

A Novel Approach for Data Hiding using Tree based Parity Check Method with Art Image

Ms. Rukaiya A. Chaugule, Ms. Amrita A. Manjrekar

Abstract— Since the rise of the Internet, security of information is one of the most important factors of information technology. This paper represents a new approach for data hiding by combining art image creation and tree based parity check method. First, a cubism-like art image which is an abstraction by prominent lines and regions is generated using source image. Then text message is embedded using tree-based parity check (TBPC) method into the cover art image created earlier. The TBPC method is a least significant bit steganographic method which is very efficient for hiding data in image due to its simplicity. Reducing distortion between the cover object and the stego object is an important issue for steganography. TBPC algorithm embeds data in cover image with minimal distortion yielding good quality stego images. This method provides a higher level of security to the valuable information.

Index Terms— cubism-like art image, steganography, tree based parity check method.

1 INTRODUCTION

THE rapid development of data transfer through internet made it easier to send the data faster to the destination via various transmission media. At the same time it may be easier to modify and misuse the valuable information through hacking. Therefore it is very important to take into consideration security of data. Data security communities and researchers have increased their interest in hiding data in digital media.

Data hiding is a method of hiding secret messages into a cover-media like image, audio, video such that an unintended observer will not be aware of the existence of the hidden messages. In other words, data hiding is the art of invisible communication. Its purpose is to hide the very presence of communication by embedding messages into innocuous looking cover objects [1][17]. There are two important uses of data hiding in digital media. One is to provide proof of the copyright, and another is assurance of content integrity. Proposed work is concerned with content integrity assurance.

Data hiding is a form of steganography. In digital image steganography (DIS), numerous tools exist for encoding data within the least significant bits (LSBs) of pixel RGB values or modulating these values to produce quantized levels of difference [2][3]. Robustness is an important issue in DIS, and generally decreases with capacity as higher-frequency signal variations are required to embed the covert signal. Proposed approach embeds data within higher-level structure in the image so as to create camouflage effect. Three different aspects in information-hiding systems contend with each other: capacity, security, and robustness. Capacity refers to the

amount of information that can be embedded in the cover medium, security to an eavesdropper's inability to detect hidden information, and robustness to the amount of modification the stego medium can withstand before an opponent can destroy hidden information.

Computer graphics research has focused on creating photo-realistic images of synthetic objects. As an alternative to photo-realism, with the help of an ordered collection of brush strokes it is possible to create abstract images. These abstract images filter and refine visual information before it is presented to the viewer. Impressionistic paintings of computer generated or photographic images can easily be created by controlling the colour, size, shape, and orientation of individual brush strokes. Two methods can be used to generate stroke based image renderings [4]. The first is to individually place each stroke on the target image until the desired target appearance is reached. The second approach is to use a set of pre-generated stroke textures and apply a texture synthesis algorithm to reproduce those patterns throughout the image.

Non Photorealistic Rendering (NPR) is a computer graphics technique which creates imagery with a wide variety of expressive styles inspired by painting, drawing, technical illustration, and cartoons [5]. NPR renders complex scenes by emphasizing high level features. Non-photorealistic rendering is of two types depending on which input it uses such as image-based NPR and object-based NPR. Image based NPR techniques use 2D images to produce the renderings. Object based techniques work directly on given 3D models and make use of the full volumetric representation. In recent years, the image-based non-photorealistic rendering has become popular trend. Proposed system continues this trend by automatically creating line-based cubism-like art image from a given source image [15].

In proposed system, automatically-generated Cubism-like image is used as cover image in which message data is hidden using tree-based parity check method (TBPC). The TBPC [14] method can be formulated as a matrix embedding method, but is more efficient than those methods which are based on linear codes. Due to its simplicity, the TBPC method provides very efficient embedding and extraction algorithms and reduces distortion.

- Ms. Rukaiya A. Chaugule is currently pursuing masters degree program in Computer Science and Technology at Department of Technology, Shivaji University, Kolhapur, India. E-mail: rukaiya.chaugule7@gmail.com
- Ms. Amrita A. Manjrekar is currently assistant professor at Department of Computer Science and Technology, Shivaji University, Kolhapur, India. E-mail: amrita5551@gmail.com

2 LITERATURE REVIEW

In recent years, the topic of automatic art image creation via the use of computers arouses interests of many people. Many image-based NPR algorithms have been proposed.

A.C. Sparavigna and R. Marazzato [6] proposed a rendering technique based on a random grid by adapting brushstrokes to the shape of different areas of the original picture. The concept of Coherence Length Diagram is applied to determine the adaptive brushstrokes, in order to simulate an impressionist painting. The aim of this technique is to shape brushstrokes across the image according to local orientations a painter could manually follow in order to reproduce the texture of the subject. For instance, the upper left area of the picture should be textured with a set of straight vertical strokes, while the lower right area should correspond to angular strokes.

P. Haeberli [7] proposed several techniques for creating static and animated abstract images of photographed and synthetic scenes. A simple interactive program allows the user to operate on a source image. The basic interactive technique is to follow the cursor across the canvas, point sample the colour of a stored image at the location of the cursor, and then paint a brush stroke of that colour.

Hertzmann [8] presented a method for adding realistic paint effects to painterly renderings, by rendering strokes with plausible lighting. The system processes a painting composed of a list of brush strokes. A height map is assigned to each stroke, and a height field for the painting is produced by rendering the brush strokes textured with the height maps. The final painting is rendered by bump-mapping the painting's colours with the height map.

Salisbury [8] introduced the notion of "orientable textures" and show how they can be used to readily convey 3D information in an image-based system for pen-and-ink illustration. In this interactive system, a user creates an illustration from a reference image by specifying three components: a greyscale target image that defines the desired tone at every point in the illustration, a direction field that defines the desired orientation of texture at every point, and a stroke example set, or set of strokes, to fill in the tone areas.

C. K. Chan and L. M. Cheng [10] proposed a data hiding scheme in which Least Significant Bits (LSBs) of cover-image are simply replaced with the message bits to form a stego-image. An optimal pixel adjustment process (OPAP) is proposed to enhance the image quality of the stego-image obtained by the simple LSB substitution method.

Min Wu, Bede Liu [10] proposed a new fragile to semi fragile data hiding method for authentication and annotation of binary images. The method manipulates "flippable" pixels to enforce a specific block-based relationship to embed a significant amount of data without causing noticeable artifacts. Shuffling is applied before embedding to equalize the uneven embedding capacity. The hidden data can be extracted without using the original image.

D. Sarmah, N. Bajpai [12] presented a system where they developed a new technique in which cryptography and steganography are used as integrated part along with newly

developed enhanced security module. In Cryptography AES algorithm is used to encrypt a message and a part of the message is hidden in DCT of an image; remaining part of the message is used to generate two secret keys which make this system highly secured.

Ch.Rupa, P.Avadhani, E.Reddy [13] introduced a novel secure steganographic approach for defending against information attacks. In this approach, instead of original message an encrypted message by Prime Number and Gray Code Encryption (PGE) algorithm is hidden into an image using a new approach named Linear Block Parity coding (LBP) which provides more security than conventional approaches.

S. Chang Chun Lu, Shi-Chun Tsai, and Wen-Guey Tzeng [14] proposed a majority vote strategy which is based on tree-based parity check method that results in least distortion for finding a stego object.

Shan-Chun Liu and Wen-Hsiang Tsai [15] developed a method of combining cubism-like art image generation and data hiding. In this method, first, line-based cubism-like image is created from source image by extracting prominent lines and forming regions. Then data is hidden in that art image during region recolouring by shifting the pixels' colours for the minimum amount of ± 1 while keeping the average colours of the regions unchanged.

3 METHODOLOGY

Proposed system consists of three modules as shown in Fig. 1. User selects colour image as an input. Then art image generation algorithm is applied to an input image which results into line-based cubism-like art image. User gives text message as an input to tree-based parity check data hiding algorithm. This algorithm embeds message bits into previously created art image. Hidden message is obtained by extracting bits from stego image by using TBPC extraction method.

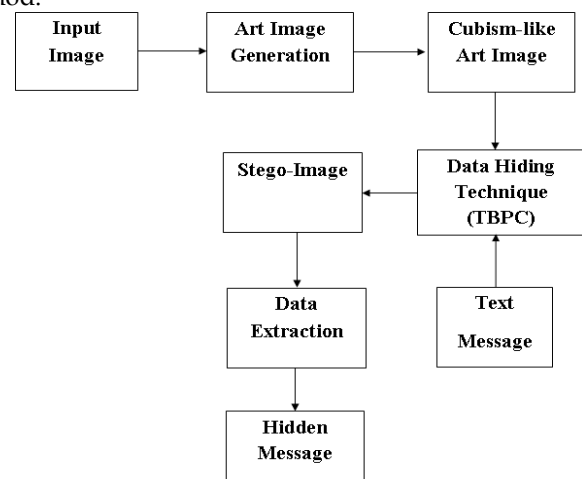


Fig. 1. System block diagram.

3.1 Art Image Generation

There are two stages in the line-based Cubism-like art image generation process:

3.1.1 Prominent line extraction

In this stage, first edge detection algorithm is used to detect edges from a source image I which results in a new image I' of edge points. Then the Hough transform is applied to I' to find line segments yielding a second new image I'' of the line type. Then, short line segments are discarded and nearby lines are merged using two thresholds such as the minimum line segment length L_{min} , and the minimum line distance D_{min} . Line segments in I'' with lengths larger than L_{min} are selected and the others are removed. If lines L_i and L_j not deleted yet, then L_i and L_j is compared and if the distance between L_i and L_j is smaller than D_{min} , then the shorter one of L_i and L_j is deleted.

3.1.2 Region Recolouring

In this stage, image space is partitioned by extending the line segments to the image boundary to create regions. Then, regions are recoloured by the average region colours and the boundaries of the regions are blacken.

3.2 Data Hiding Technique

The Tree-based Parity Check method constructs a master tree which is a complete N-ary tree. The nodes of the master tree with the LSBs of the cover-image are filled level by level, from top to bottom and left to right. In this method only the Least Significant Bits (LSBs) of the cover-image pointed by the determined locations are used for embedding. The TBPC embedding algorithm derives an L-bit binary string, called the master string, by performing parity check on the master tree from the root to the leaves as shown in Fig. 2, where L be the number of leaves of the master tree. Parity check: If the path has 1's number is odd, the message of leaf is 1, else the message of leaf is 0. Assume that the length of the message is also L. Performing the bitwise exclusive-or (XOR) operation between the message and the master string, a toggle string is obtained as shown in Fig. 2.

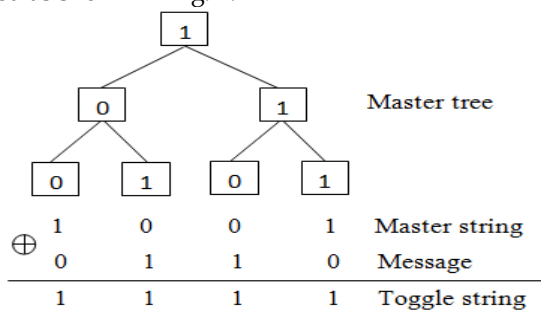


Fig. 2. A master tree with for LSBs 1, 0, 1, 0, 1, 0, 1 of the cover-image

Then, the TBPC algorithm constructs a new tree, called the toggle tree, as shown in Fig. 3. One empty N-ary complete tree with the same structure of master tree is built. The leaves are filled with the bit values of the toggle string and the other nodes are filled with 0. If each non-leaf node's child nodes are both 1, this non-leaf node is changed to 1 and its child nodes to 0 in the bottom-up order. Then the embedding algorithm obtains the stego tree by performing XOR between the master tree and the toggle tree as shown in Fig. 4.

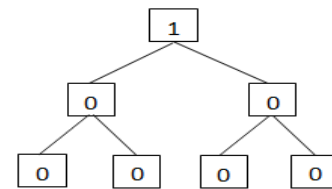


Fig. 3. A toggle tree with L = 4 for toggle string 1, 1, 1, 1.

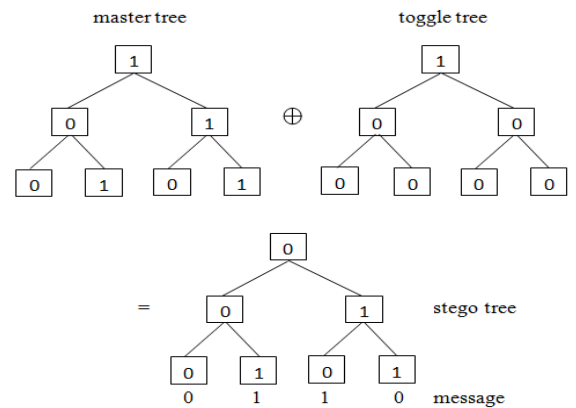


Fig. 4. Stego tree construction

3.2 Data Extraction

The TBPC extraction algorithm is simple. The message is extracted by performing parity check on each root to leaf path of the stego tree from left to right. Parity check: If the path has 1's number is odd, the message of leaf is 1, and otherwise the message of leaf is 0.

4 SYSTEM STRENGTHS

This section discusses two types of attacks on steganographic systems [16]. One type of attack is the known-cover attack. The attacker can detect the difference between a cover-image and a stego-image if she/he has access to both images. Proposed approach overcomes this attack by using tree based parity check method for data embedding in art image because TBPC algorithm reduces distortion of cover-image. The lower embedding efficiency is defined to be the ratio of the number of hidden message bits to the maximum embedding modifications. The lower embedding efficiency is related to undetectability in the worst case, and it is better in TBPC method.

The other type of attack is the stego-only attack, where the attacker is assumed to have nothing but the stego-image. A stego-image must not contain any blocking artifacts associated with message embedding because an attacker could easily utilize those artifacts to detect the secret message. Proposed approach overcomes this attack by using cubism-like art image as cover image. Because traditional data hiding methods embed data directly into photographic cover images to produce stego-images, while the proposed method firstly creates an art image and then data are embedded in it. The stego-image so generated is of an art appearance as shown in Fig. 5. It hopefully will attract hacker's more attention on the artistic content and hacker will be less suspicious about the hidden data.

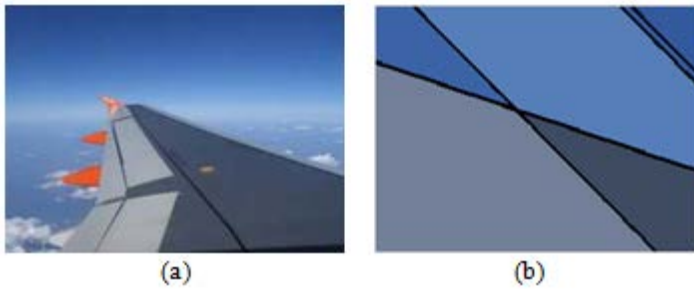


Fig. 5. Cubism-like images created in this study. (a) Source image. (b) Created art image from the source image.

5 CONCLUSION

A novel approach for data hiding applications is proposed by using tree based parity check algorithm to hide data into automatically created cubism-like art image. It generates cubism-like images as stego images to distract the hacker's attention to the message data embedded in them. TBPC method embeds data in art image with minimum number of modifications. It generates good quality stego images and it is hard for hacker to recover data from stego-image as it is constructed under the tree structure model. System is robust against known-cover and stego-only attacks. Hence the system will provide more secure communication through unreliable channels and secret data keeping.

REFERENCES

- [1] K. N. Somvanshi, A. K. Shrivastav, M. Gangavwane "Advance Steganography for Cover Media Audio, Video, Image", *International Journal of Emerging Technology and Advanced Engineering*, vol. 3, no. 4, March 2013.
- [2] Dabeer O., Sullivan K., Madhow U., Chandrasekharan S.: Detection of Hiding in the Least Significant Bit.
- [3] Deepak Aeloor, Amrita A. Manjrekar, "Securing Biometric Data with Visual Cryptography and Steganography", *Security in Computing and Communications, Communications in Computer and Information Science*, Springer Berlin Heidelberg, ISSN 1865-0929, Volume 377, 2013, pp 330-340
- [4] A. Bartesaghi, G. Sapiro, "Non-Photorealistic Rendering from Stereo".
- [5] A. Sparavigna, R. Marazzato, "Non-photorealistic Image Processing: an Impressionist Rendering".
- [6] A. Sparavigna, R. Marazzato, "CLD-shaped Brush-strokes in Non-Photorealistic Rendering".
- [7] P. Haeberli, "Paint by Numbers: Abstract Image Representations," in *Proc. 1990 Int. Conf. Computer Graphics & Interactive Techniques (SIGGRAPH 1990)*, Dallas, TX, pp. 207-214, 1990.
- [8] A. Hertzmann, "Fast Paint Texture," in *Proc. 2002 Int. Conf. Computer Graphics & Interactive Techniques (SIGGRAPH 2002)*, Annecy, France, pp. 91-96, June 2002.
- [9] M. P. Salisbury, M. T. Wong, J. F. Hughes, and D. H. Salesin, "Orientable Textures for Image-based Pen and Ink Illustration," in *Proc. 1997 Int. Conf. Computer Graphics & Interactive Techniques (SIGGRAPH 1997)*, Los Angeles, CA, pp. 401-406, 1997.
- [10] C. K. Chan and L. M. Cheng, "Hiding Data in Images by Simple LSB Substitution," *Pattern Recog.*, vol. 37, pp. 469-474, Mar. 2004.
- [11] Min Wu, Bede Liu, "Data Hiding in Binary Image for Authentication and Annotation", *IEEE Transactions on Multimedia*, Vol. 6, No. 4, August 2004.
- [12] D. Sarmah, N. Bajpai, "Proposed System for Data Hiding Using Cryptography and Steganography", *International Journal of Computer Applications (0975 - 8887)* Vol. 8, No.9, October 2010.
- [13] Ch. Rupa, P. Avadhani, E. Reddy, "An Efficient Security Approach using PGE and Parity Coding", *International Journal of Distributed and Parallel Systems (IJDPS)*, Vol.3, No.6, November 2012.
- [14] S. Chang Chun Lu, Shi-Chun Tsai, and Wen-Guey Tzeng, "An Optimal Data Hiding Scheme With Tree-Based Parity Check", in *IEEE Trans. on Image Processing*, vol. 20, no. 3, Mar 2011.
- [15] Shan-Chun Liu and Wen-Hsiang Tsai, "Line-Based Cubism-Like Image—A New Type of Art Image and its Application to Lossless Data Hiding", in *IEEE Trans. on Information Forensics and Security*, vol.7, no.5, Oct. 2012.
- [16] N. Johnson and S. Jajodia, "Steganalysis of images created using current steganography software," in *Proc. Second Workshop on Information Hiding*, pp. 273-289, Apr. 1998.
- [17] Deepak. A, Amrita. A. Manjrekar, "Multilevel Security in Face Authentication", *International Journal of Scientific & Engineering Research*, Vol. 4, Issue 8, pp 421-426, ISSN 2229-5518, August-2013.

IJSER