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A Survey on Image Steganography Techniques using Compression

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Abstract: Image steganography is one of the oldest and most famous secure data hiding technique. In this paper a survey is done on various techniques based on combination of Steganography and Image Compression along with focus on Image Compression approach.

Keywords: Steganography, Compression, Reversible hiding, Encoding, Compression ratio.

1. INTRODUCTION

The computer is becoming more and more powerful day by day. As a result, the use of digital images is increasing rapidly. Along with this increasing use of digital images comes the serious issue of storing and transferring the huge volume of data representing the images because the uncompressed multimedia (graphics, audio and video) data requires considerable storage capacity and transmission bandwidth. Though there is a rapid progress in mass storage density, speed of the processor and the performance of the digital communication systems, the demand for data storage capacity and data transmission bandwidth continues to exceed the capabilities of on hand technologies. Besides, the latest growth of data intensive multimedia based web applications has put much pressure on the researchers to find the way of using the images in the web applications more effectively.On the other hand Steganography can be stated as the art of hiding the fact that communication is taking place. It is defined as the study of invisible communication.[1] If successfully achieved, the message does not attract attention from the Eavesdropper (A secret listener to the private message), or Attacker. Using Steganography information can be buried in different embedding standards known as Carriers. These carriers can be images, audio files, video files and text files, but digital images are the most popular because of their frequency on internet.

2. LITERATURE SURVEY

Barton proposed the initial reversible information hiding [2] . The algorithm showed that if and if it was authenticated, the digital information block might be restored to its original image. Celik et al.[3] presented a novel reversible (lossless) information hiding (embedding) method, which enabled the exact recovery of the original image on the process of the embedded information extraction. Tian[4] presented a novel reversible information embedding algorithm for digital images. The method explored the redundancy in digital images to gain very high embedding capacity when keeping the distortion low. Ni et al.[5] proposed a novel reversible information hiding algorithm. The method used the minimum or the zero points of the histogram of image and slightly changed the pixel grayscale values to hide information into the image. Based on a binary tree structure, Tai et al.[6] solved the problem of communicating pairs of peak points. While keeping the distortion low, the method obtained large hiding capacity by utilizing distribution of pixel differences. Li et al [7] proposed a new reversible watermarking method which uses prediction-error expansion (PEE), pixel selection and adaptive embedding. By calculating the absolute difference of its neighboring pixels, Chang et al. [8] proposed a reversible information hiding method which could judge whether a pixel is embeddable or not. Tang et al. [9] proposed a high capacity information hiding scheme using multi layer embedding (CRS), which could enhance the performance of information hiding system while keeping the distortion low. But, they all used raw image formats rather than the compressed image formats. In the network transmission, the transmission efficiency is also very important due to the lack of bandwidth. The above methods have made some achievements. Therefore, it is meaningful to explore reversible information hiding in compressed domain because the transmission bandwidth is restricted.So far, there are a number of compression algorithms or techniques proposed, including discrete wavelet transform (DWT) , discrete cosine transform (DCT), number theoretic transform (NTT), vector quantization (VQ) and side match vector quantization (SMVQ). These methods can reduce the transmission size of multimedia files, such as image and so on, on the Internet. The latter two are two famous block-based image compression techniques.

In 2005, Yang et al.[10] first presented a reversible images watermarking method using VQ compressed by modifying fast correlation VQ (MFCVQ). However, very low hiding capacity was the lack of Yang et al.'s method. To make up for the shortcoming of Yang et al.'s scheme, Lu et al [11]. designed a reversible information hiding method which using the VQ-index residual value coding technique. Lee et al[12]. proposed a novel highly efficient lossless information hiding scheme to achieve the aim of hiding secret information into vector quantization (VQ)-

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compressed images which could be losslessly recreated when the secret information was extracted in the receiver.Delp et al.[13] proposed the block truncation coding (BTC) which was another efficient lossy block-based image compression scheme besides VQ compression technique and SMVQ compression technique in 1979. High efficiency and an acceptable compression rate were obtained for image compression using BTC transforms technique.Chang et al.[14] proposed reversible information hiding method for block truncation coding compressed (BTC-compressed) color images. In order to increase the compression rate, the original three was replaced by an approximate optimal common bitmap using a genetic algorithm (GA).By introducing the joint neighboring coding (JNC) to BTC-compressed images, Sun et al.[15] presented a reversible data hiding scheme to enhance the hiding capacity. The extra information is needed in the process of their reconstructed images and cannot be obtained by a conventional BTC-decoding scheme directory for Chang et al.'s method and Sun et al.'s scheme. This made a hidden secret information insecure. Li et al [7] proposed a reversible data hiding scheme for BTC-compressed images in order to improve the security of embedded confidential information. The flipping and histogram shifting bitmap are used for the high mean values and low mean values. But, hiding capacity is not acceptable.

Maximo and Mitchell [16] presented an absolute moment block truncation coding technique (AMBTC technique) in 1984. AMBTC technique is an optimizational variant of BTC technique. It can further deflate the size of the compression codes while providing the same image quality for the compressed image by BTC. To improve the hiding capacity and obtain the good quality of the stego image after embedding secret information, Lin et al.[17] presented a reversible data hiding scheme that is based on the absolute moment block truncation coding compression (AMBTC compression) domain. The method could judge whether the block is embeddable or non-embeddable by utilizing the redundancy in a block of AMBTC-compressed images. The method designed four disjoint sets, including scenario (00), scenario (01), scenario (10) and scenario (11). By using different combinations of the mean value and the standard deviation, four disjoint sets are constructed for embeddable blocks to embed information. The method can not only achieve very high embedding capacity, but also keep the distortion low.

3. IMAGE COMPRESSION

The image is actually a kind of redundant data i.e. it contains the same information from certain perspective of view. By using data compression techniques, it is possible to remove some of the redundant information contained in images. Image compression minimizes the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a certain amount of disk or memory space. It also reduces the time necessary for images to be sent over the Internet or downloaded from web pages. Two elementary components of compression are redundancy and irrelevancy reduction. Redundancy reduction aims at removing duplication from the signal source image. Irrelevancy reduction omits parts of the signal that is not noticed by the signal receiver, namely the Human Visual System (HVS). Image compression is an application of data compression that encodes the original image with few bits. The objective of image compression is to reduce the redundancy of the image and to store or transmit data in an efficient form. In general, three types of redundancy can be identified: (a) Spatial Redundancy or correlation between neighboring pixel values, (b) Spectral Redundancy or correlation between different color planes or spectral bands and (c) Temporal Redundancy or correlation between adjacent frames in a sequence of images especially in video applications. Image compression research aims at reducing the number of bits needed to represent an image by removing the spatial and spectral redundancies as much as possible.

3.1 Fundamentals of Image Compression

A compression method consists of definitions of two complex processes compression and decompression.Compression is a transformation of original data representation into different representation characterized by smaller number of bits. Opposite process reconstruction of the original data set is called decompression.There can be distinguished two types of compression: lossless and lossy. In lossless compression methods, the data set reconstructed during decompression is identical as the original data set. In lossy methods, the compression is irreversible the reconstructed data set is only an approximation of the original image. At the cost of lower conformity between reconstructed and original data, better effectiveness of compression can be achieved. A lossy compression method is called "visually lossless" when the loss of information caused by compression-decompression is invisible for an observer (during presentation of image in normal conditions). However, the assessment, if a compression of an image is visually lossless, is highly subjective. Besides that, the visual difference between the original and decompressed images can become visible when observation circumstances change. In addition, the processing of the image, like image analysis, noise elimination, may reveal that the compression actually was not lossless. There are many ways to calculate the effectiveness of the compression. The most often used factor for this purpose is compression ratio (CR), which expresses the ability of the compression method to reduce the amount of disk space needed to store the data. CR is defined as number of bits of the original image (B_{org}) per one bit of the compressed image (B_{comp}):

$$CR=\frac{B\ org}{B\ comp}$$

The compression percentage (CP) serves the same purpose:

$$CP = \left(1 - \frac{1}{CR}\right).100\ \%$$

Another measure of the compression effectiveness is bit rate (BR), which is equal to the average number of bits in compressed representation of the data per element (symbol) in the original set of data. High effectiveness of a compression method manifests itself in high CR and CP, but in low BR. When time needed for compression is important must be used different factor product of time and bit rate. Here were mentioned only the most commonly used factors but there are many more ways to estimate the effectiveness.

4. CONCLUSION

This paper gave an overview of different steganographic techniques using Compression and Other than that we have critically analyzed the image compression technique and its fundamentals.

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