Improved Elastic Storage of Digital Still Images

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Abstract:

In this paper, a new method for data hiding has been proposed. Determinant of the designed matrix has been used for the insertion and retrieval of the message. Matrix is designed from the four least significant bits of the selected pixel value. The pixel for insertion and retrieval of the message has been selected by using linear mathematical equation which is shared between sender and receiver. The four least significant bits of selected pixel value are adjusted according to the message bit and the determinant of the designed matrix. The experimental results show that there is very less deflection in the quality of the stego image which cannot be perceived by HVS (Human Visual System).

1. Introduction

Generally, in data hiding, the actual information is not maintained in its original form and thereby it is converted into an alternative equivalent multimedia file like image, video or audio which in turn is being hidden within another object, which is sent through the network to the recipient, where the actual message is separated from it . The requirements of any data hiding system can be categorized into security, capacity and robustness Steganography comes from Greek words Steganos (Covered) and Graptos (Writing). It is an art and science of hiding the data in some cover media. The origin of steganography is biological and physiological. The field of steganography is very old. The term "steganography" came into use in 1500's after the appearance of Trithemius' book on the subject "steganography". In ancient time, people use wooden tablets, invisible ink, microdots etc. for steganography purpose. Usually the secret information is concealed by the use of an innocuous cover as to not arouse suspicion if hostile agents discover the cover. As an example, the cover text:

I'm feeling really stuffy. Emily's medicine wasn't strong enough without another febrifuge.

Hides the sentence "Meet me at nine" if the reader retains the second letter of each word in sequence. Steganography can also be achieved by embedding secret data in an unsuspecting medium like image, video or audio, in such a way that the human-perceived quality of the unsuspecting medium is not altered..The idea was first described by Simmons in 1983. More comprehension theory of steganography is given by Anderson. In this paper, new method with the use of determinant of 2X2 matrix has been given. The 2X2 square matrix has been designed with the help of four least significant bits of the selected pixel value. The experiments show the favorable results. The experiment shows that the cover image is indistinguishable from the stego image.

The rest of the paper is organized as follows: Section 2 describes the proposed method. Algorithms have been given in the section 3.Section 4 gives the practical example. At last, section 5 gives the result and analysis.

2. Description of proposed method

We have used the concept of determinant of matrix for insertion and retrieval of message. Firstly, we extract the four least significant bits of selected pixel value (i.e. intensity). Now, make the (2x2) square

matrix from the extracted bits. We can insert 0 at a pixel position if the determinant of (2x2) square matrix designed is 0. If the determinant of designed matrix is not 0 and we want to insert 0 at that point value then change the least significant bits in increasing order of weight age such that determinant of designed matrix becomes 0. Similarly, we can insert 1 at a pixel position if the determinant of (2x2) square matrix designed is not equal to 0. If the determinant of designed matrix is 0 and we want to insert 1 at that pixel value then change the least significant bits in increasing order of weightage such that determinant of designed matrix becomes different from 0. The insertion process is shown by Fig. 1 and retrieval process is shown by Fig
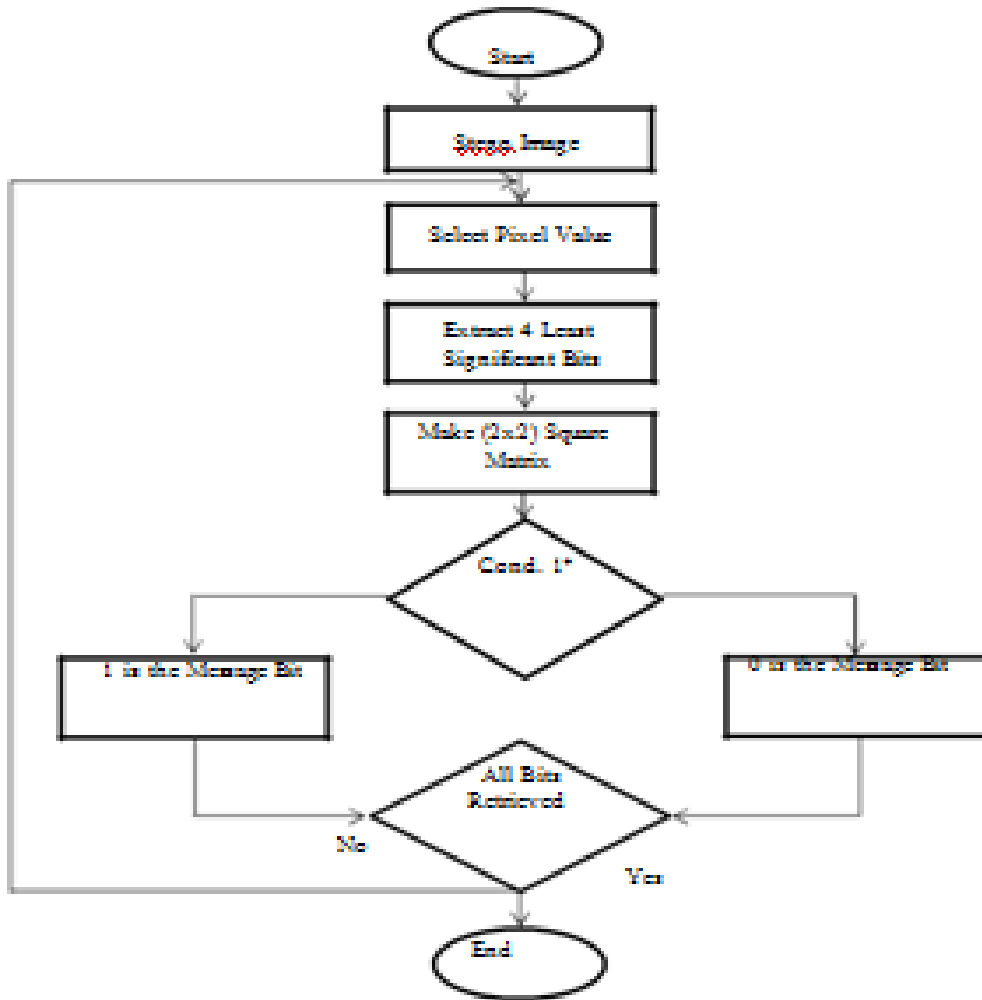
** Condition 2 = Is determinant of (2x2) square matrix 0.

Figure 1 - Insertion Process
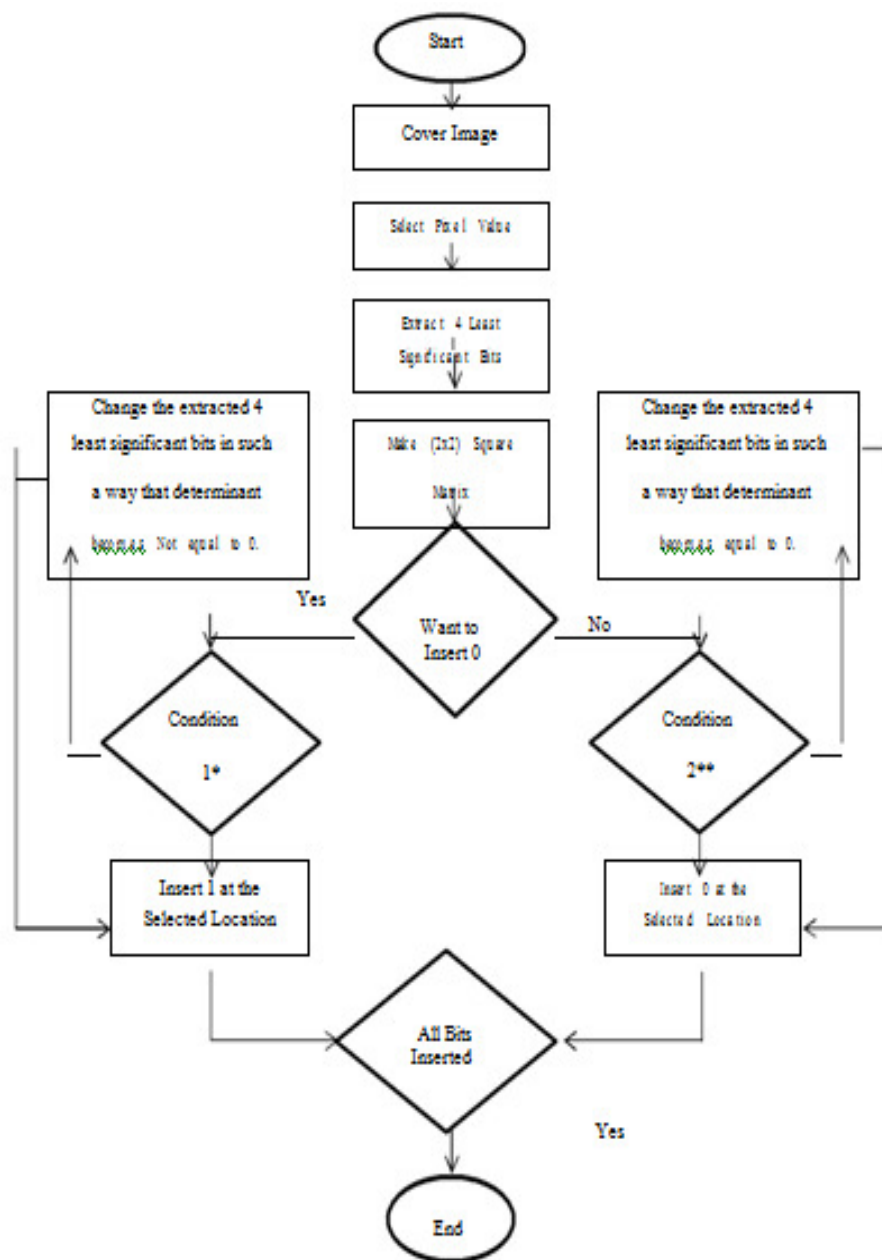
* **Condition 1 = Is determinant of (2x2) square matrix Not 0.**

Figure 2   Retrieval Process

3. Algorithms

A.   Assumptions

1.   Both sender and receiver will agree on the length of message to be hidden within the cover image.
2.   The pixels for insertion of message are chosen by a linear equation which is shared by both sender and receiver.
3.   The bits of pixels have given numbering according to Table 1.

Table 1

Bit Name	b7 (MSB)	b6	b5	b4	b3	b2	b1	b0 (LSB)
Bit Value	0	1	0	1	0	0	1	1

B.   Insertion Algorithm

    a.   Select the pixel by using linear equation shared by both sender and receiver.

    b.   Extract the bits b0, b1, b2 and b3 of selected pixel.

    c.   Create a (2x2) square matrix according to equation 1.

    ii.   Designed square matrix   iii.
       = $\begin{bmatrix} b3 & \\ b1 & b0 \end{bmatrix}$

❖ Calculate determinant of designed square matrix.

❖ If want to insert 0, then go to step vi else go to step vii

❖ (a) If determinant is equal to 0, then go to END.

      ▪   If determinant is not equal to 0, then change the values b0, b1, b2, and b3 in such a way that determinant becomes equal to 0 and go to END.

❖ (b) If determinant is not equal to 0, then go to END.

      ▪   If determinant is equal to 0, then change the values b0, b1, b2, and b3 in such a way that determinant becomes different from 0 and go to END.

❖ END.

C. Retrieval Algorithm

    Select the pixel by using linear equation shared by both sender and receiver.

i.   Extract the bits b0, b1, b2 and b3 of selected pixel.

ii.   Create a (2x2) square matrix according to equation 1.
Designed square matrix = $\begin{bmatrix} b3 & b2 \\ b1 & b0 \end{bmatrix}$ --(1)

iv.   Calculate determinant of designed square matrix.

v.   If determinant is 0, then 0 is the message bit else 1 is the message bit.

vi.   END.

4. Practical Example

    Suppose, the message bit is 0 and the selected pixel value has intensity 142. First, the value 142 is converted into binary values, represented by table 2.

Table 2

Binary Value of 142

Bit Name	b7 (MSB)	b6	b5	b4	b3	b2	b1	b0 (LSB)
Bit Value	1	0	0	0	1	1	1	0

Now, make a square matrix of order (2x2) from b0, b1, b2, and b3 as given in equation 2.

Designed square matrix = $\begin{matrix} 1 & 1 \\ 1 & 0 \end{matrix}$ --(2)

Now, calculate the determinant of the designed square matrix which is (1 x 0) – (1 x 1) = –1. Make the minimum change in values b0, b1, b2 and b3 such that determinant becomes equal to 0. So, we will change the value of b1 from 1 to 0 which makes the determinant 0. Now, modified square matrix is given by equation 3.

Modified square matrix =   1   1   --(3)

$$\begin{bmatrix} & 0 & \end{bmatrix} \quad 0$$

So, the modified pixel value becomes 140 after insertion of 0.

5. Results and Analysis

The cover image before the insertion of the message is shown by figure 3. The stego image after the insertion of the message is shown by figure 4. From figure 3 and figure 4 it is clear that visual quality of the cover image does not change after insertion of the message.

Figure 3

Cover image

Figure 4

Stego Image

6. References

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