

Steganography Techniques

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Abstract—Steganography is defined as the study of invisible communication. Steganography usually deals with the ways of hiding the existence of the communicated data in such a way that it remains confidential. It maintains secrecy between two communicating parties. In image steganography, secrecy is achieved by embedding data into cover image and generating a stego-image. There are different types of steganography techniques each have their strengths and weaknesses. In this paper, we review the different security and data hiding techniques that are used to implement a steganography such as LSB, ISB, MLSB etc.

I. INTRODUCTION

In today's world, the communication is the basic necessity of every growing area. Everyone wants the secrecy and safety of their communicating data. In our daily life, we use many secure pathways like internet or telephone for transferring and sharing information, but it's not safe at a certain level. In order to share the information in a concealed manner two techniques could be used. These mechanisms are cryptography and steganography. In cryptography, the message is modified in an encrypted form with the help of encryption key which is known to sender and receiver only. The message cannot be accessed by anyone without using the encryption key. However, the transmission of encrypted message may easily arouse attacker's suspicion, and the encrypted message may thus be intercepted, attacked or decrypted violently. In order to overcome the shortcomings of cryptographic techniques, steganography techniques have been developed. Steganography is the art and science of communicating in such a way that it hides the existence of the communication. Thus, steganography hides the existence of data so that no one can detect its presence. In steganography the process of hiding information content inside any multimedia content like image, audio, video is referred as a "Embedding". For increasing the confidentiality of communicating data both the techniques may be combined. The remaining paper consist of following section : II. Steganography III. Conclusion and Future Work

II. STEGANOGRAPHY

Steganography is a Greek word which means concealed writing. The word "steganos" means "covered" and "graphical" means "writing". Thus, steganography is not only the art of hiding data but also hiding the fact of transmission of secret data. Steganography hides the secret data in another file in such a way that only the recipient knows the existence of message. In ancient time, the data was protected by hiding it on the back of wax, writing tables, stomach of rabbits or on the scalp of the slaves. But today's most of the people transmit the data in the form of text, images, video, and audio over the medium. In order to safely transmission of confidential data, the multimedia object like audio, video, images are used as a cover sources to hide the data

A. Types of Steganography :

- ii. Text Steganography: It consists of hiding information inside the text files. In this method, the secret data is hidden behind every nth letter of every words of text message. Numbers of methods are available for hiding data in text file. These methods are i) Format Based Method; ii) Random and Statistical Method; iii) Linguistics Method.
- iii. Image Steganography: Hiding the data by taking the cover object as image is referred as image steganography. In image steganography pixel intensities are used to hide the data. In digital steganography, images are widely used cover source because there are number of bits presents in digital representation of an image.
- iv. Audio Steganography: It involves hiding data in audio files. This method hides the data in WAV, AU and MP3 sound files. There are different methods of audio steganography. These methods are i) Low Bit Encoding ii) Phase Coding iii) Spread Spectrum.
- v. Video Steganography: It is a technique of hiding any kind of files or data into digital video format. In this case video (combination of pictures) is used as carrier for hiding the data. Generally discrete cosine transform (DCT) alter the values (e.g., 8.667 to 9) which is used to hide the data in each of the images in the video, which is unnoticeable by the human eye. H.264, Mp4, MPEG, A VI are the formats used by video steganography.
- vi. Network or Protocol Steganography: It involves hiding the information by taking the network protocol such as TCP, UDP, ICMP, IP etc, as cover object. In the OSI layer network model there exist covert channels where steganography can be used.

B. Steganography Terminology

Steganography consists of two terms that is message and cover image. Message is the secret data that needs to hide and cover image is the carrier that hides the message in it.

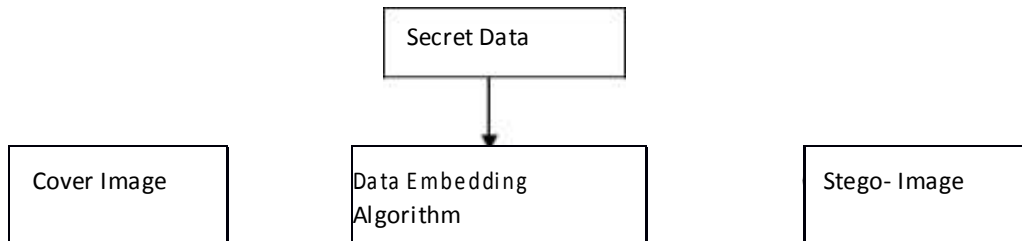


Fig 1 : Steganography Diagram

C. Steganography Techniques

1. **Spatial Domain Methods:** in this method the secret data is embedded directly in the intensity of pixels. It means some pixel values of the image are changed directly during hiding data. Spatial domain techniques are classified into following categories: i) Least significant bit (LSB) ii) Pixel value differencing (PVD) iii) Edges based data embedding method (EBE) iv) Random pixel embedding method (RPE) v) Mapping pixel to hidden data method vi) Labelling or connectivity method vii) Pixel intensity based.

i) **LSB:** this method is most commonly used for hiding data. In this method the embedding is done by replacing the least significant bits of image pixels with the bits of secret data. The image obtained after embedding is almost similar to original image because the change in the LSB of image pixel does not bring too much differences in the image.

ii) **BPCP:** In this segmentation of image are used by measuring its complexity. Complexity is used to determine the noisy block. In this method noisy blocks of bit plan are replaced by the binary patterns mapped from a secret data

iii) **PVD:** In this method, two consecutive pixels are selected for embedding the data. Payload is determined by checking the difference between two consecutive pixels and it serves as basis for identifying whether the two pixels belongs to an edge area or smooth area.

2. **Spread Spectrum Technique:** The concept of spread spectrum is used in this technique. In this method the secret data is spread over a wide frequency bandwidth. The ratio of signal to noise in every frequency band must be so small that it become difficult to detect the presence of data. Even if parts of data are removed from several bands, there would be still enough information is present in other bands to recover the data. Thus it is difficult to remove the data completely without entirely destroying the cover. It is a very robust technique mostly used in military communication.

3. **Statistical Technique:** In the technique message is embedded by changing several properties of the cover. It involves the splitting of cover into blocks and then embedding one message bit in each block. The cover block is modified only when the size of message bit is one otherwise no modification is required.

4. **Transform Domain Technique:** In this technique; the secret message is embedded in the transform or frequency domain of the cover. This is a more complex way of hiding message in an image. Different algorithms and transformations are used on the image to hide message in it. Transform domain techniques are broadly classified such as

[1] Discrete Fourier transformation technique (DFT) ii) Discrete cosine transformation technique (DCT) iii) Discrete Wavelet transformation technique (DWT) iv) Lossless or reversible method (DCT) iv) Embedding in coefficient bits

5. **Distortion Techniques:** In this technique the secret message is stored by distorting the signal. A sequence of modification is applied to the cover by the encoder. The decoder measures the differences between the original cover and the distorted cover to detect the sequence of modifications and consequently recover the secret message.

6. **Masking and Filtering:** These techniques hide information by marking an image. Steganography only hides the information where as watermarks becomes a portion of the image. These techniques embed the information in the more significant areas rather than hiding it into the noise level. Watermarking techniques can be applied without the fear of image destruction due to lossy compression as they are more integrated into the image. This method is basically used for 24-bit and grey scale images.

D. Factors Affecting a Steganographic Method

The effectiveness of any steganographic method can be determined by comparing stego-image with the cover Image.

There are some factors that determines the efficiency of a technique. These factors are:

- 1) **Robustness**: Robustness refers to the ability of embedded data to remain intact if the stego- image undergoes transformations, such as linear and non-linear filtering, sharpening or blurring, addition of random noise, rotations and scaling, cropping or decimation, lossy compression.
- 2) **Imperceptibility**: The imperceptibility means invisibility of a steganographic algorithm. Because it is the first and foremost requirement, since the strength of steganography lies in its ability to be unnoticed by the human eye.
- 3) **PSNR (Peak Signal to Noise Ratio)**: It is defined as the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. This ratio measures the quality between the original and a compressed image. The higher value of PSNR represents the better quality of the compressed image.
- 4) **MSE (Mean Square Error)**: It is defined as the average squared difference between a reference image and a distorted image. The smaller the MSE, the more efficient the image steganography technique. MSE is computed pixel-by-pixel by adding up the squared differences of all the pixels and dividing by the total pixel count.
- 5) **SNR (Signal to Noise Ratio)**: It is the ratio between the signal power and the noise power. It compares the level of a desired signal to the level of background noise.

E. Application of Steganography

- i) Confidential Communication and Secret Data Storing
- ii) Protection of Data Alteration
- iii) Access Control System for Digital Content Distribution
- iv) E-Commerce
- v) Media
- vi) Database Systems.
- vii) digital watermarking.

III) CONCLUSION AND FUTURE WORK

In this research work we reviewed many papers on steganography techniques. These papers are good enough and have wide future scope. By reviewing these papers we observed that most of the steganography work is done in the year 2012

Fig. 1. 2013. In these years, LSB is the most widely used technique for steganography. Some researchers have also used the techniques like water marking, distortion technique, spatial technique, ISB, MSB in their work and provided a strong means of secure information transmission. Most of the papers that are discussed here are taken from IEEE Explore, AICCSA, IJET, IJCSE, IJCA etc. These papers provide a lot of help to the initiator for starting their work in this field. This review paper is enough for them to start their work in this field. The different security and data hiding techniques are used to implement steganography using LSB, ISB, MLSB. In further research we are going to use more advance schemes like steganography with some hybrid cryptographic algorithm for enhancing the data security.

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