Secured Picode: Using Visual Cryptography

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Abstract

In this paper, we propose a new technology which combines the visual cryptography with a picture embedding pictode for the security of information. Hence the paper combines both the advantages of the modified visual cryptography and improved picture embedded 2D barcode. Actually, there are two methods used to introduce confidentiality and security when visual data are transmitted through unsecured channels: data hiding and visual cryptography. Data hiding usually tries to embed data in digital media and transmit it in an imperceptible way so that the confidential messages is send securely and with visual cryptography the original input is shared between a set of participants by a secret image holder. Visual cryptography is a method of protecting the image-based secrets that has a computation free decoding process. The scheme provides an efficient way to hide the natural image among different shares. The two-dimensional barcodes have been widely used as an interface to connect potential customers and advertisement contents. However, the appearance of a conventional 2D barcode pattern is often too obtrusive for integrating into an aesthetically designed advertisement.

Keyword- QR Code, 2Dbarcode, Picode, Datamatrixcode, Visual Cryptography, Security, Distortion, Perceptual Quality, Fixed Pattern, Secret

I. INTRODUCTION

In the past few decades, many discussions were carried out on barcodes and its generations as a means to connect satisfy the potential customer and to make a link between the offline and online business. In such a application, a 2D barcode encoding a product promotion web link is often attached to an advertisement to engage customers and the mobile phone with ever increasing computational power and imaging capability is employed as a 2D barcode capturing and decoding device. Potential customers can conveniently retrieve further information about an advertisement by scanning the barcode with their mobile phones. This process simply involves initiating a suitable barcode scanning mobile software and pointing the phone camera towards the barcode. More human oriented applications of 2D barcodes can be found in. However, the traditional 2D barcodes, such as QR code and Data Matrix code shown in Fig. 1 (a)-(d), are not originally designed for mobile barcode applications. Firstly, they are of binary appearance which is not perceptually. Review paper discusses about the last few years, conventional Two-Dimensional (2D) barcodes and some existing beautified QR codes. Quick Response (QR) code is widely used in many applications such as marketing, for industrial applications, retail applications, health care applications, manufacturing, and product tracking etc.

Secret sharing scheme is a method of sharing secret information among a group of participants. In a secret sharing scheme, each participant gets a piece of secret information, called a share. When the allowed coalitions of the participants pool their shares, they can recover the shared secret; on the other hand, any other subsets, namely non-allowed coalitions, cannot recover the secret image by pooling their shares. In the last decade, various secret sharing schemes were proposed, but most of them need a lot of computations to decode the shared secret information.

The simplest access structure is the 2 out of 2 schemes where the secret image is encrypted into 2 shares and both needed for a successful decryption. To begin with, every pixel is extended to 2×2 blocks, where each block is composed of two black pixels and two white pixels. By referring to a predefined coding table, a block can be produced. The pixel coding as follows: Firstly, the system randomly picks one block from the six, shown in Fig.l, to represent share 1 block. Secondly, according to the pixel in the secret image, a matching block for share 2 is selected from the Table I.

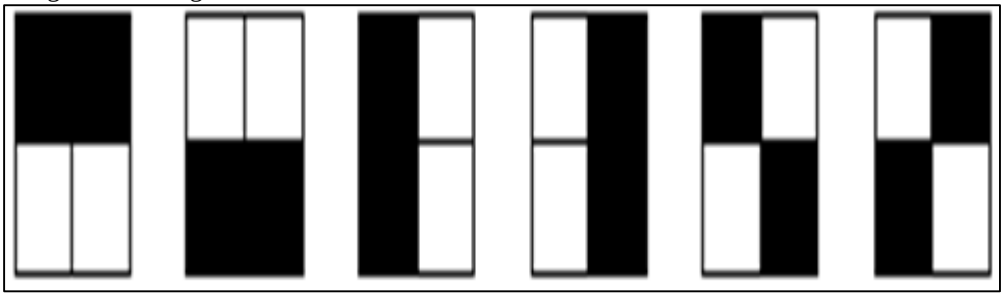


Fig. 1: Block Group

Images	White Pixel	Black Pixel
Share1		
Share2		
Overlapped Image		

Table 1: coding table for share blocks

The processed image will be two 2N×2N shares. Stacking the two shares together, we can reveal the secret image. However, the secret image can only be black and white images. The noise-like shares, which meet the requirements of security, were generated by the traditional visual cryptography, but it also brings two significant shortcomings. The first one is the passing risk. Carrying and passing the messy and meaningless shares easily incurred suspicion and interception, which leads to the risk of passer and share image itself and increases the probability of failure to pass the secrets. The second is not easy to manage. Since there is no information available for identification, which will cause the holder of shares great inconvenience in management, especially for the number large of shares held. Some scholars put forward proposals to solve the problem but not easy to manage. The studies share every image with different camouflage images in order to identify and increase the ease of management.

Although these proposals are able to solve the problem of inconvenience in share image management, it also brings shortcomings of pixel expansion and bad secret image restore quality. In order to improve this defect, R.Youmaran et al., invented an improved visual color shares encryption scheme that encrypts color picture to some color shares. The program can increase stand-by camouflage pictures' Signal-to-noise ratio as the original secret images'. In order to further improve the problem of management, Tsai et al. put forward a proposal that changes the meaningless shares into grayscale or color meaning share image, which can be applied to the traditional visual cryptography based on a password. Recently there are some Visual cryptography literature to discuss meaningful halftone image, which emphasize the visual quality of the share and restore image quality. The proposals in these literatures must give a trade-off between shares quality and pixel expansion, or shares quality and restore image quality.

Actually, there are two methods used to introduce confidentiality and security when visual data are transmitted through unsecured channels. Advertisers are taking advantage of barcodes by using them to reach out to customers in a more interactive, interesting, and unique way. This invention aims at developing PiCode, a human readable 2D barcode technology that enables almost ideal picture-barcode integration. Distinguished from common binary 2D barcodes which do not convey meaningful visual information to users, PiCode combines the attractive appearance of a picture and the decoding reliability of barcode. It offers a superior solution for mobile advertisement, media and marketing. Users can directly scan the PiCode for accessing information, while the advertiser would not have to stress over the valuable advertisement space occupied by the traditional 2D barcodes any more.

II. LITERATURE SURVEY

In 1994, Noar and Shamir proposed a new field of cryptography called visual cryptography scheme (VCS). The most significant characteristic of the new field is that human visual systems can identify confidential messages directly without any computation when restoring encrypted messages. For example, in a (k, n) visual cryptography scheme, a dealer encodes a secret into n shares and gives each participant a share, where each share is a transparency. The secret is visible if any k (or more) of participants stack their transparencies together, but none can see the shared secret if fewer than k transparencies are stacked together. The application of visual cryptography is widely discussed, such as: protection of copyright, the bank certification system, control missile launchers, fingerprint authentication and so on.The shares generated by the above method are meaningless and look like random dots. With such appearance, they make easy for the attackers to look into shares; whether or not the secrets can be easily cracked open, the looks of the meaningless shares are already revealing the existence of secrets to attackers. When the shares produced are meaningful images, then the attackers can't find the secret image. A QR Code is a Matrix-like code and was developed in Japan by Denso Wave to help for tracking automobile parts throughout production. The QR code [6] technology has been around for over a decade but has become popular as a medium for marketers to reach in smartphone users. Quick Response Codes (QR Codes) are nothing new. The security [8] of a one-dimensional (1D) barcodes is smaller than that of 2D barcodes. 1D barcodes are easy to read by scanning lines and the spaces. 2D barcodes are not easy to read by human eyes. With regard to readability, 1D barcodes should scan along in a single direction. If the angle of scan lines will not fit within a range, the data would not read correctly. However, 2D barcodes must get wider ranges of angles for scanning. The difference between the two is in the amount of data they can hold.

Bar codes are one-dimensional codes and can only hold nearly 20 numerical digits, whereas QR codes are 2D matrix barcodes that can hold 7,089 numeric characters and 4,296 alphanumeric characters, and 1,817 Japanese (kanji) characters. Their ability will hold more information and ease of use makes them practical for shorter businesses. When we scan or read a QR code

with our iPhone, Android or other camera-enabled smartphones, we can link to digital content on the web and activate a number of phone functions such as email, instant messages, and SMS and connect the mobile device to a web browser. Any of these functions are easily achieved by creating our QR code. It is a simple process of entering an appropriate data into QR code generators. It can be read by using the camera of smartphones, and it may instantly redirect them user to a web page. QR Codes are machine readable. This means that the human looking to the code is unable to determine the contents behind it. QR Codes are used in a variety of ways to market business, to provide some information's on a product or a service by encoding general texts, URLs, phone numbers etc.

Barcodes become widely popular because of their reading speed, accuracy, and functionality characteristics and their convenience universally recognized. As a result, different efforts were made to increase the amount of information stored by the bar codes, such as increasing the number of barcode layout. This improvement also causes problems such as enlarging the area of the bar code, complicating the reading operations, and increasing the printing cost. A 2D Code emerges in response to these needs and the problems. The QR code can be formed from multiple barcodes. QR Code is a kind of 2D (two-dimensional) code that primary aim of being a symbol that is interpreted by a scanner equipment. QR Code contains information in both the vertical and horizontal directions, whereas a bar code normally contains the data in one direction only. QR Code holds a greater volume of information than that of a bar code.

Image Encryption (using Keys): This approach is basically similar to the conventional encryption methods which involve using an algorithm (and a key) to encrypt an image. Some of the proposed techniques for encrypting images use "Digital Signatures" , "Chaos Theory" , "Vector Quantization" etc. to name a few.

Drawbacks: There are some inherent limitations with these techniques; they involve use of secret keys and thus have all the limitations as regards key management. Some cases the available keys for encryption are limited (restricted key space). High computation involved in encryption as also weak security functions are also an issue. However, the greatest strength of most of these schemes is that the original image is recovered in totality

Visual Cryptography (Image Splitting): The idea of Image splitting more often referred to as Visual Cryptography Schemes (VCS) involves splitting a secret image into 'n' random shares such that these shares individually reveal no information about the secret image (but for its size) but a qualified subset of the shares (as specified by the encrypter) when stacked up reveal the secret image. The random image shares (qualified set) are merely printed on transparencies and stacked up revealing the original image). The major issues which restrict its employment is the poor quality of the recovered image limited color representation.

III. EXISTING 2D BARCODE SYSTEMS

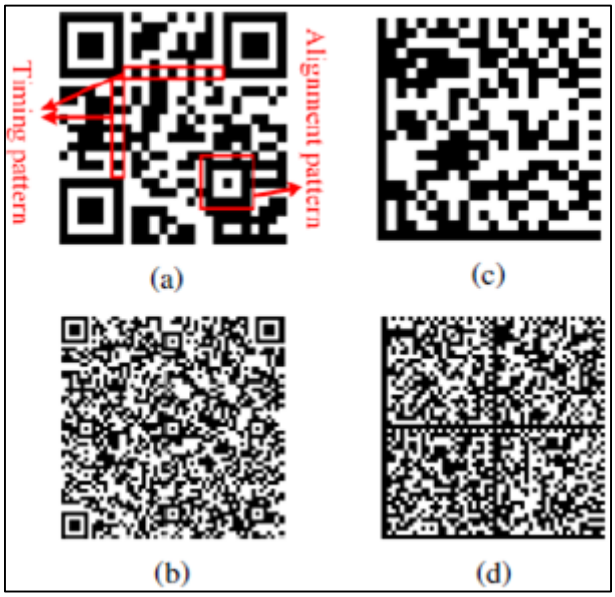
In the literature, there are some recent works on improving the aesthetic appearance of QR codes. This is due to the ever increasing popularity of the mobile barcode applications, e.g. using QR code in advertisement to bridge the gap between the online and offline marketing. Generally speaking, there are two approaches. The first approach is by direct replacement which replaces a portion of the QR code by the embedded image and relies on the error correction capability of the barcode to tolerate the replacement incurred errors. However, the embedding region has to be carefully chosen so as to ensure the decodability of the barcode. Ono et. al embeds an image into a barcode by replacing part of the encoding region with the image. The replacement region is selected by finding the appropriate scale, angle and position parameters using an optimization approach. Similarly, Samertwit and Wakahara [14] find the best embedding region by further considering the error correction level. Wakahara and Yamamoto [15] develop a picture embedding scheme for QR code with a workable software prototype which is capable of showing the error protection level and the validity of the embedding operation in real time. Lin et. al [16] embed a color image in the barcode by considering some perceptual features, such as the saliency regions of the images.

On the other hand, the second approach is to preserve the central portion of every module while replacing the pixels in the outer portion of the module by the corresponding content of the embedded image. Thus the embedding operation is directly applied to each module and a careful evaluation of the modified module is needed to ensure the decodability of the barcode. Blasinski et. al [17] design a color QR code by exploiting the spectral diversity in the CMYK print colorant channels while no image is embedded. Baharav and Kakarala [18] use an image blending algorithm to combine the image color with the black-and-white modules. In the Halftone QR code [11] (c.f. Fig. 2 (b-c)), a set of binary halftone patterns are used to replace the original black-and-white modulation of the QR code.

A pattern assignment scheme is then used to optimally substitute the image blocks by the halftone patterns with the highest similarity. An embedding method that is backward compatible with existing QR code decoders is proposed by Visualead Ltd. In. It only sets the intensity of the central patch of pixels to a dark or bright level according to the encoded bit value, while replacing the outer part of the module by the corresponding content of the embedded image. This is still compatible with the existing decoders for QR code because the latter only uses the central pixels of each module for decoding [21].

Furthermore, some obtrusive modulation results, which lead to modules that appear as white dots in dark background and vice versa, are reversed and the incurred errors are tolerable as long as they are within the error correction capability of the barcode. A recently proposed beautified QR code, called QR Image [12], also modulates only the center of each module according to the corersponding encoded bit value. To better balance between the decodability and perceptual quality of the embedded image, it employs some halftone masks to choose which pixels in outer part of each module, in addition to the central pixels, to be modified.

Examples of QR Images are shown in Fig. 2 (d-e). It is reported that QR Image has achieved the best perceptual quality among the state-of-the-art beautified QR codes.



In general, the second approach is more favourable for two reasons. First, the perceptual quality of the embedded image is better since it introduces less image distortion [12]. Second, the error correction capability of a barcode is not largely compromised as compared to the first approach. However, we observe that the existing customized modulation schemes are not optimized in achieving the trade-off between perceptual qualities and decoding robustness for the following reasons:

1) The three squarish finder patterns are usually kept intact by the beautifying process since they are pivotal in the QR code detection process. The obtrusive appearance of such finder patterns pose a strong limitation on the achievable perceptual quality of the embedded picture. Similarly, the timing and alignment patterns in the interior region of the high capacity QR code severely affect the perceptual quality. On the other hand, suppressing these patterns without taking a sufficient remedial measure, as in QR Image, leads to degradation in the decoding performance.
2) The modulation of the beautified QR codes using the second approach introduces dark or bright dot-like patterns in the embedded images. However, to achieve better perceptual quality by simply lowering the contrast or size of such dot-like patterns increases the probability of demodulation error, as also pointed out in. A less “impulsive” or dot-like modulation pattern is potentially less obtrusive and may achieve a superior trade-off.
3) The demodulation performance heavily depends on the binarization algorithm which is designed based on the assumption that there exists the same amount of black and white pixels in every local window of a selected size. While this assumption is adopted in much state-of the- art binarization algorithms, it may often be invalidated by the content of the embedded image, which is not restricted.

Given the aforementioned limitations in the existing beautified QR codes, a new picture-embedding 2D barcode achieving a better trade-off between the perceptual qualities and decoding robustness is needed. This is also what motivates us to propose the PiCode scheme.

IV. PROPOSED PICODE METHOD

A recent report shows that the scanning volume of a picture-embedding QR code is three times more than that of the traditional QR code. A picture-embedding 2D barcode, called PiCode system proposed here mainly emphasis on the new kind of encoding technique and that too securely with the help of visual cryptography. Hence the advantages of both, an adaptive visual cryptography and picture-embedding technique together makes the work more unique and much efficient to encode the information securely. The proposed system introduces an adaptive modulation technique for the generation of picode and the used new and improved \hybrid approach of visual color cryptography.

The system includes both the advantages of an adaptive modulated picture embedded coding and the hybrid approach of color visual cryptography. Also this system keeps the confidentiality of the information without any failure and ensures the doubly secured transaction of the data. The proposed PiCode is designed with less obtrusive fixed patterns to avoid distortions on the embedded image, and a modulation scheme which represents the data bit value adaptively with the embedded image intensity. That is it becomes easier for the scanner to scan and extracts the information from the image.

The PiCode encoding process divided into two parts: the input processing and the PiCode generation. Input processing method contains, Source Coding - Code data to more efficiently represent the information and Channel Coding - Code data for

transmission over a noisy communication channel. PiCode generation part image blocks of k * k pixels are modified using adaptive modulation scheme.

It should be noted that PiCode also supports various pattern sizes from 29 _ 29 modules to 65 _ 65 modules with a step size of 4 modules on each dimension. Generally speaking, the finder pattern of PiCode is similar to that of the Data Matrix code [25] and they both have a 'x'-shaped pattern of solid lines on the left and bottom sides and a 'q'-shaped pattern of broken lines on the top and right sides. (Note that the finder patterns of PiCode and those of the QR code are of very different shapes.) The main differences lie in three aspects. First, PiCode has an odd number of modules on each side while that of the Data Matrix code is even. This is so designed to cater for the proposed fine-corner detection algorithm which can improve the corner detection accuracy. Second, the high capacity PiCode does not include extra fixed patterns in the interior region of the barcode and hence no additional distortion due to such patterns is incurred to the embedded image, unlike most existing beautified 2D barcodes. Third, a new adaptive modulation scheme that induces less distortion in the embedded image is introduced to replace the binary modulation scheme of existing beautified QR codes.

V. CONCLUSION

The proposed system which generates a two-dimensional picture embedded code has been implemented using well known simulation software, MATLAB. The system includes both the advantages of an adaptive modulated picture embedded coding and the hybrid approach of color visual cryptography. Also this system keeps the confidentiality of the information without any failure and ensures the doubly secured transaction of the data. Improving security for the data in various levels by utilizing QR code is been discussed. The recent advancements in modulation and demodulation of QR codes are also reviewed in literature survey. PiCode technology improves the aesthetic value of the picture embedded barcode. Advantage of using PiCode in advertisement business to link customers is a more interactive, interesting, and unique way.

Designing and implementation of the proposed system is evaluated and the simulation has been carried out successfully. The results obtained from the MATLAB simulation shows that both the perceptual quality and the decoding robustness of PiCode has been improved much better than beautified QR codes. The perceptual quality contributes to the visual attractiveness of the barcode, while the decoding robustness affects the user experience during the decoding process. Both are critical for the targeted advertisement applications.

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VI. FUTURE SCOPE

The generation of picture embedding, picode with color visual cryptography is designed and implemented in this paper. In order to extract back the information out of these secured methods, we usually prefer a corresponding scanner which could identify and extract the input message encoded in the picture code. Hence the scanner should do the decoding part which focuses on two main things: firstly, the corner detection method for detecting the finder pattern and identifying the picode. Secondly, the adaptive demodulation scheme, which could demodulate the picture-embedded code more accurately. This could be fulfilled very easily and efficiently as the proposed system has already been designed in aware of the problems which would be faced at this decoding part.

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