

Digital Watermarking for Anti-counterfeit in Printed Image

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Abstract

In this paper, we propose an algorithm which is based on Discrete Cosine Transform (DCT) domain of original image. The technique of digital watermark can provide great useful guarantee for printed copyright. In order to embed the watermarking in a picture, firstly we divide the picture into 8×8 pieces and carry on the DCT transformation on per piece. Then we adjust each DCT coefficient of these pieces. Lastly we take out each of the parts of low frequency coefficient constitute watermarking signal. The watermark signal is imbed with different strength to the low frequency coefficient of the picture piece. The experimental results show the algorithm has very efficiency. The algorithm can be used in copyright and authentication purposes of digital image for the printed image.

Keywords: Printed; watermarking; DCT

1. Introduction

In the periodicals and the merchandise over-wrap of in the press, for prevent from a pirate edition and counterfeiting the emergence of the false and common product, people have already adopted laser holography label and change-color printing ink etc. various printings defend a false technique. But these anti-counterfeit techniques are so bad monopoly and uniquely those they are easily controlled by counterfeiter. Moreover the cost of anti-counterfeit techniques is high. And the digital watermarking technique is the method that passes the adoption signal processing and embeds some concealment information in a digital picture. The kind of anti-counterfeit method causes people's extensive concern in the copyright protection of the digital medium [1]. People have already started try as well to defend a counterfeit technique to apply to a printing. According to the printing of the digital watermarking defend a counterfeit technique and will change a traditional printing to defend false idea by the root, the printing of the digital watermarking defending a false information can be a numeral, text originally the information, picture even is a voice, they can hide in a printing arbitrarily position with the form of invisibility. Only passing the computer software or particular examination equipments then can identify these digital watermarking, and the contents of the watermarking information and the method embedded can be changed easily. So counterfeiters can hardly discover the watermarking in the printed, even discovering these watermarking they can hardly also imitate to repeat the manuscript. It will provide a good anti-counterfeit technique [2].

3. Digital watermarking algorithm of DCT

During the period of printing the picture replication, preprint carry on under the RGB mode generally. But the printing machine carry on the CMYK mode transformation to the printing pictures while divide the color system version. So a print will be converted

According to the printing of the digital watermarking anti-counterfeit technique is the picture processing means that pass before print to adopt particular algorithm to defend conduct and actions the watermarking information of the false marking imbed the printing picture. The watermarking information can make use of the computer software or particular examination equipments to identify after the picture printed, carrying out the handout to anti-counterfeit [3]. This anti-counterfeit technique with traditional printing have obvious differentiation: The traditional printing defends a special equipments creation of false demand to anti-counterfeit marking, but the digital watermarking just imbeds a special digital information in the printing the diagram text; The traditional printing anti-counterfeit is exposed completely and can be easily made duplicate it to counterfeit marking, but the digital watermarking is concealed completely and even know a embedded marking in a printed hardly to duplicate the marking. The traditional printing anti-counterfeit method is very difficulty to modify a content of anti-counterfeit e marking. However the contents of the digital watermarking can be modified very easily and can also according to need to change the watermarking information to imbed, withdraw a method in printed [4].

2. The characteristic of the digital watermarking

Generally the digital watermarking owning the copyright protection function has to be having as follows characteristics:

(1)Robust: The ability that the picture watermarking calculates way resists the common picture processing operation, be also the ability that containing the watermarking picture experiences a not intentional modification but reserves the watermarking information. The function is a very important function.

(2)Transparent: After the work process a series conceal a processing, the information should not be lowered quality obviously.

(3)Securities: To request the watermarking algorithm has the ability to resist a malice attack.

(4)Proved: A digital watermarking can be subjected to a protective information product of copyright to provide a safe and dependable proof.

(5)Efficiencies: The price of the space and time for imbedding and withdrawing watermarking in a image whether can be accepted or not.

from the RGB color space to the CMYK color space. This kind of conversion will result in the variety of the picture information lost. Therefore, the watermarking information should not imbed under the RGB mode generally in order to prevent cause the watermarking information lost. In the CMYK color mode, person's eye is lower to the Y passage sensitive degree, so the

watermarking can be imbedded to go to in the Y passage. If necessary all imbedded the watermarking information should place in the CMYK four-color passages to strengthen the robustness of the watermarking.

3.1 The basic frame of digital watermarking

The project of digital watermarking includes three basic aspects: the generation of digital watermarking, the digital watermarking imbedded the examination of the digital watermarking.

The basic frame of a whole digital watermarking is showed in figure 1.

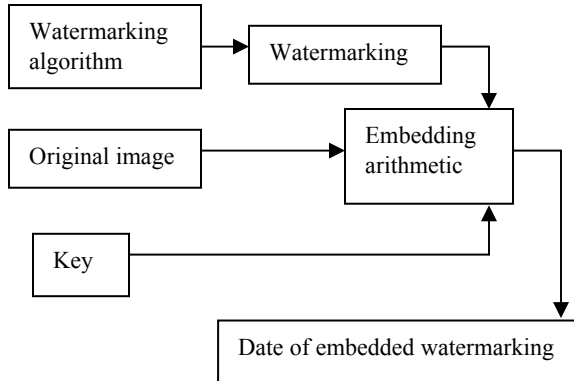


Figure 1 The basic frame of a whole digital watermarking

3.2 Discrete Cosine Transform (DCT)

BE worse with the space-area watermarking technique widespread existence anti-attack ability, the watermarking capacity be subjected to restriction etc. the weakness dissimilarity, the transformation-area the digital watermarking technique have the watermarking signal energy and can be distributed to the whole object. Still the digital watermarking technique of DCT possess simple and carries out easily etc. characteristic.

The definition of Discrete Cosine Transform can be writing as follows [3] [5]:

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

$$u, v = 0, 1, 2, \dots, N-1$$

..... (1)

Contrary transformation of DCT:

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

$$x, y = 0, 1, 2, \dots, N-1$$

..... (2)

among them :

$$C(u), C(v) = \begin{cases} \sqrt{1/N}, u, v = 0 & \dots (3) \\ \sqrt{2/N}, u, v = 1, 2, \dots, N-1 \end{cases}$$

We adopt a standard gray image as the experiment examination image. The image has 256 gray rank. Establish the image for $I = \{g(i, j), 0 < i < M, 0 < j < N\}$. The digital watermarking image is two values image. Establish the watermarking image for $W = \{w(i, j), 0 < i < P, 0 < j < Q\}$. $G(i, j)$ is a gray value of No i line and No j line in an original image. $W(i, j)$ is a gray value of No i line and No j line in a watermarking image.

The process of embedding digital watermarking in an original image is as follows:

(1) Original Image divided pieces and transformed with DCT

Firstly we divide the original image into 8*8 pieces. These pieces do not repeat each other. Then we take DCT transformation to these pieces each other.

$$I_{DCT} = DCT(I)$$

(2) Preparing process of a watermarking image

For resisting attack such as tailor, a watermarking image should be prepared process before embedded in an original image. The method disrupts each pixel position in a watermarking image because it can cancel the space relativity of each pixel.

Transformation formula:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} \bmod N \dots\dots\dots (4)$$

(3) Embed digital watermarking

The process of embedding digital watermarking is a modify process that we amend some DCT coefficient from step 1. These DCT coefficient will be controlled by Key.

So the rule is:

$$I'_{DCT} = I_{DCT} + \alpha W$$

α : Intensity of embed. If α is more big the robust of watermarking is more strong.

(4) Contrary transformation of DCT

After a watermarking message was embedded in an original image, these DCT coefficients carry on contrary transformation of DCT with formula (2). So we will gain a image with embedded watermarking [6].

$$I' = IDCT(I'_{DCT})$$

3.3 Examination algorithm for image watermarking of DCT

In experiments, the withdrawal process is a basically contrary process for embedding watermarking.

We firstly use the scanner to take digital the printed image with watermarking message. The size of picture and the original picture should be same each other. If they are not equal, we should adjust to scan a picture to make it in accordance with the original picture. The picture should be carried on a smooth processing to cancel or reduces the noise that occurs on a process of printing and scans. The process improves picture quality. Its principle is the noise seized that adopts a low wave obstructs high frequency part signal. Then we carry on DCT on the picture scanned and the original picture each other, and withdraw a watermarking signal by comparison. Because the watermarking signal was imbed in

original picture with disorderly transformation, as a result the watermarking signal withdrew isn't the original watermarking picture. So we have to carry on a contrary transformation for the originally disorderly transformation, then we can truly restore the originality watermarking picture [7]. Figure 2 show the process of withdrawing watermarking.

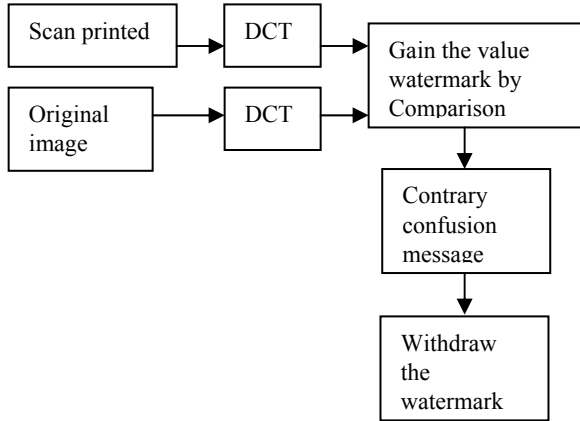


Figure 2 the process of withdrawing watermarking.

4. Conclusions

This paper analyzes printing anti-counterfeit circumstance of the original and the counterfeit, and put forward a kind of method according to DCT the printed copyright protection. The method imbeds watermarking in the picture and check the watermarking through identifies watermarking to distinguish printed. This paper anti-counterfeit method can be used for printed, such as trademark and certificate etc. Nowadays the digital watermarking anti-

counterfeit technique still stays in the research stage of the beginning start. We believe that the digital watermarking anti-counterfeit technique will provide a strong protect on printed in future.

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