Hiding Region of Interest in Image using Fuzzy Logic

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Abstract: In this research, a new method for hiding image has been proposed. The proposed method relied on hiding the region of interest in the image by specifying it using fuzzy logic. Images play a large and important role in several areas. Therefore, the more important the image, the greater the need to protect and preserve it. In this research, the work was divided into two parts, the first part represents the sending side and in it the face area is defined as an important region in the image and hidden then, while the second part, represents the receiving side and in it the hidden image is received and unhide. Fuzzy logic was used in the process. The proposed algorithm provide security to the images being transmitted. Matlab language was use to perform this work.

Keywords: Hiding Images, Fuzzy Logic, Region of Interest.

Introduction:
In recent years, due to the development in the Internet and communication, it has become necessary to maintain the confidentiality of messages sent between the sender and the receive, especially if that messages is image of people. [1] [2] Therefore, the confidentiality of that data from intruders must be preserved by hiding it. [3]

Region of Interest (ROI):
It is a selected subset of samples within a specific data set for a particular purpose. [4] [5] They are usually used in many fields. For example, in pattern recognition it is used to identify and distinguish a person’s image from the other people, also it used in medical imaging by limits of the tumor (tumor or malignancy) can be determined on the image. [6] They are often associated with a quantitative information such as volume or mean intensity. In digital images, the region of interest is determined by drawing a line around the desired location, or areas may be specified by using mathematical graphics primitives, such as Point, Line, Circle, Polygon, etc. [7]

There are many reasons for identifying region of interest in the image such as to examine the important characteristics of that part. If we need accurate information about the size, shape, or boundaries of a particular area is required. And extract important data for that part of all image data. [8] [9] [10]

In this research, the original image contains many things such as trees, landscapes and buildings, in addition to the person’s image. Therefore, face area is determine by red rectangular as an important area in image as shown in the Figure 1.

\[(r1, c1)\]
\[(10, 20)\]
Fuzzy Logic

Fuzzy logic is one of the most important methods of artificial intelligence and is used in many modern applications. [11] In this research, the main idea of using fuzzy logic is to generate a new image (stego image) that contains region of interest after hiding it by using the proposed method and then sending it to the other side. The general form of hiding image is shown in Figure 2. [12] [13] [14]

Proposed Method

After determining region of interest in the image by using fuzzy logic, you proposed this method to hide the image in the sender side:
- Convert the intensity value to binary system
- Rotate bit four
- Exchange bit 4 with bit 5
- Exchange bit 6 with bit 7
- Convert intensity value to decimal system

After determining region of interest in the stego image by using fuzzy logic, you proposed this method in the receive side:
- Convert the intensity value to binary system
- Rotate bit eight to the position of bit 4

Figure 1: Represent Three Original Images After Determine Region of Interest

Figure 2: Represent General Form of Hiding Image
- Exchange bit 5 with bit 6
- Exchange bit 7 with bit 8
- Convert intensity value to decimal system

The execution of proposed method (of some pixels) in the send and receive side was show in Figure (3).

Hide \((203)_{10}\)

\[
\begin{array}{cccccc}
1 & 1 & 0 & 1 & 0 & 0 \\
1 & 1 & 0 & 0 & 0 & 1 \\
1 & 1 & 0 & 0 & 0 & 1 \\
1 & 1 & 0 & 0 & 0 & 1 \\
\end{array}
\]

\((11000111)_2 = (227)_{10}\)

Unhide \((227)_{10}\)

\[
\begin{array}{cccccc}
1 & 1 & 0 & 0 & 0 & 1 \\
1 & 1 & 0 & 1 & 0 & 0 \\
1 & 1 & 0 & 1 & 0 & 0 \\
1 & 1 & 0 & 1 & 0 & 0 \\
\end{array}
\]

\((11010011)_2 = (203)_{10}\)

Hide \((178)_{10}\)

\[
\begin{array}{cccccc}
0 & 1 & 0 & 0 & 1 & 1 \\
0 & 1 & 0 & 1 & 1 & 1 \\
0 & 1 & 0 & 1 & 1 & 1 \\
0 & 1 & 0 & 1 & 1 & 1 \\
\end{array}
\]
$(01011100)_2 = (58)_{10}$

Unhide $(58)_{10}$

![Binary representation of 58](attachment:image.png)

$(01001101)_2 = (178)_{10}$

Figure 3 Represent the execution of proposed method

**Suggested Algorithm:**

The algorithm proposed by use fuzzy logic to hide the regions of interest in images was divided into two parts. The first part is the sending algorithm and the second part is the receiving algorithm.

**The first part algorithm is hide region of interest in image:**
1. Input original Gray level image
2. Make size of image is row=100, column=100
3. Show image
4. Select the regions of interest in image
5. Determine two pixel coordinates of ROI in image $(r_1,c_1), (r_2,c_2)$
6. Show image
7. For $i=1:100$
8. For $j=1:100$
9. If $i \geq r_1$ and $i \leq r_2$ and $j \geq c_1$ and $j \leq c_2$ Then
10. Convert the intensity value to binary system
11. Rotate bit four
12. Exchange bit 4 with bit 5
13. Exchange bit 6 with bit 7
14. EndIf
15. End
16. End
17. Convert intensity value to decimal system
18. Show image
19. End

**The second part algorithm is unhide region of interest in image:**
1. Input image after hide region of interest (stego image)
2. Show image
3. Select the ROI in image depending on the key (key is $(r_1,c_1), (r_2,c_2)$)
4. Show image
5. For $i=1:100$
6. For $j=1:100$
7-If \( i \geq r_1 \) and \( i \leq r_2 \) and \( j \geq c_1 \) and \( j \leq c_2 \) Then
8-Convert the intensity value to binary system
9-Rotate bit eight to position of bit 4
10-Exchange bit 5 with bit 6
11-Exchange bit 7 with bit 8
12-Endif
13-End
14-End
15-Convert intensity value to decimal system
16-Show image
17-End

**Result and Discussion:**

In this research, Three images of people were selected. The work in the proposed algorithm was divided into two stages. The first stage represents the sending, in which the face area is identified as region of interest in the image and is hidden. As for the second stage, the hidden image is received and it is unhide. A fuzzy logic is used to control the key values. The execution of proposed algorithm of three images in the send and receive side was show in Figure (4).

**Sending Side:**

| Image 1 | Determine ROI | Hiding ROI (Stego Image) |
|---------|---------------|-------------------------|

**Receiving Side:**

| Stego Image | Determine ROI Depending of Key | Result Image |
|-------------|--------------------------------|--------------|

| Image 2 | Determine ROI Depending of Key | Hiding ROI (Stego Image) |
|---------|--------------------------------|-------------------------|

**Sending Side:**

| Image 2 | Determine ROI | Hiding ROI (Stego Image) |
|---------|---------------|-------------------------|

**Receiving Side:**
Figure (4) Represent Execution of Proposed Algorithm of three images in the send and receive side

Conclusion:
The research revealed a set of conclusions that can be summarized as follows:

- With the technological development of information, the large increase in information available around the world, and the emergence of information networks and huge databases, it has become necessary to access this information by determining who is authorized to access this information and how and the level of access to it.

- Information security, whatever this information (whether data or images) is a process is not simple, but rather a complex process consisting of three components all of them of the same degree of importance and these components are confidentiality of information, integrity of the information and ensuring access to information.

- In this research, Three images of people were dealt with, and what is meant by image security means complete control over these images, determining the party that receives them, and determining the authority to access them. This is done through the use of a group of
technologies to ensure that it is not exposed to penetration from any of the parties. The importance of the security of images of people doubles in preserving and preserving privacy.

- An algorithm was proposed to hide region of interest in the image after they were identified using fuzzy logic. This proposed algorithm provided security to the images being transmitted. Also, determining the face area as an important area in the image and hiding it, and using fuzzy logic in determining the area gave strength to the proposed algorithm.

- The main idea of using fuzzy logic is to know whether or not the pixel is within the area of interest in the image, and then perform the hiding process.

Reference:

[1] Karthikeyan B. and Asha S. 2019 Gray Code Based Data Hiding in an Image using LSB Embedding Technique Inter. J. of Recent Tech. and Eng. , Vol 8, Issue 1, pp 1617-1620.
[2] Gurala J. and Pasala S. 2019 A Secure Framework for Communicating Multimedia Data in Cover Images using Hybrid Steganography Algorithms in Wireless Local Area Network Inter. J. of Innovative Tech. and Exploring Eng. (IJITEE), Vol 9, Issue 253, pp 35-43.
[3] Majumder J. and Chittaranjan P. 2019 High Capacity Image Steganography using Pixel Value Differencing Method with Data Compression using Neural Network Inter. J. of Innovative Tech. and Exploring Eng. (IJITEE), Vol 8, Issue 12, pp 1800-1804.
[4] Noaman K. and Jamil A. 2015 Effective Strategies for ROI and Image Matching”, (IJACSA) Inter. J. of Advanced Computer Science and Applications, Vol 6, No 2, pp1-4.
[5] Dalwadi M. and D. K. 2013 Automatic Boundary Detection and Generation of Region of Interest for Focal Liver Lesion Ultrasound Image Using Texture Analysis Inter. J. of Advanced Research in Computer Eng. & Tech. (IJARCET), Vol 2, Issue 7, pp 2369-2373.
[6] Chavada P. and Narendra P. 2014 Region of Interest Based Image Compression Inter. J. of Innovative Research in Computer and Communication Eng., Vol 2, Issue 1, pp 2747-2754.
[7] Rani T. and S. S. 2010 Region of Interest Tracking in Video Sequences Inter. J. of Computer Applications, Vol 3, No 7, pp 32-36.
[8] Mary M. and P. C. 2016 Region of Interest Based Compression of Medical Images Using Vector Quantization Inter. J. of Computational Science and Information Technology (IJCSITY), Vol 4, No 1, pp 29-37.
[9] Sahu S. Fingerprint M. 2014 Extraction and Orientation Detection using ROI (Region of Interest) for Fingerprint Matching Inter. J. of Scientific & Eng. Research, Vol 5, Issue 1, pp 289-299.
[10] Kaur H. and Reecha D. 2016 Segmentation of Tumor Region from Brain Mri Images Using Fuzzy C-Mean Clustering and Seeded Region Growing IOSR Journal of Computer Eng. , Vol 18, Issue 5, pp 20-24.
[11] Ali S. and Maryam G. 2019 PDA: A Private Domains Approach for Improved MSB Steganography Image Periodicals of Eng. and Natural Sciences, Vol 7, No 3, pp 1405-1411.
[12] Ali U. and M. S. 2019 A Robust and Secured Image Steganography using LSB and Random Bit Substitution American J. of Eng. Research (AJER), Vol 8, Issue 2, pp 39-44.
[13] Sabri M. and C. R. 2019 Digital Image Steganography in Spatial Domain a Comprehensive Review J. of Theoretical and Applied Information Technology, Vol 97, No 19, pp 5081-5102.
[14] Abu-Allhaia M. 2019 Crypto-Seganographic LSB-based System for AWS-Encrypted Data (IJACSA) Inter. J. of Advanced Computer Science and Applications, Vol 10, No 10, pp 55-60.