IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 10, December 2014.
www.ijiset.com
ISSN 2348 – 7968

# A Novel Approach for Data- Hiding based on Inpainting and SMVQ

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**Abstract:**

The main objective of this project is to develop a Joint Data- hiding and Compression Scheme for Digital Images. In this project, a novel joint data-hiding and compression scheme for digital images using side match vector quantization (SMVQ) and image inpainting. The two functions of data hiding and image compression can be integrated into one single module. Adaptive Vector quantization is utilized for some complex blocks to control the visual distortion and error diffusion caused by the progressive compression. The receiver can achieve the extraction of secret bits and image decompression Successfully side match vector quantization (SMVQ) and image inpainting. To perform a data hiding using side match vector quantization (SMVQ) and image inpainting. To perform Data hiding with less distortion and more accuracy.

## 1. Introduction:

Information hiding is the principle of segregation of the design decisions in a computer program that are most likely to change, thus protecting other parts of the program from extensive modification if the design decision is changed. The protection involves providing a stable interface which protects the remainder of the program from the implementation. Need of data hiding is Covert communication using images (secret message is hidden in a carrier image),Ownership of digital images, authentication, copyright,Data integrity, fraud detection, self-correcting images,Traitor-tracing (fingerprinting video-tapes), Adding captions to images, additional information, such as subtitles, to video, embedding subtitles or audio tracks to video (video-in-video), Intelligent browsers, automatic copyright information, viewing a movie in a given rated version, Copy control (secondary protection for DVD). 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. Data hidden images are usually compressed in a specific image format before transmission or storage. However, the compression operation could remove some embedded data, and thus prevent the perfect recovery of the hidden message. In the watermarking context, the compression process also degrades the robustness of the watermark. To avoid this, it is better to combine image compression and information hiding to design joint solutions. The main advantage to consider jointly compression and data hiding is that the embedded message is robust to compression. The compression is no longer considered as an attack. Another important advantage is that it allows the design of low complex systems compared to the separate approach. The joint approach consists of directly embedding the binary message during the compression process. The main constraints that must be considered are tradeoffs between data payload, compression bitrate, computational complexity and distortion induced by the insertion of the message. The embedding of the message must not lead to significant deterioration of the compressor's performances (compression rate, complexity and image quality). The data hiding process must take into account the compression impact on the embedded message. The watermark needs to be robust enough to allow a correct message extraction after some acceptable manipulations of the decompressed/watermarked image. The data hiding technique must be adapted and integrated into the compressor's coding framework.

## 2. Related Work:

Xin Li et.al (2001)proposed a method on Edge-Directed prediction for lossless compression of natural images. This system is based on the least-square (LS)-adaptive prediction schemes for lossless compression of natural images. The analysis shows that the superiority of the LS-based adaptation is due to its edge-directed property, which enables the predictor to adapt reasonably well from smooth regions to edge areas. The LS-based adaptation improves the prediction mainly around the edge areas. A novel approach is proposed to reduce its computational complexity with negligible performance sacrifice. The lossless image coder built is to achieve better performance than the state-of-the-art coder CALIC with moderately increased computational complexity . In the novel approach instead of using pixels in LS optimization ,the predictor coefficients are updated only when the magnitude of prediction error is beyond a pre- selected threshold. Edge directed prediction refers to the role of the pixels around an edge in LS optimization process. The draw back of edge directed prediction is computational complexity. A novel approach for reducing computational complexity can be achieved to maintain its performance.It is used in tasks such as error concealment.The main disadvantage of this system is LS optimization can be done only for a fraction of pixels in the image. Ricardo L. de Queiroz (2004)proposed method on Processing JPEG-Compressed images and Documents In this concept the Joint Photographic Experts Group (JPEG) has become an international standard for image compression. This techniques allows the processing of an image in the "JPEG-compressed" domain. The goal is to reduce memory requirements while increasing speed by avoiding decompression and space domain operations. An effort is made to implement the minimum number of JPEG basic operations. Techniques are presented for scaling, previewing, rotating, mirroring, cropping, recompressing, and segmenting JPEG-compressed data. JPEG compression is performed by a series of operations ,they are transform, quantization, zigzag scanning ,differential pulse code modulation(DPCM)and entropy coding. Previewing and resizing of the JPEG also happens .The original blocks is scaled into an integer number of new blocks. Here pixels of an image is organised as encoding cost map(ECM).By storing and deriving the ECM the individual blocks are easily addressed. Segmentation is done in regions containing halftone ,text ,pictures etc. This method reduces memory requirement, increasing the speed by avoiding decompression and space domain operations, reduced cost and simple to control image brightness. JagadishH.pujar et.al(2010) have proposed a new lossless method of image compression and decompression using Huffman Coding techniques. This proposed system uses the lossless technique for compression of Images during transmission & storage of the raw images. This compression technique is faster, memory efficient and simple suits the requirements of the user. The Lossless method of image compression and decompression is used by a simple coding technique called Huffman coding. This technique is simple in implementation and utilizes less memory .The images to be compressed are gray scale with pixel values 0 to 255,This technique collects unique symbols from source image and calculate its probability value for each symbol and sorts the symbol from lowest to highest priority.

The existing system leads to more number of drawbacks like expensive cost, more information will be lost, more distortion, limited hiding capacity etc .Many data hiding schemes for compressed codes areJPEG, JPEG2000, vector quantization. In the above three schemes vector quantization is quite simple and the cost is effective. By using the methods like adaptive data hiding method for VQ compressed image, using code word clustering techniques the attacker have the opportunity to intercept the compressed image without the water mark information embedded. Therefore the two schemes when performed individually will give lower efficiency in applications. To avoid this problem using the joint data hiding and compression techniques for digital image processing. This techniques based on the side match vector quantization (SMVQ) and image inpainting. This SMVQ and Image inpainting based on the embedding bits. The proposed method has the hiding capacity, compression ratio, and decompression quality**.** The following chapter shows the methods and results of the proposed system.

## 3. Methodology:

### 4.1 System design:

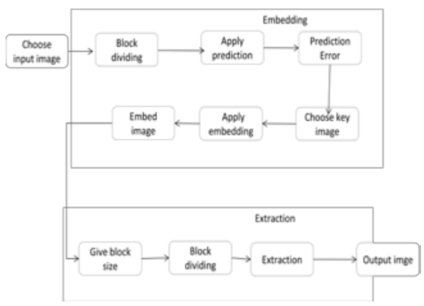


**Fig: 1 System architecture**

**4.2 Modules:**

Two methods using in this thesis are embedding and extracting. In Embedding the following steps are used.

1. Choose an image
2. Apply Block dividing
3. Apply Prediction
4. Prediction Error
5. Choose key image
6. Embedding

In Extracting the following steps are used.

1. Apply Block dividing
2. Apply Extraction

**Choose an image:**

- To choose the image for embedding process. The images are JPEG, Gif, PNG and any other format. Choose any one image and given to the block dividing.

**Apply Block dividing:**

- First give the block size and apply the block dividing. The image is divided into small blocks and the function applies in each block. In this thesis block dividing is used to divide the in blocks for example 32, 64 etc. Each block apply all operations.

**Apply prediction:**

- After block dividing apply the prediction. Get the input image from database. And apply prediction to check the image to be redundant. Repeat this process again and again. Finally it produces the reconstructed image. The advantage of prediction coding to remove the redundancy from the image pattern.

**Prediction error:**

- After prediction find out the prediction error. The prediction cannot be correctly predicted. So the prediction errors occur and remove the redundant images. A prediction error term contains the average and the least number of 1's which is identify the prediction errors.

**Embedding:**

- Embedding is the process of combining the original and key image. The embedded image seems to be like the original image. Then the embedded image is sent.

**Extraction:**

- Extraction is the process of separating the original and key image from the embedded image.

**Algorithm for Embedding:**

- This embedding algorithm is used to combine the key image and original image. This project the embedding is used for the compression

1. The input image is divided into blocks. The blocks are predicted and find the prediction error.

IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 10, December 2014.
www.ijiset.com
ISSN 2348 – 7968

2. The prediction error is greater than the threshold value then vector quantization is used for compression.

3. The prediction value less than or equal to the threshold value then embedding the watermark bit 0 and 1.

4. If the embedding bit equal to 0 then Side Matching Vector Quantization is used for compression.

5. The embedding bit is equal to 1 then image inpainting is used for compression.

**Algorithm for Extraction:**

- This Extraction algorithm is used to separate the original image and this project extract the watermark bit.

1. The embed image is given to the input of extraction. The input image is divided into blocks.

2. Take the indicator bit 0 and 1.

3. The indicator bit is equal to 0 then read the index value and apply the inverse process of VQ compression and also extract the watermark bit.

4. The indicator bit is equal to 1. Read the index values for the key images.

5. If the index values are equal then apply the inverse process of SMVQ compression and extract the watermark bit 0.

6. Otherwise apply the inverse process of image inpainting and extract the watermark bit 1.

## 4. Results:


**Fig: 4.1 Home Page**

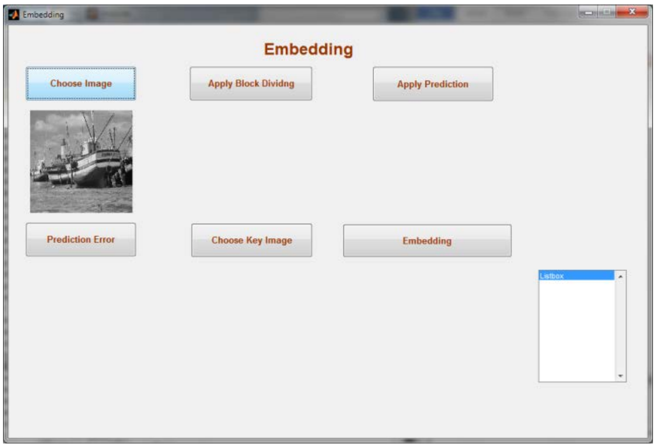


**Fig: 4.2 Choose Image**

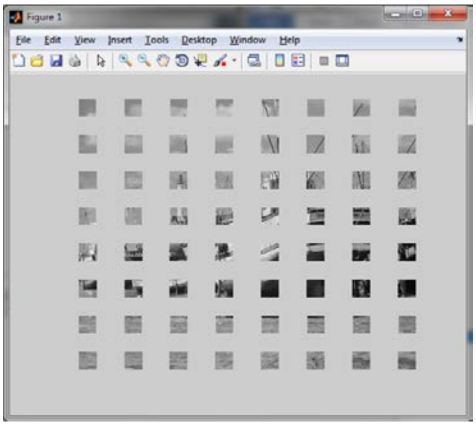


**Fig: 4.3 Block Dividing**

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www.ijiset.com
ISSN 2348 – 7968

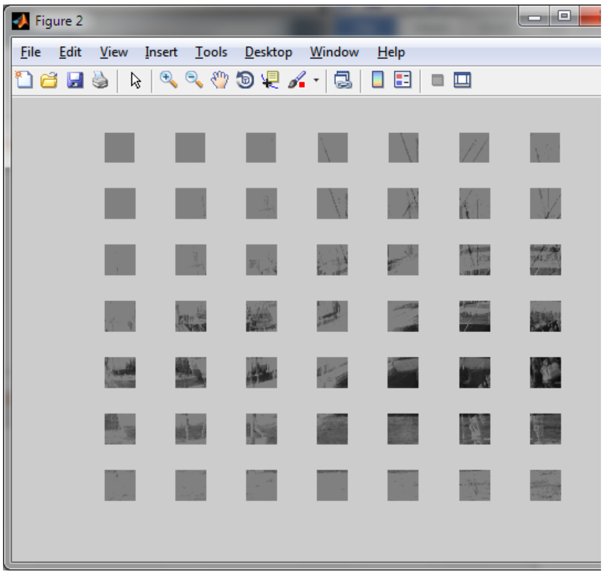



**Fig: 4.4 Prediction**

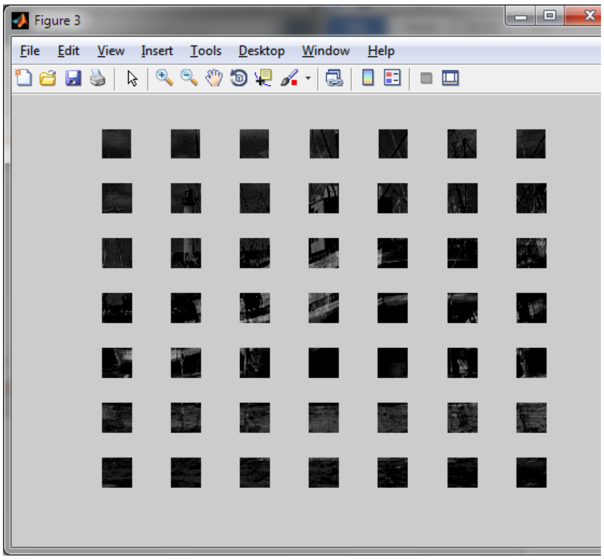



**Fig: 4.5 Prediction Error**

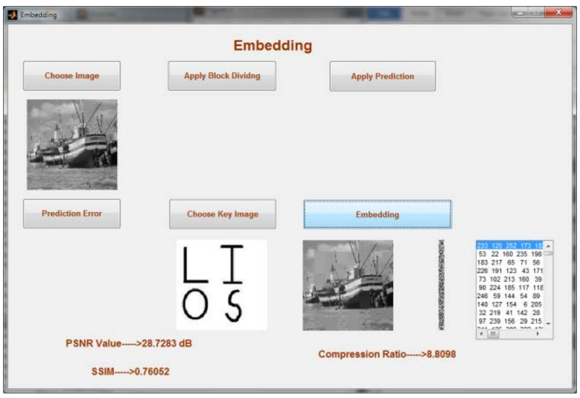



**Fig: 4.6 Embedding**


**Fig: 4.7 Extraction**

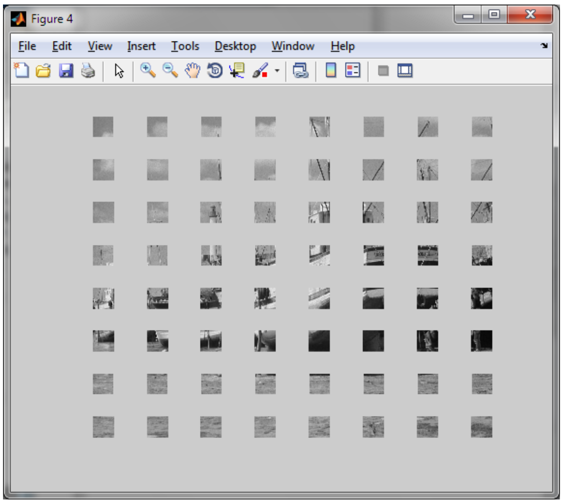



**Fig: 4.8 Apply Block Dividing**

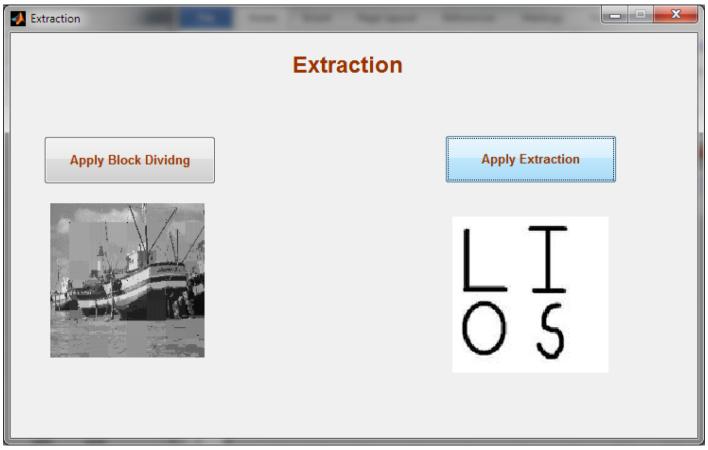



**Fig: 4.9 Apply Extraction**

**Experimental Results:**

**Performance Metrics:**

**Peak Signal-to-Noise Ratio (PSNR)**

ISSN 2348 – 7968

The peak signal-to-noise ratio (PSNR) is used to evaluate the quality between the enhanced image and the original image. The PSNR formula is defined as follows:

$$PSNR = 10\ X\ log_{10} \frac{255\ X\ 255}{\frac{1}{HXW} \sum_{x=0}^{H-1} \sum_{y=0}^{W-1} [f(x, y) - g(x, y$$

Where H and W are the height and width of the image, respectively; and f(x,y) and g(x,y) are the grey levels located at coordinate (x,y) of the original image and enhanced image, respectively.

**Mean Squared Error Rate (MSE)**

The mean square error or MSE of an estimator is one of many ways to quantify the difference between an estimator and the true value of the quantity being estimated. As a loss function, MSE is called squared error loss.

$$MSE = \frac{1}{n} \sum_{i=1}^{n} (\widehat{Y_i} - Y_i)^2$$

Where $\widehat{Y_i}$ is the vector of n predictions and $Y_i$ is the vector of true values.

**SSIM:**

SSIM is a metric which is more consistent with human subjective perception. SSIM can be calculated as follows

$$SSIM(x, y) = \frac{(2\mu_x\mu_y + C_1}{(\mu_x^2 + \mu_y^2 + C_1)}$$

**Root Mean Squared Error Rate (MSE)**

The RMSE is frequently used to measure the difference between values predicted by a model or an estimator and the values actually observed. It the square root of the mean squared root error value.

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (\widehat{Y_i} - Y_i)^2}$$

Where $\widehat{Y_i}$ is the vector of n predictions and $Y_i$ is the vector of true values.

**Compression Ratio**

The compression ratio is to identify, how much the images had been compressed. The ratio can be calculated by the following formula:

$$C_R = \frac{8\ x\ M\ x\ N}{L_c},$$

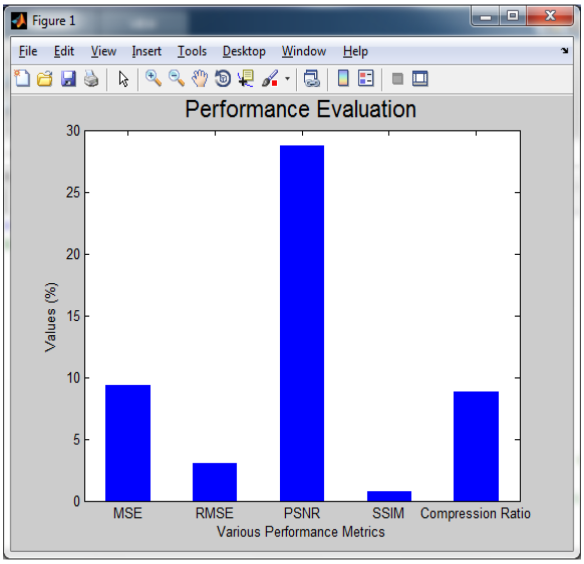
Where, M and N are the height and the width of the image.

$L_c$ is the length of the compressed codes for the image.

**Performance Evaluation:**

**Table 1 Compare the Values in different image**

| Images | PSNR | SSIM | Compression Ratio |
|---|---|---|---|
| babbon | 30.7842 | 0.9190 | 9.5905 |
| Barbara | 29.9845 | 0.8673 | 8.4627 |
| boat | 28.7282 | 0.76052 | 8.8098 |



ISSN 2348 – 7968

## 5. Conclusion:

This project proposed the new data hiding and compression in image successfully. The above chapters are briefly described about the methods of the proposed system. Embedding and extraction is done using the SMVQ compression. The results shows the performance of the proposed system

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