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Still Images Watermarking Signature

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Abstract

This paper presents a watermarking method using signatures for still images. An image authentication approach is requested to guarantee reliability of conveyed image data. To protect copyright, watermarking with digital signature is required. The watermarking method is a tool for ownership identification or content honesty information. The conventional watermarking methods are not directly applicable. To alleviate this issue, we propose a new watermarking method which uses signature and Sobel mask. We apply Sobel mask to classify image into two regions: edge and smooth regions. Pre-generated diagonal and anti-diagonal shape patterns are applied to generate specific signature for watermarking. Performance assessment is conducted in simulation results section. Watermarking signatures are embedded in the test images, and three metrics were applied to assess the performance.

Keywords: *Watermarking, signature, color image, authentication, pattern*

1. Introduction

Watermarking is generally used to protect image contents [1]. The watermarking is a favorable act which is able to defend the patent of image data through transmitting [2, 3]. Thus, copyright protection is one of reasonable expectations of watermarking applications [4]. In addition, digital watermarking is a tool of hiding a message concerning to a signal within an image [5, 6]. The goal of watermarking is to add and hide specific information, so as the contents owner may retrieve it from transmitted image when it is necessary [7-9].

In this paper, we propose a new watermarking method which efficiently hides watermarking information in lower bit plane. We apply Sobel mask to obtain edge image of signature. The diagonal and anti-diagonal patterns are drawn in edge and non-edge (smooth) regions. Section 2 presents a proposed technique. Experimental results are provided in Section 3. Performance assessment on watermarked images with embedded signatures is displayed in this section. Conclusion remarks are provided in Section 4.

2. Proposed method

The proposed watermarking method consists of three stages (Figure 1). The watermarking generation stage is explained in Figure 2. Bit plane decomposition stage separates 24 bit image into 3 color and 8 bit planes. The bit plane of a digital image is a set of bits corresponding to a provided bit position in each of the binary numbers implying the image. Among each bit plane, we substitute watermarking signal with c_0 (0^{th} bit plane). Watermarking image stage sends image data to transmitter or CODEC.

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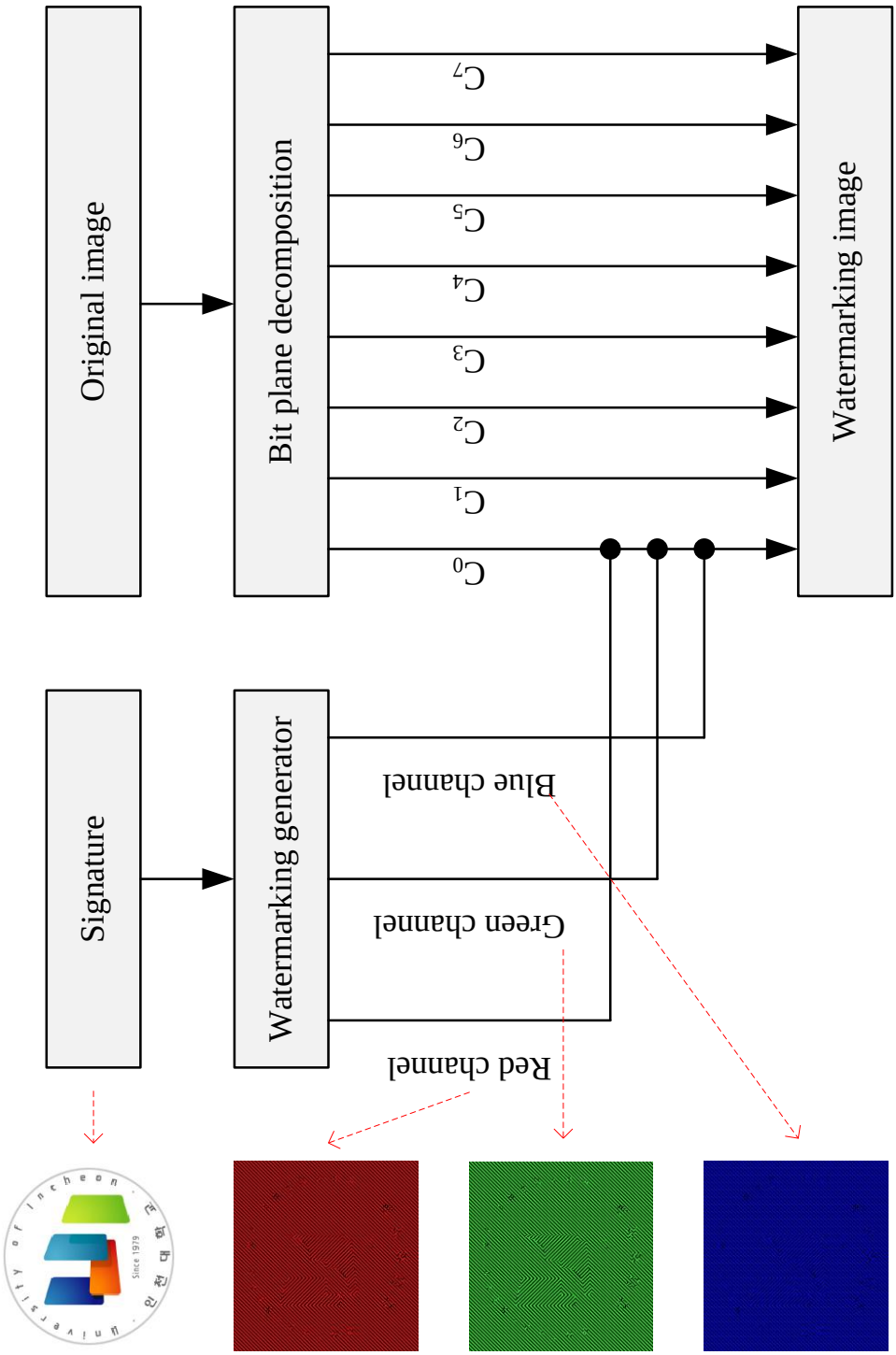


Figure 1. Flowchart of the Proposed Method

Figure 2 shows the watermarking signature generation stage. First of all, signature image is obtained. Signature image can be either color or gray image. We use Sobel masking process to classify images into edge and non-edge region. Once a region is determined as edge region, we reflect anti-diagonal shape into the watermarking signal. On the other hand, when the

region is determined as background region, then diagonal shape pattern is copied into the watermarking region. Finally, these two images are added up and sent to original image to generate watermarked image. Note that the generated watermarking symbol is replaced with c_0.

Figure 3 shows an example of the proposed watermarking images. Figure 3(a) is the original symbol and Figure 3(b) is the result watermarking image obtained from Figure 2. Figures 3(c-e) show the watermarking image on each color channels. As we can see, the edge region is with anti-diagonal shape patterns, while the non-edge region is with diagonal shape patterns.

After receiving watermarking images, one can evaluate if these images are copyright protected. Figure 4 shows the image authentication process. Higher similarity result implies higher chance of watermarking protection.

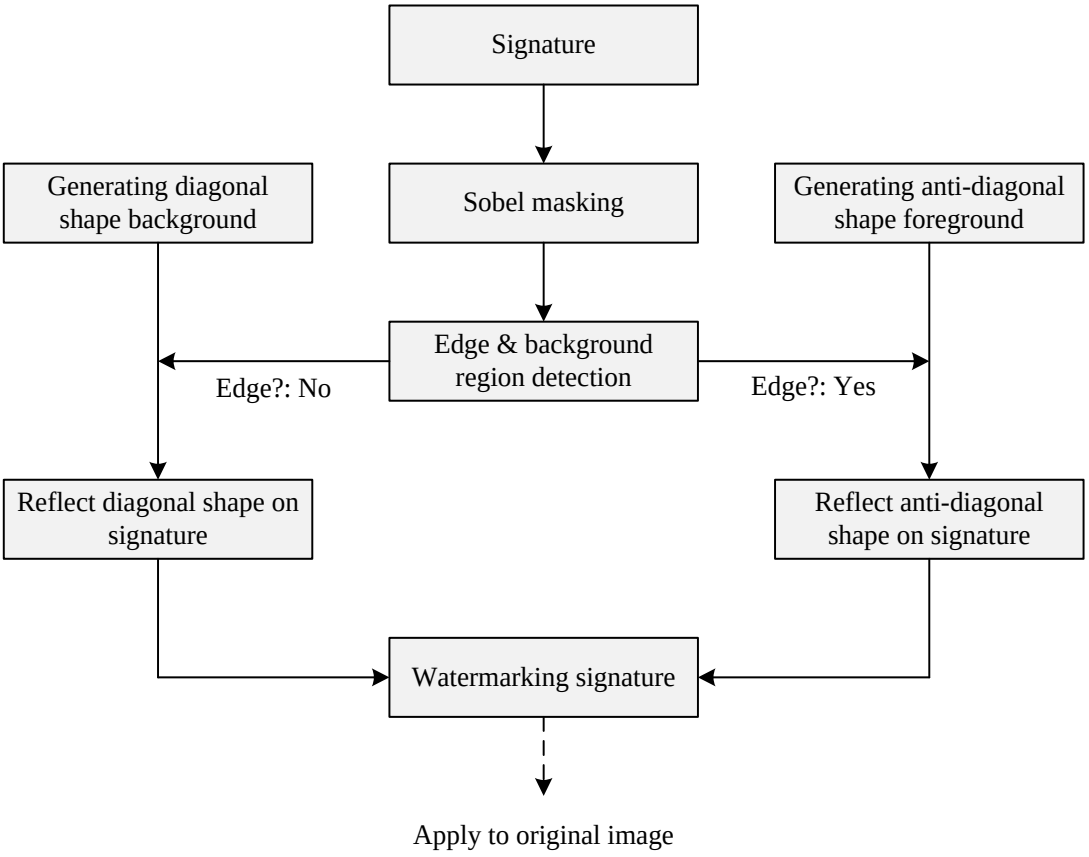
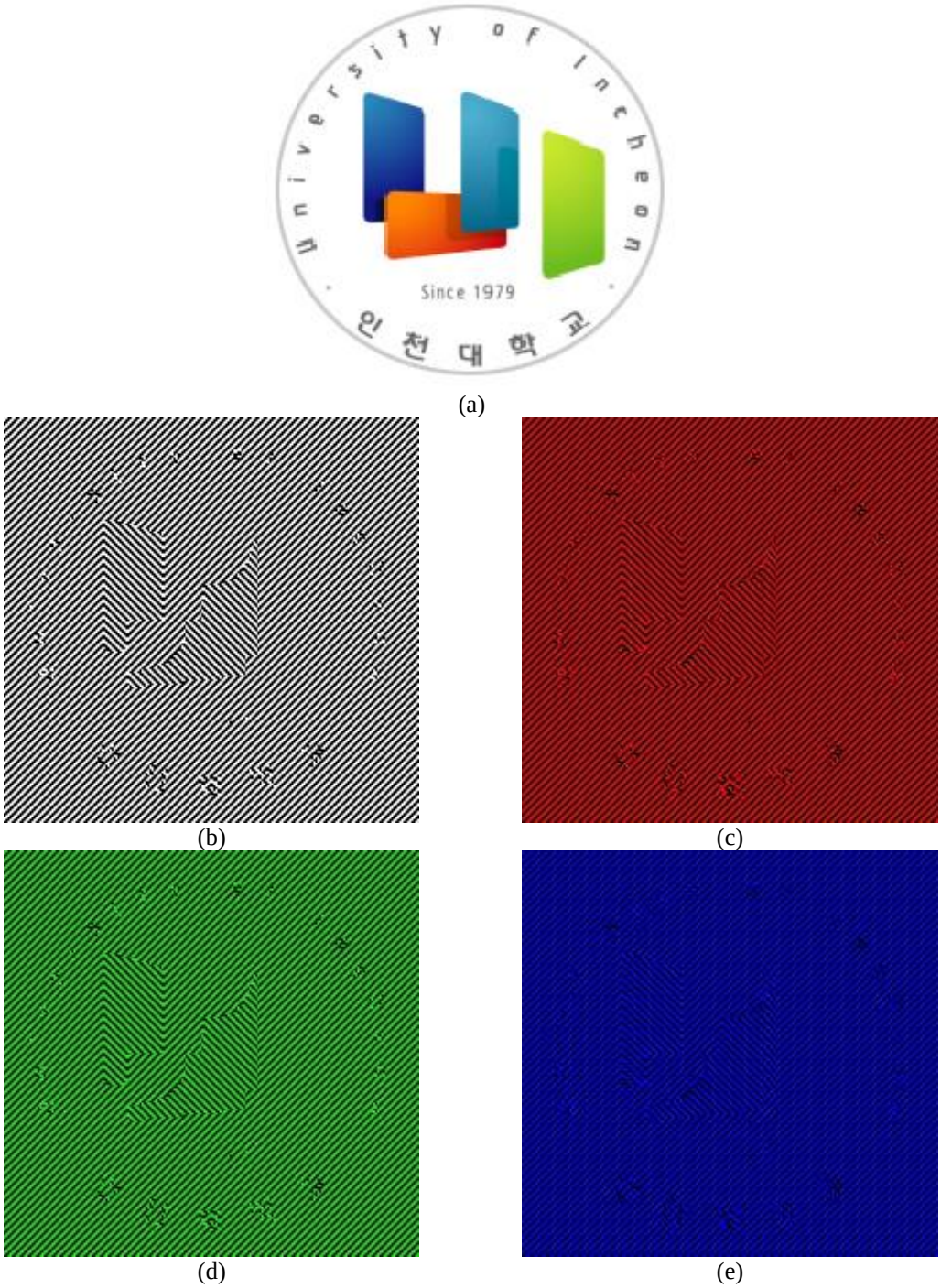


Figure 2. Watermarking Signature Generation



(a) (b) (c) (d) (e)

Figure 3. Examples of the Proposed Watermarking Signature: (a) Original Image, (b) Watermarking Image, (c) Red Channel Watermarking Image, (d) Green Channel Watermarking Image and (e) Blue Channel Watermarking Image

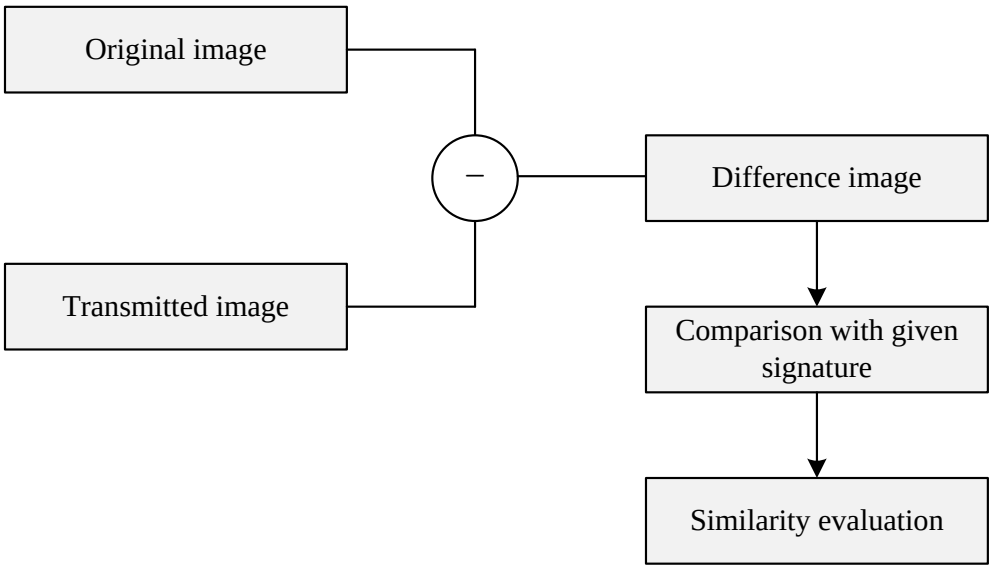


Figure 4. Watermarked Image Authentication

3. Experimental Results

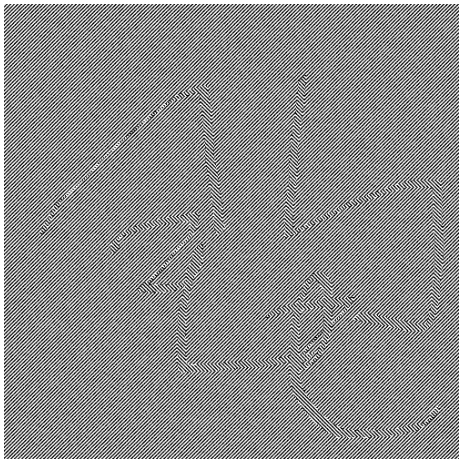
The test is conducted on seven McM images (#1, #2, #3, #7, #8, #17, and #18). The size of all images is width×height =500×500. Figure 5 shows 18 images of McM dataset.

Figure 5. Test Images: McM Dataset

To test our proposed method, we generated one signature for watermarking. Figure 6(a) shows the provided test watermarking signature and Figure 6(b) shows its corresponding watermarking symbol. Figure 6(c) shows watermarking reconstructed image. The image quality of Figure 6(c) is worse than the original watermarking symbol (Figure 6[b]), however one can possibly identify it.

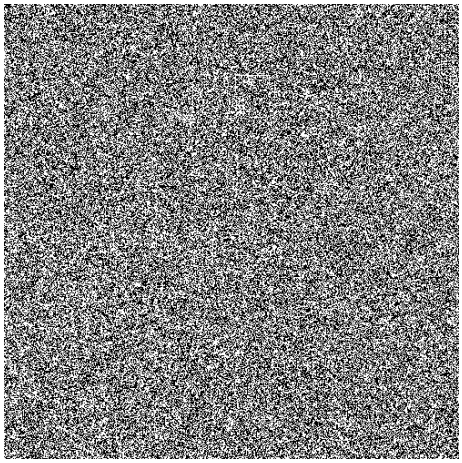
(a)

(b)

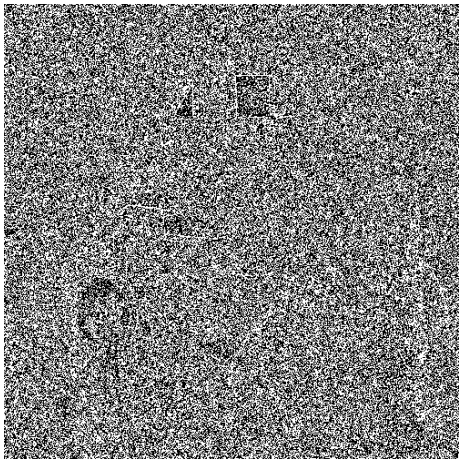


(c)

Figure 6. (a) Given Signature for Watermarking, (b) Produced Watermarking Symbol for Bit Plane 0 and (c) Watermarking Reconstructed Image



(a)



(b)

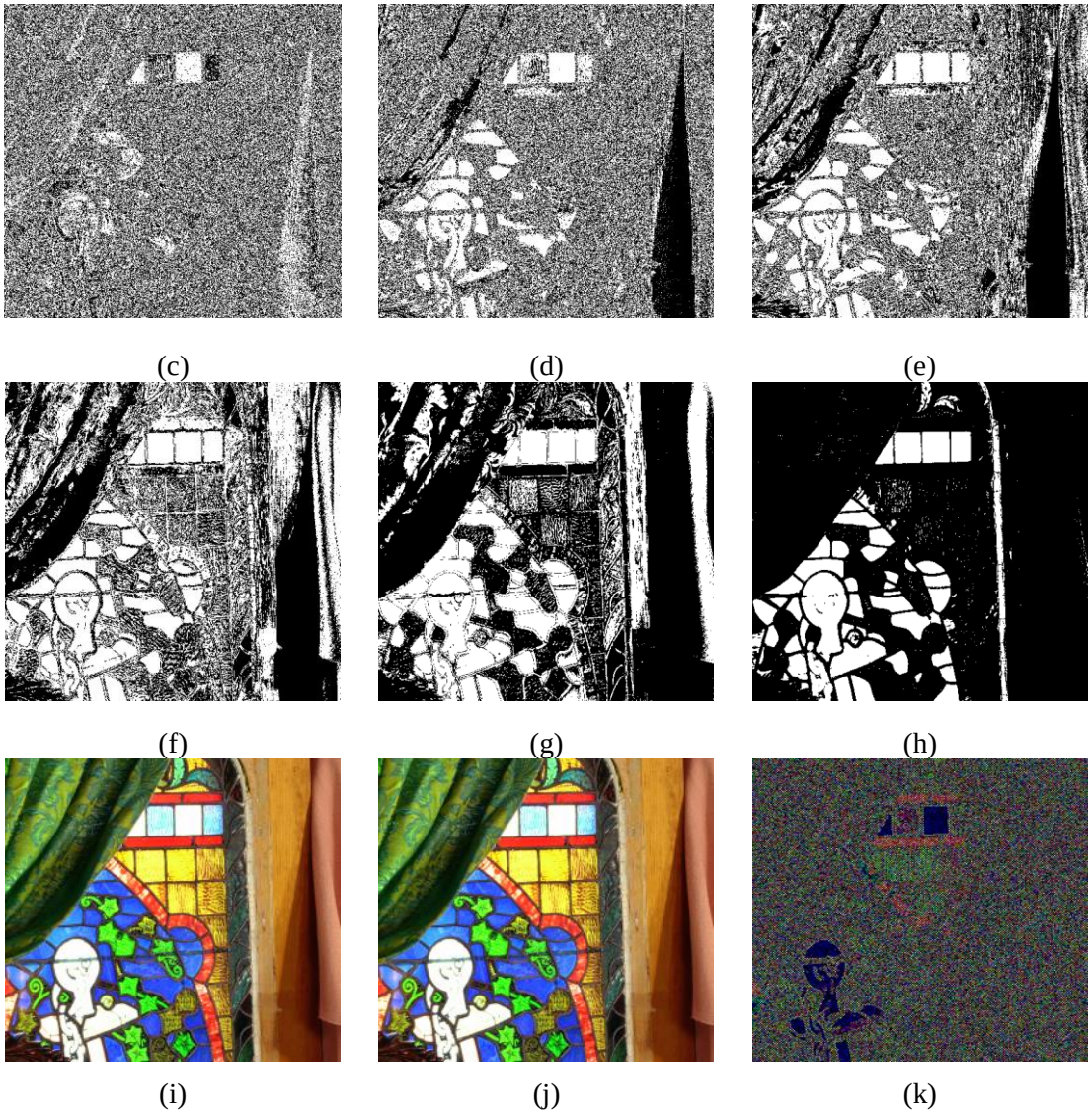
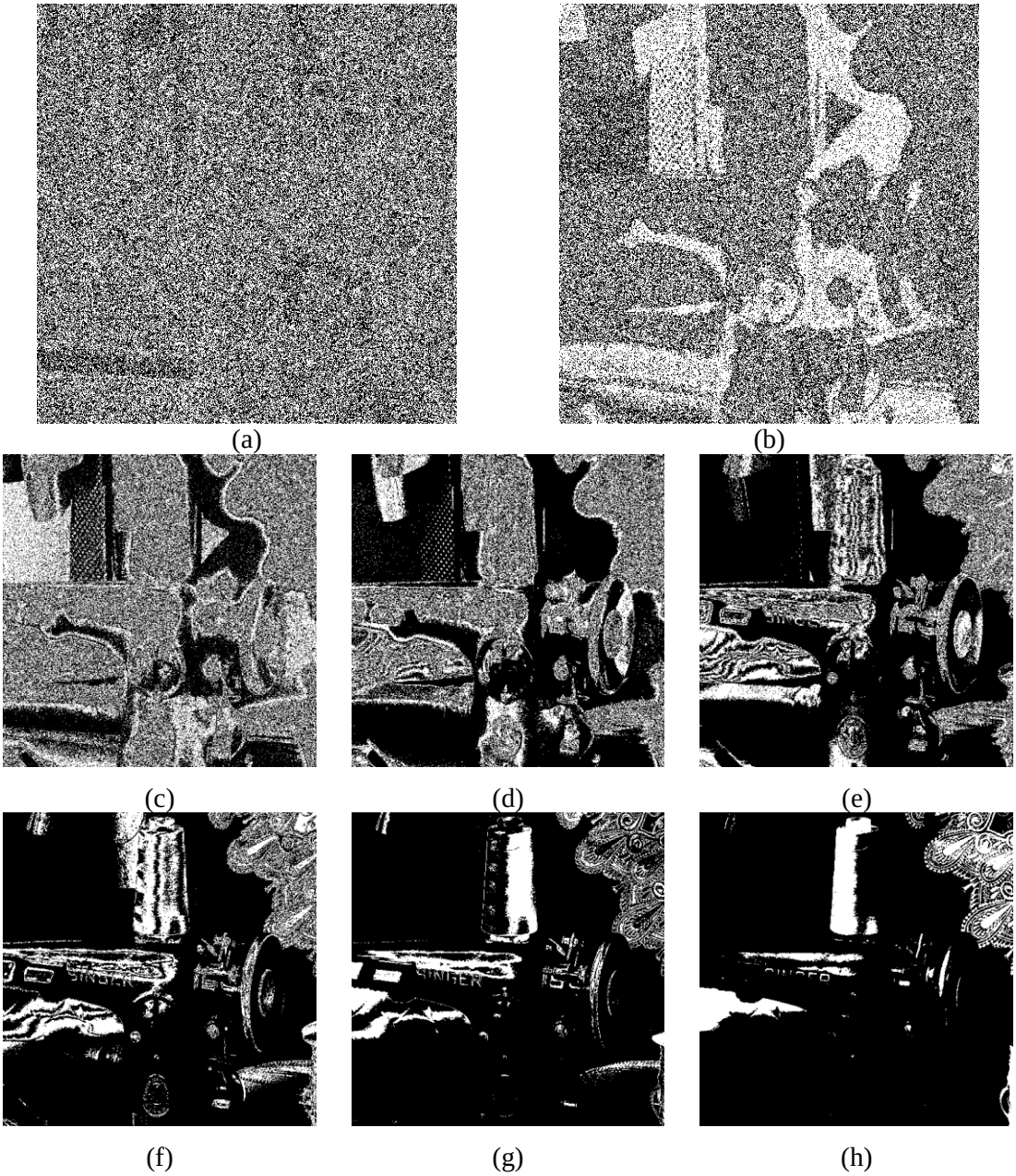


Figure 7. Decomposed Bit Planes: (a) c_0, (b) c_1, (c) c_2, (d) c_3, (e) c_4, (f) c_5, (g) c_6, (h) c_7, (i) Original #1 Image, (j) Watermarked Image and (k) Difference between Original and Watermarking Images

Table 1. MSE Performance Comparison

Image #	Red	Green	Blue	Color
1	15.0693	0.2627	71.0155	28.7825
2	594.6689	4.9658	82.0217	227.2188
3	1016.5275	305.4138	1354.5839	892.1751
7	1314.2023	4.7280	198.8955	505.9420
8	7418.9154	24.7414	677.6121	2707.0897
17	1.3185	0.0020	77.5309	26.2838
18	124.6506	2.1041	7.6306	44.7951
Average	1497.9075	48.8883	352.7558	633.1838

Figures 7(a-h) ad 8(a-h) show decomposed bit plane images. There are 8 bit planes because the original gray image (each color channel) uses eight bits per pixel. Figures 7(i) and 8(i) are original #1 and #8 images and Figures 7(j) and 8(j) are their corresponding watermarking images. Figures 7(k) and 8(k) are difference between original and watermarking images.



(a) (b)

(c) (d) (e)

(f) (g) (h)

(i) (j) (k)

Figure 8. Decomposed Bit Planes: (a) c_0, (b) c_1, (c) c_2, (d) c_3, (e) c_4, (f) c_5, (g) c_6, (h) c_7, (i) Original #8 Image, (j) Watermarked Image and (k) Difference between Original and Watermarking Images

Tables 1-3 display MSE, PSNR, and FSIM results.

Table 2. PSNR Performance Comparison (dB)

Image #	Red	Green	Blue	Color
1	36.34987	53.93604	29.61727	33.53952
2	20.38805	41.17093	28.99152	24.56636
3	18.05961	23.28192	16.81274	18.6263
7	16.94418	41.38402	25.14455	21.0898
8	9.4274	34.19655	19.82099	13.80578
17	46.93009	75.18724	29.23605	33.93392
18	27.17386	44.90017	39.3052	31.6185
Average	25.0390	44.8653	26.9898	25.3115

Table 3. FSIM Performance Comparison

Image #	FSIM	$FSIM_C$
1	0.952720	0.952029
2	0.945630	0.943095
3	0.966219	0.963664
7	0.934648	0.928139
8	0.699094	0.668576
17	0.970764	0.970477
18	0.928179	0.927808
Average	0.913894	0.907684

4. Conclusions

Ownership verification is an important which is to assure reliability of transferred image data. In this paper, we presented a new watermarking approach that utilizes Sobel mask based signature. The Sobel was used to classify given image into two areas: edge and non-edge areas. We have two patterns for watermarking symbol, and each pattern is given to

corresponding area. Objective and subjective performance evaluation is carried out in experimental results.

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