A Novel Dual Image-based High Payload Reversible Hiding Technique Using LSB Matching

Yu-Lun Wang[1], Jau-Ji Shen[1] and Min-Shiang Hwang[2,3]

(Corresponding author: Min-Shiang Hwang)

Department of Management Information Systems, National Chung Hsing University[1]

145 Xingda Rd., South Dist., Taichung City 402, Taiwan

Department of Computer Science and Information Engineering, Asia University[2]

No. 500, Lioufeng Raod, Wufeng Shiang, Taichung 41354, Taiwan, R.O.C.

Department of Medical Research, China Medical University Hospital, China Medical University[3]

No.91, Hsueh-Shih Road, Taichung 40402, Taiwan

(Email: mshwang@asia.edu.tw)

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Abstract

A dual image technique has already become more and more popular because of easily achieving higher capacity and lower distortion. Dual image copy into two images depends on both images to correctly recover the original images. This paper proposed a novel reversible data hiding to hide the secret information into the least significant bits. The experiment result shows that our proposed method is effective and with high payload.

Keywords: Data Hiding; LSB Matching; High Payload

1 Introduction

With the advance of the technology, the speed of the internet becomes faster and faster, and multimedia spreads more easily [2, 13]. Traditional, if we want to send an important message to the receiver, we can encrypt the message into ciphertext; and then the receiver can decrypt the ciphertext by using the key [11, 12, 15, 21]. Nowadays, the copyright of the image become more and more important, and through hiding data in the image we can prove the ownership of the image [22].

Data hiding has two categories, reversible data hiding [17, 18, 20] and non-reversible data hiding [1]. Non-reversible data hiding usually has higher capacity and less distortion because it don't need the recover mechanism [25]. In some case we need reversible data hiding mechanism such as binary images [26]. In some case we need reversible data hiding mechanism such as medical images [5–8, 10, 14]. We can hide the diagnosis of the patient into the X-ray image. However, a little bit of the distortion of the image may cause a diagnostic error, so correctly recovering the original image is necessary. Therefore, hiding information in the image is a popular field of data security. In this field, we pursue higher capacity and less distortion after embedding the secret information.

There are many data hiding schemes which are based on the pixel value differencing method [16, 19] and based on SMVQ [3, 4]. In 2018, Wang *et al.* introduced a survey of reversible data hiding for VQ-compressed images [24]. In 2016, Jana proposed a dual image based reversible data hiding scheme using weighted matrix [9]. In 2015, Lu *et al.* proposed dual imaging-based reversible hiding technique using LSB matching [17]. They select two pixels as a pair (block) and choose the same images to embed. In 2017, Wang *et al.* proposed an improved scheme of Lu *et al*'s scheme to increase the capacity [23]. In this paper, we will propose an improvement of Wang *et al.*'s scheme to increase the capacity and PSNR.

This paper will be described as follow. Section 2 will introduce the proposed method. Section 3 will show our experiment result and analysis of the proposed scheme. Finally, Section 4 will make a conclusion of this paper.

2 The Proposed Scheme

In our proposed scheme, we first copy the cover image into two copies, and use both copies to embed the secret bits. Then in the first image, we transform the value of the pixel into binary pattern and change its LSB (1) and LSB (2) into the secret bits. In the second image, we do the same work like the first image and change its LSB (3) into secret bits. Figure 1 shows the embedding phase in our proposed scheme.

In the extraction and recover phase, we can easily ex-

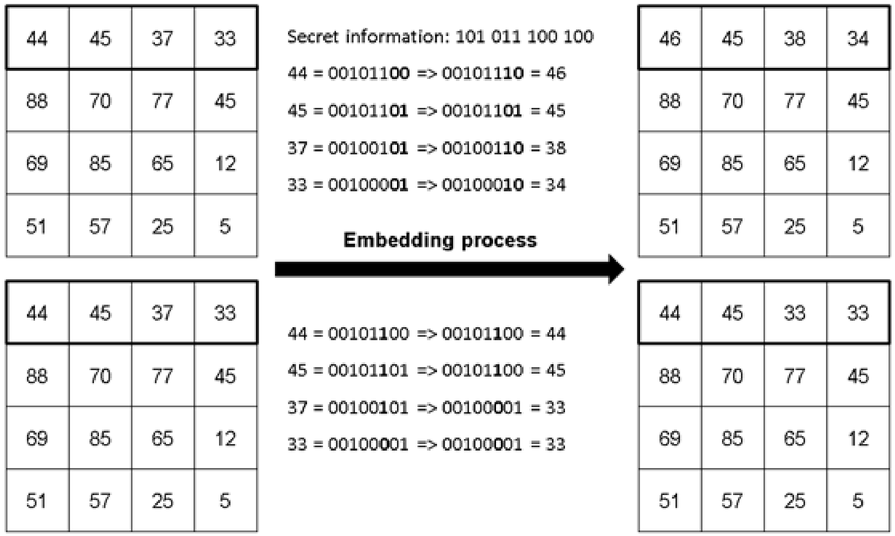

Figure 1: The embedding phase example of our proposed scheme

tract the secret bits by the rule of embedding phase. We can extract the LSB (1) and LSB (2) in the first image and LSB (3) in the second image. Then we can use the LSB (3) of the first image and the LSB (1) and LSB (2) of the second image to correctly recover the original image. Figure 2 shows the extraction and recover phase in our proposed scheme.

3 Analysis and Experiments

There are two criteria in data hiding area, quality and capacity. We use a peak signal-to-noise ratio (PSNR) to quantify image quality as follows:

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{(} j=0)^{(}n-1)[P_{(i,j)} - X_{(i,j)}]^2$$

$$PSNR = 10 \times \log_1 0[\frac{255^2}{MSE}].$$

Here, m and n are the images sizes, P is the original image, and X is the image after embedding. The size of the images is 512×512, and the secret information we assume is all of 1. The results in Table 1 show that the capacity of the proposed method is high payload and less distortion.

Through the Table 1 we can make sure that our proposed scheme have very high capacity and acceptable distortion. Chang *et al.*'s scheme [1] is an irreversible scheme and Lu *et al.*'s scheme [17] is a reversible scheme.

4 Conclusion

We propose a high payload data hiding scheme with less distortion. The embedding phase, extraction and recover phase are very easy and effective. Nevertheless, the experiment also shows that our method have an acceptable distortion results and higher capacity. The capacity of this method can be stable at 1.5 bpp.

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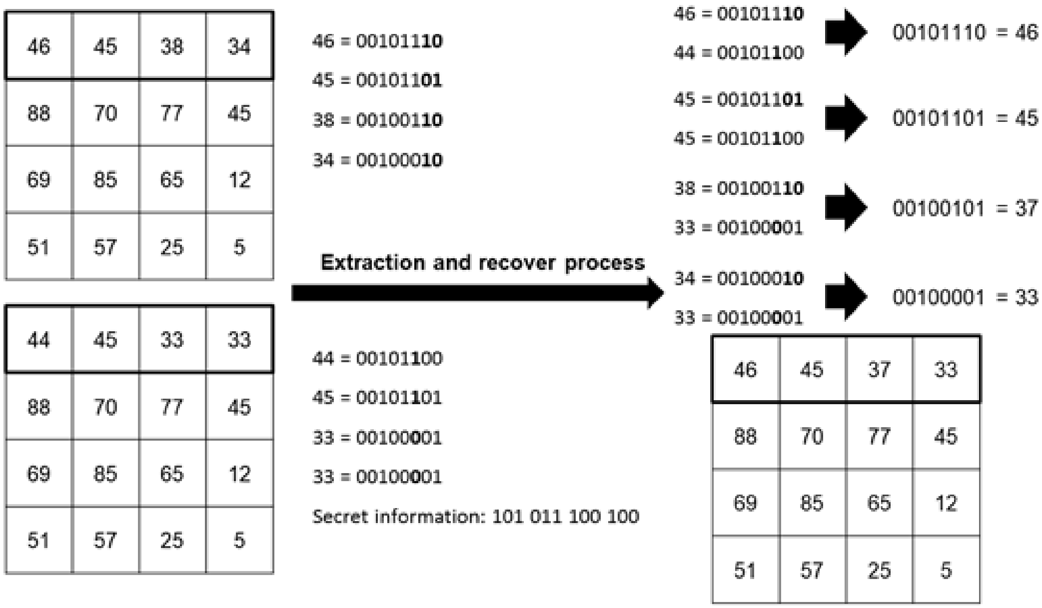

Figure 2: The extraction and recover phase of our proposed scheme

Table 1: The image and total hidden capacity comparison table

Schemes	PSNR/Capacity	Lena	Peppers	Mandrill	Boat	Goldhill
The Proposed Scheme	PSNR (1)	42.70	42.70	42.70	42.77	42.71
	PSNR (2)	38.09	39.15	39.11	39.04	39.01
	Capacity	786432	786432	786432	786432	786432
Chang *et al.*'s Scheme [1]	PSNR (1)	39.89	39.94	39.91	39.89	39.90
	PSNR (2)	39.89	39.94	39.91	39.89	39.90
	Capacity	802895	799684	802524	802716	802698
Lu *et al.*'s Scheme [17]	PSNR (1)	49.13	49.11	47.95	49.00	49.17
	PSNR (2)	49.12	49.08	49.15	49.07	49.09
	Capacity	524288	524192	522996	524208	524288
Wang *et al.*'s Scheme [23]	PSNR (1)	40.97	40.99	40.94	40.96	40.98
	PSNR (2)	41.30	41.23	41.34	41.56	41.24
	Capacity	617088	608877	618977	632797	613288

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Biography

Yu-Lun Wang received his B.S. degree in information management from Fu Jen Catholic University in 2014 and M.S. degree in Management Information Systems from National Chung Hsing University in 2016. His research interests include steganography and digital image.

Jau-Ji Shen received his Ph.D. degree from National Taiwan University in 1988. His research interests include digital image, software engineering, information security, and data base technique. His work experiences include the Director of National Formosa University Library and the Associate Dean of Management School in Chaoyang University of Technology. Now, he is a professor in the Department of Management Information Systems, National Chung Hsing University.

Min-Shiang Hwang received the Ph.D. degree in computer and information science from the National Chiao Tung University, Taiwan in 1995. Dr. Hwang was the Chairman of the Department of Information Management, Chaoyang University of Technology (CYUT), Taiwan, during 1999-2003. He was a distinguished professor and Chairman of the Department of Management Information Systems, NCHU, during 2003-2011. He obtained the 1997, 1998, 1999, 2000, and 2001 Excellent Research Award of National Science Council (Taiwan). His current research interests include information security, cryptography, image compression, and mobile computing. Dr. Hwang has published over 200+ articles on the above research fields in international journals.