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Information Hiding Technology Based on Least Significant Bit

¹Pingshui Wang and ²Qinjuan Ma

¹College of Management Science and Engineering, Anhui University of Finance and Economics,
Bengbu, Anhui, 233030, China

²Business Institute, Anhui University of Finance and Economics,
Bengbu, Anhui, 233040, China

Abstract: Information hiding technology is a new information security technology that embeds the private meaningful information into an ordinary carrier. The illegally gainer does not know whether this seemingly ordinary carrier hide other private information and even if there is hard to extract or remove hidden information. This paper introduces an information hiding technology based on least significant bit (LSB) and provides in detail the embedding algorithm to achieve the secret image hiding and extracting in Matlab environment.

Key words: Information security, information hiding, information extracting, least significant bit (LSB), Matlab

INTRODUCTION

Information hiding as a new discipline has been paid more and more attention. In the information age represented by computer and Internet, information hiding techniques have involved cognitive science, information theory, cryptography and so on, in which cryptography is of the most popular. However, there are any difference between information hiding technology and traditional cryptography.

The traditional encryption technology protects the content of the message through the incomprehensible cipher text, as shown in Fig. 1 but the incomprehensibility as a consequence of exposing the importance of the information is very easy to cause the attention of attackers, so as to attract the attackers taking various means to attack on the content of the communication or damage of the communication process, resulting in the failure of information transfer.

Information hiding technology hides the secret information in multimedia information using the redundancy of ubiquitous multimedia information and the multimedia information is not caused significant changes by physical appearance, which makes people not aware of its existence. Even if interceptors know the existence of secret information, they also extract these secrets more difficult, so as to ensure the confidentiality and security of secret information, as shown in Fig. 2.

Now the mature information hiding technology is basically based on the image. The image information hiding in spatial domain is one of the most simple,



Fig. 1: Traditional encryption model



Fig. 2: Information hiding technology model

effective implementation of information hiding method and a number of effective algorithms have been proposed (Farschi and Farschi, 2012; Hughes and Shmatikov, 2004; Leino and Nelson, 2002; Lin, 2011, 2010; Moulin and O'sullivan, 2003; Salman, 2011; Wang *et al.*, 2013).

Matlab is a powerful matrix calculation tool designed by the American MATHWORKS company. It contains a lot of matrix functions and is famous for its powerful processing ability and operation ability, is very suitable for image processing.

This study introduces a simple practical image hiding algorithm based on Least Significant Bit (LSB) designed by Matlab. The main idea is that the secret information is embedded into the pixel bits of an image to be difficultly found, i.e., Least Significant Bit (LSB). Advantage of the algorithm is that it has fine hidden performance and does not destroy the original image and so on.

APPLICATION OF THE INFORMATION HIDING TECHNIQUE

Information hiding technology is widely used in information security field. In the following several typical applications of information hiding technology are simply introduced.

Covert communication: Information hiding as a covert communication means plays a very important role in the field of military, intelligence, national security and so on.

Anonymous communication: Anonymous communication technology is widely used in electronic voting, electronic cash scheme and anonymous mail protocol in many countries and financial institutions out of the third party tracking, which makes the user privacy be protected effectively.

Copyright protection: Digital watermark as an important branch of information hiding technology, which becomes an effective means of knowledge property rights protection.

Printing anti-counterfeit: Information hiding technology has been widely accepted by many presses and issuing institutions for printing anti-counterfeiting.

BASIC MODEL OF AN INFORMATION HIDING SYSTEM

In this section we introduce the basic model of an information hiding system.

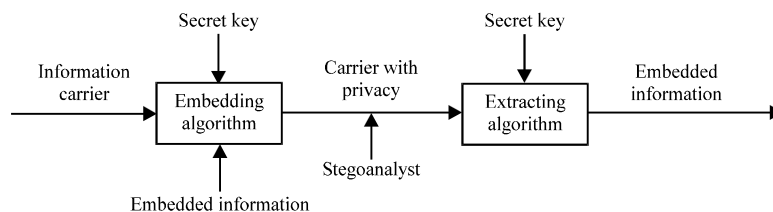


Fig. 3: Basic model

A classical information hiding system includes two stages: Embed and extract the secret information, as shown in Fig. 3. The secret information is embedded into a common information carrier by a embedding algorithm with a secret key. To prevent an attacker, the appearance of the carrier containing the secret information remains unchanged. Moreover, the receiver can easily extract the secret information from the seemingly ordinary carrier.

IMAGE HIDING AND EXTRACTING ALGORITHM BASED ON LSB

In this section we introduce the basic idea of image information hiding technology based on LSB and propose two kinds of image hiding algorithms. Comparison between the two algorithms is also carried.

Basic idea of image hiding algorithm: The basic idea of LSB image hiding algorithm: change the LSB of a two-value image has no influence on the visual effect. Based on this, the LSB can be directly used instead of the secret image information.

The embedding process is divided into three steps:

- Strp 1:** One, transform the spatial pixel value of the secret image from decimal codes to binary codes, as shown in Fig. 4
- Strp 2:** Replace the least significant bit of the ordinary carrier with each bit of the secret image, secret information [101110101] is assumed to be embedded into an ordinary carrier, the replacing process as shown in Fig. 5
- Strp 3:** Convert the binary codes of the generated carrier to decimal pixel value, so as to get the image with secret information, as shown in Fig. 6

Idea of extracting secret image: In this section we introduce the basic idea of extracting secret image.

The extracting process is divided into two steps:

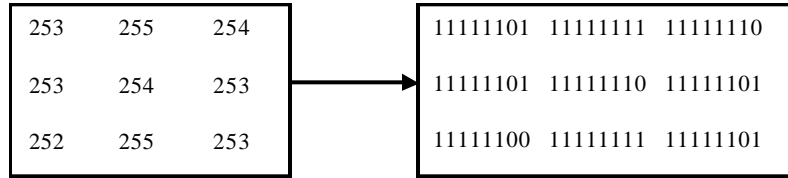


Fig. 4: Step one

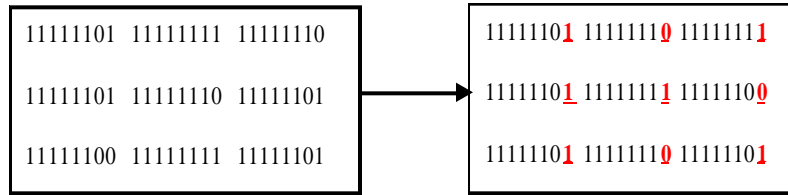


Fig. 5: Step two

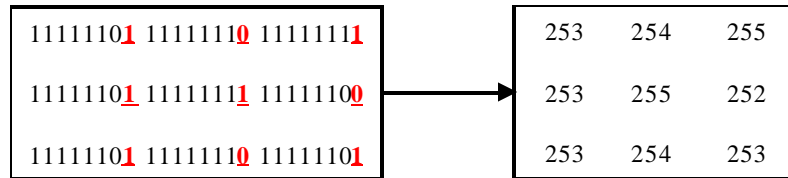


Fig. 6: Step three

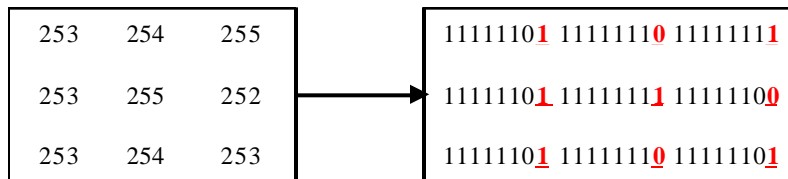


Fig. 7: Step one

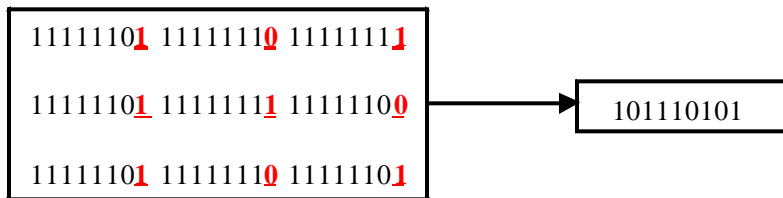


Fig. 8: Step two

Step 1: Transform the pixel value of the carrier image from decimal codes to binary codes, as shown in Fig. 7

Step 2: Extract the least significant bit of the binary data as the secret information sequence [101110101], as shown in Fig. 8

Image hiding and extracting algorithm: As the different embedded location will result in different anti-attack ability, in the following we will introduce two kinds of embedding algorithm.

Algorithm 1: Embedding algorithm for image pixels LSB order selection, namely the least significant bits of the selected pixels are replaced in order with secret information

```

Embed the secret message:
For (i = 1; i <= number of pixels sequence; i++)
    Si ← Ci //Ci for the set of cover image pixels
End for
For (i = 1; i <= length of secret message; i++)
    i → ← ji //calculate the pointer ji for storing the ith message bit
    Sji ? Cji → ← Mi //store the secret information Mi in the selected
    pixel Sji
End for
Extract the secret message:
For (i = 1; i <= number of pixels sequence; i++)
    i → ← ji //calculate the pointer ji for storing the ith message bit
    Mi ← LSB (Cji)
End for
    
```

Algorithm 2: Embedding algorithm for image pixels LSB random selection, namely the pixel location selected for embedding information is random, this can increase the invisibility of secret information

```

Embed the secret message:
For (i = 1; i <= number of pixels sequence; i++)
    Si ← Ci //Ci for the set of cover image pixels
End for
n ← k1 // generate random sequence k1 using the seed k
For (i = 1; i <= length of secret message; i++)
    Sn ← Cn → ← Mi
    n ← n+k1
End for
Extract the secret message:
n ← k1 // generate random sequence k1 using the seed k
For (i = 1; i <= number of pixels sequence; i++)
    Mi ← LSB(Cn)
    n ← n+k1
End for
    
```

Comparison between these two algorithms: As can be seen, the algorithm 1 embeds the secret information into the carrier image LSB in order, which will cause the secret information too regularly and concentrated and can not afford the visual attack, therefore the confidential information are easy to be broken out.

The algorithm 2 embeds the secret information into the carrier image LSB randomly, which strengthens the invisibility of the secret image and the hidden information is not easily be broken out, therefore the security of secret information is enhanced.

CONCLUSIONS AND FUTURE WORK

In recent years, privacy protection has been widely concerned in academic and industrial fields. Many kinds

of privacy protection techniques have been proposed. Information hiding technology is very important one. In this paper, basic idea and principle of image information hiding algorithm based on LSB was discussed and two kinds of image pixel selection algorithms were proposed. By comparison, random selection algorithm embeds the secret information homogeneously to the entire image carrier, so as to enhance the imperceptibility of secret information and the difficulty of declassification; order selection algorithm is susceptible to visual attack. In the future, we will further research and develop more effective and efficient information hiding algorithms.

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