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An Approach for Grey Scale Image in Visual Cryptography Using Error Diffusion Method

Kirti Rawat
Department of Computer Science and Engineering
IFTM University
Moradabad - India

ABSTRACT

Visual cryptography is a special encryption or cryptography technique used for securing the visual information like text, pictures etc to be performed in such a way that their decryption can be performed by human visual system. The basic idea of visual cryptography is based on the process in which the original image is firstly converted into halftone image which is a binary image and then it is divided into several parts called as shares. Secondly these shares are distributed among different concerned participants and at last to decrypt that images the images must be stacked onto each other to get the 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 and computational complexity. In this paper half toning by error diffusion is used to make a better quality halftone image and we developed a new modified process and an algorithm used to develop a better quality halftone image.

Keywords :— Visual cryptography, Half toning, Error Diffusion.

I. INTRODUCTION

Visual Cryptography is a special encryption technique used widely in the field of information technology to hide information in images in such a way that it can be decrypted by the human vision. It is the technique used for encryption of the image with less computational cost because the decryption of that image does not need any complex computation. Visual cryptography is a new type of cryptographic scheme that focuses on solving this problem of secret sharing. It uses the idea of hiding secrets within images. Multiple shares are formed by encoding these images and later decoded without any computation [1]. This decoding is done by superimposing transparencies, so the secret image is recovered. Visual cryptography was originally invented and pioneered by Moni Naor and Adi Shamir in 1994 at the Euro crypt conference. As the name suggests, visual cryptography is related to the human visual system. When out of n shares, k shares are stacked together, the secret image get decryption. So that anyone can use the system without any knowledge of cryptography and without performing any computations. This mechanism is very secure and it can be easily implemented.

Visual cryptography encodes a secret binary image (SI) into n shares and that share is of random binary patterns. If the shares are Xeroxed onto transparencies, the secret image can be visually decrypted by superimposing a qualified subset of transparencies, but no secret information can be decrypted from the superposition of a forbidden subset. In this paper, a novel technique named halftone visual cryptography is proposed to achieve good visual cryptography via half toning. Based on the blue-noise dithering principles, the proposed method uses the void and cluster algorithm to encode a secret binary image into n halftone shares (images) carrying significant and visual information. The method simulation shows that the visual quality of the obtained halftone shares is observably better than any available visual cryptography method known to date.

Half toning is an intentionally applied form of noise called as “blue noise“ that is used to randomize quantization error. If this error is continuously repeating and correlated to the signal, it results into a cyclical and mathematically determinable form. In some fields, especially where the receptor is sensitive to such artifacts, cyclical errors yield undesirable artifacts. To overcome this drawback a new special technique was developed by Zhou et al called as „Half toning". Error diffusion is a type of half toning in which the quantization residual is distributed to neighboring pixels that have not yet been processed. Its main use is to convert a multi-level image into a binary image, though it has other applications. Error diffusion is a simple but it is very efficient to use. The quantization error at each pixel is filtered and fed into a set of future inputs. The quantization error depends upon not only the current input and output but also the entire past history. The error filter is designed in such a manner that the low frequency difference between the input and output image is minimized. The error that is diffused away by the error filter is high frequency or "blue noise." These features of error diffusion produce halftone images that are pleasant to human eyes with high visual quality.

II. LITERATURE SURVEY

In 1996, Ateniese [3] proposed a more general method for VC scheme based upon general access structure. This paper provided a more efficient construction of threshold schemes. Blundo in 2000 proposed VC schemes with general access structures for grayscale share images. In this paper, it is assumed that the secret image consists of a collection of pixels, where to each pixel is associated a grey level ranging from white to black and each pixel is handled separately. 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 [4] that is applicable to black and white images. and in this method For a colored visual cryptography scheme with c colors, the pixel expansion m is c× 3 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 [5] construct a new colored visual secret sharing scheme having better block length than the van tiborg scheme. In 2002, Mr. Mizuha nakajima and Ms. Yasushi yamaguchi in their article extended visual cryptography for natural images developed EVCS. (Extended visual cryptography scheme) [6] 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. 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. And as a result a visual encryption and decryption function for gray level images is achieved [7].

In 2006, Mr. Zhi zhou, Mr. gonzalo R .Arce and Giovanni Di Crescendo in his article halftone visual cryptography gives a technique known as halftone visual cryptography via half toning [8]. 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. 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 2011, Mr. Hui Wen Liao and 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. 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 [11] with the aim of the experimental study of implementations of various available VSS techniques. In 2014, Mr. Manjula D. C, Vijaya C in their article Novel Encryption method for Grayscale Halftone Images using Random numbers [12] says that before discussing about cryptography, we firstly has to know about cryptography. 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. In2016, Ms. Shruti .M. Rakhude and Ms. Manisha Gedam in their article Survey on Visual Cryptography: Techniques, Advantages and Applications [14] develops Visual Cryptography is a new technique for securing the visual information like picture, text etc.

III. HALFTONING

Halftone is the reprographic technique that simulates continuous tone imagery through the use of dots, varying either in size or in spacing, that's why generating a gradient-like effect. The term "Halftone" can also be used to refer specifically to the image that is produced by this process [2]. Where the continuous tone imagery contains an infinite range of colors or grays in it, the halftone process reduces visual reproductions to an image that is printed with only one color of ink and with dots of differing size or spacing. We know that if the original image is a photograph, it has thousands, or even millions of colors. If we want this image to get printed with a printer having a specific color palette, there will be a loss of details of an image. The application of half toning can help to minimize such visual artifacts, and usually results in a better representation of the original It helps to reduce color banding and flatness. The result of printing a half toned image is often much closer to the original.

There are various types of halftoning but we only discuss and use halftoning by error diffusion which is most common and simpler method of halftoning. Error diffusion is very efficient way to halftone a grayscale image and it is so simpler to halftone the image through error diffusion. The quantization error at each pixel is firstly filtered and then fed into a set of future inputs. The quantization error does not depends on the current input and output only but also on the entire past history

3.1 EXISTING ERROR DIFFUSION HALFTONING ALGORITHMS

1. Floyd-Steinberg halftoning algorithm

This error-diffusion algorithm is firstly introduced by Floyd and Steinberg. It raised the idea to keep track of the error produced in the halftone image. Figure 3.6 shows the process of Floyd-Steinberg algorithm. And the algorithm implements the error-diffusion half toning of an *n* by *m* grayscale image [2]. The boundary conditions are typically ignored. It is convenient to compute the output pixels in a scan line order from upper left to lower right side of matrix. At every step, the algorithm compares the each grayscale value of the current pixel J (i, j) by an integer between 0 and 255, to some threshold value taken randomly (typically 128). If the grayscale value is greater than the threshold value, the output pixel I (i, j) is considered black whose value is 0, else it is considered white whose value is 1. The difference between the pixel's original grayscale value and the threshold is considered as an error in the image. Because we don't want to alter the already computed pixels, we spread this error intensity only to the pixels on the right side, to the right diagonal, the left diagonal and the bottom of the matrix. The amount of error which is spread to each neighbor may be different, but sending 3/8 of the error to the right and lower pixels and 1/8 to the two diagonal neighbors gives good results [1]. The matrix shown graphically inis an error-diffusion matrix proposed by Floyd and Steinberg and their distribution of error.

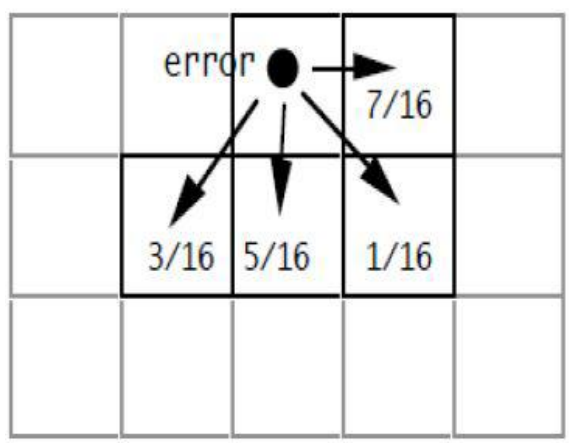


Fig: 1 Error diffusion matrix by Floyd

2. Jarvis half toning algorithm

Another error diffusion algorithm has been proposed by Jarvis, Judice and Ninke. They diffuse the error in the 12 neighboring cells instead of 4 cells as used by the Floyd-Steinberg algorithm. As a result, this algorithm is even slower because of its large size and it require at least 24·n·m floating point and memory access operations [2]. Further, when we used it for printing color images, the running time increases by a factor of four. A diffusion matrix of Jarvis algorithm is shown below.

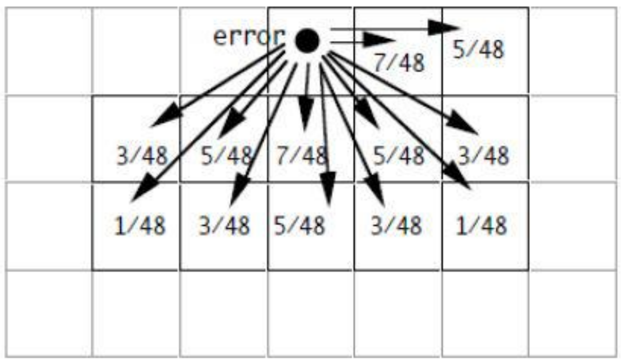


Fig: 2 Error diffusion matrix by jarvis

3. Stucki half toning algorithm

It is an error diffusion half toning algorithm developed by Stucki. Stucki diffused the error in the 12 neighboring cells just like Jarvis method of error diffusion. The only difference between Jarvis algorithm and Stucki algorithm is the fraction which is added to the neighboring pixels. After five years of Jarvis dithering, Stucki error diffusion method is used and minor changes were made in the method to overcome the errors and Stucki dithering methods also used Image Dithering along with digital audio [2]. In Stucki error diffusion algorithm the halftone image pixel error divides the 42 element error that we transferred to the pixels is to get the specific original value. As a result, this error algorithm is even slower and require at least 24·n·m floating point and memory access operations. Furthermore, when we print color images, the running time increases by a factor of four.

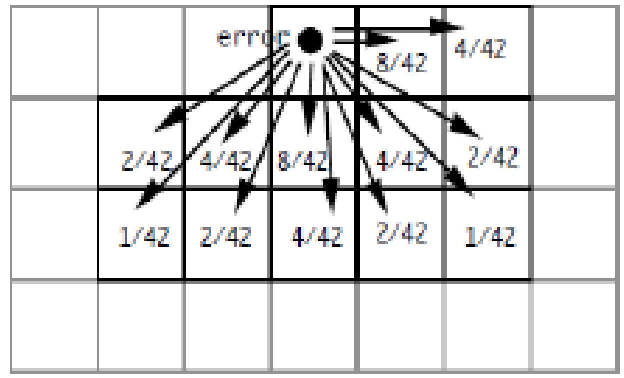


Fig: 3 Error diffusion matrix by Stucki

IV. PROPOSED WORK

We have to use our methodology for half toning the gray scale image because it represents only two colors, black and white only. Our image is a gray scale image in which m * n matrix of m row and n column displays the overall image matrix. In this method, firstly a grey scale image is converted into halftone image and the Gray scale image in the halftone image after using the error diffusion use only black and white pixels in the image. The error diffusion is used to improve the quality of the halftone image because the halftone image made is of poor quality. And the method is developed to reduce the error in the image.

For this method, we have gray scale image pixel gray scale image of intensity between 0 to **255**.Dithering method is used for converting halftone images using any of the 255 in which a value is taken to assume the Image threshold value which we believe the value of pixel is less or greater then this threshold value through which the pixels are decided to be taken as o or 1 respectively to assume that white and black displays. Threshold limit values corresponding boundaries of our research, the values which are greater than the threshold value are taken as 1 and values less than the threshold are taken as 0, By this method some error is induced in the halftone image by converting the values according to the threshold value and error diffusion is used to reduce the gap between the pixels. Secondly the halftone image is distributed into several shares and these shares does not contain any information individually and in the last to reveal the secret image the shares are stacked onto each other and the image can be easily seen by human eye without any computation.

As we discuss in half toning by error diffusion, we take an image named original image and by using half toning the secret image is converted into halftone image which is then converted into several different number of shares by applying (k, n) VSS sharing algorithm and by applying (k, n) VSS recover algorithm all shares are combined together to recover the secret original image. This can be easily recognized by human visual system. The overall process is shown by the figure mentioned below. But in our method we focuses on making a better quality halftone image made from using an error diffusion method used to reduce the error produced in converting original image in halftone image and made a better quality image with improve PSNR value.

		X	**5/28**	**3/28**
1/28	**2/28**	**4/28**	**2/28**	**2/28**
1/28	**2/28**	**3/28**	**2/28**	**1/28**

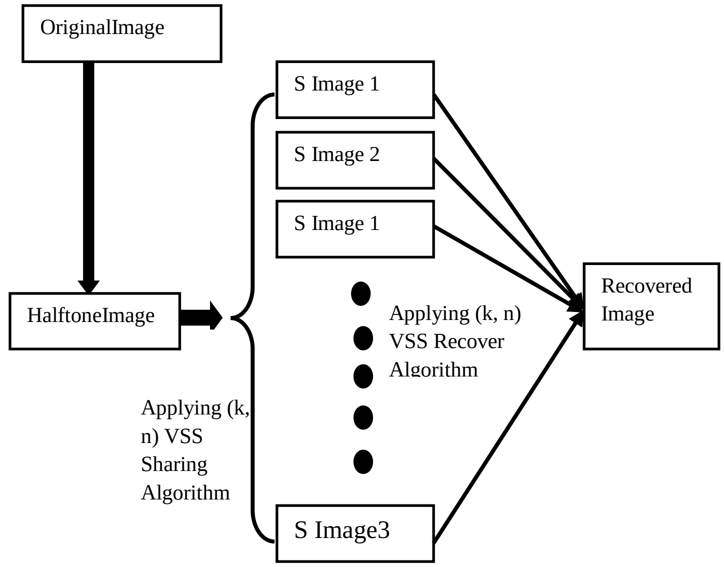


Fig: 4 Block diagram of visual cryptography

We developed a new algorithm by modifying the existing half toning algorithms to develop better quality image and to reduce the errors produced in halftone image. In our modified algorithm we take a gray scale image of matrix of 12 pixels instead of taking 4 pixels as taken in Floyd Steinberg half toning algorithm that means we distribute the error in 12 pixels. The grayscale image is a 512*512 unit 8bit image. The value of pixels ranges from 0 to255 and the value of threshold is taken as 127.5 and the pixels having values greater than the threshold is considered as 1 and the pixels having values less than the threshold is taken as 0. In this method we distribute the error in more and more parts so that the error produced by the gap of the original value and the value of the halftone image that's why we distribute the error in 12 pixels and rum the program until the error is resolved.

4.1 OUR METHOD MATRIX

This the matrix used in our method to distribute error to reduce the errors produced in the gap of binary pixels because of converting the original image to a binary halftone image and we used this matrix in our modified algorithm for converting the image in better quality halftone image.

FIG: 5 Matrix produced by our method

Fig: 6 Original house image

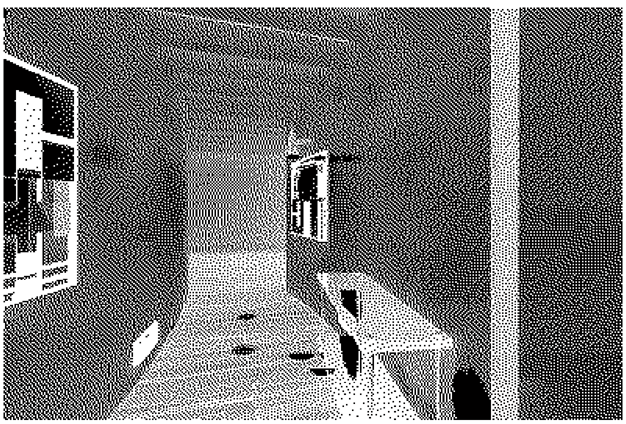


Fig: 7 Halftone image by our method

Proposed Algorithm for Halftone Process with Error Diffusion

1. Procedure HALFTONING AN IMAGE
2. For i = 1,…., n do
3. For j = 1,…..,m do
4. If J (i, j) < 127.5 is found then J(i, j) = 0
5. Else J (i, j) = 1
6. Error = J [i, j] - I [i, j]*255
7. Distribute (5/28) error to the right pixel
8. Distribute (3/28) error to the right diagonal pixel
9. Distribute (4/28) error to the bottom pixel
10. Distribute (2/28) error to next to left bottom pixel
11. Distribute (1/28) error to the left diagonal pixel
12. Distribute (2/28) error to next to right bottom pixel
13. Distribute (2/28) error to the right diagonal pixel
14. Distribute (1/28) error to the left diagonal pixel
15. Distribute (2/28) error to bottom of next to left bottom pixel
16. Distribute (3/28) error to bottom of the bottom pixel
17. Distribute (2/8) error to bottom of the next to left diagonal pixel
18. Distribute (1/8) error to the right diagonal pixel
19. End for
20. End for

V. RESULT ANALYSIS

In our result analysis we generate a better PSNR and equal UQI values that are produced than Floyd half toning algorithm and we make a new modified halftoning algorithm named as proposed algorithm is used for converting the original image to the halftone image by using error diffusion.

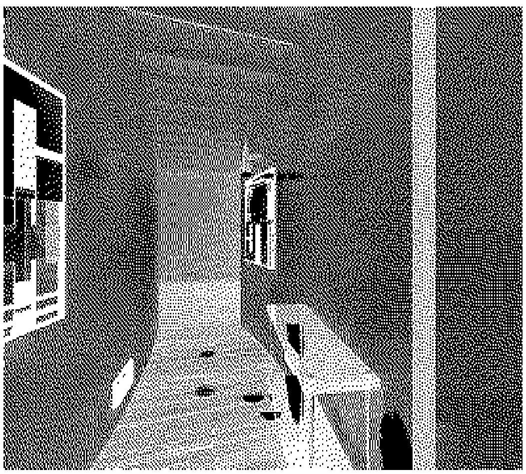
Table: 1 PSNR AND UQI IMAGE QUALITY FOR GRAY SCALE HOUSE IMAGE

Types of algorithms	PSNR	UQI
Floyd Steinberg	6.4350	0.0034
Our Method	6.4352	0.0034

Fig: 8 (A) ORIGINAL HOUSE IMAGE, (B) HALFTONE IMAGE BY FLOYD, (C) HALFTONE IMAGE BY OUR METHOD

(A) ORIGINAL HOUSE IMAGE

(B) HALFTONE IMAGE BY FLOYD

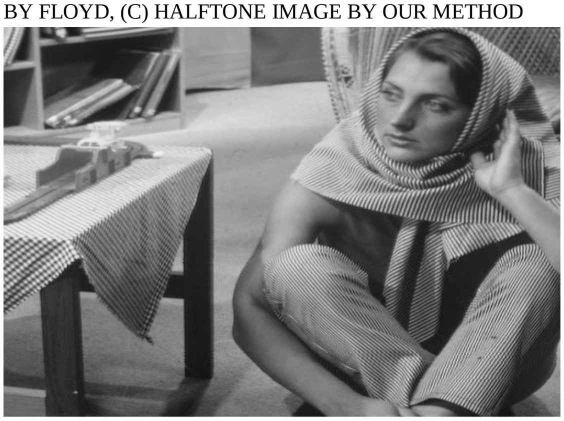


(C) HALFTONE IMAGE BY OUR METHOD

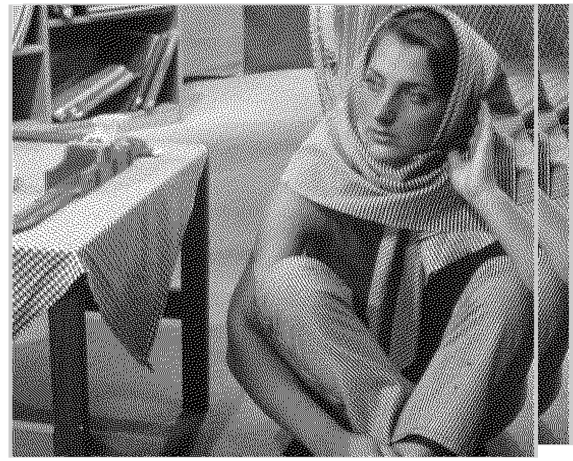
TABLE: 2 PSNR AND UQI IMAGE QUALITY FOR GRAY SCALE LADY IMAGE.

Types of algorithms	PSNR	UQI
Floyd Steinberg	**5.9557**	**8.1124e +05**
Our Method	**5.9563**	**8.1124e +05**

Fig: 9 (A) ORIGINAL LADY IMAGE, (B) HALFTONE IMAGE BY FLOYD, (C) HALFTONE IMAGE BY OUR METHOD



(A) LADY ORIGINAL IMAGE
(B) HALFTONE IMAGE BY FLOYD



(C) HALFTONE IMAGE BY OUR METHOD

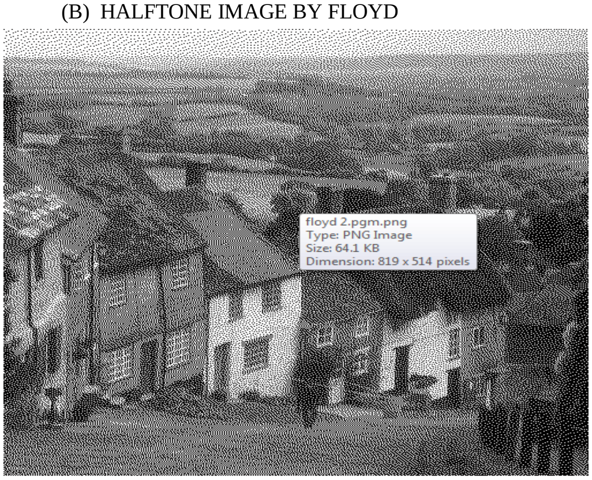
TABLE 3 PSNR AND UQI IMAGE QUALITY FOR GRAY SCALE COLONY IMAGE

Types of algorithms	PSNR	UQI
Floyd Steinberg	**6.4343**	**8.3376e -05**
Our Method	**6.4346**	**8.3376e -05**

Fig: 10 (A) ORIGINAL COLONY IMAGE, (B) HALFTONE IMAGE BY FLOYD, (C) HALFTONE IMAGE BY OUR METHOD

(A) ORIGINAL COLONY IMAGE

(B) HALFTONE IMAGE BY FLOYD



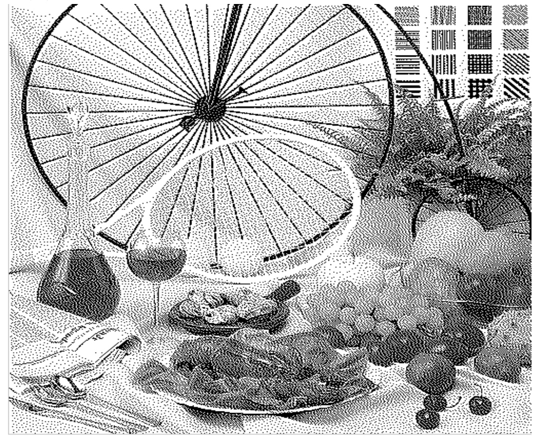
(C) HALFTONE IMAGE BY OUR METHOD

TABLE: 4 PSNR AND UQI IMAGE QUALITY FOR GRAY SCALE DINING TABLE IMAGE

Types of algorithms	PSNR	UQI
Floyd Steinberg	2.8808	8.5694e -05
Our Method	2.8811	8.5694e -05

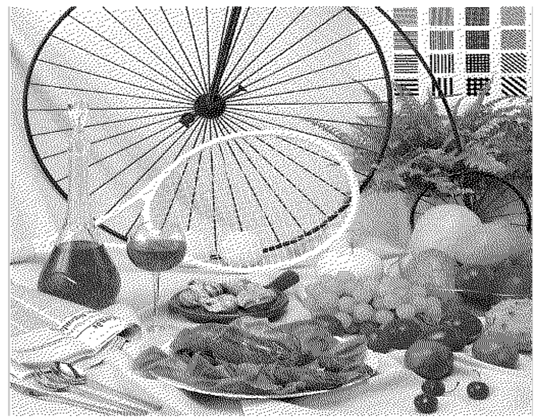
Fig: 11 (A) ORIGINAL DINING TABLE IMAGE, (B) HALFTONE IMAGE BY FLOYD, (C) HALFTONE IMAGE BY OUR METHOD

(A) ORIGINAL DINING TABLE IMAGE



(B) HALFTONE IMAGE BY FLOYD

(C) HALFTONE IMAGE BY OUR METHOD



V. CONCLUSION AND FUTURE WORK

In this paper, we show an advanced halftone scheme with error diffusion technique in order to make the secure sharing of the secret images to the participants. Which is used to share the hidden data in the secret image and the shares of that secret image is generated with the help of advanced halftone processing, and the error diffusion is used to make a better quality images. From the experimental results, it proves that the error diffusion in the advanced half toning process has minimized the image distortion which provides the high security by producing peak signal-to-noise ratio value ∞ that represents that scheme has obtained the maximum visual quality. Hence, the proposed scheme will always take short period of time for shares creation and retrieved which proves it very fast and also maintains the image quality. In future work, we will apply medical images to the proposed scheme for the health care applications.

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