JDHC Technique by using SMVQ Scheme for Enhancing the Quality of Digital Image

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Abstract— In this paper, we propose joint data-hiding and compression scheme base on SMVQ and Image Inpainting. Supported these two techniques the data-hiding scheme has been projected for up the compression rate of data-hiding supported VQ. Data-hiding is that the most vital technique to cover data in media career. Inpainting technique is employed to modifying a picture in associate degree undetectable type. The goal of data-hiding and image inpainting is to secure data. It embeds the key information before compression to consume memory. On the sender side except the leftmost and uppermost of the image each of the other residual blocks square measure used for embedding with secret information and compression simultaneously by using SMVQ and image Inpainting. The SMVQ and Imaged Inpainting techniques are integrated into single module. That compressed image with divided bits, the receiver can do the decompressed image per the index value and extraction of secret bit with none loss mistreatment these SMVQ and Imaged Inpainting.

Key words: Image compression, SMVQ, VQ, Data hiding, image inpainting

I. INTRODUCTION

Using quicker web technology, we are able to transmit and share digital content with one another convenient and simply. So as to deposit communication potency and network information measure, compression techniques will be enforced on digital content to cut back redundancy, and therefore the quality of the decompressed versions ought to even be protected. Nowadays, most digital content particularly digital pictures and videos, area unit born-again into the compressed forms for transmission.

Image, audio, video, and many other kinds of data are nowadays mostly passed from person to person or from place to place to position in a very digital form. It is typically fascinating to plant knowledge into the digital contents for copyright management and authentication, or for secret data hiding. Data-embedding techniques designed to require care of such tasks area unit normaly classified as watermarking or data hiding techniques in accordance with their functionalities. In robust watermarking strategies, the hidden information remains robust against manipulations from any potential sources as well as hostile ones. Thus such strategies area unit sometimes developed to guard copyright [1].

Many data-hiding schemes for the compressed codes are reported, which might be applied to varied compression techniques of digital images, like JPEG, JPEG2000, and vector quantization (VQ). United of the most popular lossy data compression algorithms, VQ is wide used for digital compression because of its simplicity and value effectiveness in implementation. Data hiding in images presents a range of challenges that arise because of the approach the human visual system (HVS) works and also the typical modifications that images endure. To boost, still images offer a comparatively little host signal during which to cover data hiding. A reasonably typical 8-bit picture provides more or less 40 kilobytes of data area during which to figure. This can be like solely around 5 seconds of telephone-quality audio or but one frame of NTSC television. Also, it is reasonable to expect that also pictures are subject to operations starting from easy affine transforms to nonlinear transforms like cropping, blurring, filtering, and lossy compression. Sensible data-hiding techniques have to be compelled to be immune to as several of those transformations as potential.

In a VQ-compressed image, the worth of associate index of codeword is equivalent to the value of a pixel within the spatial domain. To introduce a message into a VQ-compressed image, associate index of codeword is replaced by another index of codeword that is assigned to introduce the message. Thus, the planned embedding algorithm is completely different from LSB embedding which is simply replaces the LSBs of a component with the message to be embedded. It is very difficult to accurately detect whether a stego-image embeds some hidden data, especially when the stego-image embeds only a small amount of data. Therefore, the undetectibility with regard to blind steganalysis attacks is also preserved [2].

First of all, the SOC algorithm encodes every index within the index table one by one and with the formation scan order, that is from left to right and high to bottom. With deep insight into the SOC algorithm, the most plane is to search out identical index round the current processed index in a very predefined search path and to encode the current processed index with the search-order code instead of its original index value. All of the indices showing within the predefined search path are called search points (SP), and non-search points are those indices that seem when the present processed index within the formation scan order.

Search order codes are generated in keeping with the comparison order of the SPs and also the current processed index. If none of the SPs matches with the current processed index, the initial index price is preserved. Note that associate indicator, of that the length will be 1-bit, shoul be added in front of the result compression codes of each index in order to differentiate search-order codes from the original index value [3]. Digital techniques are starting to be a widespread manner of playacting inpainting, starting from tries to completely automatic detection and removal of scratches in film, all the way to software tools that allow a sophisticated but mostly manual process.

The repairing procedure checks the surrounding information of a damaged pixel and determines the size of the reference window that can be used to compute an interpolated color. This methodology cannot manufacture satisfactory results once the repaired pixels are close to edges. Mairal et al established dictionaries for color images by learning, and so used distributed illustration and generalized K-means cluster, termed K-SVD, to handle noise and restore low quality images. An inpainting methodology for recovering an original scene from degraded images was proposed. It consists of a replacement inter-pixel relationship perform and therefore the several refinement to synthesize missing pixels from existing spatially co-related pixels [5].

Data hiding techniques, at only secret message is recovered and cover image is impressive but in reversible data hiding (RDH) both secret message and cover media is completely obtained again. In the other word original message and image are return. In 2003 W. C. Du Ni et.al. Proposed first based on Adaptive compressed method. In this method, the VQ codebook was separated into two or three sub-codebooks, and best one of the sub-codebooks was found out to conceal/secret bits. This method increases the hiding capacity. Major drawback of this method was more misrepresentation of extraction stage and recovered image. In 2006, Chin-Chen Chang et.al proposes a replacement index domain technique supported SMVQ method. This hide the key information on the indices of the SMVQ image compressed.. Main disadvantage longer consume of extraction stage and recovered image.

Although the normal VQ scheme exploits the applied mathematics redundancy inside a vector and yields suitable performance at low bit rates, the finite-state vector quantization (FSVQ) schemes can improve performance over the normal VQ by exploiting the correlation between neighboring vectors inside a picture. The encryption state of the current input vector is decided by the previous encoded neighboring vectors. Hence, the encoding time can be reduced, and the image quality can be maintained at the lower bite rate. Moreover, side-match finite-state vector quantization (SMVQ) is a popular class of FSVQs. The fundamental plan of SMVQ is to predict the current encryption vector by exploiting the correlations of encoded upper and left vectors for the current input vector. A set of codewords are going to be elite from the master codebook by victimization the SMVQ selection function. Usually the closest codeword for the current input vector can be found in the selected codewords. In this work, when the correlations between the neighboring vectors are not high, the codewords selected by the SMVQ will be not close enough to the current input vector and achieve a large distortion within the image writing process.

II. Joint Data Hiding and Compression Scheme

Many data-hiding schemes for the compressed codes are according, which might be applied to numerous compression techniques of digital images, like JPEG, JPEG2000, and vector quantization (VQ). In concert of the foremost fashionable lossy knowledge data compression algorithms, VQ is wide used for digital compression attributable its simplicity and cost effectiveness in implementation.

Two concepts are involved here,

- Data-Hiding
- Compression

A. *Data Hiding:*

Data hiding in an image involves embedding an oversized quantity of secret information into a cover image with negligible perceptible degradation of image quality. However, the hiding capacity for secret data and the distortion of the cover image are a trade-off since a lot of hidden data always results in more degradation on the visual quality of the cover image. Moreover, when data hiding is implemented on the compressed domain of image, the hiding capacity and the visual quality of cover images can be further restricted. During the last decade, vector quantization (VQ) has emerged as an efficient method in compression. One specific feature of VQ is that prime compression ratios are possible with relatively small block sizes.

B. *Compression:*

Compression can be either lossy or lossless.

1) *Lossless Compression:*

A lossless data compression algorithm sometimes exploits applied mathematically redundancy to represent data additional shortly while not losing information, so that the process is reversible. It is potential as a result of most real-world data has statistical redundancy.

2) *Lossy Compression:*

Lossy data compression is that the converse of lossless data compression. During this scheme, some loss of information is appropriate. Dropping nonessential detail from the data source can save storage space. Lossy compression may be utilized in digital cameras, to extend storage capacities with marginal degradation of picture quality. DVDs use the lossy MPEG-2 Video codec for video compression. In lossy audio compression, methods of psychoacoustics are used to remove non-audible elements of the audio signal.

III. Compression and Secret Data Embedding

The goal of the proposed scheme is to cover secret data or images into the host image whereas conserving the nice image quality of the stego image. To attain the goal, the SMVQ scheme is used to compress the secret data before they are embedded into the host image. According to the secret bits for embedding, the image compression based on SMVQ is adjusted adaptively by incorporating the image in-painting technique. Once receiving the stego-image, one will extract the embedded secret bits with success throughout the compression.

IV. Encryption

Image compression and secret data embedding is performing in the cryptography method. As associate extension of VQ, SMVQ is develop to alleviate the block whole of the decompress image and will increases the compression ratio, because the correlation of neighboring blocks is consider and indices of the sub codebooks are stored. In this scheme, the standard algorithm of VQ is modified to further achieve better decompression quality and to make it suitable for embedding secret bits. The detailed procedure is described as follows. In this scheme, the sender and the receiver both have the same codebook Ψ with W codewords, and each codeword length is n2. Denote the initial uncompressed image sized M × N as I, and it is divided into the non-overlapping n × n blocks. For simplicity, we have a tendency to assume that M and N may be divided by n with no remainder. Denote all k divided blocks in raster-scanning order as atomic number 83, j, whereas k = M × N / n2, I = 1, 2, …, M / n, and j = 1, 2, …, N / n. The blocks in the leftmost and topmost of the image I, i.e., Bi,1 (i = 1, 2, …, M / n) and B1,j (j = 2, 3,…, N / n), are encoded by VQ directly and are not used to embed secret bits. Denote the current processing block as Bx,y (2 ≤ x ≤ M / n, 2 ≤ y ≤ N / n), and its left and up blocks are Bx, y − 1 and Bx − 1, y, respectively. cp,1 (1 ≤ p ≤ n) and c1,q (2 ≤ q ≤ n) represent the 2n − 1 pixels in the left and upper borders of Bx, y. The n pixels in the right border of Bx, y − 1 and the n pixels in the bottom border of Bx − 1, y are denoted as lp,n (1 ≤ p ≤ n) and un,q (1 ≤ q≤ n), respectively. Similar with SMVQ, the 2n − 1 pixels in the left and upper borders of Bx, y are predicted by the neighboring pixels in Bx, y − 1 and Bx − 1, y: c1,1 = (l1,n + un,1) / 2, cp,1 = lp,n (2 ≤ p ≤ n), and c1,q = un,q (2 ≤ q ≤ n). Rather than all n2 pixels in Bx, y, only these 2n − 1 predicted pixels are used to search the codebook Ψ. After transforming all W codewords in the codebook Ψ into the n î n matrices, the mean square error (MSE) Ew is calculated between the 2n − 1 predicted pixels in Bx,y with the corresponding values of each transformed codeword Cw sized n × n. where cp,qw are the elements of each codeword Cw in codebook Ψ. The R codewords with the smallest MSEs, i.e., Ew, are selected to generate one subcodebook Θx, y for the block Bx,y (R < W). Suppose that, among the R codewords in Θx, y, the codeword indexed λ has the smallest MSE, i.e., Er ,with all n2 pixels in Bx, y (0 ≤ λ ≤ R − 1). The residual blocks are encoded progressively in raster -scanning order, and their encoded methods are related to the secret bits for embedding and the correlation between their neighboring blocks. SMVQ is utilized to conduct compression, which means that the index value λ occupying log2 R bits is used to represent the block Bx,y in the compressed code. Because the codeword number R in subcodebook Θx,y is less than the codeword number W of the original codebook Ψ, the length of the compressed code for Bx,y using SMVQ must be shorter than using VQ. The used image inpainting technique is represented within the next subsection detailed. Then, the compressed codes of all image blocks are concatenated and transmitted to the receiver side.

$$E^w = \sum_{p=1}^{n}(c_{p,1}-c_{p,1}^{w})^2 + \sum_{q=2}^{n}(c_{1,q}-c_{1,q}^{w})^2 ,$$

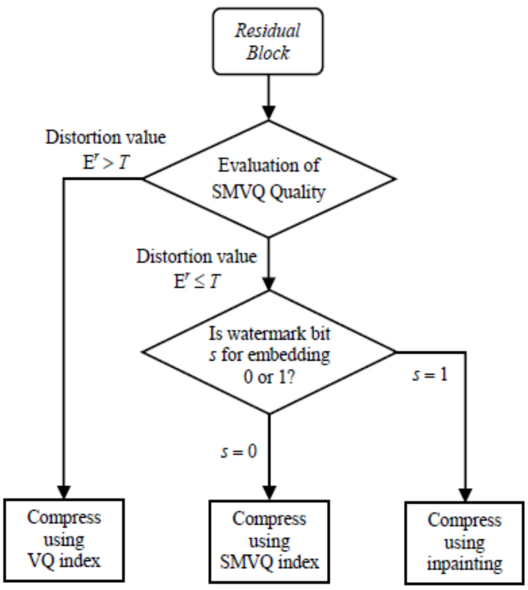

Fig. 1: Flowchart of compression and secret data embedding for each residual block

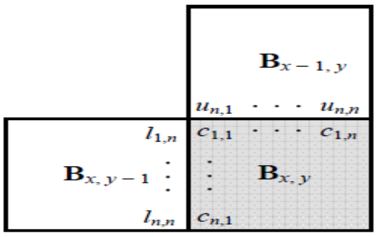

Fig. 2: Residual Block

V. DECRYPTION

Image decompression and secret data extraction is performed within the decryption method. Once receiving the decompressed codes, the receiver conducts the decompression method to get the rewrite image that is visually the same as the initial uncompressed image, and also the embedded secret bits can be extracted either before or during the decompression process. Because the (M + N − n) / n blocks in the leftmost and topmost of the image need to be used in the decompression for other residual blocks, they should be first decompressed by their SMVQ indices retrieved from the image compressed codes. Each SMVQ index of these pre-decompressed blocks occupies log2 W bits. Then, the k - (M + N − n) / n residual blocks are processed block by block in raster-scanning order and secret bit extraction for each residual block. To conduct the decompression and secret bit extraction of every residual block, the compressed codes are segmental into a series of sections adaptively in keeping to the indicator bits. If the current indicator bit is 1, this indicator bit and the following log2 (R + 1) bits are then segmented as a section, which means this section corresponds to an SMVQ compressed block. After extracting a secret data, image edge based harmonic in-painting technique is employed for reconstructing lost or deteriorated parts of the images Therefore, besides the image compression, the proposed scheme Image decompression and secret data extraction is performed within the decryption process. Once receiving the decompressed codes, the receiver conducts the decompression process to obtain the decode image that is visually similar to the original uncompressed image, and also the embedded secret bits can be extracted either before or during the decompression process. As a result (M + N − n) / n blocks in the leftmost and topmost of the image need to be used in the decompression for other residual blocks, they should be first decompressed by their SMVQ indices retrieved from the image compressed codes. Each SMVQ index of these pre-decompressed blocks occupies log2 W bits. Then, the k - (M + N − n) / n residual blocks are processed block by block in raster-scanning order and secret bit extraction for each residual block. To conduct the decompression and secret bit extraction of each residual block, the compressed codes are segmented into a series of sections adaptively according to the indicator bits. If the current indicator bit is 1, this indicator bit and the following log2 (R + 1) bits are then segmented as a section, which means this section corresponds to an SMVQ compressed block.

After extracting a secret data, image edge primarily based harmonic in-painting technique is employed for reconstructing lost or deteriorated parts of the images Therefore, besides the image compression, the proposed scheme can achieve the function of data hiding that can be used for covert communication of secret data. The sender will transmit the key data firmly through the image compressed codes, and also the receiver will extract the hidden secret data effectively from the received compressed codes to complete the method of covert communication. Additionally, because the secret data extraction in our scheme can be conducted independently with the decompression process, the receiver can obtain the secret bits at any time if he or she preserves the compressed codes.

The proposed scheme can also be used for the integrity authentication of the images, in which the secret bits for embedding can be regarded as the hash of the image principle contents. The receiver can calculate the hash of the principle contents for the decompressed image, and then compare this calculated hash with the extracted secret bits.

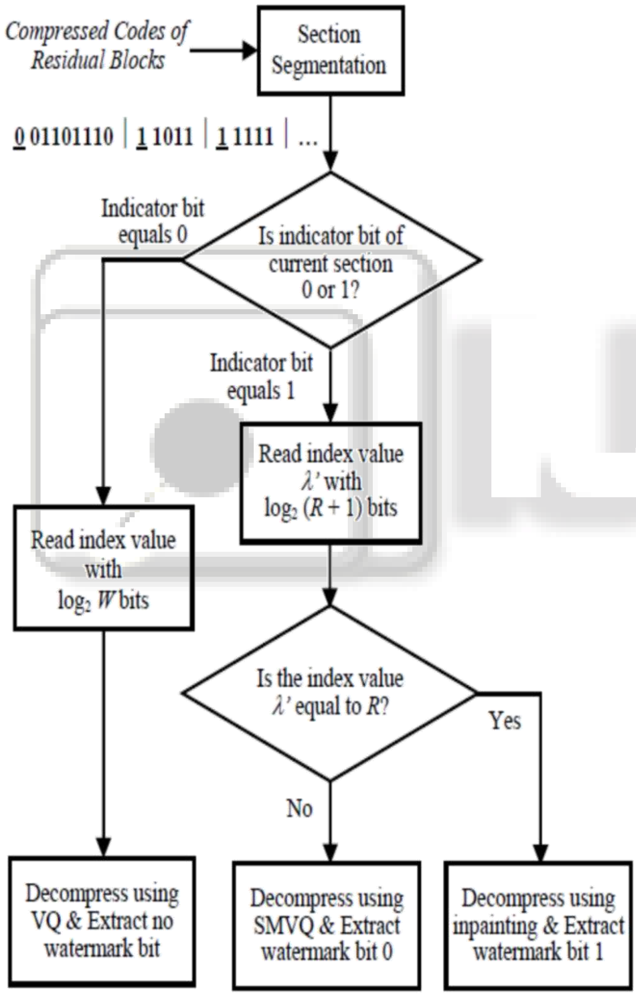

Fig. 3: Flowchart of decompression and secret data extraction for each residual block

VI. PROPOSED TECHNIQUE

A. JPEG 2000 Standard:

JPEG 2000[5] supports multiple-element pictures. Completely different components need not have constant bit depths nor have to be signed or unsigned. For reversible (i.e., lossless) systems, the only requirement is that the bit depth of each output image component must be identical to the bit depth of the corresponding input image component. Component transformations improve compression and allow for visually relevant quantization. The quality standard supports two different component transformations, one irreversible component transformation (ICT) which will be used for lossy secret writing and one reversible component transformation (RCT) that will be used for lossless or lossy secret writing, and all this in addition to encryption will not color transformation. The block diagram of the JPEG 2000 multi component encoder is depicted.

VII. RESULTS AND OUTPUT:

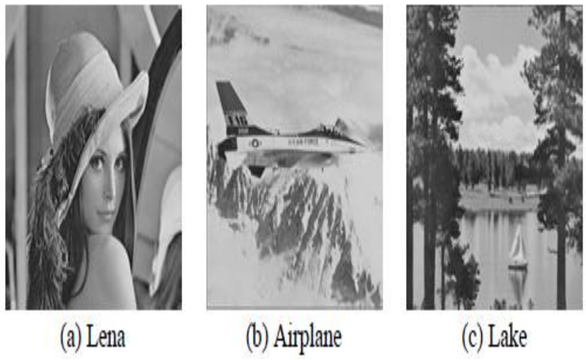

Fig. 4: Three standard test images

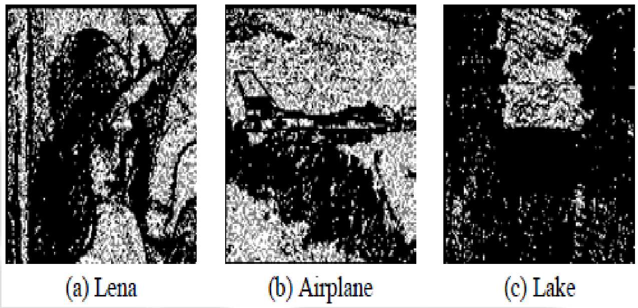

Fig. 5: Labels of image blocks with different types ($T = 16$). The black block, gray block, and white block in Figures 5(a)-(c) correspond to the blocks compressed by VQ, SMVQ, and image inpainting, respectively.

Experiments were conducted on a group of gray-level images to verify the effectiveness of the proposed scheme. In the experiment, the sizes of the divided non-overlapping image blocks were 4×4, i.e., $n = 4$. Accordingly, the length of each codeword in the used VQ codebooks was 16. The parameter R was set to 15. Six standards, 512×512 test images, i.e., Lena, Airplane, Lake, are shown in Figure 4. Besides these three standard images, the uncompressed color image database (UCID) that contains 1338 various color images with sizes of 512×384 was also adopted.

VIII. CONCLUSION

In this paper, we tend to project a joint data-hiding and compression scheme by using SMVQ and image edge primarily based harmonic in-painting. The blocks, apart from those within the leftmost and topmost of the image, may be embedded with secret data and compressed simultaneously, and the adopted compression method SMVQ per the embedding bits. VQ is also utilized for some complex blocks to control the visual distortion and error diffusion. On 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 value in the segmented sections, and the decompression for all blocks can 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.

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