The Impact of scrambling algorithms on peak signal noise ratio in watermarking image

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Abstract

Digital image scrambling can not only be a usual image encryption, but also a pre-progress of digital watermark and image hiding. Image scrambling technologies have been widely used in digital watermarking technology, and the watermarking information will be directly embedded into the image after scrambling transformation, which can accomplish image information hiding. In this paper, study the influence of scrambling image by using three algorithms that scramble image watermark on peak signal noise ratio (PSNR) for watermarking image. This work is used Arnold algorithm, affine transformation and magic square on engineering faculty logo as watermark images buy using MATLAB. The experimental results show all scrambling algorithms which used don't influence on the image transparency and the less algorithm impact on PSNR is Arnold algorithm.

Keywords: scrambling algorithm, PSNR, DWT

تاثير خوارزميات الخلط على مقياس نسبة قمه الإشارة إلى الضوضاء في الصوره المائية

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خلط الصور الرقمية عادتاً لا يمكن ان تكون صورة مشفرة ، ولكن أيضا، تطورات اولية للعلامة الرقمية الصورة المخفية. تقنيات خلط الصور التي استخدمت بصورة واسعه في مجال تقنيات العلامة المائية الرقمية ، معلومات العلامة المائية ستكون مضمنه مباشرة في الصورة بعد عمليات التحويل للخلط , والتي تكمل معلومات اخفاء الصورة . في هذا البحث دراسة حول تاثير الصوره المخلوطه باستخدام ثلاث

خوارزميات لخلط صوره العلامة المائية على نسبة قمة الاشارة الى الضوضاء (PSNR) في الصور المائية . هذا العمل استخدم خوارزمية أرنولد ، التحويلات القريبة و خوارزمية المربع السحري على شعار كلية الهندسة واستخدامه كعلامة مائية باستخدام ماتلاب. وقد اظهرت النتائج العملية كل خوارزميات الخلط المستخدمة لا تؤثر على شفافية الصورة وان اقل خوارزمية تاثيرا على مقياس نسبة الاشارة الى الضوضاء هي خوارزمية ارنولد

1. Introduction

Image scrambling as an encryption technology has become an important mean of the digital image transmission and the confidentiality storage. The so-called scrambling, it is using the characteristics that the digital image has the number arrays, to confuse the location of image pixels or color to make it into a medley of images, cannot be identified to achieve the purpose of the original image.

At present, information hiding technology is a very important research field, while image scrambling is a vital study part. Image scrambling is not only a usual image encrypt method, but also a preprocessing of data watermark and image hiding [1]. Image scrambling disarranges the position or color of pixel in image and the original image cannot be recognized. But the operator can rebuild the original image from the disordered image by some algorithms [2]. There were many image scrambling. At present, the image scrambling technology included methods based on Arnold transform, affine transform, magic square transform, transform, Gray code, generalized Gray code; based on fractal IFS model, Hilbert curve, etc[4].

2. Proposed watermark algorithm

In this section, it has been explained the proposed method for embedding the watermark. Starts with reading the RGB image and decomposing it to three images R, G and B. watermark logo image will be embedded in the B , and

Before the embedding process, blue channel segmented to four segments each one of segment is transform into DWT domain. Figure (1).

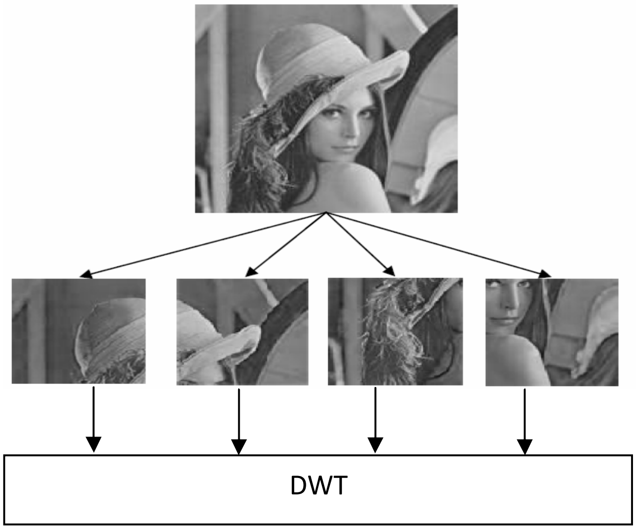


Figure (1) segmented blue channel and transform into DWT

2.1. Arnold scrambling

It is called the cat map as well as Arnold transformation (two- dimension). Using the Arnold transformation we can change the distribution of the gray of a digital image and make the image "mess". But we will get the original image if we use the Arnold transformation again and again. So we can hide our image information in the process of storing and transporting image information, especially the image information on the Internet by use of the Arnold transformation.

$$[x\ y] = [x+y\ \ x+2y] \bmod t \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, ‘t’ is the width (height) of the watermark. The transformation of each pixel is made by the above mentioned formula.

2.2 affine transformations

The transformations you can do with a 2D matrix are called affine transformations.

The technical definition of an affine transformation is one that preserves parallel lines, which basically means that you can write them as matrix transformations, or that a rectangle will become a parallelogram under an affine transformation.

Affine transformations include rotation and scaling. Note this is in spatial domain our work in frequency there are three basic 2d transformations, though you can always describe one of these in terms of the other two. In our work use rotation (**R**).

$$[x \quad y]^T \text{ by } H \text{ is: } [\hat{x} \quad \hat{y}]^T = H[x \quad y \quad 1]^T \qquad \text{.......... (2)}$$

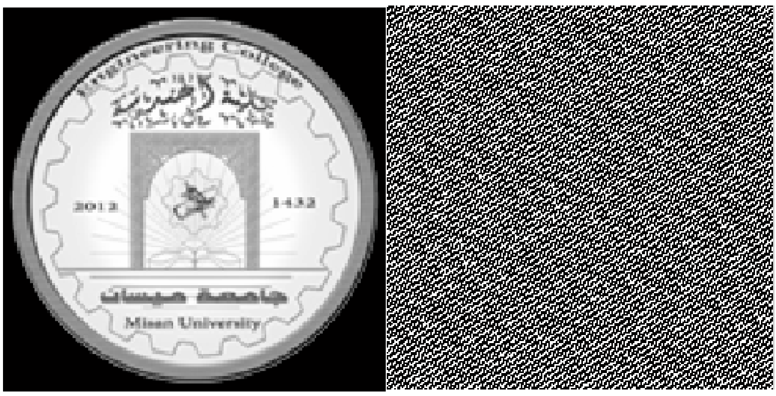
Where H is transformation matrix

2.3 Magic square

A square matrix of n rows and columns; the first n^2 integers are arranged in the cells of the matrix in such a way that the sum of any row or column or diagonal is the same.

z = N (MOD (x - A y, N)) + MOD (x - B y, N) ....(3)

Where N is the Order of the magic square, and A and B are the "lengths".

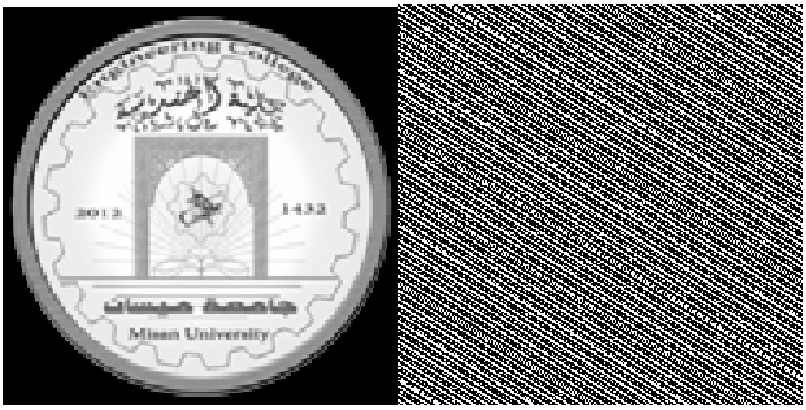


(a) **(b)**

Figure (2) **a-** before scrambling **b-** after Arnold scrambling

(a) **(b)**

Figure (3) **a-** before scrambling **b-** after affine transform scrambling



(a) (b)

Figure (4) **a-** before scrambling **b-** after magic square scrambling

3. Wavelet transform

The discrete wavelet transform has become the core technique for image processing. Since there are numerous eligible DWT basis functions, it is of fundamental importance to know the best basis for use. This problem is almost solved for image compression. A wavelet filter is expected to satisfy some of the desired properties, including time-frequency localization, regularity, large coding gain and orthogonality [3]. The main aim of use the wavelet transform in the partitioning of the image into four non overlapping sub-block in which each sub-block has certain information. Figure (4) show the 2D wavelet decomposition

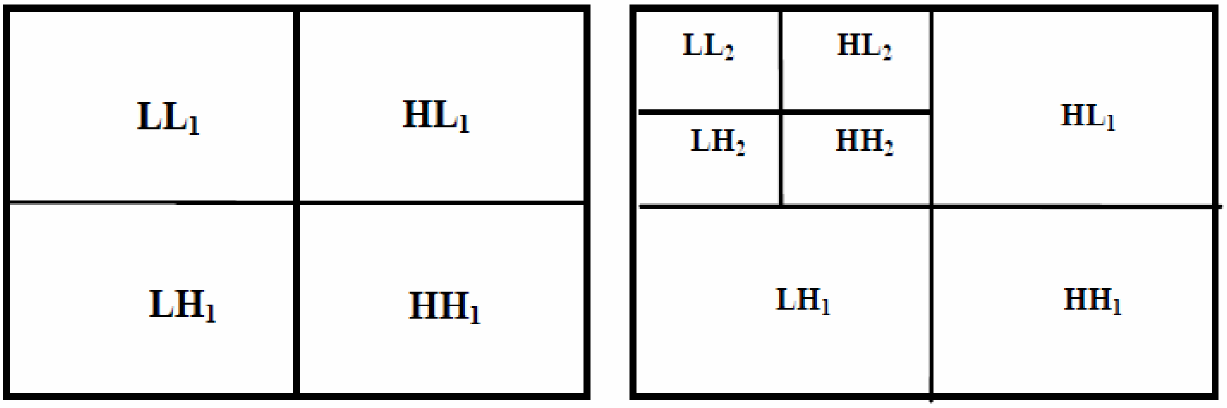


Figure (5) 2-D wavelet decomposition

4. Embedding and extracting image watermarking

A. The embed of watermark in the first 2-DWT level is more effective [5].The process of embedding can be achieved by enter the two scrambled image engineer faculty logo watermark that has size 128*128 in (LH1, HL1) for two block by using the equation (4).

$$W'_i = w_i + \alpha Y_i \quad \ldots\ldots\ldots \quad (4)$$

Where by w' is the watermarked image, w is the original image, Yi are the watermarks and α is the scaling factor. According to [8] when increase the value of α increases the robustness of the watermark, but decreases the quality of the watermarked image. The detection of the value of α must be reasonable (relational) Where is the watermarked image, is the original image, Yi are the watermarks. After the embedding process is completed, the new coefficients is reconstructed the wavelet coefficient by using IDWT. In another words the same wavelet filters that are used in the wavelet decomposition must be used in the inverse wavelet and the same thing is applied to the number of the decomposition level. These process results are the watermarked image.

At this stage, the watermarked image is obtained for greyscale image but for RGB image, watermarked blue image is obtained which is then combined to other two images to obtain the watermarked image (RGB).

B. The objective of the extraction process is to acquire a credible estimate of the original watermark. To extract the watermark from the watermarked image, perhaps distorted image, the extraction process must be an inverted procedure of the embedding process. In order to extract the watermark, the original image is required. Hence, the proposed scheme is a non-blind.

That means the scrambled watermarks are descrambled to get the watermarks by the same scrambling steps in the initial scrambling operation. The extracted watermark is comparable with original watermark and the comparability is able between original image (host image) and watermarked image as long as visually recognizable pattern as watermark has been used.

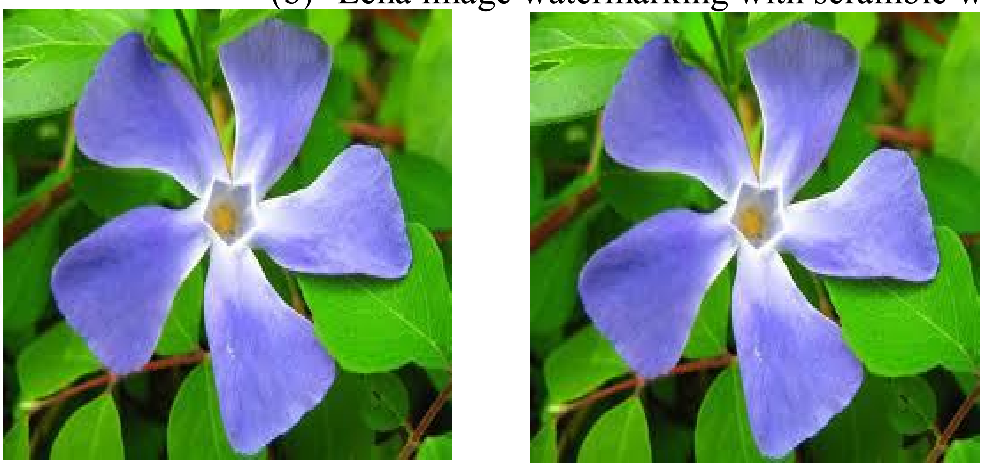
5. Experimental Results:

This algorithm is examined using color images, Lena image, flower image and lion image as a host image of size 512 * 512. Two Engineer faculty logo gray scale images of size 128 * 128 are used as watermark. From the entire results, camper the impact of proposed scramble algorithm on PSNR. The result show the less impact on watermarking image is Arnold scrambling then magic square and affine transform, table (1).

(a) (b)

Figure (6): (a) Lena host image watermarking

(b) Lena image watermarking with scramble watermark



(a) (b)

Figure (7): (a) flower host image watermarking

(c) Flower image watermarking with scramble watermark

(a) (b)

Figure (8): (a) Lion host image watermarking
(b) Lion image watermarking with scramble watermark

5.1 Peak Signal to Noise Ratio (PSNR):

Peak signal to noise ratio between two images that is given in decibels (db) could be accounted for by the PSNR block. The ratio is generally utilized for measuring the quality between the watermarked image and the host image. Increasing the PSNR values is associated with improving the quality of the reconstructed image. The PSNR formula as follows: [6]

$$PSNR= 10 \log_{10} 255^2 /MSC \text{ db} \qquad \ldots\ldots\ldots\ldots\ (4)$$

And

$$MSE = \left(\frac{1}{M\times N}\right)\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}\left(W(x,y) - W'(x,y)\right)^2 \qquad \ldots\ldots\ldots\ldots\ (5)$$

Where

M x N the images size for the watermarked and original images

W(x,y) original pixel value

W'(x,y) watermarked image pixel value

(MSE) Mean Squared Error which for two (W, W ') where one of the images is considered as a noisy approximation of the other.

According to [7] PSNR typical values ranges between 20dB and 40dB are considered good in case of the comparison between the host image and the watermarked image. On the other hand, when the watermarked image has PSNR value more than 30, it is hard to recognize any difference with the original host image by the human eyes system

Table 1: show Comparison among three scrambling algorithm

Image	Scrambled algorithms	PSNR (DB)
Lena	Arnold	37.66
	Affine transform	27.40
	Magic square	35.94
Flower	Arnold	38.24
	Affine transform	29.60
	Magic square	36.96
lion	Arnold	37.70
	Affine transform	28.22
	Magic square	36.85

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