SVD Based Robust Unsighted Video Watermarking Technique for different attacks

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Abstract. Nowadays, digital watermark protects intellectual property in the digital world. In this article, a new singular value decomposition (SVD) based robust unsighted video watermarking technique is used for protection of copyright or own individual work. The Singular Value Decomposition is used in this method to embed the information in a video file. In the embedded process the information generally referred to as watermark, which is of the form either audio, text, video, or any binary image or digital image. The embedded information can be identified in this process without considering the mechanisms of the original video, or any other knowledge about the encoded video’s main singular values. Singular value decomposition is used in embedding the information as well as retrieving the information from the embedded watermarked video. SVD based robust unsighted video technique shows that it bears required robustness on various attacks like MPEG-2 compressed video, median filtered, small rescaled, and rotational videos. In the experimental result, it is noticed that the unsighted video watermarking technique has visible quality and robustness for various attacks. In which watermark is installed in uniquely chose particular estimations of the video, and the first request can be kept up to recovering the data in our method and it has been indicated roust to different attacks.

1. Introduction

The explosive development of the web subsequently has increased the accessibility of intimate knowledge to people in general, for example, sound, images, and videos. What we've seen in the last several months, the issues of ensuring sight and sound data are becoming increasingly relevant and many content authors are worried about unauthorized duplication of the work or content. There needs to be some serious effort to keep digital media or data available and simultaneously securing the protected innovation of makers, merchants or basic proprietors of such information. This is an intriguing test and
is most likely the motivation behind why so much consideration has been drawn toward the advancement of computerized picture assurance plans.

In this report, another strong unsightly video watermarking process based on singular value decomposition (SVD) is accessed for copyright security of claims individual work. The SVD is used in this technique to implant the data in a video document. The installed data is called watermark it is as either in content, sound or any twofold picture/computerized picture. The watermark can be covered in digital video watermarking techniques [1], either in the spatial domain or in the frequency domain, including DCT (Discrete Cosine Transform), and DWT (Discrete Wavelet Transform) [2]. Let’s consider the Singular Value Decomposition (SVD) [3], which could be a suitable method of watermarking through decomposition. The SVD method is primarily used in watermarking of images. SVD-based image watermarking techniques are effective in some papers [4-6] and [7], and it reports that their watermarking techniques provide good robustness. For recover the original watermark, the technique required the singular values or their orthogonal matrices [8]. It is noted that if the singular values are changed, then the order of the singular values can be altered, creating inappropriate recognition of the watermarks that we add. So, the position information of the updated singular values must always be maintained in advance. Since these two techniques need to cover work-relevant knowledge for retrieving watermark information, they cannot be used in applications for video watermarking [9-15]. Despite the tremendous cover processing the required data function.

In it, a robust, unsightly video watermarking procedure based on SVD is proposed for various attacks [16-18]. Thinking about the identifiable reliability and robustness, the watermarks are embedded in targeted singular values, and our method can hold the first request up. The results from the experiment reveal appropriate robustness of the proposed method to MPEG-2, motion averaging, slightly rescaling, and median filtering, etc.

### 2. SVD Technique and Procedure

#### 2.1 Simple SVD method

The fundamental evaluation of unique image values suffering from these parameter variations [19,20]:

- Each matrix and transposition of the matrix must have the standard singular non-zero quantities.
- Each matrix and row or column reversed matrix in attempt to provide usual nonzero singular values.
- The matrix’s values are non-zero singular values and the it is a constant ratio to its scaled matrix (which is replicated several times by row or column).

For each real matrix A it is necessary to decomposed into several matrices[21] of the form

\[
A = U \Sigma V^T,
\]

where the matrices U and V are orthonormal, such as \(UU^T = I\), \(VV^T = I\) and other is a diagonal matrix of the form \(\Sigma = \text{diag} (\lambda_1, \lambda_2, \lambda_3, \ldots)\), where \(\lambda_1, \lambda_2, \lambda_3, \ldots\) are singular values [XXII] of matrix A. The left singular values of A are the columns of matrix U. The right singular matrix of A are columns of matrix V. The singular values are decomposition as follows:

\[
A = U_1 \lambda_1 V_1^T + U_2 \lambda_2 V_2^T + \ldots + U_r \lambda_r V_r^T
\]
Where \( r \) is the rank of matrix \( A \).

Because of above properties, SVD can be used for watermarking. The secret key used in unsighted watermarking is that maintained the original order of singular values.

### 2.2 Embedding Watermark process

The actual binary sequence needs to be followed and modulated as a sequence of bits before embedding the watermark method, it consisting of “1” and “-1” (that is, modulated from “1” modulated from “0” respectively. In the way to keep the same order of singular values in the embedding process it became provide robustness to some attacks.

The watermark embedding process steps are:

i. Consider the Singular value decomposition about the all cover frames of the form \( A: A = U \Sigma V^T \), They \( \lambda_1, \lambda_2, \lambda_3 \ldots \ldots \) are singular values of the cover frames.

ii. To achieve robustness & visibility, adjust the specific attributes of the cover frames as for the watermark sequence:

\[
\lambda'_i = 0.5 \left( (\lambda_{i-1} + \lambda_{i+1}) + \alpha \right) \cdot W_i \cdot (\lambda_{i-1} - \lambda_{i+1})
\]

Because the strong singular values are more relevant to the accuracy of the frame and the lower singular values are much more sensitive to the noise, we need to select the intermediate singular values to embed the watermarks.

iii. The watermarked video frames are choosen

\[
A: A = A' = U \Sigma' V^T, \Sigma' = diag (\lambda'_1, \lambda'_2 \ldots \ldots \lambda'_r)
\]

Where \( r \) is the rank of \( A' \).

### 2.3 Watermark Extraction Process

The watermark extraction process follows:

i. Check the SVD for entire watermarked frames \( A': A' = U \Sigma' V^T \) and they \( \lambda'_1, \lambda'_2 \ldots \ldots \lambda'_r \) are the singular values of the watermarked frames.

ii. The extraction of the watermark from the singular values:

\[
W_i = 0; \text{ if } \lambda'_i > 0.5 \left( \lambda'_{i-1} + \lambda'_{i+1} \right)
\]

\[
W_i = 1; \text{ if } \lambda'_i < 0.5 \left( \lambda'_{i-1} - \lambda'_{i+1} \right)
\]

### 3. Simulation Results and Discussion

The watermarks are the fundamental M-bit sequence. In the trials performed [29], the watermark is of length 880 bits and the video for the test is MPEG-2 standard test succession for example "Mobile". The video sequence adjusts to the standard of the Phase Alternation Line (PAL) with a precision of 756 bis576. There are 30 frames in the arrangement for a video. Watermarks were inserted through video outline chrominance screen. The watermark power is 0.48 and the procedures, sixth and eighth parameter, are mounted at each frame. Accepting the parameter for watermarking to be \( \lambda_i \) (1 ≤ \( i \) ≤ 256) the method can accomplish great robustness for different attacks.
The stated technique was tested for various attacks such as Compression, shift, rescaling, and median filtering of MPEG-2 "Mobile" watermarked video frame shows the Peak Signal to Noise Ratio (PSNR) of the first 25 watermarked "mobile" frames in Table 1 showing the results against those attacks.

Our strategy has good robustness for attacks in particular on median filtering, rotating, rotation and rescale, compression with MPEG-2 according to the findings in Table 1. If we embed one bit of each frame, the rotation and rescaling technique is robust too. The experiment can also perform other video sequences of short duration length such as “winter” is a small video with a PAL standard, and the total frames are 30 in the taken video sequence. As per the above-mentioned technique, at the second, four, sixth, and eighth coefficients, four bits are inserted in each frame. Coefficients SVD. Experimental results for various attacks such as MPEG-2 compression, rotation and rescale, shifting, and median filtering are shown.

Figure 1. a). Original videos used to perform b). Original Watermark used to this technique

Figure 2. Video frame of “Mobile” and Original watermark
Figure 3. Watermarked frames of “Mobile” and extracted watermark with PSNR=38.6343 dB, (BER) Bit Error Rate =0 and (NCC) Normalized Cross Correlation (NCC) =1

Table 1. First 25 frames PSNR values of “Mobile”

| Frames | (PSNR) Peak Signal to Noise Ratio in Db |
|--------|------------------------------------------|
| 1-5    | 30.6045 30.6522 30.8381 33.6674 31.5286 |
| 6-10   | 34.6731 33.2149 31.7984 31.8256 33.3534 |
| 11-15  | 32.1505 32.1505 32.3568 35.2990 33.8294 |
| 16-20  | 32.8845 34.1820 36.6702 33.9046 34.6449 |
| 21-25  | 34.9089 34.3374 35.7185 38.6343 33.6429 |

Figure 4. Watermarked frames of “Mobile” and extracted watermark after the median filtering attack with PSNR=24.1686 dB, Normalized cross correlation (NCC) =0.98195 and Bit Error Rate (BER) =0.01805.
Figure 5. Watermarked frames of “Mobile” and extracted watermark after the Rotation and rescale attack (1degree) with PSNR=26.4844 dB, Normalized cross correlation (NCC) =1 and Bit Error Rate (BER) =0.

Figure 6. Watermarked frames of “Mobile” and extracted watermark after the Shifting attack (1degree) with PSNR=24.9798 dB, Normalized cross correlation (NCC) =0.9277 and Bit Error Rate (BER) =0.0723
5. Conclusion

Digital Watermarking is an important requirement for providing Intellectual property rights of the Digital Multimedia data. In the case of Video Watermarking, introduce video is used to embed the information and some issues were removed in video watermarking as compared to Image Watermarking. In the proposed video watermarking technique, it provides good robustness and great visible quality. A new unsighted Video Watermarking method using SVD technique proposed. The SVD method is quite different from other commonly used techniques such as DCT (Discrete Cosine Transform), DFT (Discrete Fourier Transform), and DWT (Discrete Wavelet Transform) transformations. Non-fixed orthogonal base functions and one-dimensional non-symmetrical decomposition are employed in SVD and, these properties proved the advantages of various sizes of transformation and it became more security.

The proposed video watermarking method has provided good performance and proved that it has good in robustness and security for various attacks has been achieved. The relationship between the U, V and S components was explored in the proposed method and it provided robustness against different attacks and better quality as shown in figures 3 to 7 that is, in figure 3 Watermarked frames of “Mobile” and extracted watermark with PSNR=38.6343 dB, BER (Bit Error Rate) =0, and NCC (Normalized Cross Correlation) =1 and figure 4 shows extracted watermark after the median filtering attack with PSNR=24.1686 dB, Normalized cross correlation (NCC) =0.98195 and BER (Bit Error Rate) =0.01805, figure 5 shows extracted watermark after the Rotation and rescale attack (1degree) with PSNR=26.4844 dB, Normalized cross correlation (NCC) =1 and BER (Bit Error Rate) =0, figure 6 shows extracted watermark after the Shifting attack (1degree) with PSNR=24.9798 dB, Normalized cross correlation (NCC) =0.9277 and Bit Error Rate (BER) =0.0723 and, figure 7 shows Watermarked frames of “Mobile” and extracted watermark after the MPEG-2 attack with PSNR=22.864 dB, Normalized cross correlation (NCC) =0.90185 and BER (Bit Error Rate) =0.0985.

As depicted over, this strategy is good to the greater part of the attacks like Median sifting, Small scaling, and rescaling, moving and MPEG-2 compression. In addition, it needn't bother with any data in the location procedure while different strategies need the data of singular values. In the experimental result, it is noticed that the unsighted video watermarking technique has the great visible quality and good robustness for various attacks.

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