A Secure Authentication Technique using Edge Detection in Watermarking

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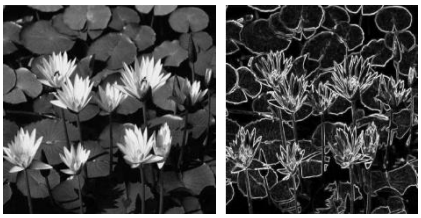
ABSTRACT
Digital watermarking is a way of authentication of multimedia objects i.e., videos, images and texts too. Watermarking functions are used not only for authentication, but also protects the data against nasty intent. In this paper the author uses the watermarking function which is purely based on the discrete cosine transform (DCT). Here the image, which is to be watermarked in the original image, is obtained from the edges of the original image using edge detection technique. On adjusting the frequency of spatial domain of the corresponding pixel in the image, the watermark image is concealed. The experimental results be evidence for this kind of the method and makes result strong robust. Here this method is bound to image only.

KEYWORDS
Watermarking, DCT, Edge detection.

1. INTRODUCTION
The swift development of the Internet in the present years has increased the accessibility of digital data such as audio, images and videos. This enhances the problem of protecting multimedia data. Digital watermarking is a procedure under which one can hide the important messages in digital video, digital audio, image and documents. Digital watermarking can be a form of steganography [1], in which image is hidden without the end user's knowledge.
Edge Detection method includes the detection of edges from image uses the edge detection algorithm. The edge detection methods mainly are Robert [2], Sobel [3][4], Prewitt[5], and Canny[6]. Here the author uses the Sobel Approach. In this approach the gradient is calculated for all pixel arrangement in the image and as a result, edge is returned for maximum gradient.
The paper is organized in the next sections. Section II shows the edge detection process & Section III describes the different digital watermarking techniques based on DCT (Discrete Cosine Transform). Section IV gives the de-watermarking process. In Section V, the author describes the experimental result and analysis. At last the whole work is concluded which includes the future work.

2. EDGE DETECTION
Edge detection is a major area in the subject of Image processing. Area of research on Edge Detection has history of more than 35 years. It defines the in between boundaries of an image that may helps in segmentation. The detection of edges in an image mainly depends on intensity, blur, illumination, objects, noise. This method mainly deals with the considerable variations of a gray scale image. There are many methods of detecting edges; the majority of different methods may be grouped into these two categories [8]:

Gradient: In the gradient method, edges are detected by searching the maximum and minimum in the first derivative of the image. For example Roberts, Prewitt, Sobel have very sharp edges. (See Fig 1)



Input Image Output Image

Fig. 1. **The Gradient Method**

Laplacian: This method includes the searching of zero crossings in the second derivative; to find edges in an image, e.g. Marr-Hildreth, Laplacian of Gaussian etc.In this derivative calculation highlights its location in an image (see Fig 2).

Input Image Output Image

Fig. 2. **The Laplacian Method**

In Sobel method, it uses the two mask i.e., horizontal mask and vertical mask. These masks are generally 3×3 matrix. Firstly the Sobel mask for x-direction is find out and then for y-direction. Finally the Gradient is carried out using both i.e., horizontal as well as vertical mask. The formula for calculating gradient using the mask is given below:
B(i,j)=abs(Gx)+abs(Gy);
B(i,j)=sqrt(Gx.^2+Gy.^2);

3. WATERMARKING PROCESS
A technique through which digital information is inserts into different digital information without altering the original information content [9]. The inserted watermark in an image not to be supposed degrades the perception of an original image in terms of visibility.

Characteristics of watermark should be [10]:
A visible watermark should be in both colored image format as well as in monochromatic images format.

- The watermark should be broadening in a huge area of the image to avoid its deletion by clipping.
- The watermark should be visible and must not hide any detail of the image.
- The watermarked image must be very difficult to remove.
- Removal of watermark should be costly as compare to the purchasing the image from the owner.

Watermarking is applied in following ways:

- Spatial domain: In this method the value pixel intensity is modified.
- Frequency domain: In this method the image is transformed into discreet a coefficient that helps to insert the watermark.

In this process, original image has RGB color intensities, therefore the image are to be converted into the gray scale image.
After successful conversion into the gray image, the edge detection method is applied on gray scale image for finding the edges of the original image. In simple words, the image which is to watermark is obtained from Sobel Edge Detection Method as discussed in above section. The resultant image which contain the edges of the original image is used for the watermarking, i.e., inserts the watermark in original image.
Now, the obtained gray image is divided in 8×8 block size and at the same time the obtained watermark image (edge of original image) is stored in an array.
On applying the DCT function on each block of 8×8 block image size. The gray color image intensity are arranged in a descending order in a diagonally way, i.e., high intensity were at top left corner and low at bottom right corner. In this way, the DCT function is applied on the whole image and thus set the intensities value in descending order for whole image.
Now, the key step is the placement of the bit position of an array into the DCT block with a unique function for each position of an array. The coding uses the concept of modulas function. This function simply states that, taking modulas of the array position with the block size (in our case, the block size is equal to 8).

4. DE-WATERMARKING

It should be noted that the reason why digital watermarking is possible is that human vision system (HVS) is not perfect. Digital watermark utilizes the limitation of HVS to make it invisible. In de-watermarking process, the reverse of watermarking is applied to get the original source image and the watermark image. In de-watermarking process, the IDCT (Inverse DCT) process is used.

5. ALGORITHM STEPS

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5.1 Sobel Edge Detection Algorithm

1. Load an input image.
2. Conversion of input color image to gray scale image.
3. Detection of horizontal and vertical mask such as x-direction and y-direction.
4. Gradient calculation of input image using above calculated mask.
5. Edge is detected, based on the threshold value and the gradient of an input image.

5.2 Watermarking Algorithm:

1. Load image captured by camera.
2. Convert the captured RGB image into the Grayscale image.
3. Find the number of rows (iR) and the number of column (iC) for the gray scale image.
4. Applying the Sobel Edge Detection Algorithm to the resultant grayscale image to get edged image which is to be watermark.
5. Calculate the maximum size of array (iR + iC) that stores the intensity values of the grayscale image.
6. Divide the grayscale image into 8×8 block.
7. Now the edged image is stored in array block which holds the gray color intensities.
8. Applying the MOD function to the array position versus block size.

5.2.1 MOD function (MOD[p,s])

In this function two entities are used. Where p is position of element of array and s is size of block.
pMOD(s) = Position of Array 'MOD' Size of Block
If the block is (8×8) and position of element of array may be 0, 1, 2, 3, 4, 5, 6, 7…n-1, n
Where n is maximum size of array.
0 MOD 8 = 0;
1 MOD 8 = 1;
2 MOD 8 = 2;
3 MOD 8 = 3;
4 MOD 8 = 4;
5 MOD 8 = 5;
6 MOD 8 = 6;
7 MOD 8 = 7;
This result provides the much more security as in the previous function the coding is designed only for 0 and 1 gray scale intensity.

5.3 De-Watermarking Algorithm

De watermarking algorithm is the reverse process of the watermarking scheme as described above. In the process of De-watermarking, the corresponding bit position is stored in array in same manner for getting the original edged image. As watermarked image consist the block intensity values that helps to regain the original image with the pixel intensity block values.

6. PSNR CALCULATION

The masking of the watermark is quantitatively analyses by using Peak Signal to Noise Ratio (PSNR). This Peak Signal to Noise (PSNR) is defined as [11]:

$$PSNR = 10log_{10}\frac{A^2}{\frac{1}{N\times M}\sum_{i=1}^{N}\sum_{j=1}^{M}[f(i,\ j)-f'(i,\ j)]^2}$$

Its unit is db. And the bigger value of the PSNR, the better result of the watermark shows.
Using the above formula, PSNR values are calculated of the sample images, as shown in Table II below. The PSNR value

depicts the quality of the sample image. Better PSNR value means better watermark image.

7. SIMULATION EXPERIMENT

For checking the performance of the above algorithm, the experiments are simulated with the MATLAB software. The experiments follow the conversion of original image into gray scale image which is used as host image to insert watermark. Same edged image is used as a watermark image. The input image is decomposed into the number of blocks and for each pixel block a separate coding is designed, which is shown below in next section.

The figure given below shows that how an input image is to be converted into invisible watermark image. This includes the conversion of original image into gray-scale image and edged image and also focuses that how the final watermarked image contain the edges of the same.

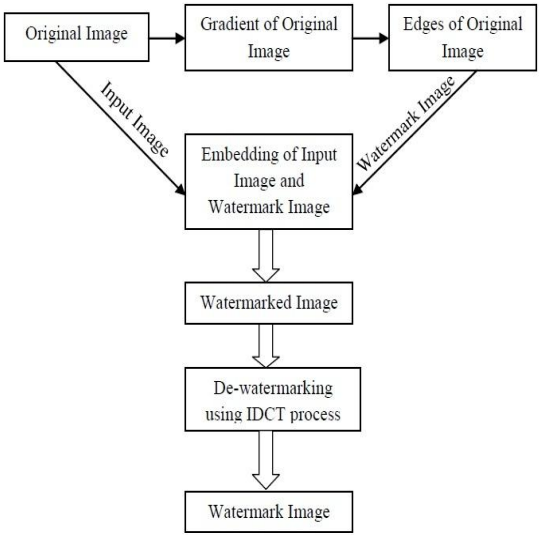

Figure 3: General diagram of the watermarking proposed scheme.

8. EXPERIMENTAL ANALYSIS

Following Table I show the arranged block intensities values of pixel values based on MOD values as already calculated.

TABLE I: MOD and Block Intensities Value

pMOD(s)	Block intensities swapping
0	The intensity value of the block (4, 6) must be less then intensity value of the block (4, 5), otherwise the pixel block intensities were interchanged.
1	The intensity value of the block (4, 7) must be less then intensity value of the block (4, 6); otherwise the pixel block intensities were interchanged.
2	The intensity value of the block (5, 1) must be less then intensity value of the block (4, 1); otherwise the pixel block intensities were interchanged.
3	The intensity value of the block (5, 2) must be less then intensity value of the block (4, 2); otherwise the pixel block intensities were interchanged.
4	The intensity value of the block (5, 3) must be less then intensity value of the block (4, 3); otherwise the pixel block intensities were interchanged.
5	The intensity value of the block (5, 4) must be less then intensity value of the block (4, 4); otherwise the pixel block intensities were interchanged.
6	The intensity value of the block (5, 6) must be less then intensity value of the block (4, 6); otherwise the pixel block intensities were interchanged.
7	The intensity value of the block (5, 7) must be less then intensity value of the block (4, 7); otherwise the pixel block intensities were interchanged.

9. EXPERIMENTAL RESULT

To compare the analytical results, we have performed experiments with the test images shown in Fig.3. The below figure depicts the flowchart of the algorithm. In the experiment, watermark has been embedded in the original image with accordance with the mod values of corresponding block pixel. This flow chart shows how the input image is taken and converted into in gray scale image. Now from the gray-scale image gradient is calculated that helps to find edges of the input image. Now edged image is inserted into the original image to get watermarked image. Now in next step, De-watermarking process is applied to get edged image or watermark image.

In Table II, the PSNR values are compared of the input image, edged image, and watermarked image

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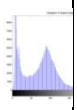
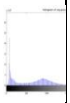
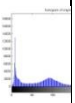
TABLE II: Comparison of Various Sample Images

Type of image	Sample	Histogram	Gaussian Blur Image	Add Spackle Noise with variance 0.08	MSE	PSNR Comparison
Original Image					104619.7	2.03

Gray Scale Image					10431.11	7.98
Gradient Image					10431.11	7.98
Edge Image					63462.57	0.14
Waterma rked Image					1273.97	17.11
Recover Waterma rk Image					1274.44	17.11

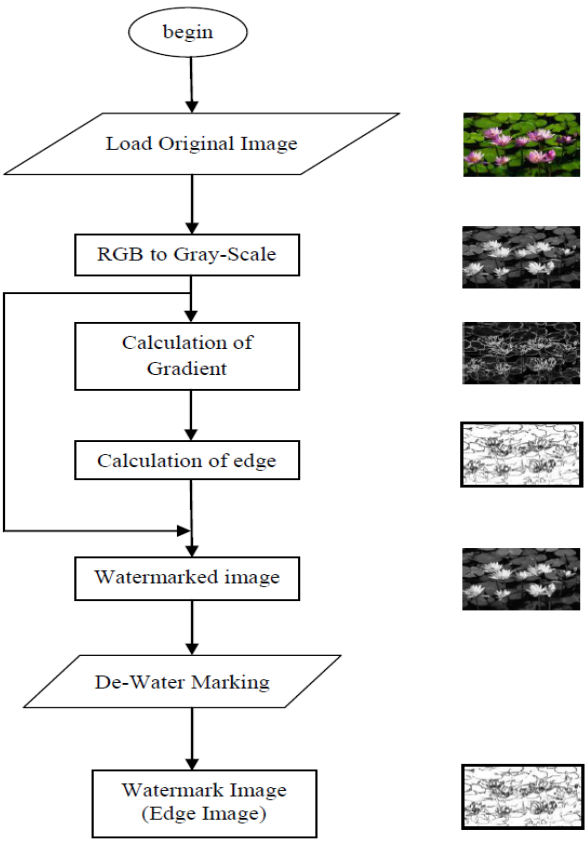


Figure 4: Flowchart of the proposed watermarking scheme

10. CONCLUSION

This paper introduces a watermarking algorithm based on the pixel block intensities values. Block intensities values are adjusted in such a way so that, it conceal the original watermark image. Finally using the IDCT function, the watermarked image is converted into the original watermark image. The simulation results shows that this watermarking scheme keep the image quality well and also healthy against many common image processing operations. This algorithm makes the embedded watermark invisible by nature.

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