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DATA HIDING AND COMPRESSION METHOD FOR DIGITAL IMAGES USING SIDE MATCH VECTOR QUANTIZATION

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ABSTRACT:

In the emerging technology people used to share and transmit digital content with each other conveniently. In order to guarantee communication efficiently and save the network bandwidth, data hiding and compression technique are implemented jointly in a single module. Today reversible data hiding is considered as one of the latest research area in the field of secret data hiding technique. Basically data hiding in our proposal is applied in such a way that the secret data are hidden in some cover images such as audio, video, image, etc. This paper covers mainly on data hiding and compression techniques like vector quantization and side match vector quantization.

***Index terms*:**

Data hiding, image compression, vector quantization, side match vector quantization.

I. INTRODUCTION:

Data hiding plays an important role in the field of information security. This technique can be used to prevent the transmitted content from the impending attraction of malicious attackers. As a result, the privacy of secret information is maintained. The use of data hiding techniques is altered from that of traditional cryptography or watermarking techniques. The role of cryptography is to encrypt the message into a meaningless data in such a way that it should not be attacked by any foreign agent. Beside cryptographic method the use of watermarking is to protect the copy right.

There are mainly two types of data hiding techniques. They are

- Reversible data hiding.
- Irreversible data hiding.

In reversible data hiding method both the secret message and the cover media are recovered completely, but in irreversible data hiding method only secret message are recovered. Some of the two important uses of data hiding in digital media are to provide the proof of the copyright and assurance of content integrity. Another application includes the inclusion of argumentation of data.

With a rapid development of internet technology, people used to convey their data and sent them in such a way that they are effectively utilized in order the scrambling problem are reduced. Image compression techniques reduce the redundancy and irrelevance of the image pixels in order to able to store or transmit information in an efficient manner.

Two different types of compression techniques are as follows. They are

- Lossy compression technique
- Lossless compression technique

Lossy compression techniques creates smaller image by discarding excess image pixel from the original image. Whereas in lossless compression technique, it never removes any

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pixels from the original image instead data's are represented in a mathematical formula.

which are applied to various compression techniques of digital images, such as JPEG, JPEG 2000 and vector quantization. Generally vector quantization is considered one of the most simplest and popular lossy compression method, because due its plainness and cost effectiveness in implementation. During the compression process of vector quantization, Euclidean distance is utilized to evaluate the similarity between each image block and codebooks are used for assigning code word in each image block. While moving to the decompression process only a simple lookup table operation is required for retrieving the corresponding index values in each block. The rest of the paper is organized as follows. Section II describes the existing studies. Proposed work is given in section III and section IV concludes the experimental results and conclusion in section V.

II. EXISTING STUDIES

Among many image compression technique vector quantization is one of the most accepted method. During the year of 2003, Du and Hsu [3] projected an adaptive data hiding method for vector quantization compressed images, in this method the process of embedding is varied based upon the amount of data hidden in it. In this method the codebook was sub divided into two or more sub codebook, and the best match is used for hiding the secret data. Later this method is found to have a low embedding capacity. In order to improve its embedding rate, a VQ-based data-hiding scheme by a code word clustering [4] technique was proposed. Here the secret data were embedded into the VQ index table by code word-order-cycle permutation. In this technique, more possibilities and flexibility can be offered to improve its performance. In 2009 Lin and Chen [5] adjusted the pre-determined distance threshold according to the required hiding capacity and arranged a number of similar code words in one group to embed the secret sub-message. The search-order coding

Presently, different types of data hiding schemes for the compressed codes has been reported

(SOC) algorithm was proposed by Hsieh and Tsai [6] , which can be utilized to further compress the VQ index table and achieve better performance of the bit rate through searching nearby identical image blocks following a spiral path. Some steganographic schemes were also proposed to embed secret data.

However in all the above schemes, data hiding and compression are performed separately in a single module. Under this condition the foreign users may have an opportunity to intercept the compressed image and which leads to lower efficiency in many applications.

III. PROPOSED WORK

In order to overcome the drawbacks of existing studies, the proposed method establishes a joint data hiding and compression process. Here the process of data hiding and compression are found to be integrated in a single module which avoids the risks of foreign attackers and increases its implementation efficiency. The proposed method is based on the use of side match vector quantization.

A. Image Compression Technique

In our scheme, the sender and the receiver both have the same codebook with W code words, and each code word length is n^2. Denote the original uncompressed image sized $M \times N$ as **I**, and it is divided into the non-overlapping $n \times n$ blocks. For simplicity, we assume that M and N can be divided by n with no remainder. Denote all k divided blocks in raster scanning order as $\mathbf{B}i, j$, where $k = M \times N/ n2$, $i = 1,2, . . , M/n$ and j = 1,2, .N/n. Before being embedded, the secret bits are scrambled by a secret key to ensure security. The blocks in the leftmost and topmost of the image **I**, i.e.,$\mathbf{B}i,1(i = 1, 2, . . . , M/n)$ and $\mathbf{B}1, j\ (j = 2, 3, . . . , N/n)$, are encoded by VQ directly and are not used to embed secret bits. The residual blocks are encoded progressively in raster scanning order, and their encoded

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methods are related to the secret bits for

B. Secret Data Embedding Algorithm

The process of secret data embedding into the JPEG compressed image includes the following steps.

1. Get an image and apply the process of entropy decoding.
2. Let *F* be the quantized DCT block with *F*(*i*, *j*). Embed the secret data with length *E*(*i*, *j*) in the LSBs of *F*(*i*, *j*).
3. The process of data hiding and compression follows the raster scanning order to embed the secret bit.
4. The blocks are chosen based on L-shape pattern.
5. After the blocks are chosen the secret data's are embedded based on the threshold value. The process gets stopped after all blocks are embedded by secret data.

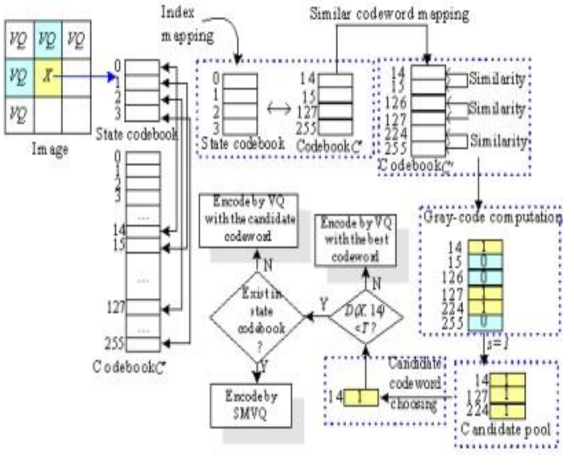

Fig.1 Flow chart of the data embedding phase

C. Data Extracting Algorithm

The process of secret data extraction includes the following steps

1. Let the currently processed (decoded) image block be *xi*, extract the first bit from the received bit stream.
2. If the extracted indicator bit is equal to 0, read the index value with log w bits and decompress it by using VQ and extract the watermark bit.
3. Otherwise if the extracted indicator bit is

embedding.

equal to 1, read the index value with

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log (R+1) bits and decompress it by using SMVQ and extract the watermark bit.

4. The process is repeated to the overall bit stream and the corresponding secret data are extracted.

The figure 2 shows the data extracting phase.

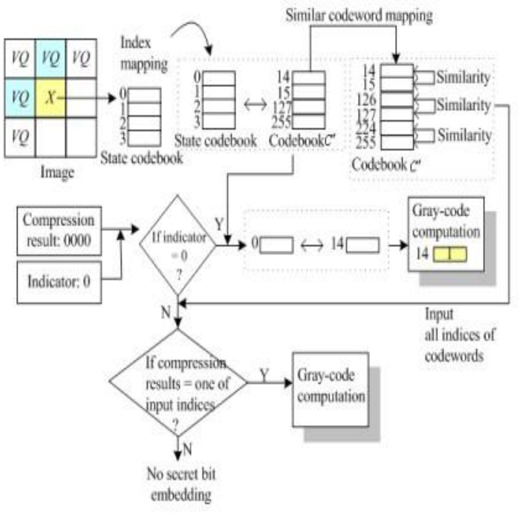

Fig.2 Flow chart of the data extraction phase

IV. EXPERIMENTAL RESULTS

Experiments were conducted on a group of gray-level images to verify the effectiveness of the scheme. In this experiment, the sizes of the images were divided into non-overlapping image blocks i.e., $n = 4$. Accordingly, the length of each codeword in the VQ codebooks was 16. The parameter P was set to 15. Six standard, 512 × 512 test images are shown in figure 3 i.e. Lena, Airplane, Lake, Peppers, Sailboat, and Tiffany, are shown in. Apart from this six standard images, the uncompressed color image database (UCID) also contains 1338 various color images with sizes of 512 × 384 was also adopted. The luminance components of the color images in this database were used in the experiments. The performance of compression ratio, decompression quality, and hiding capacity for the proposed scheme were evaluated. All experiments were implemented on a computer with Windows 7 operating system, and the programming software was Mat lab.

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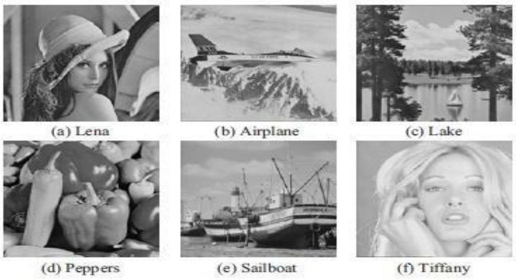

Fig. 3 Six standard test images.

In this scheme, the hiding capacity and the visual quality of cover images are mainly affected by the three parameters, the variance threshold *THvr*, the side match distortion threshold *THsmvd*, and the side-match state code book size *p*. These parameters are familiar based on the amount of data hidden and the characteristics of the cover image. They can be used as keys for the extraction of secret data. If *THvr* is set with a well-built value, more blocks will be treated as even blocks and, consequently, more secret data can be unseen into a cover image. However, the visual quality of cover image will be degraded, since more blocks were directly predicted by the proposed scheme. If *THsmvd* is given as a well-built value, more even blocks will be selected for hiding data. Therefore, the hiding capacity increases and the visual quality is reduced for the cover image. If *p* is assigned to be a well-built value, more code words are included into the state codebook and the selected even blocks will be encoded (predicted) more randomly. Accordingly, the visual quality of cover image degrades while the hiding capacity increases.

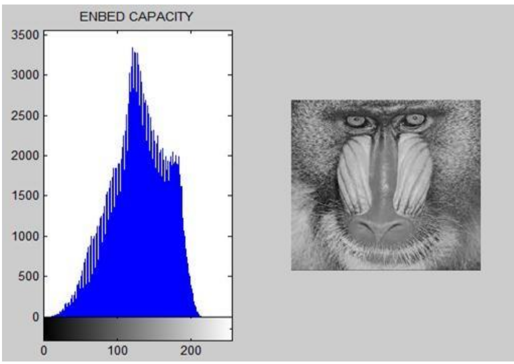

Fig.4 Image representing hidden data and histogram

Besides, we employed the peak signal-to-noise ratio (PSNR) as a measure of the stegno-image quality. It is defined as follows:

$$\text{PSNR} = 10 \times \log_{10} \frac{255^2}{MSE} \text{dB}$$

Where,*MSE* is the mean-square error. For an $N \times N$ image, its *MSE* is defined as,

$$MSE = \left(\frac{1}{N}\right)^2 \times \sum_{i=1}^{N} \sum_{j=1}^{N} \left(x[i,j] - \bar{x}[i,j]\right)^2.$$

Here, $x[i, j]$ and $\bar{x}[i, j]$ denote the original and decoded gray levels of the pixel $[i, j]$ in the image, respectively. A well-built PSNR value means that the stegno-image preserves the original image quality better. Our method employs the capacity factors α to control the level of embedding capacity. Users can adjust it to balance between the image quality (PSNR) and the embedding capacity. If the capacity factor is selected as a large number, then the embedding capacity can be raised, but the cost is that the compression ratio of the image gets low. Through quite a number of experiments, the capacity factor α is finally selected for uniform blocks, and 1.1 α for non-uniform blocks.

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V. CONCLUSION

The main contribution of the proposed method is to improve the data hiding capacity. Our method embeds a joint data-hiding and compression scheme by using SMVQ. The blocks, except in the leftmost and topmost of the image, can be embedded with secret data and compressed simultaneously, and the adopted compression method switches between SMVQ adaptively according to the embedding bits. VQ is also utilized for some complex blocks to control the visual distortion and error diffusion. On the receiver side, after segmenting the compressed codes into a series of sections by the indicator bits, the embedded secret bits can be easily extracted according to the index values in the segmented sections, and the decompression for all blocks can also be achieved successfully by VQ, SMVQ. Ours is an adaptive data hiding method with which one can adjust capacity factor to balance between the image quality and the embedding capacity dynamically.

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