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Integrated Data Hiding and Lossless Image Compression based on SMVQ and Image Inpainting

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Abstract: ***Today Reversible data hiding (RDH) is latest research area in field of data concealment scheme. In RDH, the data to be cover up is embedded in the cover image and at the origin side both conceal secret and cover image is reconstructed without any misrepresentation. In this paper we represent a RDH technique based on side match vector quantization for images. Two function data hiding and image compression can be integrated together into one single module .Experiment result show the performance of our proposed schemes better than those of other information schemes for VQ-based and SMVQ based compressed images. This scheme improved the performance of hiding capacity, compression ratio and SSIM, and also improved the performance of decompression quality.***

Keywords: Reversible Data hiding, Histogram shifting, lossless compression, image compression, Side match vector quantization

1. Introduction

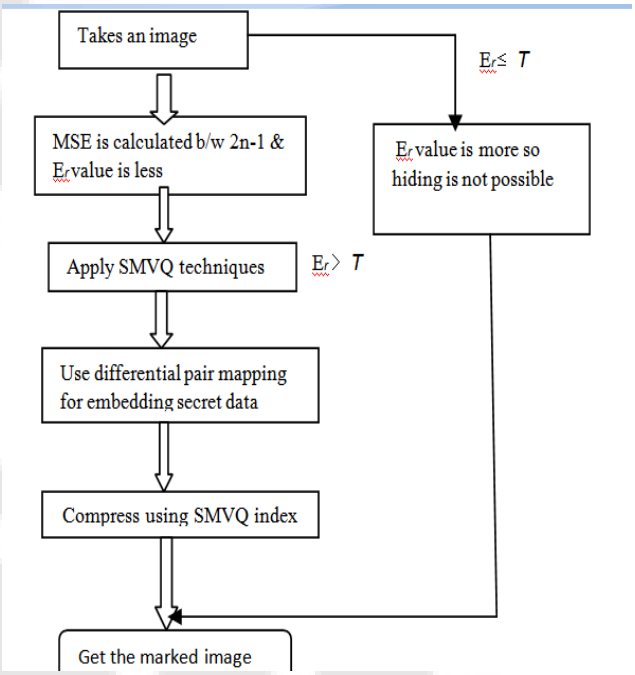
Data hiding is method of transmitting secret data to the Internet. There are mainly two types of the Data hiding techniques: -

- Irreversible data hiding
- Reversible data hiding

In irreversible 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 [1].In 2003 W. C. Du Ni et.al. [2] 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. [3] Proposes a new index-domain method based on SMVQ method. This hide the secret data on the indices of the SMVQ image compressed. It consists of two stages the encryption and decryption stage.Main focus is to compress the image without misrepresentation. Main disadvantage more time consume of extraction stage and recovered image . PSNR= 21.97 dB. In V.K.Wei et.al.[4] scheme locally adaptive data compression method . For example compress the message "The Cycle on the Right Parks by the Cycle I Right" repeated the word so it can be compressed message. The compressed message ''the || Cycle || -On || 3 || right || Parks || by || 4|| 6 || I || 6'' is obtained after the LAC method, where ''||'' represents the concatenation operation. Advantage: Marked image quality improved , PSNR=50 db. In 2013 Lingfei wang et.al. [6] Proposed a Reversible data hiding method using adaptive coding method. The main disadvantage of Vector quantization is the boundaries are clear visible between input block and SMVQ to solve this problem.

This paper covers various SMVQ based schemes. Section 2 covers the survey of side match vector quantization and histogram based RDH technique. Section 3 details and brief the proposed technique. Section 4 experiment result. Section 5 illustrates the conclusion and expected results

2. Embedding Procedure



In a side match vector quantization scheme, the blocks of any image in the firstly first column and row are implant by Vector quantization techniques, if the first column and row called seed block. The SMVQ encoder firstly predicts a codebook for input vector x by using its upper block u (U=HORIZONTAIL) and left block L (L=VERTICAL).data hiding method are masked image M with same sizes as the cover image C sizes M*N. C(x,y)=0 so it can be selected the reference pixel and C(x,y)=1 so it can be selected non reference pixel. The study is done to analyze various data hiding techniques. To get acquainted with different types of shifting and embedding functions related to SMVQ

approach. To propose a new step-by-step procedure used to solve a problem for improving the hiding capacity and marked image quality by using SMVQ method and compare the proposed algorithm with the previous existing techniques [7].

3. Experimental Results and Analysis

Experiments were conducted on a group of color level images to verify the effectiveness of the proposed scheme .Using previous technique; image is divides into 3X3 blocks. 4X4 blocks has been observed as non–overlapping block in an image (i.e. n=4). Five standards, 384*512 test images i.e Airplane, house, Lake, park, earth are shown in Figure1. Four standard images, uncompressed color image are sizes of 384* 512 or 512*512 were also adopted [10].

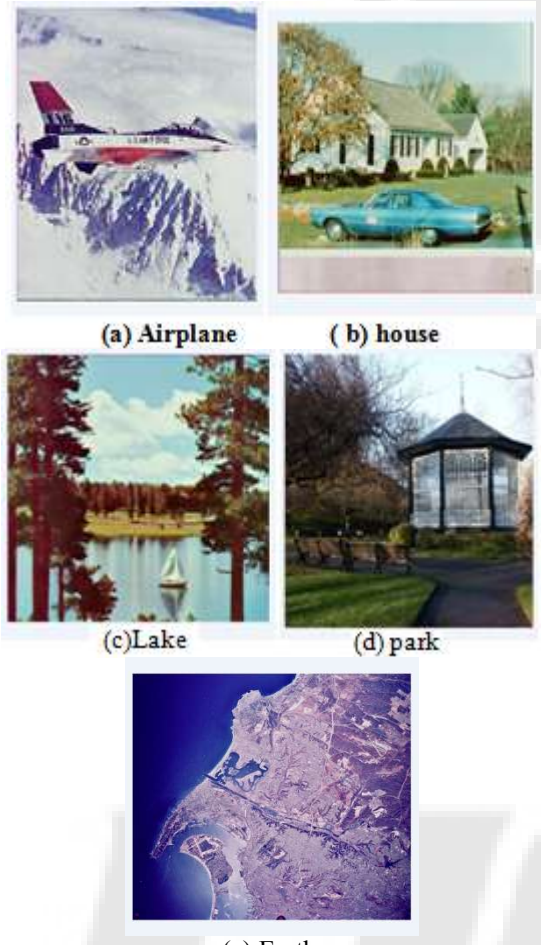


Figure 2: five standard text images.

Improved the Performance of compression ratio, decompression quality and hiding capacity. The experiment are implemented on a computer with a Intel® core (TM) i5-2410M CPU @2.30 GHz 2.30GHz,4.00 GB Memory and Window 7 operating system and the programming was Mat lab 7. Side match vector quantization (SMVQ) was designed as an improved version of Vector quantization .VQ is a lossless data compression technique. Main disadvantage of VQ does not consider correlation between neighbor blocks. Secret bits for embedding were generated by a pseudo-random number generator (PRNG). P is any image value at coordinate (x, y).Q is the mask image. Image P depend on the value of the mask image. if the value of Q at any location (Q(x, y) =0), then P is considered as reference pixel otherwise non reference pixel. The initialized $Q0$ is the mask image

$Q0(x, y)$ = 0 reference pixel
1 no reference pixel

Number of reference pixel are Increase ($Q(x, y)$ =0) in the complex part to obtain an excellent result. This technique has good marked image quality and has good hiding capacity

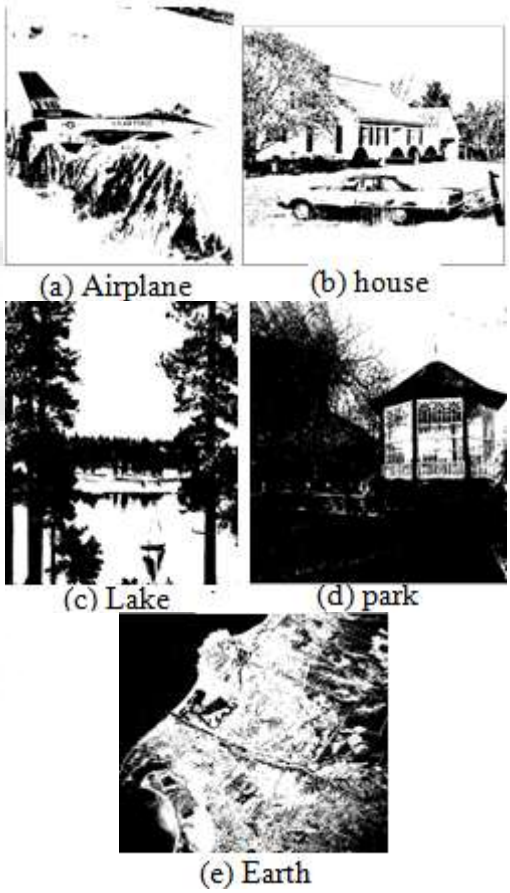


Figure 3

$$PSNR = 10\log_{10}255^2/MSE\ (dB)$$

$$MSE = \left(\frac{1}{M*N}\right) \sum_i \sum_j ((I(x,y) - Id(x,y))^2$$

Where M and N are the height and width of the images respectively .Where I (x,y) are the pixel value at coordinate (x,y)of the original image and the decompressed image **I***d*, respectively. The structural similarity (SSIM) can be used to measuring the similitude between the two images. The SSIM can be represented by this equation

$SSIM(x,y)=(2u_xu_y+c_1)(2a_{xy}+c_2)/(u_{x^2}+u_{y^2}+c1)*(ax^2+ay^2+c_2)$.where

1. μ_x the average of x;
2. μ_y the average of y;
3. σ_x^2 the variance of x;
4. σ_y^2 the variance of y;
5. σ_{xy} the covariance of x and y; $c_1=(k_1 L)^2$, $c_2=(k_2 L)^2$ two variables to stabilize the division with

weak denominator; L the dynamic range of the pixel-values

6. K1=0.04 and k2=0.05 by default.

Structural dissimilarity (DSSIM) is given by

$$\mathrm{DSSIM}(x,y) = \frac{1 - \mathrm{SSIM}(x,y)}{2}$$

Table 1: Hiding capacity between the proposed scheme (UNITS: BITS)

Hiding capacity	Proposed
Airplane	10562
House	11590
Lake	11805
Park	11959
Earth	11959

Table 2: CODE BOOK W=12

Scheme	Compression -ratio	PSNR	SSIM	DSSIM
SMVQ	18.29	29.16	0.8871	0.0567
Scheme [7]	20.66	29.85	0.9137	0.0457
Proposed scheme	25.35	48.60	0.9234	0.0383

4. Conclusion

In this paper, we proposed a integrated data-hiding and image compression scheme by using SMVQ and image in painting. SMVQ techniques are more suitable for effective data hiding due to good marked image quality, easy implementation. SMVQ techniques can be simply designed by designing shifting and embedding functions. Combinations of various techniques can be done to get more efficient data hiding scheme. The experiment result shows that our scheme has the satisfactory performance for hiding capacity compressio**.** Ratio and decompression quality. The proposed techniques integrate the two functions of joint data hiding and image compression into a single module smoothly.

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