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A Review on Various Visual Cryptography Schemes

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ABSTRACT: Visual cryptography is a technique in which the information present in an image gets hidden by encryption. It is a technique in which an image is divided into multiple images which are known as shares. When these shares are printed on transparent sheets and collected together, a hidden secret image can be seen with naked eyes. The major factors on which visual cryptography matters are contrast, security, computational complexity, pixel expansion, the shares generated, type of secret image and number of images. Also, the safety of important information is the main concern in commercial, medical and military systems. Hackers may retrieve important and vital information and misuse it. Hence visual cryptography is needed. Intent of this paper is the study of different techniques of visual cryptography.

KEYWORDS: k out of n Scheme; Single Image Sharing; Multiple Image Sharing; Gray Image Sharing; LSB Image Steganography Technique

I. INTRODUCTION

Information is very important in our daily life. Due to advancement in technologies of networking and communication, it has become very easy to share audios, videos and images. But for the sharing of secret images visual cryptography is necessary so that hackers cannot steal the secret information. To deal with this problem we have various techniques that make information transfer safe. In 1994, Moni Naor and Adi Shamir [1] were the first ones to introduce Visual Cryptography. Visual Cryptography technique removes the complexity of computation in the process of decryption and secret images can be recovered by stacking the shares. A share is a random noise

II. VISUAL CRYPTOGRAPHY TECHNIQUES

A. *Black and White Cryptography Technique for Sharing Single Secret Image:*

a. k out of n Scheme:

This concept was first proposed by Naor and Shamir[1]in 1994. They proposed a scheme known as k out of n scheme where a black and white image is encrypted into n transparent shares and the secret image will only be recoverable if the decipher has at least k shares stacked all together and if the number of shares is less than k then after stalking we will not be able to get the secret image. The (2, 2) visual cryptography technique encodes the secret image into two different images known as shares so that reconstruction of the secret image from a single share is impossible. Each share is printed in transparency and then encryption is performed for each pixel which causes the width of the share to increase. This is called Pixel Expansion.

The advantage of this visual cryptographic technique is that its computation is quite easy but the limitation is that there is lack in contrast balancing of the decoded images with comparison to original image.

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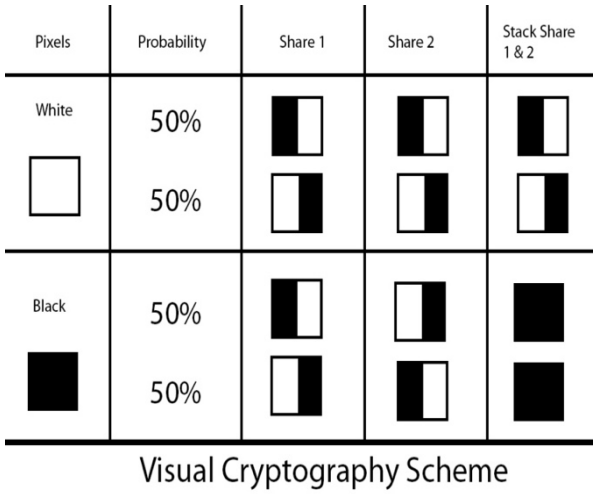

Fig.1. Visual Cryptography Scheme

For example, consider the following:

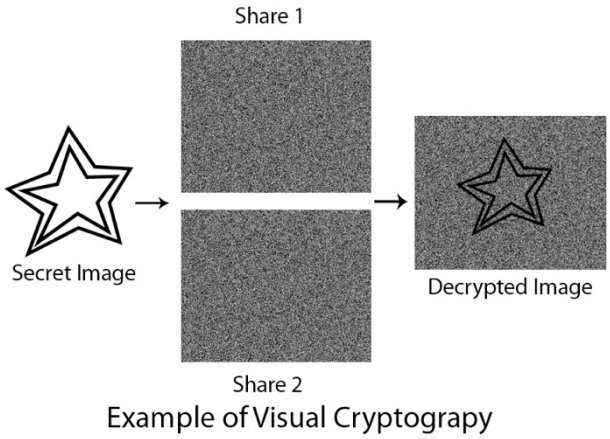

Fig.2. Example of Visual Cryptography

b. LSB Image Steganography Technique in Spatial Domain

LSB Image steganography technique was proposed by Chin-Chen Chang [2]. He proposed that LSB substitution is the most Generic method in which we directly replace the LSBs of pixels to get the stego-image in the cover image with secret bits. It exchanges the least significant bit (LSB) of every pixel from the encrypted message bit stream. Message can be extracted by the authenticated receivers with the help of pre-shared key by deciphering the LSB of every pixel of the host image. Only the least significant bit of pixels is altered, which is visually imperceptible by humans.
The problem is that in this technique only one set of secret messages can be embedded. For large number of secret messages, large numbers of shares have to be shared.

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B. *Black and White Cryptography Technique for Sharing Multiple Secret Images:*

Till 1998 every research in visual cryptography was for a single image at a time. In 1998, Wu and Chen [3] were the first ones to do it for multiple images. They started with encrypting 2 images into shares. The first image can be seen by putting one share over the other and the second secret image can be seen by rotating the first share clockwise. They kept the rotation angle to be 90 degree.

Later to remove the angle restriction, Hsu [4] proposed a technique in 2004 to hide the secret images in rectangular shares with arbitrary rotating angles.

To refine it, in 2005 Wu and Chang [5] encoded the shares to be circle to removethe restriction of angle to be 90,180 and 270.

C. *Gray Image Sharing Schemes:*

A large number of colors can make the size of shares increase. Chen Chang[6] in 2002 developed a way to overcome this limitation. Here, the share size remains fixed and with an increase in the number of colors, the size will not increase.

Tzung-Her Chen [7] in 2008 proposed another scheme that encrypts two images into two random grids that does not cause any pixel expansion and decryption is done by stacking two random grids at 90°, 180° or 270° degrees. This will reduce both the pixel expansion and improves the quality of secret communication.

To generate share A, dealer puts share a' on share a by rotating it by 90 degree anticlockwise and for share B, share b is placed on share b'. Dealer sends share A and B between two participants and for decryption in present two participants, by placing share A and B, secret image I can be decoded and by rotating share A by 90 degree on share B, image II can be decoded.

Above mentioned schemes are only acceptable for black and white and gray images but visual cryptography techniques should also support color secrete images. For this reason researches have been done to share the color images.

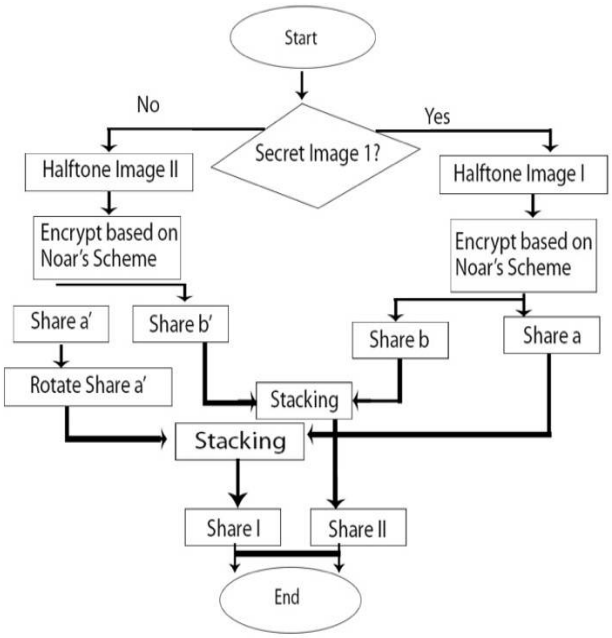

Fig.3. Flowchart showing Gray Image Sharing Scheme

D. *Color Visual Cryptography Techniques for Sharing Single Secret Image:*

Colored visual cryptography scheme was first developed by Verheul and Van Tilborg [8] and this scheme highlighted the main concept of arcs. In the scheme one pixel is transformed into m sub pixels, where each sub pixel is

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divided into c color regions. Each sub pixel has a combination of one color region and the other regions are all black..

F.Liu, C.K.Wu, X.J. Lin[9] proposed another approach for colored visual cryptography. The proposed scheme had three different approaches:

First approach: It is similar to basic visual cryptography model. In this we print the colors of secret images on the shares directly. Due to this pixel expansion increases and image quality is degraded.

Second approach: Three separate color channels are used- For the additive model we use red, green and blue and for the subtractive model we use cyan, magenta and yellow after which the usual black and white cryptography scheme is used on each of the color channels. Due to this the pixel expansion reduces and image quality degrades due to half toning.

Third approach: The binary representation of pixel color is used and the secret image is encrypted at bit-level. The image so produced is of better quality.

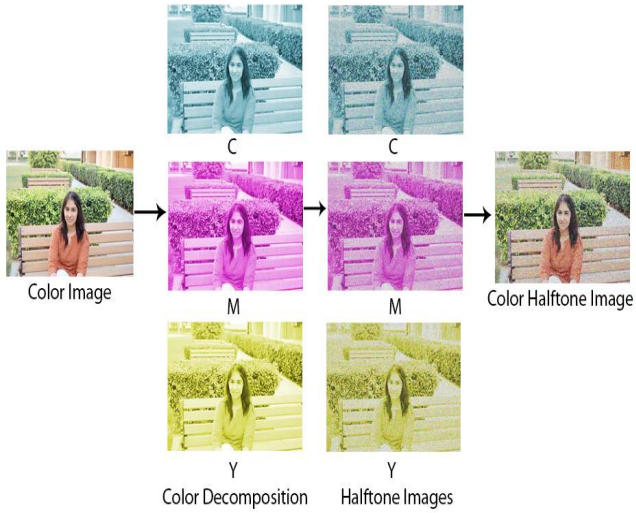

Fig.4. Colour Visual Cryptography Technique

E. *Color Visual Cryptography Techniques for Sharing Multiple Secret Images:*

According to Tzung-Her Chen [7] VSS generates share images macro block by macro block in a way that multiple secret images are converted into two share images and all the secrets can now be decoded one by one by stacking two of the share images by a way of shifting.

III. CONCLUSION AND FUTURE SCOPE

Visual Cryptography provides a secure way to transfer images on the Internet. It exploits human eyes to decrypt secret images and no computation is required. In this paper of Visual cryptography, we analyze both the black and white as well as color images. Now, according to the theory of color decomposition, every color on a colorful image can be decomposed into three primary colors: cyan (C), magenta (M) and yellow (Y). With the innovation of halftone technology, we can transform a gray-level image into a binary one suitable for performing visual cryptography. In contrast to the traditional schemes for black-and-white visual cryptography, our adopted methods expand every pixel of a color secret image into a 2X2 block in the sharing images and keep two color and two transparent pixels in the block. There is a lot of scope in Visual cryptography. This particular cryptographic technique is being used by several countries for secret transfer of financial documents, handwritten documents, internet voting etc. It is a secure way to

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transfer images on the Internet. Visual cryptography is used in many applications like biometric security and remote electronic voting etc. In this paper we have reviewed about techniques of visual cryptography and its various applications.

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