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Reversible Data Hiding Using Run Length Coding

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ABSTRACT: Here present a modified reversible data hiding (RDH) that have a compressed data structure and ensuring the security of data. In reversible data hiding most successful method is Prediction Error Expansion (PEE) Prediction error expansion is based on modification of prediction error histogram (PEH). Run length coding is used for better data compression and secret key encryption is used for ensuring the security of secret message the performance is based on PEH modification manner. In previous reversible data hiding method having no compression technique and also there have no security ensuring methods for secret message. In this reversible data hiding technique we have to adopt both of these techniques.

KEYWORDS: Reversible data hiding, Prediction error expansion, Prediction error histogram, Run length coding.

I .INTRODUCTION

Reversible data hiding (RDH) means a secret message is embed into an image by slightly modifying its pixel value and that hiding message will be retrieve from this marked image .The word reversible means lossless that means the secret message is completely retrieve from the covering image [1],[2]. This method is used for image authentication [3] in this RDH method having no any other degradation there for this method is used for military application, medical purposes. In early Reversible Data Hiding technique having only on lossless data compression that method having no security ensuring technique because these method having some security problems and also that method using the least significant bit (LSB) compression method [4] .Using this method the distortion is increases dramatically.

Using histogram modification and expansion technique to develop new Reversible data hiding methods (RDH) advantage of this method is high visual quality. In data embedding we have to use the peak point of image histogram. In this method each pixel value will be modified by 1.Using histogram difference of image that maintains the quality of marked image. In Lee *et al.*'s method utilized a regular shaped histogram [5] that histogram was centered at origin and rapid two sided decay which is more suitable for RDH. At first Tian [6] proposed an expansion technique. Tian method is performed on pixel pairs ,one data bit is embed on selected pixel pair difference of the covering image. This having high embedding capacity with an improved PSNR introducing this method an important progress in Reversible Data Hiding (RDH) .The expansion technique is mainly based on Integer to Integer transformation [7]-[11] , Location map reduction [12]-[14] and Prediction error expansion (PEE).

Day by day the importance of image processing is increasing and also the importance of Reversible data hiding so normal RDH method is changed to most effective technique. In this method we adopt Run length coding and secret key ensuring. Run length coding used to binary image compression and a linear feedback shift register is used for secret key ensuring that ensure the security of our secret message that means that secret data cannot access outsiders. PEE technique firstly proposed by Thodi and Rodriguez . In PEE method we have to predict the error and the secret data bit is embedding to this error value in PEE method we can show that better performance that means perfect secret data embedding and also ensuring the security of that secret message.

II . RELATED WORK

PEE is most effective Reversible Data Hiding technique and PEE including conventional PEE C-PEE, PEE with Adaptive embedding A-PEE, PEE with optimal expansion bin selection OPEE, combined adaptive embedding and

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optimal expansion AO PEE. In a PEE based method first step is generation of PEH, it based on specific scanning order. The cover image pixels are collected in to one dimensional sequence ($p_1,p_2,\ldots\ldots,p_n$). Totally N numbers of pixels are collected, then predict values for each corresponding pixels. The predicted value is denoted by $p_i^{\wedge}$ then we subtract the predicted value from original value this is known as prediction error.

$$E_i = p_i - p_i^{\wedge}$$

Then derived corresponding PEH from this error value is denoted by H.

$$H(E)= \#\{1 \le i \le N : E_i = E\}$$

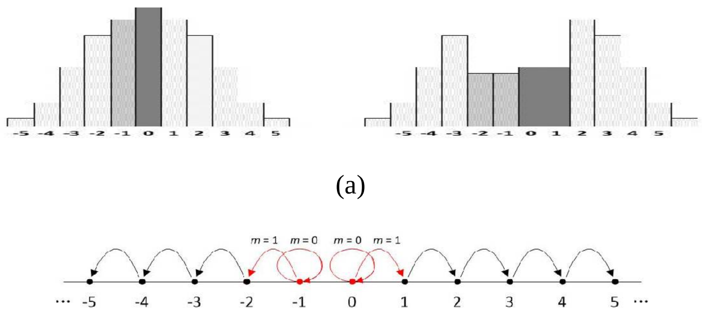
denote cardinal number of a set in this step we create a PEH then the next is modification of these PEH.

***A**. C-PEE*

In convensional PEE embedding procedure containing the bellow steps.

$$E_i' = \begin{cases} E_i+m & \text{if } E_i=0 \\ E_i-m & \text{if } E_i=-1 \\ E_i+1 & \text{if } E_i>0 \\ E_i-1 & \text{if } E_i<0 \end{cases}$$

Here m € {0,1} ,The bits -1 ,0 are expanded to data bits the other bins are creating vacancy that are ensure reversibility. The cover pixel is modified to $P_i' = P_i^{\wedge} + E_i'$ and generate marked pixel. The abow method will compleated then the all secret data bits are embedd in the covering image.



(a)

(b)

Fig. 1. Histogram modification mechanism for C-PEE. (a) PEH before (left) and after (right) C-PEE embedding. (b) Mapping of bins for C-PEE.

Figure 1 shows the hisogram modification mechanisum mapping of bins for CEE shown in fig 1(b) figure shows red point and black ponit red points are denoted the expanded bins and the black points are shifted bins.The original prediction error was recoverd from the bellow equations

$$E_i= \begin{cases} E_i' & \text{if } E_i' € \{1,0\} \\ E_i' -1 & \text{if } E_i' >0 \\ E_i' +1 & \text{if } E_i' <1 \end{cases}$$

***B.** A-PEE*

A-PEE is an extension to C-PEE this embedding strategy is proposed to better exploit the image redundancy . In APEE the complexity measurement is denoted by n_i is computed for each x_i then the pixel satisfying $n_i < T$ will be embedded here the threshold value T is greater than 0. The $n_i > T$ then x_i is ignored and its value is unchanged.

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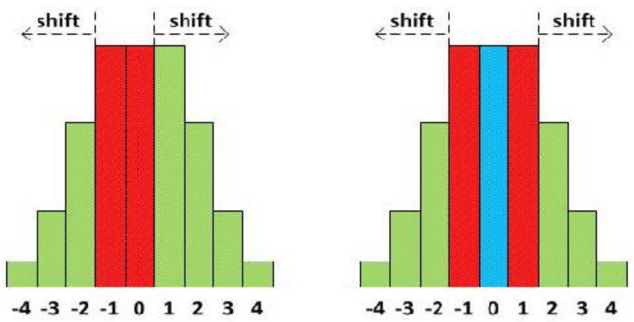

Fig. 2. C-PEE (left) v.s. O-PEE (right).

C. O-PEE

In OPEE method the specific PEH are shown in right figure of fig2. We can select the bins -1 and 1 for expansion in this situation the bins larger than 1 or smaller than -1 need to be shifted while the bit 0 will remain unchanged. Compaired with CPEE the expected value of embedding distortion is reduced from N-H to N-2H

Through this example, we see that it is possible to improve C-PEE by suitably selecting expansion bins. one can select two expansion bins $a < b$ to minimize the embedding distortion, and the optimal expansion bins can be determined by repeated embedding for a collection of *(a, b)*.

$$E_i' = \begin{cases} E_i & \text{if } a < E_i < b \\ E_i + m & \text{if } E_i = b \\ E_i - m & \text{if } E_i = a \\ E_i + 1 & \text{if } E_i > b \\ E_i - 1 & \text{if } E_i < a \end{cases}$$

The O-PEE extraction is just the inverse of data embedding. The data extraction and image restoration procedure of PEE is omitted.

D. AO-PEE

AOPEE is the combination of adaptive embedding and optimal expansion bins selection. This combined embedding having better performance is occurring. The cover pixel value is x_i, Then consider the complexity measurement $n_i < T$, E_i is the prediction error, x_i is modified same as APEE. In AO-PEE three parameters are determined complexity, Threshold, and expansion bins (a,b).

$$x_i' = \begin{cases} \min(u, v) & \text{if } w \geq \max(u, v) \\ \max(u, v) & \text{if } w \leq \min(u, v) \\ u + v - w & \text{otherwise.} \end{cases}$$

III. PROPOSED RDH METHOD

In previous RDH method shows that fully enclosed based method is accurate than the half enclosing based prediction. In this proposed method we have to divide the covering image in to two group that are shadow and blank and also the secret message will be divided in to two one half will be embed in to shadow pixel and the other half in blank pixel.

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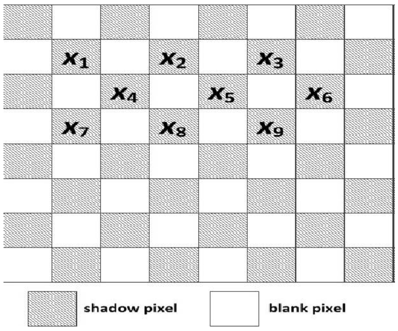

Fig. 3. Shadow and blank pixels partition. The scanning order for shadow (blank) pixels is from left to right and top to bottom.

The blank pixel is embedding after the completion of shadow pixel embedding. But in the extraction phase first extract the message from blank pixel after that the extraction process of shadow pixel. Except the border pixel, The shadow pixels are scanned from left to right and top to bottom and get the cover sequence are x_1, x_2 ……………x_n ,For avoiding the over flow and underflow we assume that the value of pixel 0 will be changed to 1 and 255 changed to 254 and a location map is created for showing this changes this location map is a binary sequence. For compression of this location map we choose RUN LENGTH CODING . In this proposed method having also an secret key ensuring technique that will be ensure the security of secret message. Run Length coding is producing sequence of integer run values it is stored in integer arrays each run value represent the length of run.

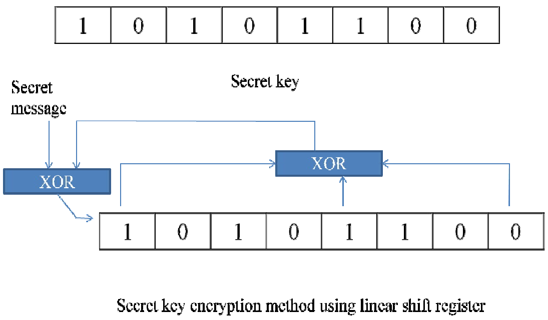

Fig 4.scret key encryption method

Secret key ensuring is a method used to ensure the security of secret message. A stream cipher is a symmetric cipher which operates with a time-varying transformation on individual plaintext digits. By contrast, block ciphers operate with a fixed transformation on large blocks of plaintext digits. More precisely, in a stream cipher a sequence of plaintext digits, m_0, m_1 . . ., is encrypted into a sequence of cipher ext digits c_0, c_1 . . . as follows: a pseudorandom sequence s_0, s_1 . . ., called the running-key or the key stream, is produced by a finite state automaton whose initial state is determined by a secret key. Figure shows the secret key encryption method using linear feedback shift register (LFSR)

IV.PERFORMANCE EVALUATION

Reversible Data Hiding using run length coding and secret key ensuring that have a location map for reducing under flow and over flow. Run length coding is used for reducing length of large data and secret key is used to ensure the security of secret data.

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	Area (No. of slices)	Delay(ns)
Normal RDH	42	16.49
RDH using run length coding	44	14.075

Comparison result of Normal reversible data hiding and modified reversible data hiding. Normal RDH method is proposed based on PEE of multiple histograms. For each pixel, its prediction value and complexity measurement are first computed according to its context, then multiple histograms are generated by counting the prediction-errors for different complexity levels. Finally, data embedding is implemented according to the proposed embedding strategy based on multiple histograms modification. Moreover, to optimize the embedding performance, the expansion bins are adaptively selected in each generated histogram such that the distortion is minimized. In the case of modified reversible data hiding the run length coding is used to compress the length of large data and the secret key will ensuring the security of secret message .In secret key ensuring have using linear feedback shift registers.

V. CONCLUSION

An efficient RDH method is based on prediction error histogram. In PEE method we calculate the pixel value of each pixel, prediction value and complexity measurement then the histograms are generated by counting the prediction error. The data embedding is based on proposed embedding strategy. The previous RDH method have no compression techniques and also they have no security protection for the secret messages but in the case of modified RDH method have run length coding is used for create compression location map and secret key ensuring is used for ensure the security of secret message.

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BIOGRAPHY

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