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# AN INNOVATIVE APPROACH FOR DATA HIDING IN COLOUR IMAGES USING COMPRESSION TECHNIQUES

**Shalini Gupta, Shubha Jain, Vijatashwa Awasthi, Ajay Gaur**

Department of Management, Axis Institute of Higher Education, Kanpur, Uttar Pradesh, India

**ABSTRACT-** A new method is proposed for concealing data and reducing file size in color images. This approach combines the technique combines pattern-based side match vector quantization with patch-based image inpainting. This integration consolidates data hiding and image compression into a unified module, enhancing overall efficiency. At the sender's end, Adaptive Vector Quantization compresses boundary blocks of the image, while residual blocks accommodate embedded secret data and undergo compression using either PSMVQ or patch-based image inpainting. Adaptive Vector Quantization handles more Advanced blocks are utilized to handle visual distortion and facilitate error diffusion. After segmenting the compressed image into blocks, the recipient can effectively retrieve concealed data and decompress the image employing PSMVQ and patch-based image inpainting methodologies.

**Keywords: Data hiding, compression, adaptive vector quantization (AVQ), pattern-based side match vector quantization (PSMVQ), and patch-based image inpainting.**

## I. INTRODUCTION

In everyday life, a vast amount of digital information is stored, processed, and transmitted. To ensure efficient transmission and capacity utilization, digital images can undergo compression methods aimed at reducing redundancy while maintaining the quality of the reconstructed print. Another critical concern in open network environments involves securely transmitting confidential or sensitive data. Cryptographic techniques are employed to encrypt plaintext into ciphertext, although the random nature of ciphertext data may attract attention from potential attackers.

Compression aims to decrease the redundancy and irrelevant data in digital images to facilitate improvement in all aspects. Categorization of compression is as:

Lossless: It ensures that every bit of data remains unchanged when the image is uncompressed, preserving all information completely.

Lossy: Reduces file size by permanently discarding redundant information, which may result in some loss of quality in the decompressed image.

### *1. Data Hiding*

In data hiding, secret information is embedded by altering each pixel in the original (cover) image, which is then compressed to conserve storage and bandwidth in the resulting image. Different techniques, including JPEG, JPEG2000, and vector quantization (VQ), are used to embed secret data into compressed images.

Methods of embedding data into images using vector quantization (VQ) encompass both reversible and irreversible techniques. VQ stands out for its simplicity and cost-effectiveness in implementation, making it highly valued in this field.

Integrating data hiding and compression into a unified approach includes embedding binary data directly during the compression phase. Critical factors to consider are balancing the data payload, compression bit rate, computational complexity, and managing potential distortions introduced by the embedding process.

## II. RELATED WORKS

In the context of embedding data in compressed color images, techniques such as Side Match Vector Quantization (SMVQ) and Patch-based Image Inpainting are commonly used. Below is a summary and breakdown of the different approaches discussed in the referenced materials:

Side Match Vector Quantization (SMVQ):

Description: SMVQ is a method that uses vector quantization (VQ) to compress images while also embedding data covertly.

Application: It involves matching regions (blocks) of pixels within an image to predefined patterns or vectors, optimizing compression while facilitating data embedding.

Advantages: SMVQ is known for its efficiency in both compression and data hiding, leveraging pattern matching to achieve robust embedding without significant loss in image quality.

Patch-based Image Inpainting:

Description: This technique focuses on filling in missing or damaged parts of an image (inpainting) based on surrounding image patches.

Application: In data hiding, inpainting can be utilized to embed information in areas of an image that are less perceptible to human eyes, ensuring concealment.

Advantages: Patch-based methods are effective for hiding data by modifying areas that are visually less critical, thereby minimizing noticeable distortion.

Unified Approach:

Description: Some approaches integrate data hiding and compression into a single process during image encoding or decoding phases.

Considerations: Key considerations include optimizing the balance between data embedding capacity, compression efficiency (bit rate), computational complexity, and maintaining acceptable image quality.

Benefits: This unified approach can enhance efficiency by reducing redundant processing steps and optimizing the use of available image data for both compression and embedding purposes.

These techniques illustrate diverse strategies for embedding data covertly within compressed color images, each offering unique advantages depending on specific application requirements such as image fidelity, payload capacity, and computational resources.

JPEG2000 Compression and Hiding Capacity: Arjun Nichalet al. (Reference [1]) discuss the JPEG2000 compression system. They emphasize the importance of hiding capacity in enabling efficient secret communication. Their approach uses a Redundancy Evaluation method to adaptively determine embedding depth, maximizing the amount of embedded secret data while minimizing changes to image quality.

Watermarking Adaptation for Data Hiding: B. Smith al. and K.A. Navas (Reference [2]) adapt watermarking techniques for embedding data in applications such as Electronic Patient Record (EPR) images. They highlight using JPEG compression on large images to preserve diagnostic content without loss of redundancy.

Histogram Shifting for Data Embedding: Che-Wei Lee et al. (Reference [3]) present a hierarchical scheme for embedding data in cover images using histogram shifting. This method involves dividing the cover image into smaller blocks, allowing for a high data hiding capacity. Importantly, it aims to preserve high quality in the resulting stego-images, ensuring minimal perceptible distortion.

JPEG Compression for Continuous-tone Images: Gregory K. Wallace (Reference [4]) discusses the widespread applicability of JPEG compression for continuous-tone images. The Baseline method suffices for many applications despite its high computational costs.

High-Capacity Data Hiding in JPEG: Hsien- Wen et al. (Reference [5]) propose a method that builds on JPEG compression, integrating a capacity table to estimate the embedding capacity for each Discrete Cosine Transform (DCT) component. The primary goal of this approach is to minimize distortions in the resulting stego-image while maximizing the amount of hidden data that can be reliably embedded.

Lossless Compression of Raw Images: Jagadish H. Pujar et al. (Reference [6]) describe a lossless compression technique suitable for transmitting and storing raw images. Their method is characterized by its speed, memory efficiency, and simplicity, catering well to user requirements.

Steganography in JPEG 2000 Compressed Images: Po-Chyi Su et al. (Reference [7]) address steganography challenges in JPEG 2000 compressed images. They propose a scheme that integrates both forward and inverse image transforms to effectively embed large volumes of data into the JPEG2000 bitstream.

Quantized Projection Embedding: Ranade et al. (Reference [8]) detail an embedding algorithm based on quantized projection with enhancements to achieve high embedding rates. This method focuses on efficiently embedding data while maintaining robustness.

These references collectively explore diverse techniques and methodologies for embedding data in compressed images, highlighting strategies to balance data capacity, image quality, computational complexity, and application-specific requirements.

## III. PROPOSED SYSTEM

To improve the compression ration Data hiding performed in compressed images and also improves secure communication and integrity of the data. Compression used to save the network bandwidth for efficient data transmission. SMVQ used to reduce the size of an image and patch-based Image Inpainting used for image improvement.

## IV. SYSTEM MODEL

In data hiding, the cover image is segmented into K x K blocks. Within each block, correlations with neighboring blocks are assessed to predict values for embedding data. The secret information is embedded into the image using these predicted values. During extraction, the hidden data is retrieved from the cover image using corresponding index values. Figure 1 illustrates the architecture of the proposed system.

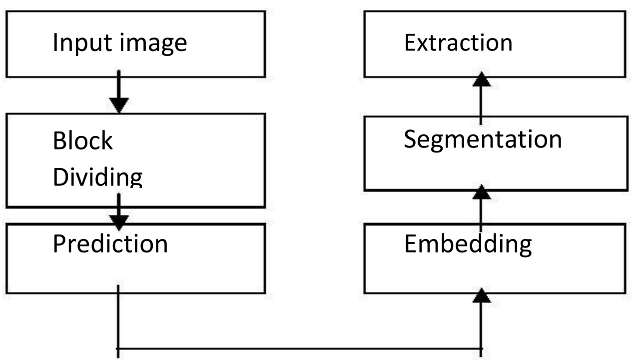



Figure 1: System Architecture

## V. IMPLEMENTATION

### *A. EMBEDDING*

In the embedding phase described, both the sender and receiver share the same codebook. The input image, represented as BBB with dimensions L×WL \times WL×W, is divided into blocks of size k×kk \times kk×k. A prediction method is applied to assess the correlation between neighboring blocks. Blocks with high correlation, particularly those at the leftmost and topmost edges of the image are compressed using Adaptive Vector Quantization (AVQ) and are excluded from data hiding operations. The process for embedding an image nnn into the cover image is depicted in Figure 2. Here's a breakdown of the procedure:

Block Representation and Prediction: The current processing block B(x,y)B(x, y)B(x,y) is being considered.

The blocks to the left and above are referred to as B(x,y−1)B(x, y-1)B(x,y−1) and B(x−1,y)B(x-1, y)B(x−1,y), respectively.

The blocks to the right and below are denoted as B(xn,y−1)B(x_n, y-1)B(xn,y−1) and B(xn−1,yn)B(x_n-1, y_n)B(xn−1,yn), respectively.

This version clarifies the sequence and relationships between the blocks being discussed.

Prediction Error Calculation:

Prediction methods are applied to each block to estimate the expected values based on neighboring blocks.

The prediction error is then computed as the difference between the actual pixel values and the predicted values.

Threshold Comparison:

Each block's prediction error is compared against a fixed threshold value.

This threshold distinguishes between smooth regions (where prediction errors are small) and complex regions (where prediction errors are large).

Data Embedding:

If the prediction error surpasses the threshold, indicating a complex region, data embedding can occur.

Embedding involves modifying the pixels of the cover image to incorporate the secret data.

In regions where embedding is feasible (typically in complex regions), the embedded image undergoes significant changes.

Overall, this embedding process aims to optimize data hiding by selectively modifying image blocks based on their predicted error characteristics. Complex regions are prioritized for embedding to ensure effective concealment of data while minimizing perceptual impact on the cover image.

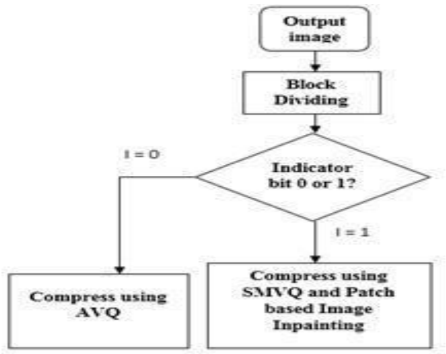



Figure 2 flowchart for embedding an image

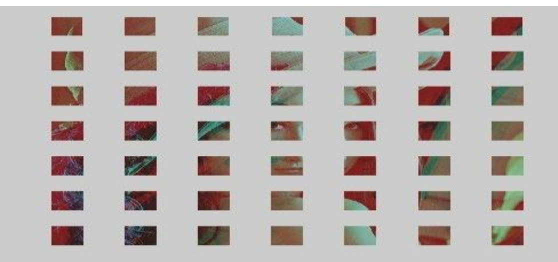
The secret image is extracted from the cover image using the index value. If the index value is equal to 0 then the side match vector quantization (SMVQ) is used. If the index value equal to 1 then the patch-based Image Inpainting method is used.

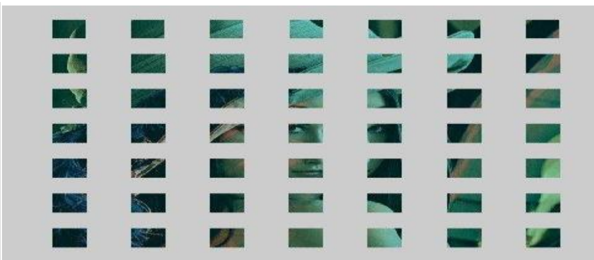
Figure 2 illustrates the flowchart for embedding an image, with considerations for potential attacks that may compromise image quality. Embedding in smooth regions helps maintain image integrity. If the predicted error PPP exceeds a threshold TTT, Adaptive Vector Quantization (AVQ) is employed to enhance image quality and compression efficiency. Conversely, if PPP is below TTT, Side Match Vector Quantization (SMVQ) and Patch-based Image Inpainting methods are utilized. The choice between SMVQ and Inpainting depends on indicator bits: SMVQ is used if the indicator is 0, while Inpainting is used if the indicator is 1. This strategy aims to ensure optimal embedding while preserving image quality under various conditions.

***B. EXTRACTION***

In an Extraction Phase, sec ret bits are extracted from the cover image. Fig 2 shows the procedure for extracting the secret data.

## VI. RESULT





A) Prediction B) Prediction error



C) Embedding D) Extraction

## VII. CONCLUSION

A combined data-hiding scheme along with compression is proposed utilizing pattern-based Side Match Vector Quantization (SMVQ) and patch-based Image Inpainting techniques. Adaptive Vector Quantization (AVQ) is employed to manage visual distortion in color images. The system aims to achieve high data-hiding capacity, a high compression ratio, and excellent decompression quality. This approach integrates SMVQ for efficient data embedding and Inpainting for seamless image reconstruction, ensuring robust performance across various image types and embedding scenarios.

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