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A NOVEL JOINT DATA-HIDING AND COMPRESSION SCHEME BASED ON SMVQ AND IMAGE IN PAINTING

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Abstract: - We propose a novel joint data-hiding and compression scheme for digital images using Side Match Vector Quantization (SMVQ) and image in painting. The two functions of data hiding and image compression can be integrated into one single module seamlessly. On the sender side, except for the blocks in the leftmost and topmost of the image, each of the other residual blocks in raster-scanning order can be embedded with secret data and compressed simultaneously by SMVQ or image in painting adaptively according to the current embedding bit. VQ is also utilized for some complex blocks to control the visual distortion and error diffusion caused by the progressive compression. After segmenting the image compressed codes into a series of sections by the indicator bits, the receiver can achieve the extraction of secret bits and image decompression successfully according to the index values in the segmented sections. Experimental results demonstrate the effectiveness of the proposed scheme.

1. INTRODUCTION

Recently, many data-hiding schemes for the compressed codes have been reported, which can be applied to various compression techniques of digital images, such as JPEG, JPEG2000, and vector quantization (VQ). As one of the most popular Lossy data compression algorithms, VQ is widely used for digital image compression due to its simplicity and cost effectiveness in implementation. During the VQ compression process, the Euclidean distance is utilized to evaluate the similarity between each image block and the code words in the codebook. The index of the codeword with the smallest distance is recorded to represent the block.

2. HISTORY

The concept of information hiding was first documented in a project by David Parnas, "On the Criteria to Be Used in Decomposing Systems Into Modules" published in the Communications of the ACM in December 1972. Before then, modularity was discussed by Richard Gauthier and Stephen Pont in their 1970 book titled Designing Systems Programs although modular programming itself had been used at many commercial sites for many years previously - especially in I/O sub-systems and software libraries- without acquiring the 'information hiding' tag - but for similar reasons (as well as the more obvious code reuse reason).

3. IMAGE COMPRESSION AND SECRET DATA EMBEDDING

As an extension of VQ, SMVQ was developed to alleviate the block artifact of the decompressed image and increase the compression ratio, because the correlation of neighbouring blocks is considered and the indices of the sub code books are stored. In our scheme, the standard algorithm of SMVQ is modified to further achieve better decompression quality and to make it suitable for embedding secret bits.

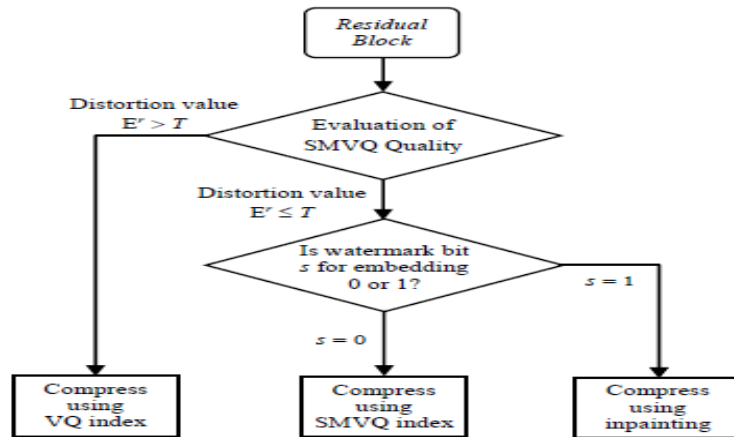


Fig. 1. Flowchart of compression and secret data embedding for each residual block

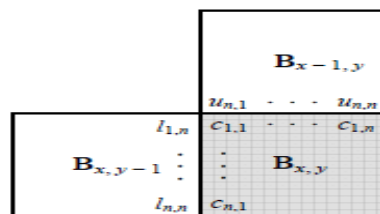


Fig. 3.1. Illustration of the prediction based on left and up neighboring pixels

4. IMAGE DECOMPRESSION AND SECRET DATA EXTRACTION

After receiving the compressed codes, the receiver conducts the decompression process to obtain the decoded image that is visually similar to the original uncompressed image, and the embedded secret bits can be extracted either before or during the decompression.

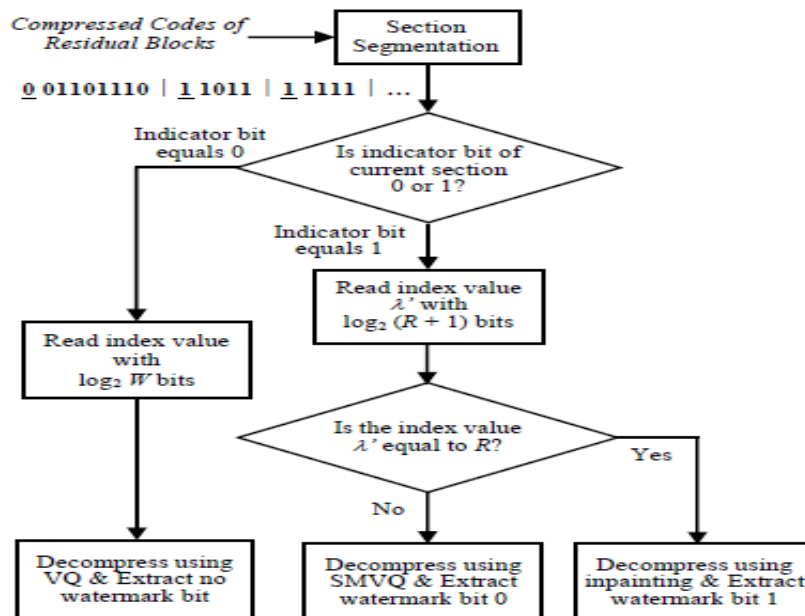


Fig. 4.1. Flowchart of decompression and secret data extraction for each residual block

5. IMAGE IN PAINTING

Painting is the process of reconstructing lost or deteriorated parts of images and videos. For instance, in the museum world, in the case of a valuable painting, this task would be carried out by a skilled art conservator or art restorer. In

the digital world, in painting (also known as image interpolation or video interpolation) refers to the application of sophisticated algorithms to replace lost or corrupted parts of the image data (mainly small regions or to remove small defects).

6. SIMULATION RESULTS

6.1. Encryption Results

- Original Image



Fig.6.1: Original Image

- Secret Image



Fig.6.2: Secret Image

- Corrupted Encrypted Image



Fig.6.3: Corrupted image (After Encryption without In painting)

- In painted Image



Fig.6.4: In painted Image

6.2. Decryption Results

- Encrypted Image



Fig.6.5: Input image for Decryption

- Decrypted Image

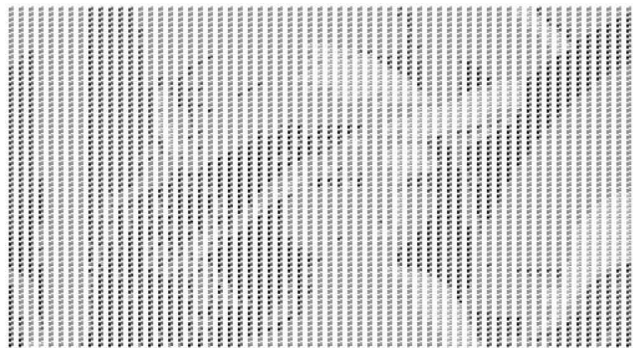


Fig.6.6: Original Image (After Decryption)

- Secret image



Fig.6.7: Secret Image (After Decryption)

CONCLUSION

In this paper we proposed a joint data-hiding and compression scheme by using SMVQ and PDE-based image in painting. The blocks, except for those 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 and image in painting 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, and image in painting. The experimental results show that our scheme has the satisfactory performances for hiding capacity, compression ratio, and decompression quality. Furthermore, the proposed scheme can integrate the two functions of data hiding and image compression into a single module seamlessly.

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