the data and the user. The proposed system comprises of six modules. They are:

- Login
- Camera Settings and Data Input
- Video Recording
- Embedding Watermark
- Extracting Watermark
- Mail

Each module has their specific role where in each module the role are as respectively, Login ensures authentication of the user, the user will be able to select the required camera according to their need and input the patients detail
and provide a file path to save the video, once the settings are made appropriately the video is recorded and the video gets embedded with the inputted data by using DWT in accordance with PCA, after embedding the next process is extraction where the patients details are extracted and displayed in the output panel using DCT and finally a screenshot of the video is mailed to the respected recipient.

Fig 2.1.1: Methodology of the proposed System

**Video Watermark Embedding Process**

Steps involved in watermark embedding process:

- The Real time Video is captured and its various properties are measured. All the video frames are extracted using LabVIEW programming.
- Absolute difference between the successive frames is calculated, where \( f_i(x,y) \) is the present image and \( f_{i+1}(x,y) \) is the next successive image.
- The difference images are processed over morphological filter to reduce the noise.
- The area/region of the moving object is clearly noticed, marks it as M1 and converts into Binary Images.

\[
G_i(x, y) = f_{i+1}(x, y) - f_i(x, y)
\]

- The area/region of the moving object is clearly noticed, marks it as M1 and converts into Binary Images.
- The Static area/region in the video frames is marked as S1 and 2level of DWT is applied. The static area/region is divided into LL, LH, HL and HH, the diagonal elements LH and HL have less information content than LL and HH so these two regions are marked as S’1,1 and S’1,2.
The “H” shape of the scrambled logo is embedded in morphological filter frames M’1 and 2-level of DWT is embedded in S’1,1 and S’1,2.

2-level Inverse DWT is applied and the frames are re-converted into a video which contains the watermark.

Watermarking Extraction Process

Steps involved in Watermarking Recovery process:

- In the process of extracting the watermark from the video, embedded video is converted into frames and static and dynamic frames are obtained.
- The difference/moving frames are converted to binary form and morphological filter is performed and marked as M’1 and the Static frames as S’1.
- The “H” shape of scrambled data is scanned from the region M’1 and the Watermarked Logo extracted from S’1,1 & S’1,2.
- Anti-Arnold transform is applied to the frames and 2-level DWT and Inverse DWT is applied to S’1,1 and S’1,2 as above process.
- The watermark logo/ Image is processed from each video frame separately and checked with various types of attacks and the robustness is calculated.
- The video is extracted from the recovery process vice versa as the embedding process, and the block diagram is shown in the Fig.2.2.1.
- Various attacks are performed and MSE and PSNR values are calculated.
3. Techniques Used

DCT (Discrete Cosine Transform)

- $X = \text{DCT (video/audio input)}$
- Returns the discrete cosine transform of the data input
- Can be referred to as the even part of the Fourier series
- Converts an image or audio block into its equivalent frequency coefficients

Concept

- The DCT transform of an image brings out a set of numbers called coefficients.
- A coefficient’s usefulness is determined by its variance.
- If the coefficient of the frames has large variance then the quality of the image is lost.
The image is broken into 8x8 groups, each containing 64 pixels. Three of these 8x8 groups are enlarged in this figure, showing the values of the individual pixels, a single byte value between 0 and 255. [7]

Applications
- DVD/Video CD Players
- Cable TV
- DBS Systems
- HDTV

Disadvantages of DCT
- Only spatial correlation of the same block is considered whereas the neighboring block is neglected.
- High compression ratios have very low bit rates
- DCT function is fixed
- Transmission and storage of uncompressed video would be extremely costly and impractical
- It contains a large number of byte information

DWT (Discrete Wavelet Theorem)

Equations

1-D wavelet transform

\[ W_r(a,b) = \int_{-\infty}^{\infty} x(t) \psi_{r,a,b}(t) dt \]

wavelet transform converts an input series \( x_0, x_1, \ldots, x_m \) into one high-pass wavelet coefficient series and one low-pass wavelet coefficient series (of length \( n/2 \) each)

\[ H_i = \sum_{m=0}^{k-1} x_{2i-m} \ast s_m(z) \quad (1) \]

\[ L_i = \sum_{m=0}^{k-1} x_{2i-m} \ast t_m(z) \quad (2) \]

- where \( s_m(Z) \) and \( t_m(Z) \) are called wavelet filters, \( K \) is the length of the filter, and \( i=0, ..., \lfloor n/2 \rfloor - 1 \).

- In practice, such transformation will be applied recursively on the low-pass series until the desired number of iterations is reached

DWT for an image

![DWT Diagram](image-url)
Advantages
- No blocking effect
- It has good localization both in time and spatial frequency domain.
- Transformation of the whole image introduces inherent scaling
- Interpretation of data is easy

Adaptive FPS (Frames per Second)

It is a technique which is mainly used to maintain the quality of the video. When the video is run on the system that is been used its gets adapted to it and does not provide any distortion or overlapping of frames. The fps value is made dynamic where the rate of distortion is self-corrected. The distortion rate is justified through histogram.

4. Experimental Result

The proposed system is mainly implemented in order to authenticate the data when transmitted the data over a public network. The system comprises of embedding and extraction of watermark, where the frames are divided with the lowest frequency coefficients and the watermark is embedded is based on the quality of the video. In order to maintain the quality of the video without any distortion from the cover and watermarked video a technique called adaptive FPS is used. It helps in retaining the quality of the video and makes camera settings adjustable to the system being used. Since a hybrid algorithm is used here the disadvantages of both the DCT and DWT is overcome and provides a reliable system. When the data is transmitted over a public network the watermark is extracted by inversing the embedding process. The comparison of existing and proposed system is given below:
Table 4.1: Comparison

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>EXISTING SYSTEM</th>
<th>PROPOSED SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPS</td>
<td>Static</td>
<td>Dynamic</td>
</tr>
<tr>
<td>RANGE</td>
<td>Example: 30fps (fixed)</td>
<td>Gets adapted to the system being used. (Example: 10-60fps)</td>
</tr>
<tr>
<td>TECHNIQUE USED</td>
<td>Only input functions</td>
<td>Adaptive FPS</td>
</tr>
<tr>
<td>ALGORITHM USED</td>
<td>DCT</td>
<td>DWT with DCT</td>
</tr>
<tr>
<td>GRAPH</td>
<td>Mathematical calculations</td>
<td>Histogram</td>
</tr>
<tr>
<td>FRAMES</td>
<td>Error correction among frames is higher and the watermark is embedded in each bit of the frame</td>
<td>No frame missing and frames get overlapped</td>
</tr>
</tbody>
</table>

5. Conclusion and Future Work

A text watermark is embedded over a real time video as and when the video is recorded. This enhances authentication and copyright protection when the video is transferred over a public network. It is found that imperceptibility is high and number of pixels that can be embedded in the video is also high. It is robust against various attacks. An adaptive FPS technique is used to automatically adjust the settings of the camera according to the system used. Correlations of the frame among wavelet coefficients are reduced and PSNR metric is enhanced to maintain the quality of the video. An adaptive FPS technique is used to automatically adjust the settings of the camera according to the system used. The pattern recognition is made easier and determines how to use an image into a computer vision application, through object detection and the use of other functionalities of LabView suggest that the use of LabView as an excellent platform to develop robotic projects as well as vision and image processing applications. The main disadvantage of the proposed system is that it occupies a large space since the number of bits to embed is higher, it can be resolved by either minimizing the bits or by developing an efficient algorithm. Security measures can be enhanced such as identifying video cracking attacks.

References


