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A Review Paper on Joint Data Hiding and Compression Scheme based on SMVQ and Image Inpainting

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Abstract

Data hiding is mainly used to hide the secret data into a cover data like a video file, an audio file, an image, etc. It is popularly used in medical and military applications. Nowadays reversible data hiding is the latest research area in the field of secret data hiding techniques. This paper covers many hiding and compression techniques like vector quantization (VQ), side match vector quantization (SMVQ), histogram shifting technique, locally adaptive data compression technique, and many more. But the topic of our interest is side match vector quantization.

1. Introduction

Data hiding involves embedding significant data into various forms of digital media such as texts, audio, video, images, etc. secretly. It is a method of secret data transmission in the internet. Data hiding has been widely used in secret communication, copyright protection, and fingerprinting. The purpose of data hiding techniques is different from that of traditional cryptography or watermarking techniques. Cryptography encrypts the messages into a meaningless data while watermarking is used to protect the copyright.

There are mainly two types of data hiding techniques: irreversible and reversible data hiding techniques. In irreversible data hiding techniques, only the secret message is recovered, while in reversible data hiding technique, both the secret message and the cover media is recovered completely.

There are many data hiding techniques for the compressed data, which can be applied to various compression techniques of images like JPEG, JPEG2000 and vector quantization (VQ).

The VQ technique is very simple and cost-effective, but one of its main disadvantages is that the boundaries of the input block are clearly visible. Following figure shows the encryption and decryption process that takes place in reversible data hiding.

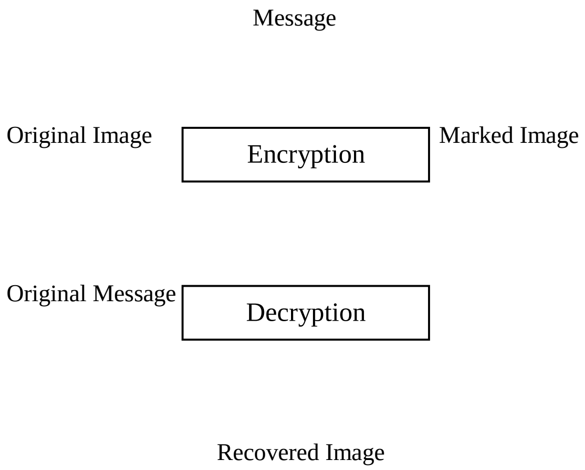

Figure 1 Block Diagram of Reversible Data Hiding Process

Two important uses of data hiding in digital media are to provide proof of copyright, and assurance of content integrity. Other applications of data hiding, such as inclusion of augmentation data need not be modified for detection or removal since this data may be useful for the author. Thus, the techniques used for data hiding vary depending on the quantity of the data being hidden and how that data would be modified after manipulation.

As the technology evolves, people are able to transmit and share the digital content with each other conveniently. Compression techniques can be implemented on the digital content to reduce redundancy and to guarantee communication efficiency. With the question of transmitting secret data privately, arises another question of security. For this, information hiding techniques have been developed which can embed secret data into cover data imperceptibly.

This paper covers various SMVQ based schemes. Section 2 covers the study of side-match vector quantization and histogram based reversible data hiding techniques. Section 3 gives an overview of the proposed technique. Section 4 illustrates the conclusion of the study.

2. Survey

In 2003, W. C. Du Ni et.al. [1] proposed a reversible data hiding based on adaptive compresses method. In this method, the VQ codebook was separated into two or three sub codebooks and the best one of the sub codebooks was found out to conceal the bits. This method increased the hiding capacity. Major drawback of this method was more distortion of extraction stage and recovered image.

In 2006, Chin-Chen Chang et.al. [2] proposed a new index-domain method based on SMVQ. This hides the secret data on the indices of SMVQ compressed images. It consisted of two stages: encryption and decryption . This technique was very simple and had a good image quality. The sizes of the codebooks generated by the LBG (Linde-Buzo-Gray) technique are 128,256 and 512. The main focus of this technique was to compress the image without distortion. A drawback of this technique was that at the extraction stage, it was time consuming.

In 2009, C. C. Lin et.al. [3] proposed an adaptive embedding technique which used VQ as the image compression technique. The main disadvantage of this technique was that it used VQ which is a lossy method for compression.

In 2010, Chin Feng Lee et.al. [4] proposed a multilevel reversible data hiding technique based on adaptive coding method. This method improved the quality of the marked images. The hidden data was embedded into smooth blocks and the hiding capacity of these blocks was increased. When the sizes of the codebooks varied among 32, 64, 128, 256, five codebooks of sizes 512 were generated using the LBG algorithm.

The Chang and Nguyen's scheme [5] was an effective data hiding technique. It used the combination of LAC (Locally Adaptive Coding) method and VQ.

There are mainly two types of reversible data hiding techniques: reversible data hiding by difference and reversible data hiding by histogram shifting. In 2013, Zhi Hui Wanga et.al. [6] proposed a reversible data hiding technique based on histogram method. In this technique, histogram shifting is applied on the difference of pixel values rather than the original pixel values.

In 2013, Chuan Qin et.al. [7] proposed a new method of steganographic data hiding based on histogram shifting. Here the peak and zero point are selected from the histogram of prediction error to encode the hidden bits by the histogram shifting operation. This technique has a good marked image quality and has good hiding capacity. The only disadvantage is that the hiding capacity is limited to the value of the peak point.

Lingfei Wang et.al. [8] proposed a reversible data hiding method using adaptive coding method in 2014. This technique uses SMVQ technique to overcome the disadvantage of VQ as well as increase the compression performance of VQ. In SMVQ, the first column and row blocks are encrypted by conventional VQ and the residual blocks are encoded in a raster scanning order using a smaller sub codebook which is generated by online side-match distortion prediction.

In 2014, Chuan Qin et.al. [9] proposed a joint data hiding and compression techniques based on side-match vector quantization (SMVQ) and image inpainting. Two functions, viz. data hiding and data compression can be integrated into one single function. Here, original uncompressed image sized M x N is divided into non-overlapping n x n blocks. The capacity is improved and the image quality is maintained.

3. Proposed Work

In all of the schemes, data hiding is always conducted after image compression, which means that the compression and hiding processes are two independent modules on the sender side. Under this circumstance, the attacker may have the opportunity to intercept the compressed image without the watermark information embedded, and the two independent modules may cause a lower efficiency in applications.

Thus, a joint data hiding and compression concept is established and the two separate modules are integrated into a single module seamlessly, which can avoid the risk of the attack from interceptors and increase the implementation efficiency.

SMVQ was designed as an improved version of VQ, which is a lossy data compression technique. The main disadvantage of VQ is that it does not consider correlation between neighbour blocks. SMVQ improves compression performance of VQ by removing such redundancies.

The main objective is to study and analyze various data hiding techniques and to get acquainted with different types of shifting and embedding functions related to SMVQ. A new algorithm would improve the hiding capacity and marked image quality by using the SMVQ method.

4. Conclusion

In this paper, various existing algorithms related to SMVQ technique have been discussed. Due to ease of implementation and good marked image quality, SMVQ is used more suitably for effective data hiding. This paper discusses many techniques to improve the hiding capacity and also improve the quality of the image. Combinations of various schemes can be done to get more efficient data hiding scheme. The embedding capacity and image quality can be improved by using the newly designed joint data hiding and compression algorithm.

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