A Survey on Joint Data-Hiding and Compression Techniques based on SMVQ and Improved Locally Adaptive Coding Method

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ABSTRACT
Today Reversible data hiding is latest research area in the field of secret data hiding technique. Data hiding is a technique in which conceal secret data is hidden in some cover image like video, audio, movie, file, and image. Data hiding popularly used in medical and military application. 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 but main focus in this paper is on side match vector quantization.

Keywords
Side Match Vector Quantization (SMVQ), Histogram shifting technique, locally adaptive coding method, Reversible data hiding

1. INTRODUCTION
Data hiding is a secret method for secret data transmission in the Internet. There are mainly two types of the Data hiding techniques: - irreversible and reversible data hiding technique. In irreversible data hiding techniques, at only secret message is recovered and cover image is effective but in reversible data hiding (RDH) both secret message and cover media is completely recovered. In general, two types of reversible data hiding techniques exist-method based on difference expansion and histogram shifting. Data hiding is necessary for protection of data.

Recently, many data hiding techniques for the compressed data have been reported, which can be applied to various compression techniques of image like JPEG, JPEG2000 and vector quantization (VQ). Vector quantization based image data hiding schemes are proposed both reversible techniques and irreversible techniques. VQ technique is very simple and cost effectiveness in implementation. In general Vector quantization method, image I is divided into many non-overlapping block whose size is I. Vector quantization based image data hiding method must be able to recover original VQ table after receiver hide (secret) data. Main disadvantage of Vector quantization, boundaries is Clear Visible in input block. Fig.1 shows encryption and decryption process.

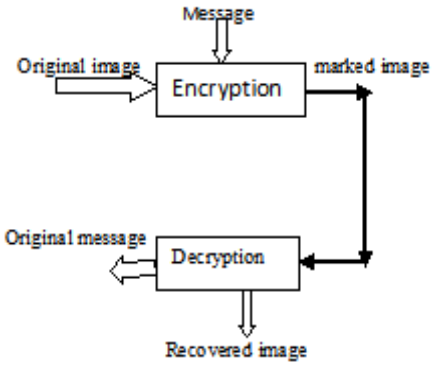


Fig 1. Block diagram of Reversible data hiding.

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 illustrates the conclusion and expected results

2. PRELIMINARY
In 2003 W. C. Du Ni et.al. [1] Reversible data hiding 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 distortion of extraction stage and recovered image.

In 2006, Chin-Chen Chang et.al. [2] 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. This technique is very simple and has good image quality. The sizes of the code books generated by LBG techniques are 128,256 and 512. Main focus is to compress the image without distortion. Performance Value: bpp (bits per pixel) =0.39 and PSNR= 21.97 dB. Major drawback of this method was more time consume of extraction stage and recovered image

In 2010 chin-Feng -Lee et.al. [3] Proposed a multilevel reversible data hiding technique based on adaptive coding method .embedding method for encoding secret data into edge block and non-sufficiently smooth blocks to conceal (hide) secret data. This method improves the quality of the marked image. The hide data are embedded into smooth block. When the sizes of the codebooks are varied among 32, 64,128 and 256.five codebooks of sizes 512 is generated using LBG algorithm. Increase the hide capacity the smooth blocks are

partitioned into non-sufficiently smooth block. Performance Value: bpp (bits per pixel) =0.51 and PSNR =28dB.

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. Table 1 shows the corresponding LAC technique.
Performance Value: bpp (bits per pixel) =0.51 and PSNR =50dB. Advantages: Marked image quality too good, Simple technique and less complex.

Table 1

Process	Input	Self organizing sequence (N)	output
1.	The	N=THE	The
2.	cycle	N=cycle, the	cycle
3.	On	N=on ,cycle the	On
4.	The	N=the,on,cycle	3
5.	Right	N=right, the ,on, cycle	Right
6.	Parks	N=parks, right, the ,on, cycle	Parks
7.	By	N=by, parks, right, the ,on, cycle	By
8.	The	N=the, by, parks, right,on,cycle	4
9.	Cycle	N=cycle, the, by, parks, right, on	6
10.	I	N=I , cycle, the, by, parks, right, on	I
11.	Right	N=right ,I , cycle, the, by, parks, on	6

The Chang&Nguyen's scheme [5] is an effective data hiding technique; it uses the combination of LAC method and VQ. The histogram of indices' position by using VQ compression and the LAC techniques

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. increase the compression performance of VQ .In the SMVQ method the first column and row blocks are encryption by conventional VQ and the residual blocks are encoded in a raster scanning order using a smaller sub-codebook (SC) which is generated by on-line side-match distortion prediction. The distribution of VQ is much less concentrated than that of SMVQ.

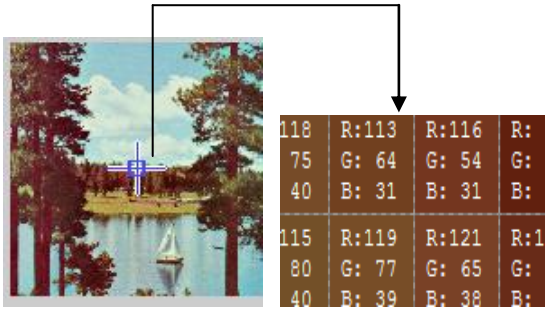


Fig 2. Example of the VQ encoder

In 2014 chuan Qin et.al. [8] we propose a Joint Data-Hiding and Compression techniques based on SMVQ (side vector quantization) and image in painting. Two function Joint Data-Hiding and image compression can be integrated into one single code. In the other word in the proposed method two separated modules, only a single module is used to the two function i.e. data hiding and image compression simultaneously. Original uncompressed image sized M*N as I (image).and it is divided into non overlapping n*n blocks. For example standard image size 512*512,384*512.the code book sizes W=128,256,512 and 1024. Capacity is improved and image quality (PSNR=30.54dB) is maintained. Size of codebook is increase it can be effective in PSNR and compression ratio decrease. Mean square error (MSE) is calculated between the 2n-1 predicted pixels. Note the blocks in the topmost row and the leftmost column must be black, i.e., compressed by VQ (vector quantization). The number of SMVQ blocks and inpainting blocks increases with, while the number of VQ blocks decrease. Performance measure used as PSNR (peak signal to noise ratio) and embedding capacity and image quality is measured by no of bits per pixel (bpp).
Advantage: Hiding capacity and marked image quality get enhanced. This method is quite useful when embedding capacity is very high.

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

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

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 similarity between the two images. The SSIM can be represented by this equation

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

Advantage: - (1) Improving the marked image quality of marked image.
(2).Increasing the embedding capacity.
(3).Achieving the reversibility of cover image.

In 2013 Chuan Qin et.al.[7] new method are Proposed steganographic data secret method based on histogram shifting method. Reference pixel considers, the PDE technique based on CDD model peak and zero point are selected from the histogram of prediction error to encode the hide bits by the histogram shifting operation.
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 *Q*0 is the mask image

$$Q0(x,y) = \begin{cases} 0 & \text{reference pixel} \\ 1 & \text{no reference pixel} \end{cases}$$

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. Main disadvantage capacity is limited to value of peak point.bpp=depends on value of peak point and PSNR=37.06dB.experiment result, color-level images with different sizes such as 128, 256 and 512. For color images,

input, output and recovery part can be done on Red, Green and Blue channels with accordingly.
Advantage:-1) Multi pair concept can be used to increase hiding capacity

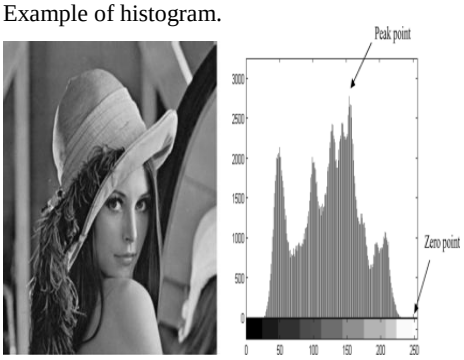
2) Original cover image can be recover and without distortion

In 2012 Zhi-Hui Wang [9] Reversible data hiding technique based on the histogram method. There are mainly two types of the reversible Data hiding techniques: reversible data hiding by difference expansion and histogram shifting. Zhi-Hui Wang[9]proposed a new reversible image authentication scheme in which histogram shifting is applied on difference of pixel values rather than original pixel values.

ER (embedding rate)=EC/ (W*H) (bpp)

EC (embedding capacity)=$k * \sum_{i=0}^{n}(pe$ak-1) (bits)

Where W and H are the width and height of the image.
Performance values:bpp=0.544bpp and PSNR=51 dB.
Example of histogram.



3. PROPOSED WORK

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. SMVQ improves compression performance of VQ by removing such redundancies. 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). Four standard images, uncompressed color image are sizes of 384* 512 were also adopted [10].codebook of size 128 is generated by LBG algorithm. In an SMVQ scheme, the blocks of any image in the firstly first column and row are embedding 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. To study and analyze various data hiding techniques. To get acquainted with different types of shifting and embedding functions related to SMVQ approach. To propose a new algorithm for improving the hiding capacity and marked image quality by using SMVQ method and compare the proposed algorithm with the previous existing techniques.

4. CONCLUSION

In this paper various existing algorithms related to SMVQ technique has been discussed. SMVQ techniques are more suitable for effective data hiding due to good marked image quality, easy implementation. This paper discusses many techniques to improve the hiding capacity and also improve the quality of image.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. It has been expected that by using new designed joint data hiding and image compression algorithm. Embedding capacity and image quality can be improved. For marked image quality it has been expected to be around 32dB

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