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Security Enhancement Scheme for Image Steganography using S-DES Technique

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Abstract: In today's information age, information sharing and transfer has increased exponentially. The information vulnerable to unauthorised access and interception, while in storage or transmission. Cryptography and Steganography are the two major techniques for secret communication. The contents of secret message are scrambled in cryptography, where as in steganography the secret message is embedded into the cover medium. This paper presents a new generalized model by combining cryptographic and steganographic Technique. These two techniques encrypt the data as well as hide the encrypted data in another medium so the fact that a message being sent is concealed. In cryptography we are using Simplified Data Encryption Standard (S-DES) algorithm to encrypt secret message and then alteration component method is used to hide encrypted message. By using these two techniques the security of secret data increases to two tier and a high quality of stego image is obtained.

Keywords: Steganography techniques; Cryptography techniques; Information Hiding; Information Security; Image hiding; S-DES

1. Introduction:

Classic methods of securing communication mainly base on cryptography, which encrypts plain text to generate cipher text. However, the transmission of cipher text may easily arouse attackers' suspicion, and the cipher text may thus be intercepted, attacked or decrypted violently. In order to make up for the shortcomings of cryptographic techniques, steganography has been developed as a new covert communication means in recent years. It transfers message secretly by embedding it into a cover medium with the use of information hiding techniques.

Cryptography and Steganography are two important branches of information security. Cryptography provides encryption techniques for a secure communication. Cryptography is the science that studies the mathematical techniques for keeping message secure and free from attacks [1], [2]. Steganography is the art and science of hiding communication [3]. Steganography involves hiding information so it appears that no information is hidden at all.

Cryptography and Steganography achieve the same goal via different means. Encryption encodes the data so that an unintended recipient cannot determine its intended meaning. Steganography, in contrast attempts to prevent an unintended recipient from suspecting that the data is there. [4].Combining encryption with steganography allows for a better private communication. The goal of steganography is to avoid drawing suspicion to the transmission of the secret message. On other hand, steganalysis is a way of detecting possible secret communication using against steganography. That is, steganalysis attempts to defeat steganography techniques. It relies on the fact that hiding information in digital media alters the carriers and introduces unusual signatures or some form of degradation that could be exploited. Thus, it is crucial that a steganography system to ascertain that the hidden messages are not detectable.

This paper organized in Sections. Firstly I describe the introduction of Steganography and Cryptography Techniques under the heads of Introduction in Section-I. Subsequently I have gone through the literature review and give overview of S-DES. All this we have mentioned under heads of Backgrounds in Section-II. In Section-III, the proposed architecture and mechanism described in detail. Finally, this paper concluded and mentions its further enhancements under future scope in Section – IV and Section-V respectively. All used references used during writing of this paper are mention in Section –VI under head of references.

2. Background:

Compared to other types of steganography, image steganography has attracted extensive research as well as popular usability in recent years. This is due to the fact that huge amounts of data can be hidden without perceptible impact to the carriers and possibly because of the popularity of electronic images that have become widely available. With this in mind, I describe steganography techniques and tools that use image files in more details. I present a set of criteria to appraise them. Due to limited space, we include a subset of the tools that we have studied and compared.

An early work on the image steganography is Least Significant Bit technique (LSB) [5, 8, 10]. This technique is simple in both the embedding and de-embedding (extracting messages) processes, but suffers several disadvantages. Fridrich et al. [14] point out that recent advances in steganalysis have shown that LSB does not guarantee detectability, evidenced by the fact that they can be successfully attacked using statistical [15], or even visual attacks [13]. In addition, it is extremely vulnerable. For example, re-saving in a BMP image can destroy the hidden information [5]. Further this technique is not appropriate for JPEG and GIF format.

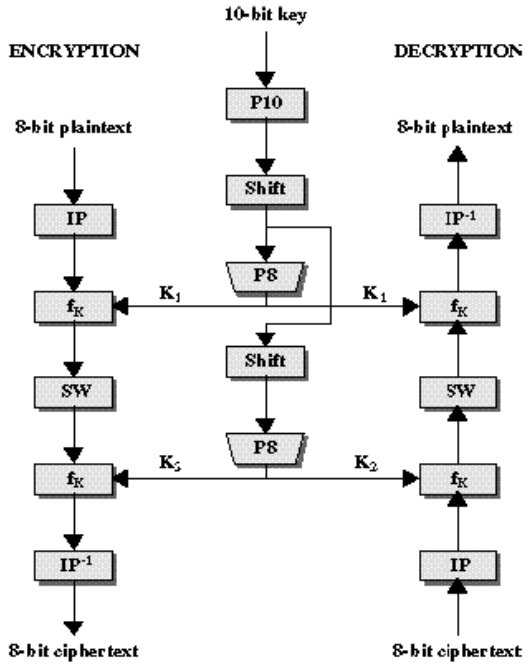
Transform domain steganographic methods hide data in the coefficients of the represented domain [6, 12]. After mapping the signals to another domain such as discrete Fourier transform, cosine transform, Hartley transform, and wavelet transforms, the obtained coefficients are altered or replaced [17]. The methods are more robust than spatial domain embedding techniques while maintaining good image quality. They are also independent to various image file formats either lossy or lossless image formats; however, have lower capacity. Examples include F5 [20], OutGuess [7] and StegHide [9]

A more sophisticated technique is proposed in [21, 19] where all cover bits can be accessed in the embedding process. It is referred to as pseudorandom permutation technique. In this technique, the secret message bits can be distributed randomly over the whole cover. In the Encoding process, the outputs of a random number generator are used as indices where the embedded message bits are. In this technique, the secrecy may be higher

as it is not guaranteed that subsequent message bits are embedded in the same order. As it is the case with LSB, part of data that are randomly stored in LSB may be lost. In addition, it may produce a highly noisy image.

Simplified DES (S-DES)

The S-DES encryption algorithm takes an 8-bit block of plaintext (example: 10111101) and a 10-bit key as input and produces an 8-bit block of ciphertext as output. The S-DES decryption algorithm takes an 8-bit block of ciphertext and the same 10-bit key used to produce that ciphertext as input and produces the original 8-bit block of plaintext. The encryption algorithm involves five functions: an initial permutation (IP); a complex function labeled f*K*, which involves both permutation and substitution operations and depends on a key input; a simple permutation function that switches (SW) the two halves of the data; the function f*K* again; and finally a permutation function that is the inverse of the initial permutation (IP–1). The function fK takes two 8-bit keys which are obtained from the original 10-bit key [16]. The S-DES algorithm flow is shown in below figure.



The 10-bit key is first subjected to a permutation (P10) and then a shift operation is performed. The output of the shift operation then passes through a permutation function that produces a 8-bit output (P8) for the first sub key (K1). The output of the shift operation again feeds into another shift and (P8) to produce the 2nd sub key (K2) [18].We can express encryption algorithm as superposition

$$\text{Ciphertext} = IP^{-1}\left(f_{K_2}(SW(f_{K_1}(IP(plaintext))))\right)$$

$$K_1 = P8(Shift(P10(key)))$$

$$K_2 = P8(Shift(Shift(P10(key))))$$

$$\text{Plaintext} = IP^{-1}\left(f_{K_1}(SW(f_{K_2}(IP(ciphertext))))\right)$$

Considering a 24-bpp color image, the image is split into three matrices (frames) each matrix containing pixels indicating the intensities of Red, Green and Blue. If m by n is the dimension of that image, then there will be mxn number of pixels in that image. Hence, the matrices corresponding to Red, Green and Blue intensities will also have mxn number of pixels.

3. Proposed Technique:

3.1 Proposed Message Embedding Procedure:

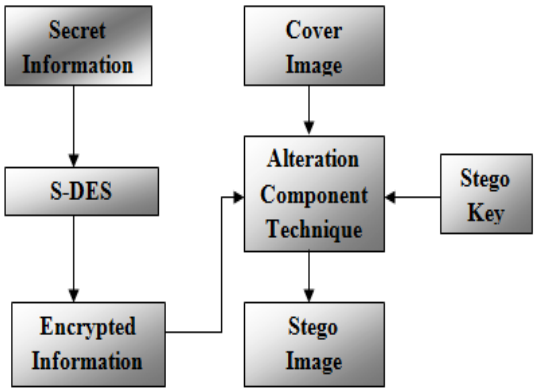


Fig 1: Sender Prospect

Figure-1 shows the sender's prospect of Proposed Technique in which the secret information is encrypted by using simplified data encrypted standard (S-DES) encryption algorithm. Then encrypted message is embedded into cover image by using Alteration component technique. Image containing the secret data is called stego image. Next phase is to select the stego key for encoding. In Embedding process data is hidden by using Alteration component technique in which pixels have been replaced by key and secret message. Firstly key is converted into binary form and its binary form is filled in the first component of first pixels. After then, secret message is converted into binary form and its binary form is filled in first component of next pixels.

Embedding Algorithm

Step (a): Extract all the pixels in the given image and store it in the array called Pixel-Array.

Step (b): Extract all the characters in the given text file and store it in the array called Character- Array.

Step (c): Extract all the characters from the Stego key and store it in the array called Key- Array.

Step (d): Choose first pixel and pick characters from Key- Array and place it in first component of pixel. If there are more characters in Key- Array, then place rest in the first component of next pixels, otherwise follow Step (e).

Step (e): Place some terminating symbol to indicate end of the key. '0' has been used as a terminating symbol in this algorithm.

Step (f): Place characters of Character-Array in each first component (blue channel) of next pixels by replacing it.

Step (g): Repeat step (f) till all the characters has been embedded.

Step (h): Again place some terminating symbol to indicate end of data.

Step (i): Obtained image will hide all the characters that we input.

3.2 Proposed Message Extraction Procedure:

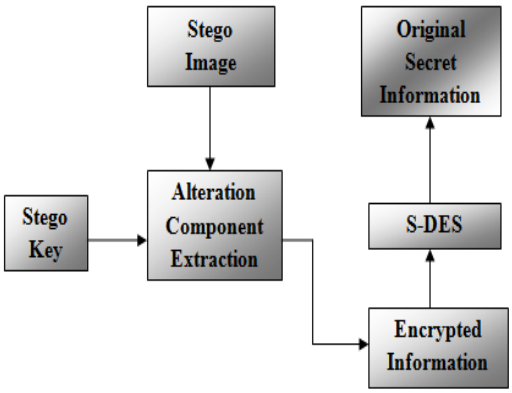


Fig 2: Receiver Prospect

Figure-2 shows the receiver's prospect of Proposed Technique in which the sender sends a stego-image to the receiver or legitimate user. The legitimate user having the stego key to extract secret data from stego image. The legitimate user must have the same key with which the image is embedded. On Stego image Extracting process is applied by using Alteration component technique. After data extraction I get the secret message which is in encrypted form. Simplified data encryption standard (S-DES) decryption algorithm is used to decrypt message. Finally we get the Secret Data which is embedded.

Extraction Algorithm

Step (a): Consider three arrays. Let they be Character-Array, Key-Array and Pixel-Array.
Step (b): Extract all the pixels in the given image and store it in the array called Pixel-Array.
Step (c): Now, start scanning pixels from first pixel and extract key characters from first (blue) component of the pixels and place it in Key-Array. Follow Step 3 till we get terminating symbol, otherwise follow step (d).
Step (d): If this extracted key matches with the key entered by the receiver, then follow Step 5, otherwise terminate the program by displaying message ―Key is not matching.
Step (e): If the key is valid, then again start scanning next pixels and extract secret message characters from first (blue) component of next pixels and place it in Character Array. Follow Step (e) till we get terminating symbol, otherwise follow step 6.
Step (f): Extract secret message from Character-Array.

4. Conclusion:

Cryptography and steganography are two major branches of data security. In this proposed system cryptographic and steganographic security is combined to give two tier security to secret data. In proposed scheme secret message is encrypted before hiding it into the cover image which gives high security to secret data. Simplified data encryption standard (S-DES) is used to encrypt secret Message and Alteration component technique is used to hide encrypted secret message into cover image. Since the resulting perceptual quality of the mixed images is good, it is hardly attracted from eavesdropper by naked eye. Finally we can conclude that the proposed technique is effective for secret data communication.

5. Future Aspects:

In the future work, there is a planning to design a sophisticated software based on this technique which will targeted to use in highly secure multimedia data transmission applications.

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