Multi-data embedding in to RGB Image with using SVD method

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Abstract

Owing to the rapid of the communication and multimedia technology, documents are distributed through the internet simpler than before, but at the same time, these Advantages can also be used by pirates. The concept of digital watermarking is associated with data- hiding technique known Steganography. This mechanism of leading insertion should respect two conditions at least: mark must be indiscernible; the human eye should not differentiate between a not marked and marked image; the watermark should resist any voluntary or involuntary changes. Extraction should be also blind: to extract mark they don't need original picture. Many watermarking algorithms in the field DCT, wavelet and CDMA have been proposed seeking to optimize a compromise imperceptibility / robustness. Many recent techniques of watermarking are inspired by usual methods of coding and compression. The singular value decomposition (SVD) is one example. In this paper, we present the most recent method of SVD algorithm applied in color image; this blind method is based on embedding different data into the matrix of singular values. The results show that this method is robust against JPEG compression, color reduction (GIF) and the spreading of histogram.

Keywords: *Watermarking, robustness, singular value decomposition.*

1. Introduction

Nowadays, the usage of computers and the Internet has become increasingly common and widespread. The security of information exchange is very important on the network. Authentication and information hiding have also become important issues. To achieve these issues Digital watermarking plays a role to prove the rightful ownership or protect a customer's right of using the medium. The work in this field has led to several watermarking techniques such as correlation-based techniques, frequency domain techniques, DFT based techniques and DWT based techniques. The novel watermarking algorithm based on singular value decomposition (SVD) performs well in manipulations such as re-sampling, filtering, compression, cropping, scaling, rotation, etc.

We concentrate on a singular value decomposition (SVD) watermarking scheme. SVD is a linear algebra scheme that can be used for many applications, particularly in image compression, embedding watermark into the singular value decomposition (SVD) domain. First the SVD is performed on the original M x N image A

$$A = U S V^{H}$$

Where U and V are an MxM orthogonal matrix and N x N orthogonal matrix, respectively, and S is an MxN diagonal singular value matrix. A watermark matrix W is then added into the matrix S, and SVD is performed on the new matrix $S+ \alpha W$ to get Uw, Sw *and* $V w$, where is the scaling parameter that determines the strength of the watermark W.

$$S + \alpha W = Uw\, Sw\, V\, H$$

The watermarked image Aw is obtained by:

$$U\ Sw\ V^{H} = Aw$$

In this paper, we improve the SVD watermarking method, and extend it to the color images. Because the process of SVD does not involve the sensitivity of the human visual system, three components (R, G and B) on the color space are able to be utilized. Our proposed method can hide three grayscale images simultaneously to the color image. From a series of experiments, we will show it could resolve the rightful ownership of the watermarked image with good robustness, good imperceptibility and higher security

IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 5, No 2, September 2013
ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784
www.IJCSI.org

2. Numerical Results

The host color image A with size m× m is known, it contains three channels called red, green and blue channels. We can easily divide a color image into its red, green and blue channels and similarly red, green and blue channels can simply be combined to get the corresponding color image. We consider three images M1, M2 and M3 with size l× l as watermarks.
First, we apply the SVD to each component of the original image (red, green and blue component)

$$\mathbf{A} = \begin{pmatrix} A_R \\ A_G \\ A_B \end{pmatrix} \xrightarrow{\text{SVD}} \begin{pmatrix} U_1 S_R V_1 \\ U_2 S_G V_2 \\ U_3 S_B V_3 \end{pmatrix}$$

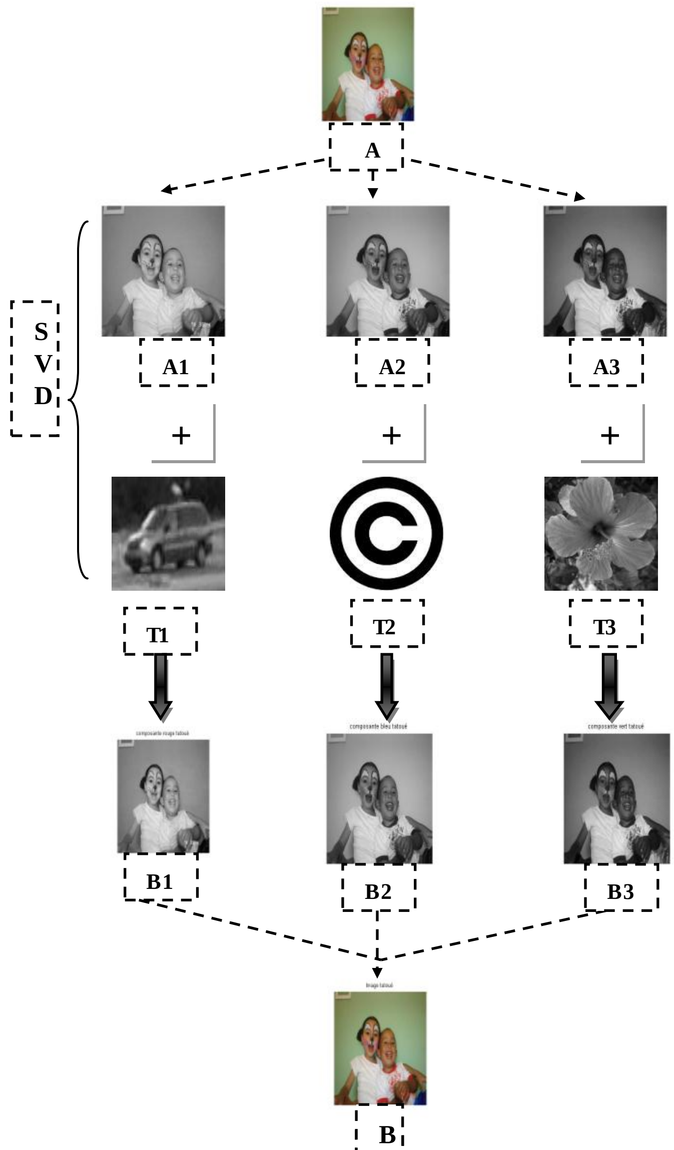
We can perform the embedding procedure by the following steps.

$$\begin{pmatrix} S_{wR} \\ S_{wG} \\ S_{wB} \end{pmatrix} \xRightarrow{\text{Insertion}} \begin{pmatrix} S_R+\alpha T_1 \\ S_G+\alpha T_2 \\ S_B+\alpha T_3 \end{pmatrix}$$

α is a scaling factor, which controls the strength of the watermark to be inserted. Because the embedded watermark can't degrade the host image quality, the value of **α** should be small. During the process of SVD, three matrices U, V and S are produced.
(U_1, V1); (U_2, V2); (U_3, V3) these matrices are the user's secret keys, which don't contain any information about three watermarks.
A method of desirable watermarking should satisfy the ownership of imperceptibility, where the integrated watermark is not visible for the observer.
(A) Represent the Host image.

(T1,T2,T3) Represent the three watermarks for the protection of copyright, (A1,A2,A3) represent the three components of RGB image, (B1, B2, B3) represent the three components watermarked of RGB image ,(B) The watermarked image.
Here, we define the value of scaling factor α=0.1 and inject these watermarks into the RGB components of the host image

Fig1: Procedure for Digital Watermarking image RGB using SVD method



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IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 5, No 2, September 2013
ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784
www.IJCSI.org

3. Results:

We implemented the three watermarks in the host image. Several calculations were made to evaluate the watermarking algorithms. The watermarked images were examined and suitable tests were performed as explained below.

3.1 Imperceptibility

The imperceptibility of the watermark is tested through comparing the watermarked image with the original one.
As a measure of the quality of a watermarked image, Peak Signal to Noise Ratio (PSNR) is used.

To compute the Peak signal to noise ratio, first we need to compute the Mean Square Error (MSE) as in (1) [1]:

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

Peak Signal-to-Noise Ratio (PSNR) takes the signal strength into consideration (not only the error), is a better test here. It is written according to the following

$$PSNR = 20\log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right)$$

K: represents the matrix data of our original image
I: represents the matrix data of our watermarked image in question
m: represents the numbers of rows of pixels of the images
i: represents the index of that row
n represents the number of columns of pixels of the image
j: represents the index of that column
f represents the matrix data of our original image
MAX_f: is the maximum signal value that exists in our original "known to be good" image.

The result table shows the influence of insertion rate on the degradation value of psnr but not on the imperceptibility of the mark.

Number of watermarks	***1***	***2***	***3***
Image watermarked			
Psnr	***36.0151***	***32.5601***	***30.6426***

Number of watermarks	***1***	***2***	***3***
Image watermarked			
Psnr	***43.6500***	***40.6288***	***38.9514***

Table1: PSNR values for the multi data embedding using SVD method in to color image

4. Conclusions

In this paper, a new method of RGB image watermarking was proposed, the basic idea is to insert multiple watermarks in an RGB image
Based on the results obtained we can deduct that there is no visual difference between the original image and the watermarked image. Experimental results show that our method maintains a high quality of watermarked images and very robust against more conventional attacks.

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