# Graphical User Interface Software Model for Real Time Image Authentication


Suthar A.C.[1], Dr. Kulkarni G.R.[2]

[1]Research Scholar, Dept. of E.C.E., KSV University, Gandhinagar, Gujarat, India and
I/C Principal, Leads Institute of Tech. & Engg., Matar,Bharuch,Gujarat,India.
[2] DNYANSHREE Institute of Engineering and Technology, Satara, Maharashtra 411004, India

([1]acsuthar@ieee.org, [2] grkulkarni29264@rediffmail.com)



*Abstract* - We develop a real time graphical user interface tools for Image authentication, also used two transform techniques to embed a watermark or message in a cover image. For our paper, we have used joint Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) algorithm. According to the characters of human vision, in this algorithm, the information of digital watermarking that has been discrete cosine transformed, is put into the high-frequency band of the image which has been wavelet transformed. Image authentication hides the secret or private information in digital images. The proposed image authentication scheme invisibly embeds an authenticated image into the host image and increases robustness & concealing properties of an image. It is very effective for various security issues/attacks that applied on image for process. The authentication extraction process necessitates not only the watermarked image but also the original image and its characteristics.



*Keywords* - Digital image watermarking, Discrete cosine transform, Discrete wavelength transform, Spatial domain watermarking, Frequency domain watermarking


## I. INTRODUCTION

Digital watermarking technology is to use for multimedia components like audio and video so, the digital embedding method to hide the watermarking information for any digital products. The watermarking signal being embed into the carrier is as a feeble signal to add into a strong background [1]. Figure 1 show the fundamental diagram of secure model for digital media. The technique known as digital watermarking, it has two different domains: Spatial and frequency. One of the simplest methods of spatial domain is to change the Least Significant Bit of the original image by the watermark bits to get the watermarked image. Such change is not at all noticeable by the human eyes. However, the disadvantage is if either the LSB of the image intentionally changed with all 0's or all 1's then the whole information of watermark is lost and can never retrieved. Therefore, the other spatial domain watermarking method is change the intensity level of the original image depending on the watermark data. Again, this method is not robust at all.

This paper introduces an algorithm of digital watermarking based on Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT), which increases robustness, and concealing of a watermarked image. At

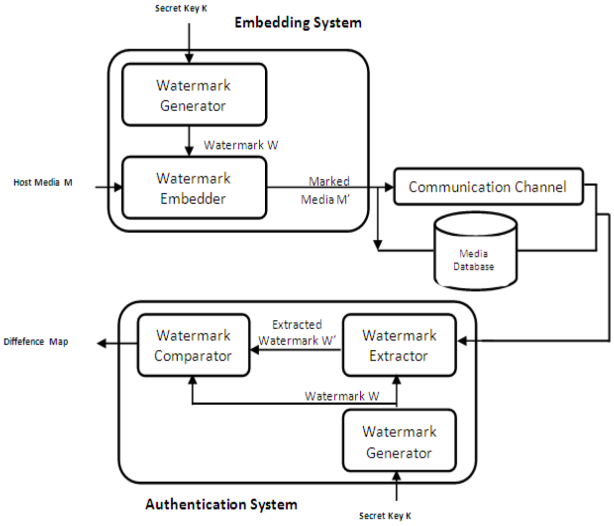


Figure.1 Secure model for digital media

first, the watermarking image utilized using the discrete cosine transformed. Because of the discrete cosine, transformed modulus has only the low frequency component information of watermarking image, as long as this information do not lose or lose little then the watermarking image can be renewed well. This enhances the robustness and concealment. The original image It is decomposed via the discrete wavelet transform and choose the appreciate wavelet modulus in the high frequency level. The watermarking information is embedding into the corresponding position. Make the whole image IDWT transformed and get the watermarked image $I\omega'$. The watermarking is pure but it quite in the different manner. Although significant progress has made in watermarking of digital images, many challenging problems remain in practical applications. Among these problems is the resilience of watermarking to removal attacks. Such attacks are easy to implement, but can make many of the existing watermarking algorithms ineffective.

## II. DISCRETE COSINE TRANSFORM

Various types of transforms are available for image processing, the character of discrete Fourier transform (DFT), and discrete cosine transform (DCT) turn over the image edge to make the image transformed into the form of even function. It is one of the most common linear transformations in digital signal process technology.

DCT coefficient in row u and column v of the DCT matrix.

$$C(u,v)=\alpha_u\alpha_v\sum_{x=0}^{M-1}\sum_{y=0}^{N-1}I(x,y)\cos\frac{\pi(2x+1)u}{2M}\cos\frac{\pi(2y+1)v}{2N},$$

for $0\le u\le M-1$ , $0\le v\le N-1$ and

$$\alpha_u=\begin{cases}1/\sqrt{M}, & u=0\\ \sqrt{2/M}, & 1\le u\le M-1\end{cases}$$ and

$$\alpha_v=\begin{cases}1/\sqrt{N}, & v=0\\ \sqrt{2/N}, & 1\le v\le N-1\end{cases}$$

$$x(m,n)=\sqrt{2/M}\sqrt{2/N}\sum_{u=0}^{M-1}\sum_{v=0}^{N-1}\alpha u\alpha vy(u,v)$$

The image is reconstructing by applying inverse DCT operation according to Eq. shown below:

$$f(x,y)=\sum_{u=0}^{M-1}\sum_{v=0}^{N-1}\alpha_u\alpha_vC(u,v)\cos\frac{\pi(2x+1)u}{2M}\cos\frac{\pi(2y+1)v}{2N},$$

for $0\le x\le M-1$ , $0\le y\le N-1$ and $\alpha_u$, $\alpha_v$ as defined above.

The main information of 2D-DCT can not only concentrate of original image into the smallest low-frequency coefficient, but also it can cause the image blocking effect being the smallest, which can realize the good compromise between the information centralizing and the computing complication.

## III. DISCRETE WAVELET TRANSFORM

Wavelet transform is a time domain localized analysis method with the window's size fixed and forms convertible. There is quite good time differentiated rate in high frequency part of signals DWT transformed. In addition, there is quite good frequency differentiated rate in its low frequency part. It can distill the information from signal.

The basic idea of discrete wavelet transform (DWT) in image process is to multi-differentiated decompose the image into sub-image of different spatial domain and independent frequency district. Then transform the coefficient of sub-image. After the original image has been DWT transformed, it is decomposed into four frequency districts which is one low-frequency district(LL) and three high-frequency districts(LH,HL,HH). If the information of low-frequency district is DWT transformed, the sub-level frequency district information will obtained. A two-dimensional image after three-times DWT decomposed can shows as Fig.2. Where, L represents low-pass filter, H represents high-pass filter. An original image can decomposed of frequency districts of HL1, LH1, and HH1. The low-frequency district information also can decompose into sub-level frequency district information of LL2, HL2, LH2 and HH2. By doing this the original image can be decomposed for *n* level wavelet transformation [3].

The information of low frequency district is an image close to the original image. Most signal information of original image is in this frequency district. The frequency districts of LH, HL and HH respectively (figure 2) represent the level detail, the upright detail and the diagonal detail of the original image.

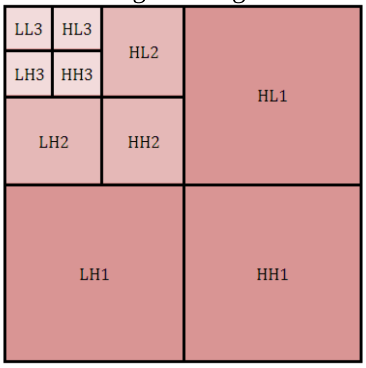


Figure.2 Frequency districts of DWT

The information of low frequency district is an image close to the original image. Most signal information of original image is in this frequency district. The frequency districts of LH, HL and HH respectively represents the level detail, the upright detail and the diagonal detail of the original image.

According to the character of HVS, human eyes are sensitive to the change of smooth district of image, but not sensitive to the tiny change of edge, profile and streak. Therefore, it is hard to conscious that putting the watermarking signal into the big amplitude coefficient of high-frequency band of the image DWT transformed (figure 3). Then it can carry more watermarking signal and has good concealing effect.

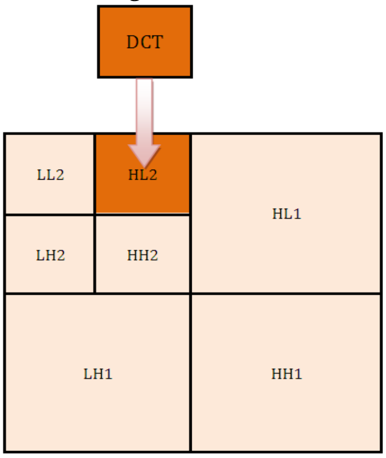


Figure.3 Embedding concept with DWT

## IV. PROPOSED DCT-DWT METHOD

### *A. Watermark Embedding*

**Inputs:** Visual (host) Image, Watermark Image.

1. Read the host image.
2. Decompose the host image by L-levels using two-dimensional DWT. The higher DWT level is, the better the concealing effect of embedding watermark is.
3. Add the watermark image into the higher DWT coefficient (High frequency band) of host image.

4. Apply 2D-DCT to the selected block of DWT decomposite block in which watermark image is added.
5. Apply IDWT to the host image to get watermarked image.
6. Calculate PSNR & MSE of watermarked image to the original image.

**Output:** Watermarked Image, Figure 4 shows the Image security encoder model.

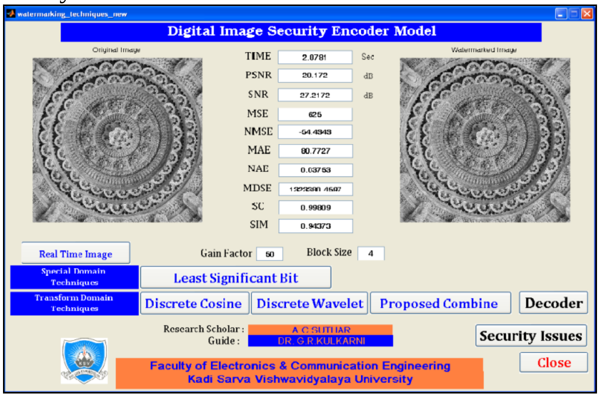


Figure: 4 Digital Image Security Encoder Model

### *B. Watermark Decoding*

**Inputs:** Visual (host) Image, Watermarked Image.

1. Read the host & watermarked image.
2. Apply DWT to watermarked image to decompose the image by L-levels.
3. Obtain information from high frequency band.
4. Apply 2D-IDCT to the selected decomposed block & recover watermark image.
5. Calculate PSNR & MSE of recovered watermark image with original watermark image.

**Output:** Recovered Watermark image. Figure 5 shows the Image security decoder model.

## V. ANALYSIS AND RESULTS

We can conclude robustness and concealing of watermarked image from some analysis parameters.

The simplest of image quality measurement is Mean Square Error (MSE). The large value of MSE means that image is poor quality. MSE defined as follow:

$$MSE = \frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}\left(x(m,n) - \hat{x}(m,n)\right)^2$$


Figure:5 Digital Image Security Decoder Model

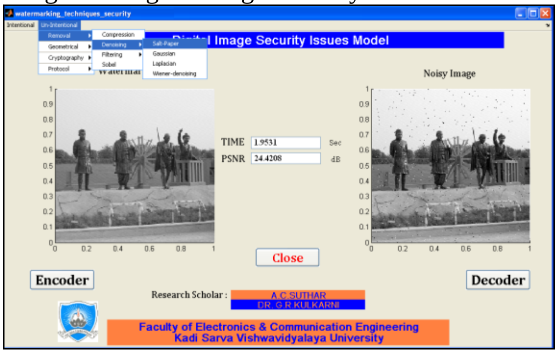


Figure:6 Digital Image Security Issues Model

The small value of Peak Signal to Noise Ratio (PSNR) means that image is poor quality. PSNR defined as follow:

$$PSNR = 10\log\frac{255^2}{\frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}\left(x(m,n) - \hat{x}(m,n)\right)^2} \quad \text{or}$$

$$PSNR = 10\log\frac{255^2}{MSE}$$

The large value of Mean Average Error (MAE) means that image is poor quality. MAE defined as follow:

$$MAE = \frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}\left|\left(x(m,n) - \hat{x}(m,n)\right)\right|$$

The small value of Signal to Noise Ratio (SNR) means that image is poor quality. SNR defined as follow:

$$SNR = \frac{\sum_{m=1}^{M}\sum_{n=1}^{N}\left(x(m,n)\right)^2}{\sum_{m=1}^{M}\sum_{n=1}^{N}\left(x(m,n) - \hat{x}(m,n)\right)^2}$$

The large value of Structural Content (SC) means that image is poor quality. SC defined as follow:

$$SC = \frac{\sum_{m=1}^{M}\sum_{n=1}^{N}\left(x(m,n)\right)^2}{\sum_{m=1}^{M}\sum_{n=1}^{N}\left(\hat{x}(m,n)\right)^2}$$

The large value of Normalized Absolute Error (NAE) means that image is poor quality. NAE defined as follow:

$$NAE = \frac{\sum_{m=1}^{M}\sum_{n=1}^{N}\left|\left(x(m,n) - \hat{x}(m,n)\right)\right|}{\sum_{m=1}^{M}\sum_{n=1}^{N}\left|x(m,n)\right|}$$

The reliability of an objective measurement could evaluate by finding the correlation between objective measurement and subjective measurement.

The possible values of correlation coefficient are between -1 and 1, the better correlation make the correlation coefficient closer to -1 or 1.

$$NCC = \frac{\sum_{m=1}^{M}\sum_{n=1}^{N}\left(x(m,n)\times \hat{x}(m,n)\right)}{\sum_{m=1}^{M}\sum_{n=1}^{N}\left(x(m,n)\right)^2}$$

Where, $x(m,n)$ and $\hat{x}(m,n)$ are the series of subjective and objective measurements, respectively.

In addition, we can build the graphical user interface real time simulation model, which useful for run on all machines and every one can easily understand about the various watermarking methods and proposed i.e. combined of DCT-DWT method. Figure 7 and 8 shows the comparative analysis of combined method with previous DCT and DWT methods with various parameters.

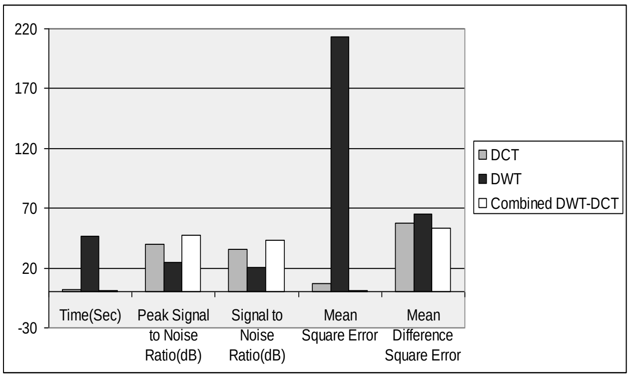


Figure:7 Comparative Analysis chart-I for combine method

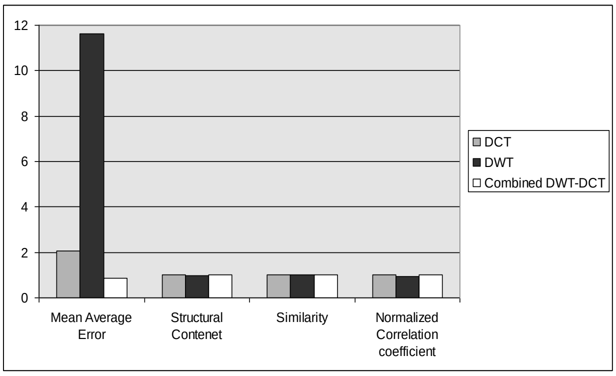


Figure:8 Comparative Analysis chart-II for combine method

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