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Visual Cryptography for Light Encryption Scheme Using LED Based On Halftoning Algorithm

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Abstract-Visible Light is regarded as a reliable mode of communication in comparison with Radio Frequency communication. It has a great scope in 5G networks. But this visible light communication is prone to security issues like eavesdropping due to its visual nature. This paper deals with the light encryption scheme using Light Emitting Diode.
Keywords: Security, Visual Cryptography, Otsu, Halftone, Lifi

I. INTRODUCTION

As the technology rules the world currently, security plays a very vital role in data transfer. This can be provided by means of Network security. Cryptography is a study of mathematical technique that relates the aspects of security issues like Data confidentiality, Data Integrity and Data Availability which is referred to as CIA triangle.

Visual Cryptography is a new technique of providing information security using simple user algorithms. Complex, computationally intensive algorithm is not used in this technique as used in the traditional cryptographic techniques. As images are more attractive than text, they are more prone to hacking nowadays. The security should be provided for Visible Light Communication of image transmission. As far as now the security for image transmission in VLC was provided by an Otsu algorithm which has enhanced Bit Error Rate but has a limitation on computational time and image sharing scheme. This can be overcome by an Image security algorithm called halftone algorithm. The proposed idea will overcome the limitations that were mentioned above.

Figure1 represents the light encryption system using laptops. The VLC signal from a LED can be received by a light encrypting device like mobile or laptops, which could be any device that has a optical receiver such as photodiode or an camera image sensor, and also having a visible LED for optical transmitter. After the visible light signal from LED is received by the light encrypted device, the image data can be encrypted by applying halftone algorithm followed by an XOR cipher. This ensures double encrypted security for the data to be sent. The above implementation could be made possible for the future VLC medium.

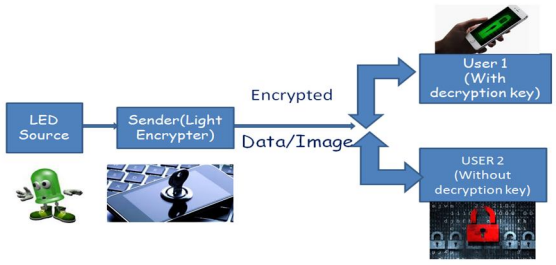

Fig.1.Proposed Light Encryption Scheme.

For the practical implementation it requires three components. They are

A. Power supply section
B. Transmitter section
C. Receiver section

II. RELATED WORKS

Visual Cryptography is a technique that provides security to the data that is being transmitted in the visible range. Based on the analysis made to overcome the security issues, algorithms exists whose working were analyzed. The existing algorithm called Otsu algorithm [1] have an advantage of increased bit error rate while has a disadvantage on Image sharing capability. This was rectified to an extent by working with an algorithm based on Halftoning technique [10]. Visual Cryptography schemes are secret sharing schemes where the image is diffused into n number of transparencies. These are then given to n number of participants and participants when

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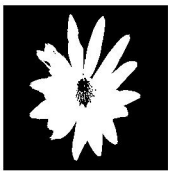
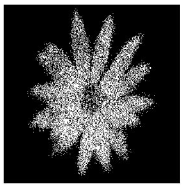
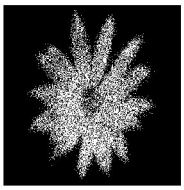
simply stack a qualified set of transparencies gets back the original image. This uses a k out of n transparencies to get back the original image [2].Halftone is a reprographic technique in which simulation is done through dots and spacing [4]. This differs from continuous tone imagery which has a wide range of colors; this technique reduces visual reproduction by producing image through dots in one color. Halftone algorithm is found to be secured as it involves image sharing technique. Halftone algorithm can be made possible by means of error diffusion filters. With the work done on Jarvis, Floyd's error diffusion algorithms, the parameters were analyzed [6]. The output images of various image security algorithms are:


Original Image
Output Image


Otsu algorithm
Output Image


Jarvis Halftone
Output Image


Floyd's Halftone
Output Image

III. PROPOSED WORK

Based on the works done in the security algorithm there were issues like computational complexity, PSNR calculation and time consumption. These issues can be overcome by the proposed visual cryptographic algorithm [5] which is based on dividing the black and white pixels by which the image sharing is done.

A. Software Algorithm

This algorithm is based on the binary image separation that includes two shares namely black pixel and white pixels [9]. This scheme is based on k out of n scheme where n is the total number of shares produced and k is the number of images to be stacked together so as to get back the final image. This work is done on Matlab platform.

1) The input image variable is initialized.
2) Two share variables are declared and are initialized to zero.
3) The black and white pixels are processed separately.
4) The share matrices are declared. Based on the random number generated, the values of pixels vary. If the random number is 0 then it remains as such, else the value gets swapped [2].
5) The similar procedure is repeated for black pixel.
6) Individual shares are produced.
7) The above algorithm could produce two shares.
8) Six shares can be produced as in Figure 2 are bit-ORed so that the shares get combined together.
9) Then an encryption algorithm is used which is XOR operation. This provides a double security to the data being sent.
10) The (2, 6) scheme is used to retrieve back the original image.

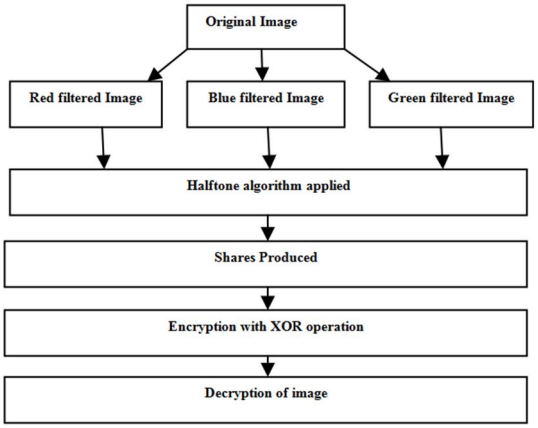


Fig 2: Share increase

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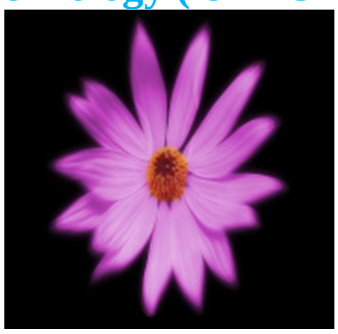
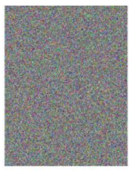
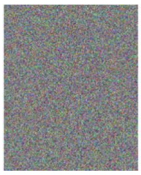


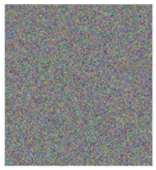
(Original Image)


(Red xor share 1)


(Red xor share 2)


(Green xor share 1)


(Green xor share 2)


(Blue xor share


(Blue xor share 2)


(Decrypted Image)

Fig 3: Finalized outcome

B. Hardware Implementation

Data transfer over long distances is done usually in serial form. Data from a transmitting system is converted into a stream of serial bits, and is transferred on a single line to a receiving system at a time. Serial to parallel conversion is used to retrieve the data at the receiving end. The speed of data transmission in measured in baud rate. This is done by means of RS232 cables that can serially transmit data from one system to another [7]. Here LED acts as a source for Visible Light Communication.

IV. BLOCK DESCRIPTION

Hardware Circuit used for visible light communication consists of three blocks. They are

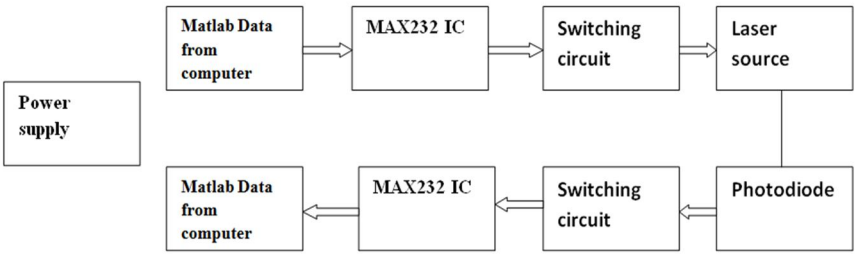


Fig 4: Block diagram of the transmitter and receiver section

A. Power Supply Block

Both the transmitter and the receiver section will be operated in 5V DC supply.

B. Transmitter Block

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The transmitter section is used for transmitting image data from the transmitter PC. Several components used are mentioned below,

1) Computer with MATLAB software
2) Max 232 IC
3) Switching circuit
4) LED diode

The transmitter section starts with the data being received serially from the MATLAB through RS232 cable to the hardware. This data is received by the MAX232 IC which is a serial IC. The data is then sent to the LED source [8] which is the main component in the Visual communication. The LED source is used in serially communicates with the receiver end in the presence of light. With the presence of the LED source using the supply, there is a data being transmitted serially.

C. Receiver Block

The receiver section consists of a photodiode which is used as the receiver. The data that was serially transmitted by the LED is received by the photodiode. This data is sent to the MAX232 IC for conversion of TTL logic. This is then sent via a serial cable to the PC or any other device to get back the output (i.e.,) the data or image that was transmitted.

V. WORKING PRINCIPLE

Serial communication is done for transmission of data. The MAX232 IC is used that converts the signals from RS232 logical input into TTL logic that is being used to drive the data through the LED diode. Based on the voltage being sent to the other side the output received is judged. As the photodiode has the ability to receive the data through the light source, the data is received through it and is sent to MAX232 to send the data serially. Serial cable is used on the both the ends to transmit and receive data in the devices.

Table I Performance Analysis

Algorithm	Time taken(seconds)	PSNR
Otsu Algorithm	4.57	9.6694
Jarvis Error diffusion Algorithm	3.96	9.6397
Floyd's Error diffusion algorithm	4.0938	9.6397
Proposed Algorithm	1.11	54.1408

VI. CONCLUSION

Reliable communication could be provided by visual cryptographic technique and has a greater usage in case of 5G technology. With the implementation of halftone secured data communication may be made possible through this. The proposed algorithm has better PSNR and computational time on comparison with the existing algorithms. Its future applications include the data transmission with the help of li-fi technology, where visible light communication plays a vital role. The drawback of this technique is that this data transfer can be done only in the presence of a visible light source.

VII. ACKNOWLEDGEMENT

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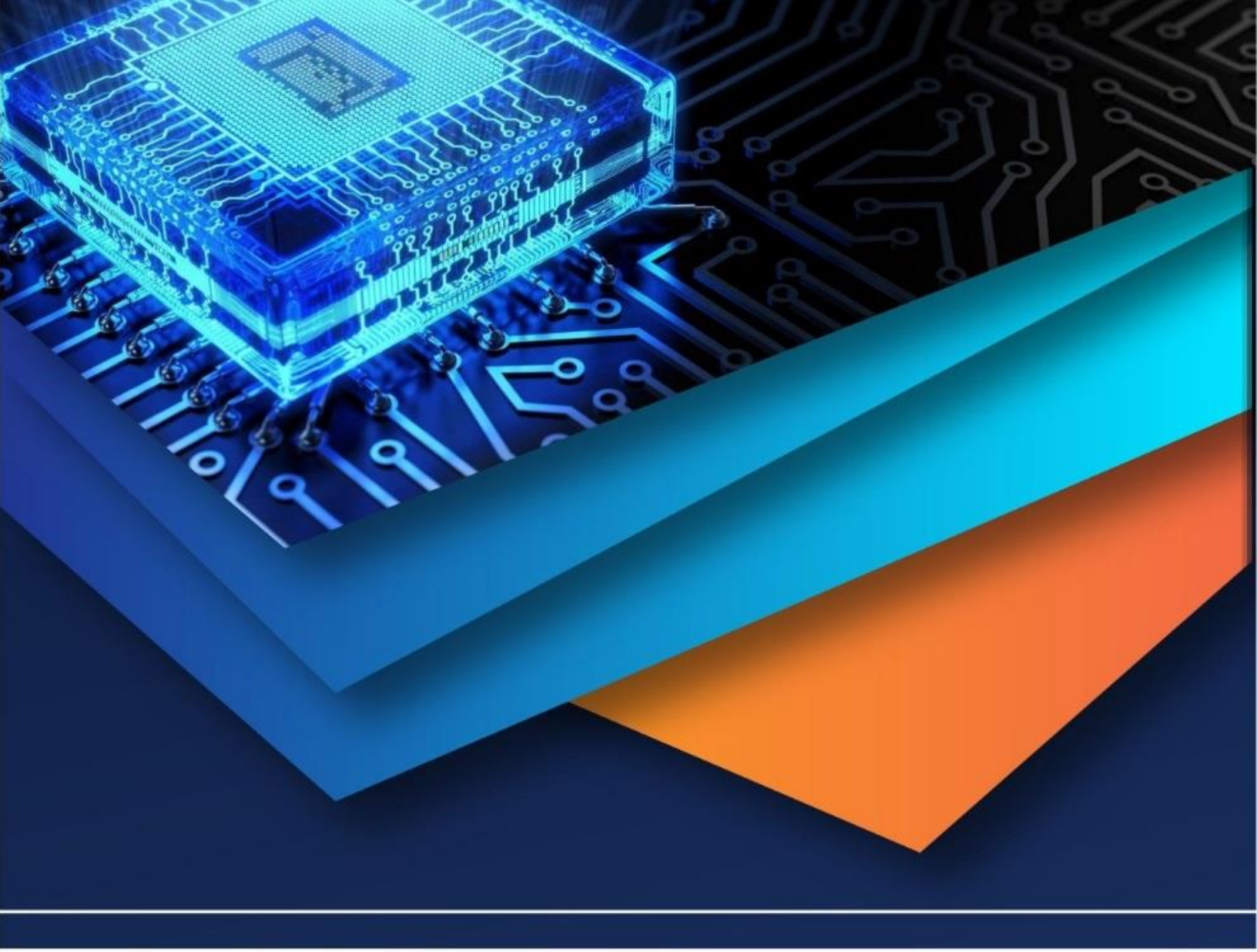

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