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# A New Approach of an Image Watermarking Technique Based on DWT DCT and SVD, ARNOLD

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**Abstract:** There has been rising use of SVD, the digital watermarking tools in change domain has really evolved. It is based on DWT, DCT and SVD, we prepare a new watermarking system for algorithmic image. Our experimental results show that this practice combines the advantages of these three transforms. We can see compared with the SVD and the DCT plus SVD system the projected method has stronger robustness and faster speed in implanting and extracting.

## 1. Introduction

There is digital watermarking technology is the process of implanting useful info which can be convert into a digital media especially picture, acoustic, or videocassette for the purpose of copy control, content authentication, etc. Now it is observe an effective watermarking method should at least meet the following two uniqueness: imperceptibility, the disparity between the WI and OI cannot be distinguished by human eyes, and robustness, the unauthorized individuals or groups can not eliminate the watermark from the implanted useful info. The strength of robustness determines the watermarking technique's capacity of change during spread and storage space, including planned (such as malevolent attacks) and inadvertent (such as compression, noise, filtering, and rotation, etc.). In this we talk about generally speaking, watermarking can be grouped into two categories: spatial domain methods(SDM) and transform domain methods(TDM). In spatial domain approaches, the watermark is implanted directly to the pixel locations [3-10]. Now,In transform domain approaches, a mathematical transform is applied to the original image to implant watermark into the transform coefficients, then apply IT to get the implanted image. The most frequent used methods are Discrete Wavelet Transform (DWT), Discrete Cosine Transform(DCT), and Discrete Fourier Transform (DFT). As the transform domain methods always have good these are techniques which is having robustness to common image processing such as compression, noise, filtering cutting, and rotation, etc. They now come into more widespread used.

In recent years, Singular Value Decomposition (SVD) has been started to use in watermarking as a different transform [3]. It's a numerical technique that diagonalizes the matrix. In [2], the author proposed a non-blind watermarking system based on SVD. In [3], the author robustness and quicker calculating rate.

## 2. Preliminary

### 2.1 DWT

An Image applied DWT is divided into four sub- conjugate transpose of V , an n*n unitary matrix[4].The non-negative components of S represent the luminance value of the image. Further we can see changing them slightly does not affect the image quality and they also don't change much after attacks, watermarking practice make use of these two properties [3]. Arnold Transform As Seen the digital image as a form of matrix N * N matrix, then bands:

a)LL
b)HL
c)LH
d)HH

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The image's energy is mainly focused on the LFB.The other three bands characterize the marginal information of the corresponding direction and have little energy.

### 2.2 DCT

Furthermore it is observe DCT is one of the most popular linear transforms on DSP. It has been widely used [12-23]because of its good capacity of energy compression and de-correlation. DCT is faster than DFT because its transform kernel is real cosine function while it is complex exponential in DFT[5].For a given image f (x, y).

## 3. Generate and Embed an Watermark Into an Image

Producing implanting tide marking into an images as see in figure 1.

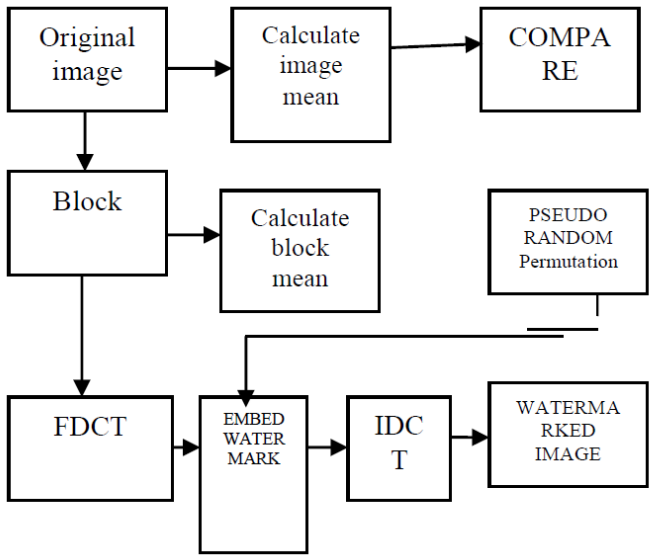


**Fig.1:** Generate and embed a watermark into an image

Firstly original image is resizing and then calculating image mean using eq. 1 and then comparing the block by which we calculate block mean. Using FDCT algorithm we embed watermark behind text image Performing IDCT algorithm on watermark image. Also calculating extracted coefficient in another side, in figure 2.

### 3.1 Extracting Watermark from Suspicions Image

During the process of extracting watermark from a suspicious image, the original image is not required, but the secret key (permutation rule). The block diagram of the watermark extraction is shown in First, the suspicious image X, is segmented into blocks with size 8x8 and block-based DCT is performed on those blocks. That is

$$Ys = FDCT(Xs \quad (1)$$

Then eliminate the effects of the middle-coefficient modification. It is the revene process of embedding watermark operation. For the block X,(k, I) , form equation (1), it has

Ye (k,l) (m)= Ys(k,l)(m) if wp(k,j) =0;
1/1+α Ys(k,l)(m)
If wp(k,j)=1 (2)
To obtain the extracted image which is the same size as the original image. IDCT operation performed on Ye i.e.
xe = IDCT (Ye) (3)
Then segment the extracted image X, and calculate the gray mean m,, and the block means
Meb, of the N1/8 * N2/8 blocks of the image Xe.
Mex = 1/N1*N2 ∑i=0 ∑ j=0 Xe (I,j) (4)
Meb = {Meb(k,l); 0≤k<N1/8 , 0≤L<N2/8} (5)
Compare the blocked mean meb(k,l) with the mean value mex. The result is the binary pattern, i.e.
Wsp(k,l) = { 0 meb(k,l) ≤mex }
1 meb(k,l) ≤mex (6)
Wsp = {Wsp(k,l) , 0≤k<N1/8 , 0 ≤L<N2/8} (7)
In order to recover the normal sequence of the extracted watermark, inverse pseudo-random permutation is performed on Wsp .Then the extracted watermark is obtained, i.e.
Ws = InversePemute( Wsp ) (8)
To compare the extracted watermark with the reference watermark objectively, normalized correlation (NC) is used, which is the crosscorrelation normalized by the reference watermark energy to give unity as the peak correlation
NC = ∑I ∑ J Ws (,j) w (,j)/ √∑I ∑ J Ws (,j)2 w (,j)2 (9)
Because the watermark is generated from the image by comparing the gray mean of blocks and the gray mean of the entire image, the robustness of the watermark is inherent. The method presented in this paper is sensitive to the luminance or contrast alteration. For most image, the normalized correlation is over 0.95. The value can be a threshold to judge whether the image is changed.
In order to be compatible with the JPEG compression standard, the method of watermarking is based on JPEG lossy compression model. The original image is segmented into N1/8 * N2/8 blocks,
Xb={ Xb(k,l),0 ≤ k < N1/8 ,0 ≤L<N2/8 } (10)
where image block xb (k, I) is expressed as
Xb (k, l) = {xb (k x 8 + i, l*8 + j) = x(k* x 8 + i, l* 8 + j),0, 5 i < 8,0≤j ≤ 8}
for 8 * 8 value is computed in term of the following equation. For 8 x 8 image block Xb(k,l) , the gray mean
mb(k, l) = 1/64 ∑ ∑ xb (k*8 + I ,l *8 +j) (11)
So the means of all image blocks is expressed as
Mb= { mb(k, l) , 0 ≤k ≤ N1/8 ,0 ≤L<N2/8 } (12)
The gray mean of the entire original image X is calculated according to the following equation
Mx =1/N1*N2 ∑ i=0 N1-1∑ i=0 N2-1 x(I,j) (13)
The mean m, is considered as the reference value of watermarking. Then compare the means of the N1/8 * N2/8 blocks.
with the reference mean mX, The comparison result is a binary pattern, i.e.
W= {w.(k,l), 0 ≤ k≤,N1/8 , 0≤L<N2/8 } (14)
where w(k, l) is obtained from the following equation
wp(k, l) ={ 0 mb (k,l) ≤mx
1 mb (k,l) >mx } (15)
The element number of W is equal to the block number of the image X. W is derived fiom X and can be considered as a binary watermark. Because the watermark is generated directly form the image, it is the visually recognizable pattern. So each element of the W can be regarded as a pixel of the watermark W. In order to eliminate the spatial correlation among pixels of the watermark, pseudo-random permutation is performed on W. A secret key (permutation rule) is generated from the permutation, i.e. Wp = Permute (W)
wp(k, l) ={ w (k,l) , 0 ≤k ≤ N1/8 ,0 ≤L<N2/8 } (16)
where pixel (K,r) is shuffled to pixel (k,l) by the pseudo-random permutation. Since the human eye is more sensitive to noise in lower-frequency components than in higher-frequency ones and information hidden in higher-frequency components might be discard after quantization of lossy compression, such as JPEG lossy compression. The traditional trade-off is embedding watermark into the middle-frequency range of an image. To embed the watermark into the image, discrete cosine transform DCT) is performed on each block with size 8x8 of Xb
where FDCT means forward discrete cosine transform. For image block Xb(k, r) , its DCT result &(k, l) has 64 coefficients. Those coefficients are ordered according to the
zigzag-scan sequence. They are denoted as
Yb(k,l)(0), Yb(k,l)(l) , .. ., yb(k,l) (16)

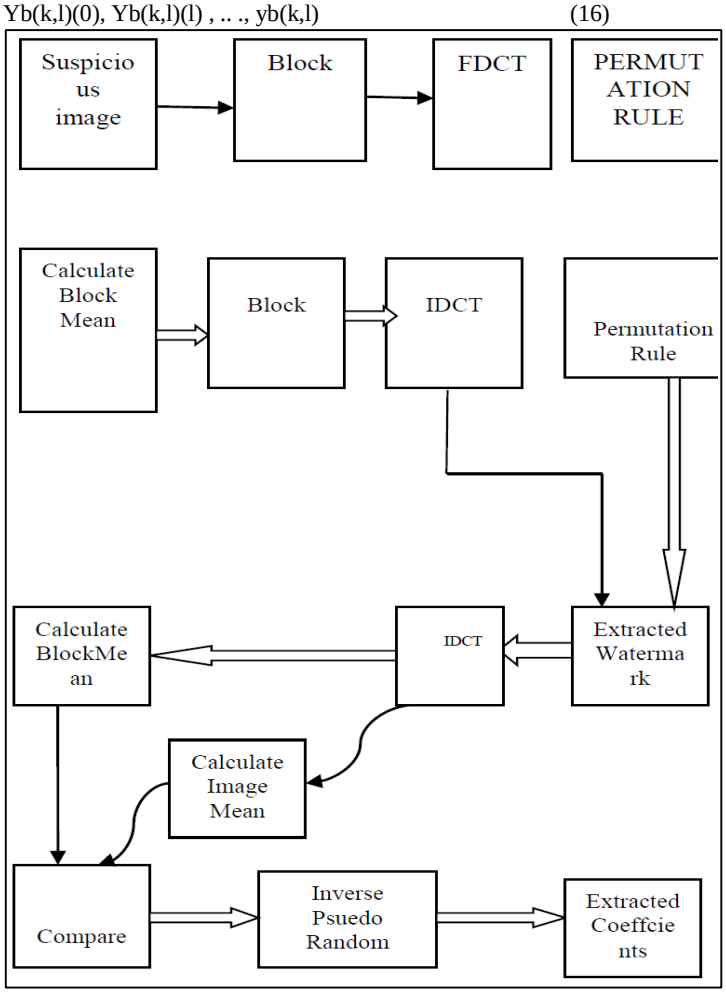


**Fig.2**: Extracting watermark from a suspicious image

For pixel wP (k, I) , only one middle-frequency coefficient is selected and modified in corresponding image block yb(k,l). Suppose the selected middle frequency coefficient is Yb(k,l)(m) , in which m is the index in the zigzag sequence. Embed the same watermark into the image according to the formula
Y, (k, L)(m) = Y(k, l)(m) + α wP (k, I)Y(k, I)(m) (17)
where a is the scale factor to control the modification value of the selected middle-frequency coefficient. It is defined by users and related to the texture complexity of the image. Finally,inverse discrete cosine transform (IDCT) is performed on each block of Y, and the watermarked image X , is obtained. That is
XW = IDCT (YW) { IDCT (YW(k,l) ≤N1/8 ,0 ≤l< N2/8} (18)

## 3.Results

**Fig.3:** Original Image

**Fig.4:** watermarking image using eq.10

**Fig. 5:** Watermarking image using eq.17

**Fig.6:** Watermark image using eq 1

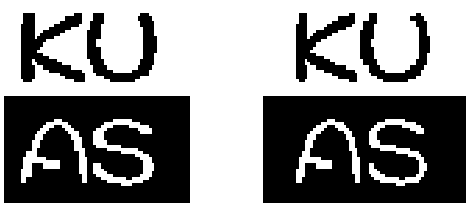

**Fig.7:** Extracted watermark image using IDCT

## 4. CONCLUSIONS

In this paper, it is planned a watermarking system for digital picture based on DWT, DCT and SVD. The experimental technique and test shows it has a better performance on imperceptibility and robustness. although It is robust to some common image processing including whereas GN, LPF, pepper & salt noise, contrast enhance, JPEG compression, cutting, and rotation than a SVD or a DCT+SVD technique

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