RESEARCH ARTICLE OPEN ACCESS

# Four Level Multiple Image Sharing Scheme Using Visual Cryptography for Colour and Gray Scale Images

Rajeev Kumar Sao[1], Mr. Prabhakar Sharma [2]
[1]M.Tech. Scholar, Raipur Institute of Technology (RITEE), Raipur, C.G.
[2] Asst. Professor, Computer Science Department, RITEE, Raipur, C.G.

## Abstract:

Information is increasingly important in our daily life. Information gets more value when shared with others. Due to advances in technologies related to networking and communication, it is possible to share the information like audio, video and image easily. It may give rise to security related issues. Attackers may try to access unauthorized data and misuse it. One of the variants of the visual cryptography is multiple image sharing scheme of visual cryptography in which more than one images are hidden and shared between the receiver and the transmitter securely. In this thesis, a multiple sharing scheme is presented for color image which is designed to hide 4 secret images. With slight modification in this scheme, this scheme can be extended to share more than 4 images

*Keywords* — **visual cryptography scheme (VCS), pixel expansion, OR operation security, accuracy, computational complexity.**

## I. INTRODUCTION

With the quick advances in organize innovation, interactive media data can be transmitted over the Internet advantageously. Different private and mystery information, for example, military maps and business distinguishing pieces of proof are transmitted consistently finished the Internet. While utilizing mystery pictures, security issues ought to be considered on the grounds that programmers may use the frail connection on the correspondence system to take the data that they need to get.

To manage the security issues of mystery pictures, different picture mystery sharing plans have been composed and created.

Visual cryptography conspire is presented first in 1994 by Noar and Shamir [1]. Visual cryptography is a cryptographic technique which permits visual data (e.g. printed content, manually written notes or content and pictures) to be encoded such that the decoding procedure can be refined by the human visual framework, without the utilization of PCs. Visual cryptography conspire takes out the utilization of complex calculation in decoding process, and the mystery pictures can be re-established by applying stacking operation.

This property makes visual cryptography extremely helpful for the low calculation stack condition. Naor and Shamir's[1] proposed encoding scheme for sharing a binary format image into two shares i.e. $Share_1$ and $Share_2$ . Chin-Chen Chang et al [5] proposed spatial domain visual cryptography method for hiding the binary image and generating the two meaningful shares. Liguo Fang [6] proposed a (2, n) scheme which was based on the combination. Xiao-qing and Tan [16] presented VCS which is the combination of the XOR , OR operation and threshold based visual secret sharing image. Wu and Chen [2] were the first research scholar who proposed the VCS capable of hiding two secret image. Hsu et al. [3] proposed another multiple secret sharing scheme which was also used to hide two secret image. Wu and Chang [4] also redefined the idea of Wu and Chen [2] method of VCS.S J Shyu et al [7] were first researchers to suggest the multiple secrets sharing. Fang[8] suggested reversible visual cryptography scheme. Jen-Bang Feng et al [9] also offered a visual secret sharing scheme to hide multiple secret images into two different shares. Mustafa Ulutas et.al.[10] proposed secret sharing scheme which was based on the rotation of shares. Tzung-Her Chen et al [11] advised the multiple secret sharing schemes by rotation of the random grids, A non-expansion reversible visual secret sharing scheme that does not require to define the lookup table advised by Fang [13]. For encoding four secrets into two shares Zhengxin Fu et al [14] offered a rotation based visual cryptography scheme. Jonathan Weir et al [15] offered a scheme for sharing multiple secrets using visual cryptography. Verheul and Van Tilborg [17] presented a VCS scheme for hiding color secret image. Yang and Laih [18] improved the pixel expansion of Verheul and Van Tilborg [17]. Chang and Tsai [19] offered a novel color visual cryptography scheme. In this method of a secret color image two significant color images are chosen as a cover images which are of the same size as the size of secret color image. Chin-Chen Chang et al [20] suggested a secret color image sharing scheme based on modified visual cryptography. To share true-color image Lukac and Plataniotis [21] offered bit-level based visual cryptography scheme. Tzung-Her Chen et al [12] advised a multiple secrets visual cryptography scheme which is an extended form of traditional visual secret sharing. Some another noteworthy contribution can also be found in [19-30].

## II. METHODOLOGY

In this work, a new scheme of visual cryptography is proposed which can be applied to the color images. This scheme is called multiple image sharing scheme in color image (MISSICI). It is called multiple image sharing because in this scheme more than one images can be shared. Block diagram of this scheme is shown in the figure given below. In this scheme, first of all the input image i.e. IM1 is given to the system as input. Key image play very important role in this scheme as it works like a password without this image it is impossible to get back all the secret image. In this scheme C1 is obtained by the XOR operation between S1 and key. Where S1 is the first secret image.H11 is obtained by the XOR operation between the IM1 and the C1 while H12 is obtained by the XOR operation between H11 and S1. Once the H11 and the H12 is obtained then concatenation operation is performed horizontally between H11 and H12 to get the IM2. This IM2 image work as a input image for the next block as shown in the figure. Now the secret image S2 in given as the input and the resize to match the size of the IM2 and at the same time Key image K is also resized to match the IM2. In the second block again the XOR operation between the resized secret image and the resized key K image gives the image C2. Here since both key image and the secret image are resized to match the size of the IM2 therefore the image C2 has the same dimension of IM2. Now by applying the XOR operation betweenIM2 and C2 H21 image is obtained and in the similar fashion the XOR operation between H21 and s2 gives the H22 image. By concatenation of H21 and H22 horizontally we get the image IM3 whose number of rows is equal to the number of rows of the H21 and H22 but number of column of IM3 is equal to the sum of the column of the H21 and the H22.

XOR operation is applied on the different images to get the encrypted images.

### *A. Algorithm Steps for Encryption*

Algorithm steps adopted to carry out the visual cryptography using above mentioned method are as follows-

Step 1- Input the image IM1.
Step 2- Input the Key image K.
Step 3- Input the First secret image S1.
Step 4- Input the Second secret image S2.
Step 5- Input the third secret image S3.
Step 6- Input the fourth secret image S4.
Step 7- Obtained the C1 image by XOR operation between first secret image S1 and the key image K
Step 8- Apply the XOR operation between the C1 image obtained in step7 and input image IM1 to get the H11 Image.
Step 9- Apply the XOR operation between H11 obtained in step 8 and the first secret image S1 to get the H12 image.

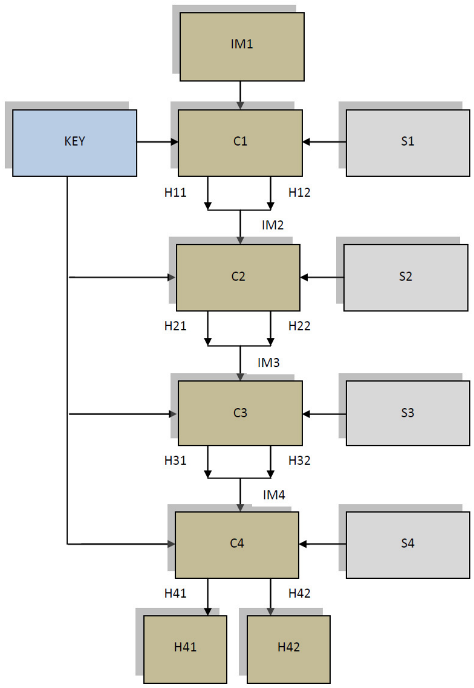



**Figure 1 Block Diagram of Proposed Method**

Step 10- Concatenate the image H11 and H12 horizontally to get the IM2.
Step11- Resize the Secret image S2 to the dimension of the IM2.
Step12- Resize the key image K to the dimension of the IM2.
Step13- Apply the XOR operation between S2 obtained at the step 11 and the key image obtained at the step 12 to get the C2 image.
Step14- Perform the XOR operation between C2 image obtained at step 13 and the IM2 image obtained at the step 10 to get the H21 image.
Step 15- Obtained the H22 image by performing the XOR operation between H21 image obtained at the step 14 and the resized secret image S2 obtained at the step 11.
Step 16- Concatenate the H21 and the H22 obtained at the step 14 and step 15 to get the image IM3.
Step 17- This process is repeated till the last block to get the final encrypted Image H41 and H42.
Step 18- Send the image H41 and Image H42 to two different people.

### *B. Algorithm Steps for Decryption*

At the receiver side since image H41 and image H42 is sent to two different people. So in order to get back the original image these two images must be stacked into one other to get the secret image S4. XOR operation is performed between these H41 and H42 images which is equivalent to stacking operation.
Step 1- Input the H41 image.
Step 2- Input the H42 image.
Step 3- Input the key image K.
Step 4- Resize the key image K to the dimension of H41 or H42.

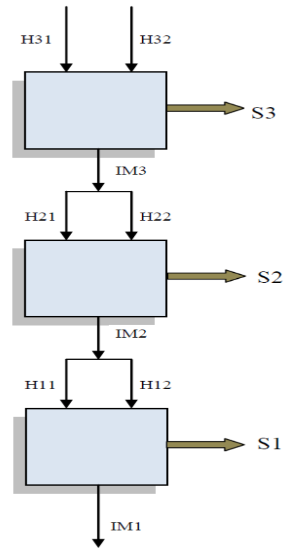



**Figure 2 Decryption Process**

Step 5- Perform the XOR operation between H41 and H42 to get the secret image 4 i.e. S4.
Step 6- Apply the XOR operation between S4 obtained at step 5 and the key image K obtained at the step 2 to get the C4 image.
Step7- Perform the XOR operation between C4 image obtained at the step 6 and the H41 image obtained at the step5 to get the IM4 image. This image work as a input to the next block.
Step8-De-concatenate the Image IM4 horizontally to get the H31 and H32 image.
Step 9-Resize the key image as per the dimension of the H31 or H32.

S2

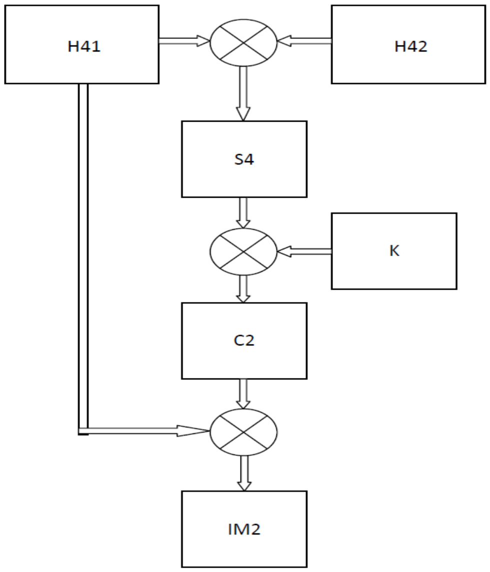



**Figure 3 Decryption of IM2 image**

Step10- Obtain the Secret image S3 by performing the XOR between H31 and H32.
Step11- Obtain the image C3 by performing the XOR operation between secret image S3 and the key image K.
Step12-Apply the XOR operation between C3 and H31 to get the Image IM3.
Step13- Repeat this process till we get the secret image S1.
Step14- End of the process.

## III. Experimental Results

In this work, a system is designed for multiple image sharing scheme by applying the visual cryptography algorithm. The proposed designed is designed to share 4 secret images in single instance. This algorithm can be improved easily to accommodate more secret images.

The graphical user interface designed for this system is shown in the figure 4 given below. This system take all the secret images one by one and then with the help of the proposed algorithm generate the single encrypted images which carry all the secret images.

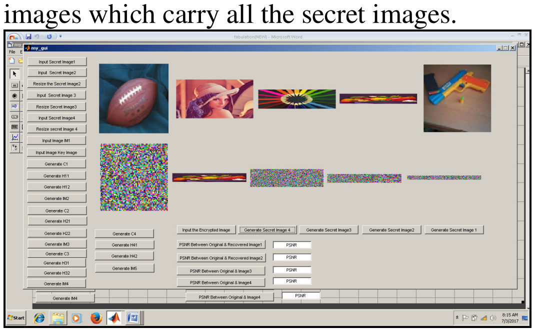


**Figure 4 Graphical User Interface (GUI) for the Visual cryptography system**

The visual cryptography system designed for this project work is tested by

i. hiding 2 secret image i.e. two level multiple sharing scheme.
ii. Hiding 3 Secret images i.e. Three level multiple sharing scheme.
iii. Hiding 4 secret images i.e. 4 level multiple sharing scheme.

**Table 1 Two level Multiple Sharing Scheme For gray level**

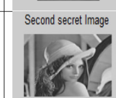
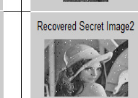
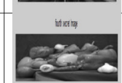
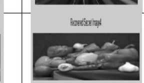
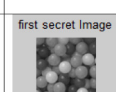
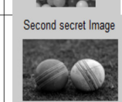
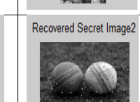
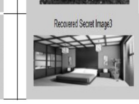
| Set | level | Size | Input Secret Image | Output Recovered Image | PSNR |
|---|---|---|---|---|---|
| 1 | 1 | 64x64 |  |  | 40.6373 |
| | 2 | 64x128 |  |  | 58.5442 |
| | 3 | 64x256 |  |  | 67.4354 |
| | 4 | 64x512 |  |  | 72.1551 |
| | | | | | |
| 2 | 1 | 64x64 |  |  | 38.1271 |
| | 2 | 64x128 |  |  | 54.6607 |
| | 3 | 64x256 |  |  | 67.6205 |

**Table 2 PSNR, RMSE and Correlation Comparison of Gray and Color Secret image**

| S.N. | Secret Image | Size/Level | Parameter | Gray Image | Color Image |
|---|---|---|---|---|---|
| 1 | First | 64x64 (2nd Level) | Average PSNR | 53.563 | 52.464 |
| | | | Average RMSE | 0.618 | 0.639 |
| | | | Average Correlation | 0.8805 | 0.931 |
| | | 64x64 (3rd Level) | Average PSNR | 40.999 | 39.443 |
| | | | Average RMSE | 2.323 | 2.806 |
| | | | Average Correlation | 0.807 | 0.899 |
| | | 64x64 (4th Level) | Average PSNR | 38.918 | 38.004 |
| | | | Average RMSE | 2.910 | 3.298 |
| | | | Average Correlation | 0.806 | 0.834 |
| 2 | Second | 64x64 (2nd Level) | AveragePSNR | 61.682 | 59.6639 |
| | | | Average RMSE | 0.267 | 0.303 |
| | | | Average Correlation | 0.942 | 0.963 |
| | | 64x64 (3rd Level) | Average PSNR | 61.682 | 59.663 |
| | | | Average RMSE | 0.267 | 0.303 |
| | | | Average Correlation | 0.942 | 0.963 |
| | | 64x64 (4th Level) | Average PSNR | 54.158 | 52.221 |
| | | | Average RMSE | 0.486 | 0.667 |
| | | | Average Correlation | 0.921 | 0.922025 |
| 3 | Third | 64x64 (2nd Level) | Average PSNR | NA | NA |
| | | | Average RMSE | NA | NA |
| | | | Average Correlation | NA | NA |
| | | 64x64 (3rd Level) | Average PSNR | 66.99948 | 64.295 |
| | | | Average RMSE | 0.1164 | 0.158 |
| | | | Average Correlation | 0.993 | 0.9785 |
| | | 64x64 (4th Level) | Average PSNR | 66.99948 | 64.295 |
| | | | Average RMSE | 0.1164 | 0.158 |
| | | | Average Correlation | 0.993 | 0.9785 |
| 4 | Fourth | 64x64 (2nd Level) | Average PSNR | NA | NA |
| | | | Average RMSE | NA | NA |
| | | | Average Correlation | NA | NA |
| | | 64x64 (3rd Level) | Average PSNR | NA | NA |
| | | | Average RMSE | NA | NA |
| | | | Average Correlation | NA | NA |
| | | 64x64 (4th Level) | Average PSNR | | 76.6636 |
| | | | Average RMSE | | 0.038 |
| | | | Average Correlation | | 0.985 |

Table 2 represent the comparative performance on the basis of the PSNR, RMSE and correlation parameters. From the table 2 it is clear that if the level is increased then PSNR is increased and hence RMSE decreased which shows that the quality of image is increased as we increases the level. In the same way correlation is becoming more closer to the 1 as we increase the level under gray scale image operation which again indicate that the quality of image is improving as we increase the level.

Same method is again applied to the color image for different level of MISS and the result and the PSNR is tabulated in the table 3.

Table 3 **Multiple sharing Scheme for Four level (Color Image)**

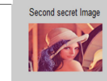
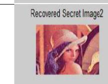
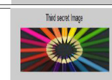
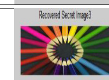
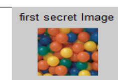
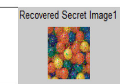
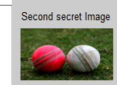
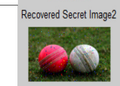
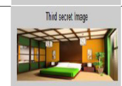
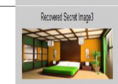
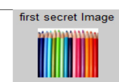
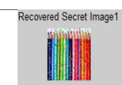
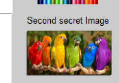
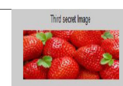
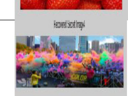
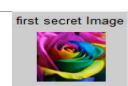
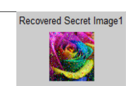
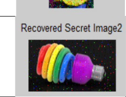
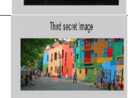
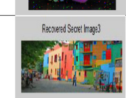
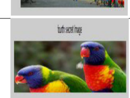
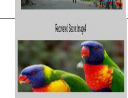
| Set | level | Size | Input Secret Image | Output Recovered Image | PSNR |
|---|---|---|---|---|---|
| 1 | 1 | 64x64 |  |  | 39.7041 |
| | 2 | 64x128 |  |  | 56.0708 |
| | 3 | 64x256 |  |  | 65.2770 |
| | 4 | 64x512 |  |  | 74.3495 |
| 2 | 1 | 64x64 |  |  | 40.3051 |
| | 2 | 64x128 |  |  | 52.6779 |
| | 3 | 64x256 |  |  | 66.7657 |
| | 4 | 64x512 |  |  | 78.8844 |
| 3 | 1 | 64x64 |  |  | 35.6400 |
| | 2 | 64x128 |  |  | 52.7917 |
| | 3 | 64x256 |  |  | 62.0365 |
| | 4 | 64x512 |  |  | 77.5725 |
| 4 | 1 | 64x64 |  |  | 36.3692 |
| | 2 | 64x128 |  |  | 47.3469 |
| | 3 | 64x256 |  |  | 63.1008 |
| | 4 | 64x512 |  |  | 75.8480 |

**Table 4 Average PSNR,RMSE and Correlation Comparison Table**

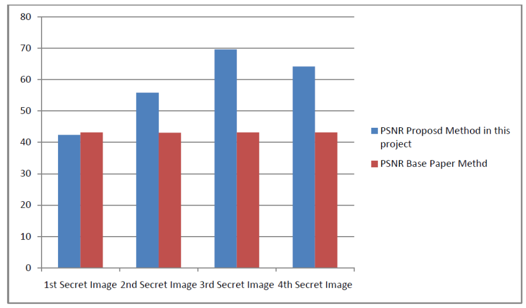
| S.N. | Secret Image | Size/Level | Parameter | Gray Image | Color Image |
|---|---|---|---|---|---|
| 1 | First | 64x64 (2nd Level) | Average PSNR | 53.563 | 52.464 |
| | | | Average RMSE | 0.618 | 0.639 |
| | | | Average Correlation | 0.8805 | 0.931 |
| | | 64x64 (3rd Level) | Average PSNR | 40.999 | 39.443 |
| | | | Average RMSE | 2.323 | 2.806 |
| | | | Average Correlation | 0.807 | 0.899 |
| | | 64x64 (4th Level) | Average PSNR | 38.918 | 38.004 |
| | | | Average RMSE | 2.910 | 3.298 |
| | | | Average Correlation | 0.806 | 0.834 |
| 2 | Second | 64x64 (2nd Level) | AveragePSNR | 61.682 | 59.6639 |
| | | | Average RMSE | 0.267 | 0.303 |
| | | | Average Correlation | 0.942 | 0.963 |
| | | 64x64 (3rd Level) | Average PSNR | 61.682 | 59.663 |
| | | | Average RMSE | 0.267 | 0.303 |
| | | | Average Correlation | 0.942 | 0.963 |
| | | 64x64 (4th Level) | Average PSNR | 54.158 | 52.221 |
| | | | Average RMSE | 0.486 | 0.667 |
| | | | Average Correlation | 0.921 | 0.922025 |
| 3 | Third | 64x64 (2nd Level) | Average PSNR | NA | NA |
| | | | Average RMSE | NA | NA |
| | | | Average Correlation | NA | NA |
| | | 64x64 (3rd Level) | Average PSNR | 66.99948 | 64.295 |
| | | | Average RMSE | 0.1164 | 0.158 |
| | | | Average Correlation | 0.993 | 0.9785 |
| | | 64x64 (4th Level) | Average PSNR | 66.99948 | 64.295 |
| | | | Average RMSE | 0.1164 | 0.158 |
| | | | Average Correlation | 0.993 | 0.9785 |
| 4 | Fourth | 64x64 (2nd Level) | Average PSNR | NA | NA |
| | | | Average RMSE | NA | NA |
| | | | Average Correlation | NA | NA |
| | | 64x64 (3rd Level) | Average PSNR | NA | NA |
| | | | Average RMSE | NA | NA |
| | | | Average Correlation | NA | NA |
| | | 64x64 (4th Level) | Average PSNR | | 76.6636 |
| | | | Average RMSE | | 0.038 |
| | | | Average Correlation | | 0.985 |

From 4 shows the comparative performance of the proposed method in term of gray scale image and color image. From this table it is clear that the PSNR values are almost similar in case of color and gray scale images. From the table it is also clear that as we increase the level of MISS we get higher values of PSNR, lower values of RMSE and the correlation is closer to the 1.

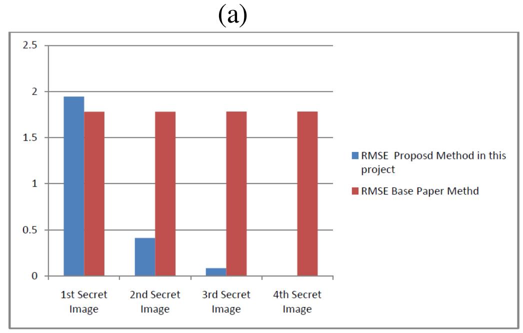
In order to compare the performance of the proposed method with the method presented in the paper [31], a comarision chart is prepared and tabulated in the table 5.

**Table 5 PSNR,RMSE and Correlation comparison chart for proposed method and the method[31]**

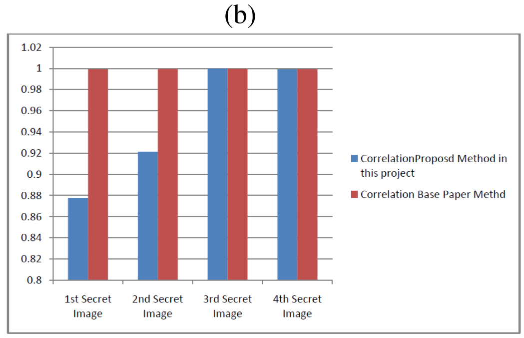
| Secret Image | PSNR(dB) | | RMSE | | Correlation | |
|---|---|---|---|---|---|---|
| | Proposd Method in this project | Base Paper Methd | Proposd Method in this project | Base Paper Methd | Proposed Method in this project | Base Paper Methd |
| First | 42.3623 | 43.16 | 1.9428 | 1.7796 | 0.8776 | 0.9992 |
| Sccod | 55.8421 | 43.10 | 0.4115 | 1.7796 | 0.9212 | 0.9994 |
| Third | 69.6444 | 43.15 | 0.0840 | 1.7808 | 0.9998 | 0.9995 |
| Fourth | 64.1715 | 43.15 | 0,1577 | 1.7808 | 0.9991 | 0.9993 |




(a)




(b)




(c)

**Figure 5 (a) PSNR Comparison graph(b) RMSE Comparison Graph (c) Correlation Comparison Graph**

From the graph shown in the figure 5 and the table 5, it is clear that the proposed system outperform the system proposed in the[31] in term of PSNR and RMSE. The value of PSNR in the proposed method is greater than the previous method[31] which shows the better quality of the decrypted image. Similarly the value of RMSE is lesser in the proposed method as compare the previous method[31]. Which again shows the better quality of the decrypted image in the proposed system. As far as correlation is concerned, for first and second secret image correlation value in the proposed method is lower than the previous method while in 3rd and fourth secret image the value of the correlation value is is almost equal in both the method.

## IV. Conclusion

This project work present an efficient and effective data hiding scheme for multiple image sharing with the help of visual cryptography. Experimental results shows that the scheme present in this project work is capable of performing the encryption – decryption operation very effectively. It also clear from the result that the scheme is capable of producing less distortion as compared to the previous method[31].

So From the results we can conclude that the scheme is able to achieve the desired goal along with the improvement in the efficiency of visual cryptography for different kind of multiple color as well as the gray scale images. It can be concluded that as we increase the level of the MSS, the quality of the secret images gets degraded but the amount of degradation is very less and can not be noticed with naked eyes.

## References


[1] Moni Naor and Adi Shamir, "Visual Cryptography", advances in cryptology-Eurocrypt, pp 1-12,1995.

[2] C.C. Wu, L.H. Chen, "A Study On Visual Cryptography", Master Thesis, Institute of Computer and Information Science, National Chiao Tung University, Taiwan, R.O.C., 1998.

[3] H.-C. Hsu, T.-S. Chen, Y.-H. Lin, "The Ring Shadow Image Technology Of Visual Cryptography By Applying Diverse Rotating Angles To Hide The Secret Sharing", in Proceedings of the 2004 IEEE International Conference on Networking, Sensing & Control, Taipei, Taiwan, pp. 996-1001, March 2004.

[4] H.-C. Wu, C.-C. Chang, "Sharing Visual Multi-Secrets Using Circle Shares", Comput. Stand. Interfaces 134 (28) ,pp. 123-135, (2005).

[5] Chin-Chen Chang, Jun-Chou Chuang, Pei-Yu Lin , "Sharing A Secret Two-Tone Image In Two Gray-Level Images", Proceedings of the 11th International Conference on Parallel and Distributed Systems (ICPADS'05), 2005.

[6] Liguo Fang, BinYu, "Research On Pixel Expansion Of (2,n) Visual Threshold Scheme", 1st International Symposium on Pervasive Computing and Applications ,pp. 856-860, IEEE.

[7] S. J. Shyu, S. Y. Huanga,Y. K. Lee, R. Z. Wang, and K. Chen, cryptography", Pattern Recognition, Vol. 40, Issue 12, pp. 3633 - 3651, 2007.

[8] Wen-Pinn Fang, "Visual Cryptography In Reversible Style", IEEE Proceeding on the Third International Conference on Intelligent Information Hiding and Multimedia Signal Processing (IIHMSP2007), Kaohsiung, Taiwan, R.O.C, 2007.

[9] Jen-Bang Feng, Hsien-Chu Wu, Chwei-Shyong Tsai, Ya-Fen Chang, Yen-Ping Chu, "Visual Secret Sharing For Multiple Secrets", Pattern Recognition 41 ,pp. 3572 - 3581, 2008.

[10] Mustafa Ulutas, Rıfat Yazıcı, Vasif V. Nabiyev, Güzin Ulutas, (2,2)- "Secret Sharing Scheme With Improved Share Randomness", 978-1-4244-2881-6/08, IEEE, 2008.

[11] Tzung-Her Chen, Kai-Hsiang Tsao, and Kuo-Chen Wei, "Multiple-Image Encryption By Rotating Random Grids", Eighth International Conference on Intelligent Systems Design and Applications, pp. 252-256 , 2008.

[12] Tzung-Her Chen, Kai-Hsiang Tsao, and Kuo-Chen Wei, "Multi-Secrets Visual Secret Sharing", Proceedings of APCC2008, IEICE, 2008.

[13] Wen-Pinn Fang, "Non-Expansion Visual Secret Sharing In Reversible Style", IJCSNS International Journal of Computer Science and Network Security, VOL.9 No.2, February 2009.

[14] Zhengxin Fu, Bin Yu, "Research On Rotation Visual Cryptography Scheme", International Symposium on Information Engineering and Electronic Commerce, pp 533-536, 2009.

[15] Jonathan Weir, WeiQi Yan, "Sharing Multiple Secrets Using Visual Cryptography", 978-1-4244-3828-0/09, IEEE, pp 509-512,

2009.
[16] Xiao-qing Tan, "Two Kinds Of Ideal Contrast Visual Cryptography Schemes", International Conference on Signal Processing Systems, pp. 450-453, 2009.
[17] E. Verheul and H. V. Tilborg, "Constructions And Properties Of K Out Of N Visual Secret Sharing Schemes." Designs, Codes and Cryptography, 11(2) , pp.179-196, 1997.
[18] C. Yang and C. Laih, "New Colored Visual Secret Sharing Schemes". Designs, Codes and cryptography, 20, pp. 325-335, 2000.
[19] C. Chang, C. Tsai, and T. Chen. "A New Scheme For Sharing Secret Color Images In Computer Network", Proceedings of International Conference on Parallel and Distributed Systems, pp. 21-27, July 2000.
[20] Chin-Chen Chang , Tai-Xing Yu , "Sharing A Secret Gray Image In Multiple Images", Proceedings of the First International Symposium on Cyber Worlds (CW.02), 2002.
[21] R. Lukac, K.N. Plataniotis, "Bit-Level Based Secret Sharing For Image Encryption", Pattern Recognition 38 (5), pp. 767-772, 2005.
[22] R.Youmaran, A. Adler, A. Miri , "An Improved Visual Cryptography Scheme For Secret Hiding", 23rd Biennial Symposium on Communications, pp. 340-343, 2006.
[23] S.J. Shyu, "Efficient Visual Secret Sharing Scheme For Color Images", Pattern Recognition 39 (5) ,pp. 866-880, 2006.
[24] Mohsen Heidarinejad, Amirhossein Alamdar Yazdi and Konstantinos N, Plataniotis "Algebraic Visual Cryptography Scheme For Color Images", ICASSP, pp. 1761-1764, 2008.
[25] Haibo Zhang, Xiaofei Wang, Wanhua Cao, Youpeng Huang , "Visual Cryptography For General Access Structure By Multi-Pixel Encoding With Variable Block Size", International Symposium on Knowledge Acquisition and Modeling, pp. 340-344, 2008.
[26] F. Liu1, C.K. Wu X.J. Lin , "Colour Visual Cryptography Schemes", IET Information Security, vol. 2, No. 4, pp 151-165, 2008.
[27] Wei Qiao, Hongdong Yin, Huaqing Liang , "A Kind Of Visual Cryptography Scheme For Color Images Based On Halftone Technique", International Conference on Measuring Technology and Mechatronics Automation 978-0-7695-3583-8/09, pp. 393-395, 2009.
[28] Du-Shiau Tsai , Gwoboa Horng , Tzung-Her Chen , Yao-Te Huang , "A Novel Secret Image Sharing Scheme For True-Color Images With Size Constraint", Information Sciences 179 3247-3254 Elsevier, 2009.
[29] Daoshun Wang, FengYi, XiaoboLi, "On General Construction For Extended Visual Cryptography Schemes", Pattern Recognition 42 (2009),pp 3071 - 3082, 2009
[30] Jung-San Lee, T. Hoang Ngan Le, "Hybrid (2, N) Visual Secret Sharing Scheme For Color Images", 978-1-4244-4568-4/09, IEEE, 2009.
**[31]** Rajput Mohit , Deshmukh Maroti "Secure ($n$, $n$ + 1)-Multi Secret Image Sharing Scheme Using Additive Modulo" , 677 – 683., Procedia Computer Science 89 ( 2016 ).