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A Survey Paper on Visual Cryptography for Grey Scale Images

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ABSTRACT

Visual cryptography scheme is a cryptographic technique which allows visual information (e.g. printed text, handwritten notes, and picture) to be encrypted in such a way that the decryption can be performed by the human visual system and without the aid of computers. It encodes the secret image into shares of different patterns. When the shares are Xeroxed onto transparencies, the secret image can be visually decoded by superimposing a set of transparencies. But the shares of the decoded image does not contain any information This paper shows different kinds of Visual Secret sharing techniques existing and framing all the techniques together as a literature survey. We have also reviewed various papers, techniques of halftoning and illustrate it according to the method used, their result and their limitations.

Keywords:- Visual cryptography, Halftoning,, secret sharing scheme, Error-diffusion.

I. INTRODUCTION

Visual Cryptography is a cryptographic technique used for encrypting the visual information like picture, text etc. The basic function of Visual Cryptography is that images are divided into several parts called shares. These shares are distributed among different participants and to decrypt that images these shares are stacked together to get the image back. Which is known as the halftoning process And there are various measures on which performance of visual cryptography schemes depends, such as pixel expansion, visual quality, contrast, security, quality of shares, size, computational complexity. And error diffusion method is used to increase the quality of the image and different error diffusion methods are used to reduce the error produced in the halftone image.

II. LITERATURE SURVEY

In 1996, Mr. G.Ateniese, Mr. C.Blundo, Mr. A.Desantis and D.R Stinson in his article Visual cryptography for general access structures information and computation [1] describes a general access structure in which it gives a set of n share divided into two subsets given name as qualified and forbidden according to their importance of shares. The secret information can be opened only by the any of the k shares from qualified subset of shares that is called as subset n and that secret information can't be opened by k or more shares of forbidden set.

In 1997, Mr. E.Verheul and Mr. H.V tilborg in his paper construction and properties of k out of n visual secret sharing scheme presents visual cryptography scheme [2] that is applicable to black and white images and it develops first gray colored visual cryptography scheme for sharing single sequence colored secret images can be shared with the concept of arcs or MDS secret.

Colored visual cryptography is done in such a way that one pixel is transformed into m sub pixels then that sub pixel is divided into color regions. In every sub pixel there is only one colored region and the other region of color is black for colored VCS with colors. The pixel expansion m is cx3 and the share generated was meaningless.

In 2000, Mr. Ching-nung yang and Mr. chi-sung laih in his article new colored visual secret sharing schemes [3] construct a new colored visual secret sharing scheme having better block length than the van tiborg scheme because this method of construction are based on the modifications extension of the black and white visual secret sharing scheme

and the share generated in this scheme were meaningless and was developed for sharing a single secret.

In 2002, Mr. Mizuhanakajima and Ms. Yasushi yamaguchi in their article extended visual cryptography for natural images developed EVCS (extended visual cryptography scheme)[4]this technique provide a way to create meaningful share instead of random share and also helps in avoiding the possible problems which may arise by noise like shares and this technique also gives a method to improve the image quality of the output by enhancing the image contrast beyond the constraints .

In 2003,Mr. Chang-Chou Lin and Mr. Wen –Hsiang Tsai in their article gives dithering technique for visual cryptography scheme for grey images instead of using grey sub pixels directly to contrast shares.[5] A dithering technique is used for the extension of visual cryptography binary to grey level one is useful for wider applications . There are several steps in this dithering technique method firstly an input grey level images first converted into an approximated binary image and then a visual cryptography method for binary images is then applied to the resulting dithering image having advantage of inheriting any developed cryptography technique for binary images and the size of image increased is smaller than the ordinary situations .The decoded images can reveal most details of original images and most visual cryptographic methods make use of pixel expansion because of which the size of the shares to be much larger than that of the secret image this situation is more critical for grey level and chromatic images.

In 2005, Mr. young-chang hou and Mr. shu-fen tu in their article a visual cryptographic technique for chromatic images using multi pixel encoding method which gives a multi pixel encoding method of grey level and chromatic images without pixel expansion [6].In this pixel expansion method two basis matrices simultaneously encrypt r successive white or black pixels each time. The probability of these r pixels being colored black depends on the ratio of blacks in the basic matrices and it also shows that the shares are not only of the same size as the secret size image but also attain the requirements of security.

In 2006, Mr. Zhizhou, Mr. gonzaloR.Arce and Giovanni Di Crescendo in his article halftone visual cryptography gives a technique known as halftone visual cryptography via half toning [7]. This visual cryptography technique uses dots to stimulate contiguous tone imagery which may vary either in size in space or in spacing based on the blue-noise dithering principles and this method uses the void and cluster algorithm for encoding a secret binary image into n Halftone shares carrying significant visual information and the visual quality of the obtained halftone share is better than any cryptography method.

In 2010, Mr.P.S.Revenkar, Ms. AnisaAnjum and Mr. W .Z Gandhare in his article Survey of Visual Cryptography Schemes[8]presents a visual cryptography schemes which allows visual information to be encrypted so that their decryption can be done by human visual system without any computing process used and this paper shows various measures on which performance of visual cryptography scheme depends like pixel expansion, contrast, security, accuracy, computational complexity and whether its share generated is meaningful or meaningless, type of secret images which is either binary or color and number of secret images(either single or multiple) encrypted by the scheme.

In 2010, Mr. Sozan Abdullah in his article New Visual Cryptography Algorithm for Colored Image [9] presents a special encryption technique of visual cryptography to hide information in images, which divide secret image into multiple layers. In this technique each layer holds some information and the receiver aligns the layers and the secret information is revealed by human vision without any complex computation. This algorithm is for color image and presents a system which takes four pictures as an input and generates three images which correspond to three of the four input pictures. The decoding requires only selecting some subset of these three images, by making transparencies of them, and stacking them on top of each other, so the forth picture is reconstructed and that reconstructed image achieved is of the same size as the original secret image.

In 2011, Mr. Hui Wen Liaoand Hsim Wei Huang in their article A Multiple Watermarking Scheme for Gray-Level Images using Visual Cryptography and Integer Wavelet Transform[10] develop a multiple watermarking scheme for gray-level images by

making use of visual cryptography, modified Histogram , integer wavelet transform, and the wavelet tree is presented. The process rearranges the share image and embeds it in the coefficients of the corresponding IWT middle frequencies, and the owner keeps another share image as the key. And Under this scheme, all owners will have dual watermark authentication, and through this method, the number of ownerships can be increased. The goal of the proposed scheme for multiple watermarking is to satisfy more requirements of the watermarking characteristics

In 2011, Mr. N Krishna Prakash, Member, IACSIT and Mr. S.Govindaraju in their paper Visual Cryptography Scheme for Color Images Using Half Toning Via Direct Binary Search with Adaptive Search and Swap[11] develops a method of encoding a color image into n meaningful halftone shares using the scheme of halftone visual cryptography. And it encrypts the color image into high quality n halftone shares generated via direct binary search (DBS) with adaptive search and swap method. This scheme achieves lossless recovery and reduces the noise in the shares without any computational complexity. The DBS algorithm with adaptive search and swap improves runtime performance while still generating a halftone with low error. Simulation results show that the proposed method out performs the other techniques and the recovered image is of high quality. This method firstly achieves better quality halftone images and revealed secrets, secondly holds good for multiple colored images and thirdly does not require any additional computational Complexity.

In 2012, Mr. John Justin.M and Alagendran.B and Mr. Manimurugan.S in his article A Survey on Various Visual Secret Sharing Schemes with an Application presents different kinds of visual secret sharing techniques[12] with the aim of the experimental study of implementations of various available VSS techniques and its study extends to an application of the visual secret sharing scheme that embeds an extra confidential image with pair key structure with no pixel expansion and everyday new VSS techniques are used so the selection of fast and secure Visual secret sharing technique will always useful mainly in terms of security issues. And this paper holds a pair key structure which promotes good level of security in revealing the extra confidential image.

In 2012, Mr. Anshul Sharma in his article performance of error filters in halftone visual cryptography [14] defines Visual cryptography which firstly divides a secret binary image into shares of random binary patterns. and the process is performed directly by the human eyes; while, the shared images need some processing to reconstruct the secret image. The shares are xeroxed onto transparencies, the secret image can be visually decoded by superimposing a qualified subset of transparencies, but no secret information can be obtained from the superposition of a forbidden subset. Halftone visual cryptography is extended technique in visual cryptography where the random shares are embedded in high quality grayscale images to give them meaning and to remove the doubt of eve's droppers. Improved shares have been developed by changing the error filters that were earlier used in halftone visual cryptography through the use of error diffusion and results were compared with the existing work. This paper defines various error diffusion filters which are applied to improve the image quality of the Halftone shares .The error filter is better when the more error is distributed among the neighboring pixels.

In2013, Mr.Sonalwangein his article A Visual Cryptography to Secure Biometric Database [15] shows about the increasing demand of securing information or data in computer system like visual cryptography in which the secret image is first divided into shares and provides secured digital transmission which is used only for one time. Through this the original images can be reuse by using this scheme. And this technique is easy and uncomplicated used to execute the secret image for shadow images (share of image). This paper described the concept of visual cryptography which is secure for keeping images secret. This paper not only reviews how to apply sharing of single secrete image and multiple secrete image on black and white as well as on color images but also provides a comparative analysis on various visual cryptography schemes. This survey is very useful to understand different scheme of visual cryptography techniques implement in the biometric applications and there is four criteria of performance which is the number of secret images, pixel expansion, image format and type of share generated. This comparative study about different visual cryptography techniques helps us to find better method to provide security to our biometric database template.

In 2014, Mr. L.N pandey and Mr. Neeraj shukla in his article Visual Cryptography Schemes using Compressed Random Shares [16] defines visual cryptography which is one of the most secure techniques that allows the user to encrypt the secret images .In this method the images is first transformed into printable transparent sheets and then these sheets can be distributed to different intended person

through any of the mediums (physically, internet). The receiving person can regenerate the original image by stacking all transparent sheets on each other. And in this world there are many visual cryptography schemes available this paper presents a visual cryptography scheme that can generate n number of transparent shares with reduced size and supports a variety of image formats and presents an integrated approach for binary, Gray and color image visual cryptography by maintaining the visual quality and pixel expansion. This proposed VCS system is easy to use and their performance is analyzed on four things one is numbers of secret images second is pixel expansion third is image format and fourth is the type of share generated. Security is the main concern of today's communication world

In 2014,Mr. Manjula D. C, Vijaya C in their article Novel Encryption method for Grayscale Halftone Images using Random numbers[17]says that before discussing about cryptography we firstly has to know about cryptography the Cryptography is derived from the Greek words krypton, "hidden", and graphing, "to write" or "hidden writing''. It means transforming the data in such a way that it is unreadable by anyone except the intended recipient. Visual cryptography which is developed by Naor& Shamir in 1994 is a method of securing encrypting messages in such a way that the receiver won't need a computer to decrypt that message. In this technique the secret image is first divided into multiple shares and each share is carrying some important information and when k shares out of n stack together, the secret image will reveal. However less than k shares do not work. This paper encryption method is used for gray scale halftone images using random numbers. The size of the retrieved image is same as the size of input secret image. Extra security is added by introducing keys, which are same at both encryption and decryption time. This method can be widely used in a number of visual secret sharing applications which require high-quality visual images, such as watermarking, electronic cash, military etc. Further proposals include extending this method to the colour images.

In 2014,Mr. Mona F. M. Mursi ,May Salamaand Manal Mansour in their article Visual Cryptography Schemes: A Comprehensive Survey[18] presented that cryptography is a study of transforming the information in order to make it secure from unintended recipients and the visual cryptography scheme VCS is designed that encrypt any information so their decryption can be performed using human visual system The motive behind this paper to provide various cryptographic technique is to define

the importance of encrypting and decrypting the secret images there are some factors which decides the technique to be used A comparison table is presented to summarize the different features of each technique reviewed. And their future work is to use a public key to decrypt multiple images with utmost security.

In 2014, Mr. Prateek Kumar ,Ms. Suneeta Agarwal and Mr. Shivendra Shivani in their article halftone visual cryptography with pixel expansion through error diffusion presents extended visual cryptography(EVC) concept[19] which provides meaningful shares instead of non-meaningful shares and it presents an algorithm based on EVC which enhance the contrast of recovered secret image and the size of image visible on shares is of three times as that of secret image and both the images are assumed in grey level. In this method secret image and the visible image is first converted to halftone image using halftone error diffusion method and it uses three algorithm first for halftone process and second is for constructing initial share and third for constructing final share recovered image from the share generated is found to be of better quality. In this paper error diffusion is used to construct the halftone image so that the noise introduced by the present pixel is diffused away

In 2015, Mr. Prajakta Nikam and Dr. Kishor Kinage in their paper Survey on Visual Cryptography Schemes [13] defines Visual cryptography (VC) is a technique used to share secret image. It encodes image into n shares. These shares are either printed on transparencies and are stored in a digital form. The shares can be noise-like pixels or as meaningful images. Decoding does not require all shares .These shares are printed on transparencies and stacking them top to each other reveal the secret image. The literature of visual cryptography schemes are briefly defined in this paper. The visual cryptography (VC) scheme techniques can decode concealed images without cryptography technique .The shares of EVCS scheme are meaningful images and the stacking of qualified subset of shares will recover the secret images visually.

In 2015, Mr. Nazimul islam and Ms. Shaloo kikan in their article A Survey: Novel Study for Visual Cryptography in Discrete Wavelet Transforms presents visual cryptography scheme (VCS)[20] and it is an encryption method that uses combinatorial techniques to encode secret written materials. The basic idea is to convert the written material into an image and encode this image into n shadow images. For decoding it requires some of the selected subset

of these n images, making transparencies of them, and stacking them on top of each other. This paper briefly reviewed the literature of visual cryptography schemes, describes visual cryptography techniques. The visual cryptography (VC) scheme techniques can decode concealed images without using cryptography techniques currently, many new schemes are proposed in the field of Color Visual Cryptography. But at the same time, the shares produced by all the methods above are either meaningless or are dependent upon some factors like the number of colors in the secret image, the proposed scheme i.e. wavelet based can effectively minimize transmission risk and provide the highest level of user friendliness, both for shares and for participants

In2015, Mr. RiteshD.Yelane, Dr. Nitiket. N. Mhala and Prof. B. J. Chilke in their article Security Approach by Using Visual Cryptographic Technique [21] nowadays each and every transmission system is depending on internet which increases security, efficiency and reduces response time. Visual Cryptography is also taking advantages of real time on internet and also at destination user for security technique and for this system we work with digital gray scale images for secrete and covering image, data confidentiality using asymmetric cover image encryption and finally it will improve the contrast of the recovered secret image and produce clear resultant image. In this paper, construction of EVCS was realized by embedded random shares into the meaningful covering shares. These shares are of the meaningful images, and the stacking of a qualified subset of shares will recover the secret image visually.

In2016, Ms. Shruti .M. Rakhude and Ms. Manisha Gedam in their article Survey on Visual Cryptography: Techniques, Advantages and Applications [22] develops Visual Cryptography is a new technique for securing the visual information like picture, text etc. In the process of Visual Cryptography the images are divided into several encoded image called shares. These shares are distributed among concerned recipients and their encryption can be done by decrypting them by overlapping the shares to get original image. At first there are various measures on which performance of visual cryptography schemes depends, such as pixel expansion, visual quality, image quality, contrast, security, quality of shares, size, computational complexity. Firstly the Visual Cryptography techniques were developed for binary images only but later on it was advanced and invented for color images also.

In 2016, Mr. T. Ambritha, Mr. J. Poorani Sri and Mr. J. Jessintha Jebarani and Mr. M. Pradhiba Selvarani in their paper Comparative Study of Various Visual Cryptography Techniques [23] to Analyze the Quality of Reconstruction shows that visual cryptography is a technique in which the secret information encryption is done through the keys given. The secret image will be encrypted into n number of shares and by overlapping those shares the original secret image is decrypted. Here, decryption uses human eyes to recover the secret image without any complex decryption algorithm. Visual cryptography is unique way to protect secrets. This paper compares various algorithms used in visual cryptography in terms of quality, security and size of the recovered image

TABLE: Year wise review of different papers according to their methods, results and limitations.

S. N O	YEA R	AUTHOR	TOPIC NAME	METHOD	RESULT	LIMITATION
1.	1996	Mr. G.Ateniese , Mr. C.Blundo ,Mr. A.Desantis and D.R Stinson	Visual cryptography for general access structures information and computation	Extended visual cryptograph y (EVC).	Meaningful share images is formed	The pixel problem is not solved.
2.	1997	Mr. E.Verheul & Mr. H.V tilborg	Construction and properties of k out of n visual secret sharing scheme presents visual cryptography scheme	colored visual cryptograph y schemes	For a colored visual cryptography scheme with c colors, the pixel expansion m is c× 3 and The share generated was meaningless.	The share generated was meaningless.

3.	*2002*	Mr. Mizuha nakajima and Ms. Yasushi yamaguchi	Extended visual cryptography for natural images developed EVCS (extended visual cryptography scheme)	Extended visual cryptography scheme (EVS) for natural images.	It Creates meaningful shares instead of random shares of traditional visual cryptography and improve the quality of the output images.	Needs to establish a sophisticated color mixing model for the extended visual cryptography with better Color quality.
4.	*2003*	Mr. Chang-Chou Lin and Mr. Wen – Hsiang Tsai	Dithering technique for visual cryptography scheme for grey images instead of using grey sub pixels directly to contrast shares	Visual Cryptography Scheme for Grey images by dithering technique	Achievement of visual encryption and decryption Functions for gray-level images.	More critical for grey-level and chromatic images
5.	*2005*	Mr. young-chang hou and Mr. shu-fen tu	A visual cryptographic technique for chromatic images using multi pixel encoding method	Multi-pixel encoding method for grey-level and chromatic images without pixel expansion.	The shares are not only the same size as the secret image, but also attain the requirement of security.	It exploits the human visual system to read the Secret message from some overlapping shares.
6.	*2006*	Mr. Zhiz hou, Mr. gonzalo R. Arce and Govanni Di Crescenzo	Halftone visual cryptography gives a technique known as halftone visual cryptography via half toning	Halftone visual cryptography schemes	The visual quality of obtained halftone shares is observably better than any available visual cryptography method known to date and Maintains good contrast and security and increases quality of the shares.	Lower image quality is achieved in some of the methods
7.	*2010*	Mr. Sozan Abdullah	New Visual Cryptography Algorithm for Colored Image	Security visual cryptography new algorithm for 24-bit bitmap Color image.	The security of the scheme depends critically on the color composition And distribution of the original secret image.	Contrast and clarity of the resulting image is low
8.	*2011*	Mr. N Krishna Prakash, Member, IACSIT and Mr. S Govindaraju	Visual Cryptography Scheme for Color Images Using Half Toning Via Direct Binary Search with Adaptive Search and swap	Halftoning via Error Diffusion, Visual Secret Sharing Scheme, HALFTONE VISUAL CRYPTOG RAPHY FOR COLOR IMAGES,	1).Better quality of halftone image and the revealed secret, 2). Holds good for multiple colored image also, 3) Does not require any additional computational complexity.	Quality of halftone image Computational Complexity

				DIRECT BINARY SEARCH HALF TONING.		
9.	*2012*	Mr. John Justin .M and Alagendran.B and Mr. Manimurugan.S	A Survey on Various Visual Secret Sharing Schemes with an Application presents different kinds of visual secret sharing techniques	Visual secret sharing (VSS).	Visual secret sharing technique will always useful mainly in terms of security issues scheme	Some techniques are sensible, because they suit for appropriate places but not in all the places.
10.	*2012*	Mr. Anshul Sharma	Performance of error filters in halftone visual cryptography	Visual secret sharing scheme, halftone visual cryptography, error diffusion.	Visual quality of the halftone shares increases with the complexity Of the error filters.	Image quality of halftone shares
11.	*2013*	Mr. Sonal wange	A Visual Cryptography to Secure Biometric Database	Black And White Visual Cryptography Scheme , Color Visual Cryptography Schemes, Biometric identification technique	Perfectly secure method of keeping images secret, for feasible use in biometric identification technique and protection such as fingerprint images	Visual Cryptography is used with short messages.
12.	*2014*	Mr. Manjula D. C.,Vijaya C	Novel Encryption method for Grayscale Halftone Images using Random numbers	(2,2) VC scheme, Decryption ,encryption algorithm	The proposed scheme is highly Secured, and the quality of the reconstructed image is good.	Affects the contrast of the resulting image.
13.	*2014*	Mr. Mona F. M. Mursi ,May Salama and Manal Mansour	Visual Cryptography Schemes: A Comprehensive Survey	Visual cryptography schemes (VCS), Extended Visual Cryptography (EVC), Key Based VC	Improved visual quality of the retrieved image.	The shares were still meaningless
14.	*2014*	Mr. Prateek Kumar, Ms. Suneeta Agarwal and Mr. Shivendra Shivani	Halftone visual cryptography with pixel expansion through error diffusion presents extended visual cryptography(EVC) concept	Error diffusion, halftone visual cryptography, Half toning visual cryptography, Image processing, secret sharing	We get good quality and better contrast image with pixel expansion	Recovered image has degradation in visual quality

15.	2015	Mr. Nazimul islam and Ms. shaloo kikan	A Survey: Novel Study for Visual Cryptography in Discrete Wavelet Transforms presents visual cryptography scheme (VCS)	(2, 2) Visual Cryptography Scheme , Halftone Visual Cryptography, Visual Cryptography for scan and print applications, Recursive Threshold visual cryptography	Wavelet based can effectively minimize transmission risk and provide the highest level of user friendliness, both for shares and for participants.	The shares produced by all the methods above are either meaningless or are dependent upon some factors like the number of colors in the secret image.
16.	2015	Mr. Ritesh D.Yelane, Dr. Nitiket. N. Mhala and Prof. B. J. Chilke	Security Approach by Using Visual Cryptographic Technique	Embedded Extended Visual Cryptography Scheme, Secret Sharing, Half toning, Privacy and security, EVCS.	Improved contrast of the recovered secret image and produce clear resultant image.	Information security Contrast
17.	2016	Ms. Shruti .M. Rakhude and Ms. Manisha Gedam	Survey on Visual Cryptography: Techniques, Advantages and Applications	Visual Cryptographic Schemes for Black and White Images / Binary Images , Visual Cryptography Schemes for color images.	Various applications systems can be made more secure and reliable by the application of visual cryptography techniques.	Only one secret could be hidden using this technique.
18.	2016	Mr. T. Ambritha, Mr. J. Poorani Sri and Mr. J. Jessintha Jebarani and Mr. M. Pradhiba Selvarani	Comparative Study of Various Visual Cryptography Techniques	Region Incremental Visual Cryptography, Visual Cryptography Scheme (with Random Key), (2, 2) Visual Cryptographic Scheme, Digital Watermarking	poor RIVC ,Good VCS (with Random Key),Fair (2,2)VCS and Digital Watermarking.	The quality of the image was degraded because of half toning and The recent research works well for text, logos but for color image and Gray scale image it works average.

III. CONCLUSION

In this paper different visual secret sharing schemes are discussed together as a literature survey and shows various error diffusion methods which is used to improve the quality of the halftone shares. Visual cryptography is discussed along with the concept of halftoning where the contiguous tone image is converted into a binary image by using error diffusion which provides halftone shares with good image quality. And we have also reviewed various papers according to their methods, results and limitations.

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