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Hybrid Stegnography using ImagesVaried PVD+ LSB Detection Program

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Abstract:-Image Stegnography can be achieved by two techniques i.e LSB and PVD. In LSB technique it provide high capacity and good quality but it can be detected very easily by human eye. In other technique PVD, it usually provide less capacity and higher distortion but it can not detected by human eye. So, in this paper I combine the advantages of both the technique and with this I get with the result of higher capacity , low distortion and secrete data will not be detected very easily by human eye.

Keywords:-
Least Significant Bit ; Pixel-value differencing ; PSNR ; Stegnography ; Detection Analysis

I. Introduction

Steganography means 'covert writing'. It embeds secret data into digital media such as images, texts, and audio. The purpose of steganography is to prevent malicious plunders from the existence of secret data hidden in the stego-image . The embedding capacity and the quality of the stego-image are two main goals for the techniques of steganography. The qualities of the stego images are usually evaluated by the peak signal-to-noise ratio (PSNR). One of well-known steganographic techniques is least significant- bit (LSB) substitution, which replaces the least significant bits of the cover image with secret bits LSB approaches usually receive a considerably high capacity and remain a good quality. Because the simple LSB substitution method degrades the stego-image significantly when a large data are embedded, some methods have been proposed to improve the simple LSB substitution method proposed a LSB substitution scheme based on the secret data transformation to improve the PSNR values of the stego-images and they proposed a genetic algorithm to find an approximate solution in this scheme. For searching an optimal solution exactly and efficiently, dynamic programming strategy[2] and matching approach[1] are one of the method available with us. To improve the quality of the stego-image more efficiently, most significant- bits (MSBs) are modified in some of LSB approaches . Moreover, to consider the characteristic of the human visual system, the approaches with variable sizes of LSBs have been proposed. Although LSB approaches are efficient for the capacity and image quality, the existence of embedding data can be easily detected by the bit-plane analysis method or some detection programs. Therefore, some hiding approaches were based on the concept of human visual system and were different to the LSB approach proposed a "pixel-value differencing" steganographic [6] method that uses the difference value between two pixels in a block to determine how many secret bits should be embedded.

LSB +PVD approach, which combined the PVD method with the LSB method, for the purpose of improving the capacity and the PSNR value of the PVD method. In their LSB +PVD method, the PVD approach is applied if the 2-pixel blocks have larger differencing values and the LSB approach is applied if the 2-pixel blocks have smaller differencing values. In this paper, I look into the strategies of combining PVD and LSB replacement methods. In this paper, I emphasized that this method made the capacity and the PSNR value of the PVD method better than ever studies. However, I point out that LSB +PVD approach is too conformable to LSB approach. In my analysis, the blocks with smaller differencing values occupy the major part of a cover image. Therefore, most of the embedding operations belong to LSB approach. Also, according to their approach, smooth areas are embedded with more secret data than edged areas. This fact seems to be opposite to the concept of human visual system. I can show you that this results can be detected by the program of PVD .

The fact shown in my experimental results is that LSB replacement methods display both higher capacity and higher PSNR values than that of Wu et al.'s LSB +PVD approach. Does it mean that the LSB +PVD approach is not worth?I point out a concept to support the idea of the LSB +PVD approach. Because lots of detection methods are developed to attack one certain kind of hiding approaches, it is a good idea to develop hiding approaches which harmoniously combine multiple hiding strategies. Combining both PVD and LSB replacement methods maybe confuse the attacks of some detection programs. In this paper, the sophisticated skills are provided to significantly promote LSB +PVD approach. Also, a proof about the correctness of the general LSB +PVD method is provided. Experimental results show that our proposed LSB +PVD approach has better PSNR values and can get rid of the detection program.

II. Review of literature

It will explain about Pixel value differencing (PVD) and Least Significant Bit (LSB) technique.

A. Pixel value differencing

Pixel-value differencing of two pixels to embed secret data. The gray-valued host image[5] is partitioned into non-overlapping blocks of two consecutive pixels by running through all the rows of the host image in a zigzag manner. The block difference value di is calculated by |pi −pi+1|, where pi and pi+1 are two pixels in the block. All possible values of di (0–255) are considered and they are classified into a range table with n contiguous ranges, say Rk, where k=1, 2, 3, . . ., n. The width wk of Rk is uk −lk + 1, where uk is the upper bound of Rk and lk is the lower bound of Rk. The number of embedded bits is determined by the width of Ri, which di falls into, and is equal to [log2wi] . Let be the decimal value of embedded bits. Then, the embedding operation is to replace di with a new difference value d_i, where d_i = li + b. Finally, an inverse calculation of d_i is performed to yield the new gray values of the two pixels in the block.

Table 1 The distributions of difference values for various images.

Cover images (512 × 512)		Differencing ranges					
		0–7	8–15	16–31	32–63	64–127	128–255
Lena	Amounts	112,421	12,202	5091	1280	78	0
	Percents	85.77	9.31	3.88	0.98	0.06	0
Baboon	Amounts	55,151	28,449	24,468	17,285	5642	77
	Percents	42.08	21.70	18.67	13.19	4.30	0.06
Peppers	Amounts	111,329	13,533	4417	1444	343	6
	Percents	84.94	10.32	3.37	1.10	0.26	0.00
Jet	Amounts	109,901	11,208	6282	2622	968	1
	Percents	83.92	8.55	4.79	2.00	0.74	0.0

In the extracting phase, it is necessary to get the original range Table 1. The secret data are extracted from the blocks of the stego image in the same order as the embedding phase. The number of secret bits embedded in a two-pixel block is determined by the range Ri which the difference value between the two pixels belongs to. In addition, the value of the embedded data in the block is calculated by subtracting the lower bound of Ri from the difference value of the block. Therefore, the embedded bits in the block can be reconstructed.

B. LSB + PVD approach

It embeds data into smooth areas by the LSB method and edged areas by the PVD method. The range table is divided by a value Div into the lower-level (i.e. smooth areas) and the higher-level (i.e. edge areas). For example, let Div = 15, the lower-level contains R1 and R2, and the higher-level contains R3, R4, R5, and R6 as shown in Fig. 1. The gray-valued host image is partitioned into non-overlapping blocks of two consecutive pixels by running through all rows of the host image in a zigzag manner.

Table 2 The capacities and PSNRs of embedding random bit stream into various cover images by simple 3-bit LSB substitution method and 3-bit LSB +PVD method.

Cover image (512 × 512)	Simple 3-bit LSB		3-Bit LSB + PVD	
	Capacity (byte)	PSNR	Capacity (byte)	PSNR
Lena	98,304	37.92	96,871	37.69
Baboon	98,304	37.91	90,036	34.53
Peppers	98,304	37.92	97,020	37.52
Jet	98,304	37.95	96,405	37.28

The block difference value di is calculated from the two pixels, say pi and pi+1, by |pi – pi+1|. Let di fall into the range Ri. If Ri belongs to the lower-level, both pi and pi+1 are embedded using the simple 3-bit LSB substitution. Let p_i and p_i+1 be the embedded results of pi and pi+1, respectively. After secret data are embedded, if the new difference d_i is larger than Div (i.e. d_i ∈ higher-level), p_i and p_i+1 are re-adjusted by the following rule:

(p_i, p_i+1) = (p_i− 8, p_i+1+ 8), if p_i ≥ p_i+1

(p_i+ 8, p_i+1− 8), if p_i < p_i+1.

On the other hand, if Ri belongs to the higher-level, two pixels are embedded using PVD method. For example, assume pi = 64, pi+1 = 52, b = 111000(2), and Div = 15. Note, that the difference value d is |64−52| = 12, which belongs to lower-level. After embedding data by the 3-bit LSB substitution, we have p_i= 71 and p_i+1= 48. Because d_i= 71 − 48 = 23 > Div = 15,p_i and p_i+1 are re-adjusted by above Equation. After the re-adjust operation, we have p_i = 63, p_i+1 = 56, and d_i= 63 − 56 = 7, which belongs to lower-level as shown in Table 2.

Fig. 1. A division of 'lower-level' and 'higher-level' (Div = 15).

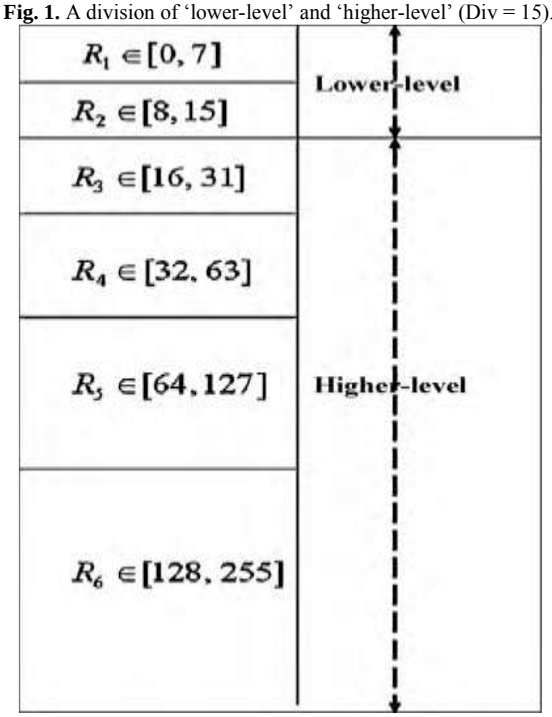


Table 4 The averaged difference |pi − p_i| between original pixels pi and their embedded results p_i in differencing ranges of various images by the simple 3-bit LSB substitution method.

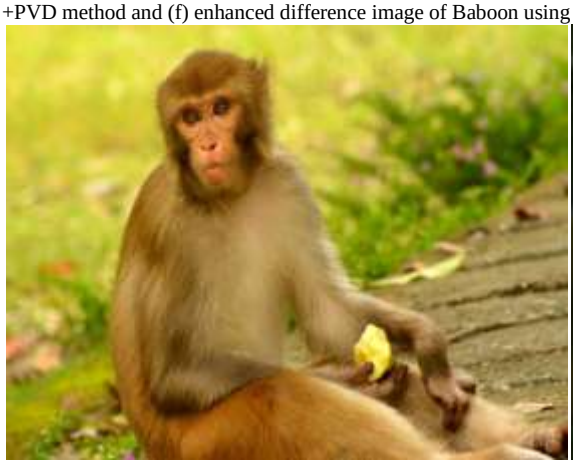
Cover images (512 × 512)	Differencing ranges					
	0–7	8–15	16–31	32–63	64–127	128–255
Lena	2.608	2.637	2.629	2.606	2.705	2.500
Baboon	2.664	2.631	2.639	2.624	2.920	None
Peppers	2.704	2.727	2.702	2.658	2.623	2.250
Jet	2.644	2.627	2.585	2.548	2.822	None

III. Different views of LSB +PVD approach

In this section, I point out some different views of LSB +PVD approach. Firstly, from the embedding process of LSB +PVD approach is too conformable to the LSB approach. I know that two pixels of a block are embedded by simple 3-bit LSB[7] substitution method if their difference value belongs to lower-level. Table 1 shows the distributions of difference value di of various images. As shown in Table 1, as Div = 15, almost 90% of difference values belong to lower-level. This demonstrates that using LSB substitution. Secondly, their LSB +PVD approach embeds more bits into smooth areas than edged areas. It seems to conflict with the concept that changing in smooth areas is more noticeable than changing in edged areas. For the division case of Fig. 1, two pixels with difference value belonging to lower-level can embed 6 bits (3 bits/pixel). In the contrary, difference value of the two pixels belongs to higher level may embed 4, 5, 6, or 7 bits. It may cause the condition that smooth areas embed more secret data than edged areas. This condition conflicts with the mind of PVD method. Fig. 2 shows the corresponding enhanced difference images between the stegoimages[3] and the host images (with the differences of gray[4] values being scaled eight times and complemented). Fig. 2(c) and (d) shows the enhanced difference images of Lena and Baboon for the PVD method, and Fig. 2(e) and (f) shows the enhanced difference images for the LSB +PVD method.

Fig. 2. Results of the enhanced difference images between the host images and the stego-images: (a) host image Lena; (b) host image Baboon; (c) enhanced difference image of Lena using PVD method; (d) enhanced difference image of Baboon using PVD method; (e) enhanced difference image of Lena using LSB

+PVD method and (f) enhanced difference image of Baboon using LSB +PVD method.



(a)

(b)

(c)

(d)

(e)

(f)

From the enhanced difference images, it can be seen that most of the distortions are found on the edged areas for the PVD method, but the LSB +PVD method is not. This means that the edged areas are embedded more secret data and are less noticeable by human eyes in the PVD method, but the LSB +PVD method does not own this characteristic.

IV. Our scheme on the basis of varied LSB +PVD

From previous analyses, we have some basic concepts about LSB replacement methods and PVD methods. LSB-based methods could provide larger capacity and lower PSNR values than that of PVD-based methods. However, PVD-based methods could pass the detection of some detecting programs which aim at LSB-based methods. Therefore, combining both PVD and LSB replacement methods would provide larger capacity and lower PSNR values than that of PVD-based methods and pass the detection of some LSB-based detecting programs. In this section, we propose some methods to promote the PSNR[8] value of LSB +PVD approach with the same capacity, and show the detection results. As we know, pure LSB-based approaches are easy detected by some LSB-based detection programs. Therefore, the LSB +PVD approaches provide a strategy to pass these detections and own high embedding capacity. The strategies for passing detections depend on how large part of pixels are embedded by the l-bit LSB substitution method and the value of the detecting results of our Modified 2-bit LSB +PVDand Modified 3-bit LSB +PVD methods. It is clear that these two methods pass the detection.

V. Conclusion

In this paper I present different views on LSB + PVD method conflicts with the concept of PVD method. In PVD, the edge areas will be embedded with more bits. After

analyzing LSB and PVD based approaches I come to know about the capacities, PSNR values. Moreover I propose the theoretical analysis and discussion on algorithm which are applied on this scheme. It turns out with the proposal of LSB + PVD program to spatial domain is workable and efficient in data embedding system. It can not be detected and it also fulfill the requirement of high capacity and Imperceptibility in data embedding system.

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