International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

Implementation of Pi Code using QR Code by embedding 2D Image

Miss. Jayshree V.Shingare & Prof. Nutan M.Dhande
Department of CSE , ACE Nagthana Wardha India

Abstract

In 21st century, 2D barcodes are used very commercial. It has been mostly used to product advertisement contents and many other purposes. However, it can appears a 2D barcode pattern is often too obtrusive for integrating into an aesthetically designed advertisement. In this way, before the barcode is decoded, no human readable information is provided. This paper proposes a new picture-embedding 2D barcode, called PiCode, which overcome these two limitations by equipping a scannable 2D barcode with a picturesque appearance. PiCode is designed with mannerly both the perceptual quality of the embedded image and the decoding robustness of the encoded message. It compared with the existing beautified 2D barcodes show that PiCode achieves one of the best perceptual qualities for the embedded image, and maintains a better tradeoff between image quality and decoding robustness in various application conditions. PiCode has been implemented in the Android based on a system and some key building blocks have also been provided to Android and iOS platforms. It is practicality for real-world applications has been successfully demonstrated.

Keywords: 2D Barcode Detection, 2D Barcode, Decoding Robustness, Embedded Picture, Perceptual Quality

INTRODUCTION

A two-dimensional (2D) barcodes are widely used in the advertisement business as a bridge to link the offline and online contents. 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 [1]. Potential customers can conveniently retrieve further information about an advertisement by scanning the barcode with their mobile phones. This process simply involves initiating suitable barcode scanning mobile software and pointing the phone camera towards the barcode. More human oriented applications of PiCode embedded 2D barcode system. However, the traditional

2D barcodes, such as QR code and Data Matrix code shown in Fig. 1 (a), (b), (c), (d), are not originally designed for mobile barcode applications [2]. Firstly, they are of binary appearance which is not perceptually attractive and are too obtrusive to be integrated with colorful and aesthetic advertisement contents. Secondly, no visual hint

about the encoded information content is provided before a successful decoding is accomplished [3]. These two issues limit the potential customer"s interest in scanning the barcode and reduce the chance of successful customer engagement.

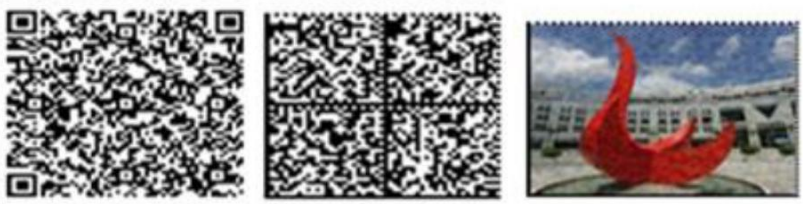
A barcode is an optical machine-readable representation of data, which shows certain data on certain products. Originally, barcodes represented data in the widths (lines) and the spacing of parallel lines, and may be referred to as linear or 1D (1 dimensional) barcodes or study of symbols. They also come in patterns of squares, dots, hexagons and other geometric patterns within images termed 2D (2 dimensional) matrix codes or study of symbols. Although 2D systems use symbols other than bars, they are generally referred to as barcodes as well. Barcodes can be read by optical scanners called barcode readers, or scanned from an image by special software.

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 [4]. Therefore, designing a superior picture-embedding 2D barcode for the customer engaging applications is a problem of practical significance. In this paper, a novel picture-embedding 2D barcode, called PiCode (Fig. 1 (e)-(f)), and the corresponding decoding algorithm is proposed.

(a)

(c)

(e)



(b) (d) (f)

Fig 1.1 The Low and high capacity versions of the conventional 2D barcodes and the proposed PiCode listed in the top and bottom rows, respectively. (a)-(b) QR codes; (c)-(d) Data Matrix codes; (e)-(f) PiCodes embedding the HKUST Academic Building image.

LITERATURE SURVEY

REVIEW OF RELATED STUDIES

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.

Barcodes have played a great role in facilitating numerous identification processes since their invention in 1952 [3]. In fact barcode is a simple and cost-effective method of storing machine readable digital data on paper or product packages. As pressing needs to transfer even more data faster and with high reliability have emerged, there have been many improvements that were made on the original barcode design [7]. Invention of two dimensional (2D) or matrix barcodes open new front forth cost-effective codes and their application in more complex data transfer scenarios like storing contact information, URL same on go there things, in which QR codes have become increasingly popular. A comparison of 2D barcode performance in camera phone applications can be found. In this paper Differential Phase Shift Keying was combined with Orthogonal Frequency Division Multiplexing in order to modulate data stream into visual two dimensional barcodes. It was shown that QPSK-OFDM modulation has serious

short-comings in the mitigation of camera LCD movements where the phase of each element changes continuously. On the other hand, addition of a differential phase modulator before OFDM to modulate the data stream into phase differences of adjacent elements (DPSK-OFDM) causes the motion effect to increasingly weaken because of its gradual change from element to element, contributing to a small deviation from the ideal phase in the received signal. It was observed that under relative LCD-camera motions that generate error rates in excess of 30% in PAM and QPSK-OFDM, the proposed system of DPSK-OFDM will maintain an error rate less than 8% which is practically correctable using error correction coding. Future inquiries in a resolution to this problem have to address the best choice of differential pattern to optimize performance for various motion scenarios. Moreover, extension of the current two-bit per symbol constellations increases data transfer capacity, and its BER performance evaluation would be required. Nevertheless, a study on the effect of perspective correction errors on the BER performance of this algorithm compared to the other ones could augment our understanding of its applicability to real world scenarios.

"Designing A 2D Color Barcode"

BARCODE is a representation of digital data that are encoded [7] in it and can be read using an optical machine. Due to its advantage over human performance in accuracy, speed and so on, barcode technology is used extensively. Once the traditional 1D barcode was developed, people started to think of developing 2D barcodes [7]. 2D barcodes can be formed using simple geometrical shapes such as square, circle, hexagon, triangle and so on, rather than using adjacent parallel lines. Moreover, the need to maximize data capacity of the barcode, led to the development of 2D barcodes such as Quick response (QR) codes and color barcodes. A QR code is a graphical representation of data in vertical and horizontal positions over a fixed space. For example, the Microsoft's High Capacity Color Barcode (HCCB) or the tag barcode. has the data density of 16,000 bits per square inch which is three times larger than data density in QR barcodes[7]. Nowadays, application of QR code can be seen in airport boarding pass, retail shops, and company logo and so on. The main challenge of the color barcode technology is the intensity and depth of the colors used in barcode. In barcode, colors are not used for aesthetic

purpose only, but rather they increase data capacity. The drawbacks in using the color can occur only during the print and scanning time, which depend on the paper and color quality. The six papers reviewed in this manuscript are mainly related to the challenges such as color blur, intensity of color variations and complex color classifiers existing in the barcode during the decoding time.

"A Novel Approach for Color Barcode Decoding Using Smart Phones" Color barcodes accessible by mobile devices become popular as an inexpensive computing tool for information encoding. The information density of conventional black and white barcode technologies is limited because only one bit per symbol is possible. Color barcode systems such as HCCB (Microsoft"s High Capacity Color Barcode) increase the information density by using more colors (e.g. four or eight colors). Increasing the number of colors to encode information makes barcode decoding a challenging task. This is due to the fact that the observed color patch depends on several factors such as unknown illuminant, viewing parameters, printing device and material, and color fading in addition to other nuisance parameters [8]. A mainstream approach to ensure robust decoding is to use a color palette of barcode colors printed with the barcode. One challenge facing such color clustering methods using a large number of colors is that the color distribution of one class can overlap significantly with color distributions of other classes. The clustering techniques may not work well in case of blur-induced color mixing from neighboring color patches.

PROPOSED SYSTEM

The decoding part the algorithms for perform corner detection. PiCode is achieve by design of barcode pattern and better decoding algorithm. The PiCode is designed with less obtrusive fixed patterns to avoid distortion on the embedded image and a modulation.

The proposed PiCode system is described with an emphasis on the novel aspects of the encoding and decoding algorithms. For the encoding part, the details of the modulation scheme will be presented to illustrate how PiCode preserves the perceptual quality of the embedded image while minimizing the interference of the latter incurred on the modulation waveform. For the decoding part, the algorithms for performing corner detection, module alignment and demodulation will be described.

This designed a novel picturesque 2D barcode, named the PiCode. Comparing with existing beautified QR codes, it provides one of the best perceptual quality in preserving the aesthetic appearance of the embedded image, while maintains the decoding robustness. It is achieved by the design of barcode pattern and better decoding algorithms. The 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. On the other hand, some key steps of the decoding process have also been developed to guarantee the decoding robustness including the coarse-fine corner detection, module alignment with barcode structural information and demodulation with information from all pixels in each module.

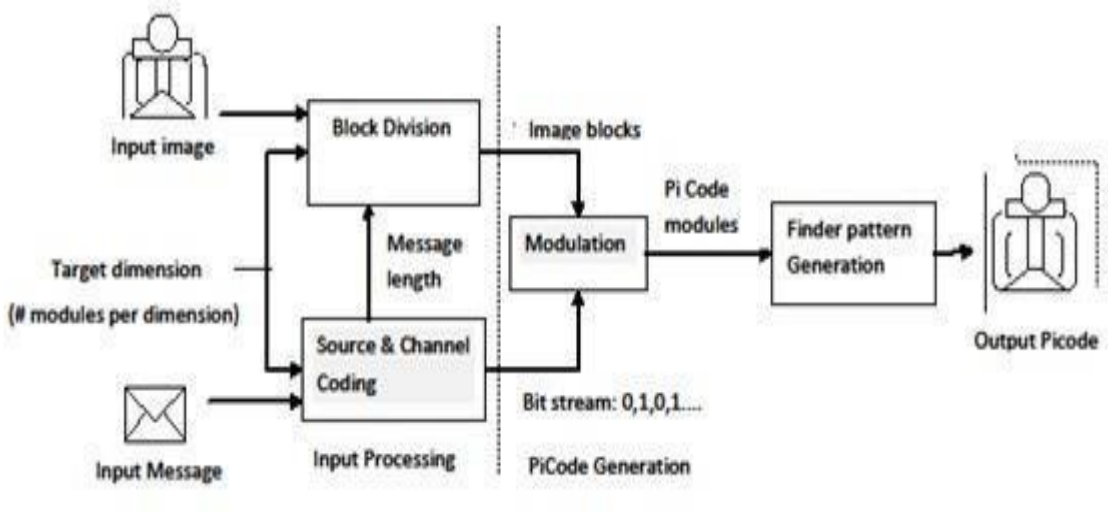


Fig 3.1 Block diagram of PiCode Encoding

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

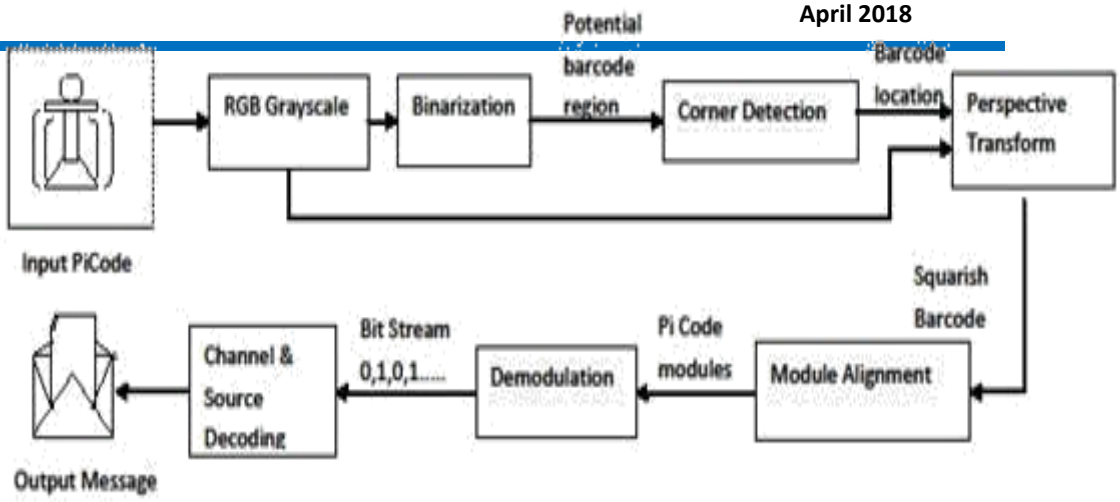


Fig Block diagram of PiCode Decoding

ALGORITHMS

There are two algorithms

PiCode Encoding
PiCode Decoding

PiCode Encoding

Encoding Process

1) Block Division

The PiCode encoding process can be divided into two parts: the input processing and the PiCode generation. In the first part, the input message is converted into a bit stream with source coding and channel coding to improve the efficiency and robustness of the encoded message.

2) Source and channel coding

Source and channel decoding compress the naturally generated image into the bit stream format that is 0.0.1.1. The goal of channel coding is to protect the information bits against errors after the demodulation step.

3) Modulation

The input image is then divided into a 2D grid of image blocks according to the user,,s input on the number of modules per dimension. The modulation schemes

which are essential in balancing the decoding robustness and perceptual quality. Each block consists of k ×k pixels . In the PiCode generation part , the pixels in each image block are modified by the proposed adaptive modulation scheme so that each image block conveys a bit „0„ or „1„.

4) Finder pattern Generation

Finally, a layer of finder pattern of one module wide is added to the exterior of the modulated 2D grid of image blocks to form the PiCode. In the following. In PiCode, a Reed-Solomon (RS) code over the finite field GF (28) is adopted. The code rate3 is adaptive to the message length and vice versa. This is designed to maximize the error correction capability under a given pattern size and message length.

PiCode Decoding

1) Coarse-Fine Corner Detection:

The corner detection algorithm locates four extreme corners of the barcode from the captured image. This is a non-trivial task due to various image distortions, such as even illumination, perspective distortion, blurriness and complex background structures.

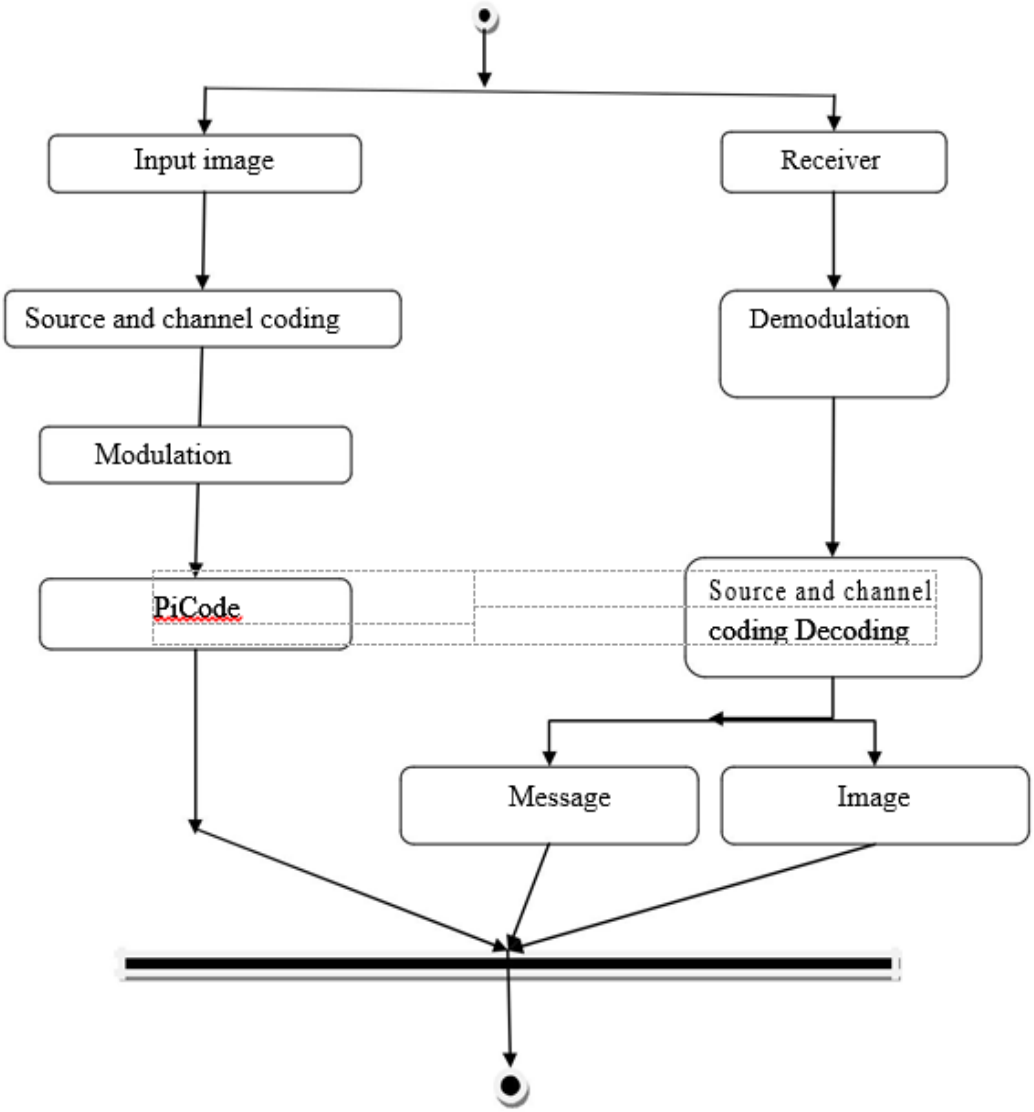
2) Module Alignment*:*

The module alignment step slices the barcode region into image blocks with reference to the black and white alternations in the „_“-shape pattern is illustrated. Each block corresponds to one module which is then input to the succeeding demodulation step. The accuracy of the module alignment step is therefore critical to the decoding performance. The slicing operation depends on the broken line„_“-shape pattern, as also used in the Data Matrix code.

3) Demodulation*:*

In the demodulation step, each received module resulted from the module alignment step is analyzed to retrieve the data bit. The demodulation scheme is designed according to the modulation scheme described. Before the demodulation operation, each module is first resample with the bilinear interpolation into 8 × 8 pixels since it is the minimum size required for our demodulation algorithm, luminance change, e.g., a sharp edge and a corner.

Basic Flow Diagram



EXPERIMENTAL RESULT

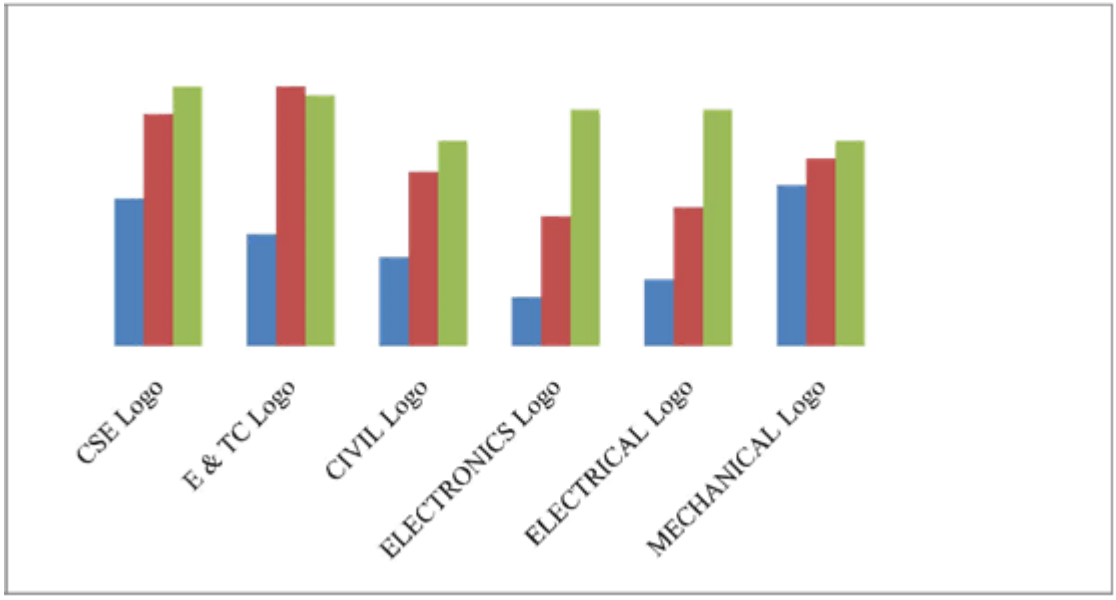
To study the perceptual quality and the decoding robustness of PiCode as well as existing beautified QR codes experiments have been conducted. The multi-scale structural similarity (MS-SSIM) metric which aims to design

quality measures that can automatically predict perceived image quality. The experiments are conducted with quality parameter λ=25 have highest MS-SSIM scores across all images. For the high capacity case, a quality improvement can be achieved by PiCode because module size gets smaller and the modulation waveform becomes less obtrusive to the overall image.

Module size	Low Capacity(29×29)			High Capacity(65×65)		
Image	Halftone QR	QR Image	PiCode	Halftone QR	QR Image	PiCode
CSE Logo	0.33	0.52	0.58	0.38	0.44	0.63
E & TC Logo	0.25	0.58	0.56	0.24	0.46	0.63
CIVIL Logo	0.20	0.39	0.46	0.24	0.47	0.61
ELECTRONICS Logo	0.11	0.29	0.53	0.13	0.35	0.65
ELECTRICAL Logo	0.15	0.31	0.53	0.16	0.31	0.63

MECHANICAL Logo	0.36	0.42	0.46	0.43	0.46	0.61

Table 7.1 Perceptual quality comparison of existing Halftone QR code, QR image and PiCode



Quality comparison for low quality image

Fig 7.1 shows the quality comparison between Halftone QR, QR image and PiCode for low quality image. Here we apply image with size with 29x29 pixels and the dataset are CSE logo, E&TC logo, Civil Logo, Electronics logo, Electricals logo and mechanical logo from different organization, and here the graph shows that the quality of PiCode is greater than the other. So that it is efficient to use instead of Halftone QR and QR image for low quality pixel image.

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

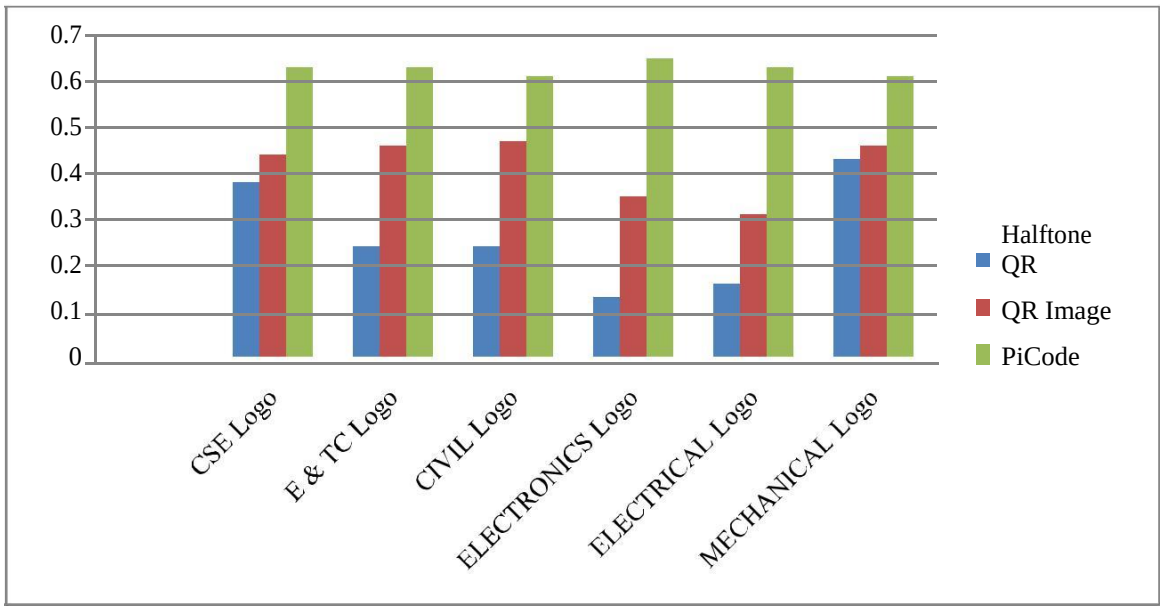


Fig 7.2 Quality comparison for high quality image

Fig 7.2 shows the quality comparison between Halftone QR, QR image and PiCode for high quality image. Here we apply image with size with 65x65 pixels and the dataset are CSE logo, E&TC logo, Civil Logo, Electronics logo, Electricals logo and mechanical logo from different organization, and here the graph shows that the quality of PiCode is greater than the others. So that, it is efficient to use instead of Halftone QR and QR image for high quality pixel image.

CONCLUSION

This report has designed a novel picturesque 2D barcode, that named PiCode is very efficient technique. Comparing with existing QR codes, it provides one of the best perceptual quality in preserving the aesthetic appearance of the embedded image, while maintains the decoding robustness. It is achieved by the design of barcode pattern and better decoding algorithm. The PiCode is design with less obtrusive fix patterns to avoid distortion on the embedded image, and a modulation scheme which represents the data bit value adaptively with the embedded image intensity. On the other hand, some key steps of the decoding process have also been develop to guarantee the decoding robustness including the coarse-fine corner detection, module alignment with barcode structural information and demodulation with information from all pixels in each module. Comparison with existing beautified QR codes by experimental result shows that PiCode has maintain a better trade-of between the perceptual quality and the decoding robustness.

FUTURE SCOPE

In future, the unobtrusive pilot symbols will be embedded into the PiCode center to serve as center alignment pattern and training symbols for the camera response function. Hopefully, a lower BEP in the demodulation process can be achieved. Also develop an application that will change the daily time records of the faculties and staff of the institute and it will provide an online checking of grade results, fees, and other information of the student.

REFERENCES

[1] W. Huang and W. H. Mow, "*PiCode: 2D barcode with embedded picture and ViCode: 3D barcode with embedded video*," in Proc. Int. Conf. Mobile Comput. Netw., 2013, pp. 139–141.

[2] C. Chen and W. H. Mow, "*Poster: A coarse-fine corner detection approach for*

two-dimensional barcode decoding," in Proc. Int. Conf. Mobile Comput. Netw., 2014, pp. 351–354.

[3] J. M. McCune, A. Perrig, and M. K. Reiter, "*Seeing-is-believing: Using camera phones for human-verifiable authentication*," in Proc. IEEE Symp. Secur. Privacy, May 2005, pp. 110–124.

[4] E. Ohbuchi, H. Hanaizumi, and L. A. Hock, "*Barcode readers using the camera device in mobile phones*," in Proc. Int. Conf. Cyberworlds, Nov. 2004, pp. 260–265.

[5] H.-K. Chu, C.-S. Chang, R.-R. Lee, and N. J. Mitra, "*Halftone QR codes*," ACM Trans. Graph., vol. 32, no. 6, pp. 217:1–217:8, Nov. 2013.

[6] H. Kato and K. T. Tan, "*2D barcodes for mobile phones*," in Proc. 2nd Int. Conf. Mobile Technol., Appl., Syst., Nov. 2005, p. 8.

[7] T.-Y. Liu, T.-H. Tan, and Y.-L. Chu, "*2D barcode and augmented reality supported english learning system*," in Proc. Int. Conf. Comput. Inf. Sci., Jul. 2007, pp. 5–10.

[8] Rinju Alice John and Kaamran Raahemifar "*Designing A 2D Color Barcode*." – May 2015.

[9] Denso-Wave *"QR Code features"*. Archived from the original on 2013-01-29. Retrieved 3 October 2011.

[10] G. J. Garateguy, G. R. Arce, D. L. Lau, and O. P. Villarreal, "*QR images: Optimized image embedding in QR codes*," IEEE Trans. Image Process., vol. 23, no. 7, pp. 2842–2853, Jul. 2014.

[11] Dr. Stephen Brokaw, "*The Expectations of Quick Response (QR) Codes in Print Media: An Empirical Data Research Anthology*", UW-L Journal of Undergraduate Research XV (2012).

[12] "*Security of QR Codes"* from http://www.diva-portal.org/smash/get/diva2:644988/FULLTEXT01.pdf

[13] Mark Anthony D. De Chavez Denise R. de Ocampo John Lerry M. Palma Romar M. Roca, "*an automated inventory system using quick response (qr) code and barcode for property management of the boy scouts of the philippines*", Mapúa Institute of Technology September 2015.

[14] Almazan, et. al, " *Identity Verification and Entry Control System with Counter Data Center College of the Philippines*", Laoag City, 2012.

[15] Rourkela, *"Student Attendance System Based on Fingerprint Recognition and One-to-Many Matching Department of Computer Science and Engineering National Institute of Technology Rourkela*""-769 008, Orissa, India November 2009.

[16] Engr Shoewu, "*Development of Attendance Management System using Biometrics Department of Electronic and Computer Engineering*", Lagos State University, Epe

[17] CB Espiritu, "*Cksm Student Attendance Monitoring System With Rfid Technology*",

[18] Clement Creusot, Asim Munawar, "*Low-computation egocentric barcode detector*

For the blind",Conference: 2016 IEEE International Conference on Image Processing (ICIP), September 2016

[19] Amin Motahari , Member, IEEE, and Malek Adjouadi , Member, IEEE, "*Barcode Modulation Method for Data Transmission in Mobile Devices*", IEEE

TRANSACTIONS ON MULTIMEDIA, VOL. 17, NO. 1, JANUARY 2015.

[20] J. Z. Gao, L. Prakash, and R. Jagatesan, "*Understanding 2D-barcode technology and applications in M-commerce—Design and implementation of a 2D barcode processing solution*," in Proc. 31st Int. Comput. Softw. Appl. Conf., vol. 2. Jul.

2007, pp. 49–56.

[21] H.Bagherinia, R.Manduchi, "*A Novel Approach For Color Barcode Decoding Using Smart Phones*", -2014.

[22] A.Motahar, M.Adjouadi "*Barcode Modulation Method for Data Transmission in Mobile Devices.*" – Jan 2015.

[23] Clement Creusot, Asim Munawar " *Low-Computation Egocentric Barcode Detector For The Blind.*" -2016.

[24] Denso ADC, *"QR Code Essentials",*. 2011. Retrieved 12 March 2013.

[25] Borko Furht, "*Handbook of Augmented Reality*", *Springer. p. 341.* ISBN 9781461400646, (2011).

[26] Denso-Wave. *"QR Code—About 2D Code"*. Retrieved 27 May 2016.

45

[27] Denso-Wave *"QR Code Standardization"*. QR Code.com.. Retrieved 23 May 2016.

[28] "ISS QR Code|AIM Store: Historical Archive". Aimglobal.org. Retrieved 26 May 2016.

[29] NTT DoCoMo, *"Synchronization with Native Applications"*.. Retrieved 26 May 2016.

[30] Sean Owen (17 January 2014). *"Barcode contents". Retrieved 26 May 2016.*

[31] Rimma Kats (23 January 2012). *"Starbucks promotes coffee blend via QR codes".*

[32] Jenny Lee (4 January 2012). *"Tesco's cool QR code advertising campaign".*