Efficiency measurement with different demodulation techniques by designing picturesque 2D barcode

Ms.Arati P. Patil [1], Mr. C. J. Awati[2], Ms. Sonam S. Kharade [3]

[1] M.Tech Computer Science & Technology,
Department of Technology Shivaji University, Kolhapur
aratipatil5@email.com

[2]Assistant Professor Computer Science & Technology,
Department of Technology Shivaji University, Kolhapur
cja_tech@unishivaji.ac.in

[3] M.Tech Computer Science & Technology,
Department of Technology Shivaji University, Kolhapur
Skh9624@email.com

Abstract: ***In this paper introduced Picode by use with, conventional Two-Dimensional (2D) barcodes and some existing beautified Quick Response (QR) code. In various applications such as tracking of products, applications related to human services, in product manufacturing and modern application QR code is widely used. This paper portrays the essential idea of QR images. The principle center of this paper is to revise preprocessing strategies with utilization of source and channel coding and block division technique. Image binarization, corner detection, perspective transformation and error correction these are the decoding process steps. So the existing barcodes technologies have some limitations like proposed the new picture-embedding 2D barcode system developed. PiCode technology innovation enhances the visual value of the picture embedded barcode. To save perceptual feature of the embedded image also to preserve the decoding robustness of the encoded message PiCode is implemented with cautious considerations. In advertisement business PiCode will be used to connect customers in a more interactive, interesting, and distinctive way. To achieve improved visual appearance and high decoding reliability PiCode permit pictures/logo to be integrated with a 2D barcode.***

Keywords: ***QR Image, Bit Error rate (BER), Halftone QR code, RS coding***

1. Introduction

Bar code technology it is an automatic identification technology. Barcode is presented in the format of dark bars and white spaces. To gather information more precisely and rapidly barcode technology will be used. Performance, effectiveness and productivity are improves with barcode technology. 2D barcodes are used in goods identification and tracking as well as in mobile advertising. Many companies have their own customized barcodes that is used to advertisements, such as newspaper, magazine. The customized barcodes usually contain hyperlinks to direct to a webpage containing further information about the products to be promoted, and can also be used as a convenient electronic replacement of conventional coupons and membership cards. The existing 2D barcodes, such as Quick Response (QR) codes, is being used for this purpose by overwriting a central region of the barcode by a small picture. Recently beautified QR code, called QR image concept proposed. So the existing barcodes have some restrictions, so the new picture-embedding 2D barcode system: Picode proposed. PiCode is a new form of the 2D barcodes. By the use of PiCode technology which will help to improve the aesthetic value of the picture embedded barcode. The perceptual quality is used to achieve the visual attractiveness of the barcode.

2. Literature Review

A. Changsheng Chen et al. [1], proposed PiCode system which gracefully integrates a 2D barcode with a picture. In this paper encoding and decoding enhancements are proposed to preserve perceptual quality of the embedded image and the decoding robustness of the encoded message. A new adaptive modulation scheme & corner-detection, module alignment, demodulation techniques.

B. **QR code beautifier techniques**

Shih-Syun Lin et al. [2] presents a two-stage QR code beautifier that not only ensures the decodability but also preserve most visual semantics of the embedded content in near real-time. The concept of control bits proposed to ensure the decodability of the generated QR code. C. Chen and W. H. Mow [3] proposed**,** a systematic scheme for measuring the performance of the display camera channel: Display-camera communication has recently gained significant attention due to the pervasive and advancing of mobile phone camera. In this proposed system, a precise calibration scheme for the geometric parameters in the display-camera communication channel was developed.

To embed images in QR code [4], proposed by Student member and senior member IEEE [4] an optimization based approach for embedding color images into QR

codes. The goal is to embed the codes into color images color optimization used. A new approach contains halftoning techniques based on halftone mask. To minimize the image distortion the modification of the luminance levels used.

Y.-H. Lin et al. [5] embed a color image in the barcode. This paper presents how the saliency of the embedding image is considered in QR code beautification by considering some perceptual features. Global optimization mechanism used Simulated annealing (SA) optimization is chosen, to achieve the goal of generating visual pleasant QR codes.

C. Halftone QR Code technique presented in et al. [6]. In QR code challenges are visual quality and machine readability so that a new approach halftone QR codes are proposed to produce high quality visual QR codes. Halftone QR code encodes module's appearance using a set of binary patterns. To maximizes readability a pattern assignment optimization method used.

D. Binarization process proposed in et al. [7]. A novel adaptive thresholding technique for the binarization of the barcode images captured by mobile phones. The proposed strategies have focal points like of high flexibility to various the different barcodes, text and sketches, good conservation of weak edges and fine details, effective in tackling irregular illumination and objects of different sizes.

E. S. Ono et al. [8] embeds an image into a barcode using real-coded genetic algorithm to find an appropriate position. The replacement region is selected by finding the appropriate scale, angle and position parameters using an optimization approach.

F. To measure Image Quality Assessment technique presented in et al[9]. Digital images are focus on a broad variety of distortions during acquisition, processing, compression, storage, transmission and reproduction, any of which may result in a degradation of visual quality. The objective of research in objective image quality assessment is to develop quantitative measures that can automatically predict perceived image quality. In the proposed system, developed a measure of structural similarity (SSIM) that compares local patterns of pixel intensities that have been normalized for luminance and contrast.

G. Reed Solomon Encoder and Decoder [10] falls in the category of forward error correction encoders and it is optimized for burst errors rather than bit errors. Reed Solomon code is mainly based on the concept of Galois Field Arithmetic. Reed–Solomon error correction technique is now used for 2D bar codes. By using RS code allows us to correct reading even if a portion of the bar code is damaged.

3. Proposed System

A. Outline of proposed work

This project work proposed a novel picture-embedding 2D barcode, called PiCode system. PiCode system mainly emphasison the new kind encoding and decoding algorithms. Fig.1 shows PiCode encoding process divided into two parts: the input processing and the PiCode generation. Source Coding method and channel coding methods are used for input processing. Fig.3 shows PiCode decoding process contains three key steps- coarse fine corner detection, module alignment and demodulation will be described. The corner detection algorithm locates four extreme corners of the barcode from the captured image. To reach higher accuracy, the projected coarse-fine corner detection scheme exploits the earlier information of the barcode structure in refining the corner locations. The module alignment step slices the barcode region into image blocks with reference to the black and white alternations in the '_'-shape pattern. Three demodulation schemes are proposed: contrast-based demodulation, matched filter-based operation, gradient-based operation.

Gradient of an image is a directional change in the intensity or color in an image. In image processing technique the gradient of the image is one of the fundamental building blocks. Mathematically, at each image point the gradient of a two-variable function is a 2D vector with the components given by the derivatives in the horizontal and vertical directions.

We develop the linear filter that will maximize output signal-to-noise ratio by invoking a geometric argument. The perception behind the matched filter relies on correlating the received signal (a vector) with a filter (another vector) that is parallel with the input, maximizing the inner product. This enhances the throughput. When we consider the additive noise, we have the additional challenge of minimizing the output due to noise by choosing a filter.

To modify contrast a simple way is to scale the pixel values within an image. The pixel estimations of showed pictures normally run from 0 to 255. Byte-scaling changes the ranges of values inside a picture to a linear progression from at least 0 to a greatest of 255. For pictures with pixel esteems surpassing 255, byte-scaling produces a more direct show with the base value as the darkest pixel and the most extreme value as the brightest pixel. For pictures with a littler range in pixel esteems, byte-scaling expands the contrast and brightens dark territories.

The system is proposed to have the following modules along with functional requirements.

I. PiCode Encoding Process
II. PiCode Decoding Process

A. *PiCode Encoding Process*

1. Source and Channel Coding method used to convert input message into bit stream to improve efficiency and robustness of the encoded message.
2. Adaptive modulation algorithm generates PiCode Modules.

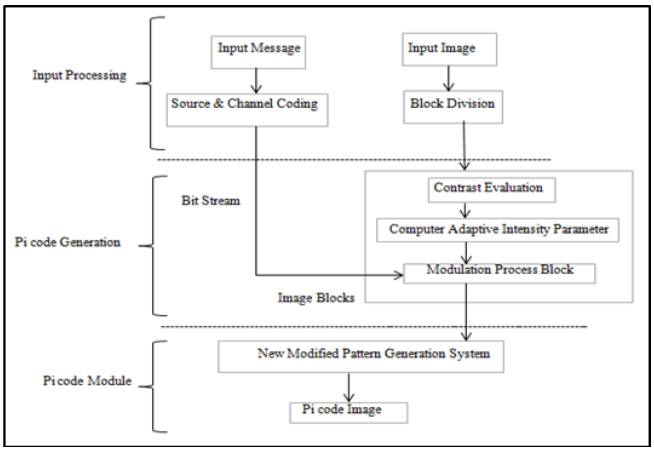


Figure 1: Encoding Procedure

In the first module we are applying a picode or a picture which hides large amount of data. This module work in two site that is client site and server site. If users want to purchase any product then he will goes to the ecommerce site at that site multiple products are available then user click on any particular product that he want to purchase after clicking to that product the picode is generated at a server site that is picode is embedded then the encoding is perform after performing encoding picode is generated. Embedded picode contains picture and information of that product. If user want to get the whole information about that particular product first he scan that product picode then the decoding is perform and after user get the whole information about the product.

Input: Image I1, Text T

Output: Picode Image PI

Procedure:

For image I calculate set of pixel area with RGB to block division.

T = {T1, T2, T3, T4, ….Tn}

Apply image blocks

I= {Im1, Im2, Im3, ….Imn}

I=Im+T For all Im i.e. Im1,Im2,Im3, ……,Imn

For all block division B

Calculate contrast evolution & compute adaptive intensity parameters.

AdP={P1,P2,P3, ….,Pn}

I1=I1+T1 where I1 € I, T1 € T

Pi=I1 with Picode pattern modulation.

Figure 2: PiCode Encoding Algorithm

B. *PiCode Decoding Process*

Coarse Fine Corner Detection algorithm locates four extreme corners of the barcode from the captured image. Module Alignment scheme:

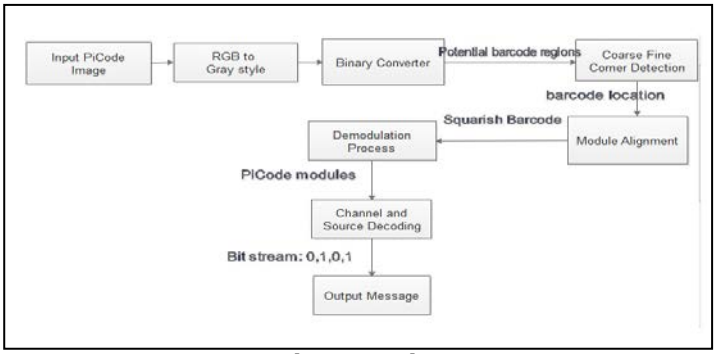


Figure 3: Decoding Procedure

To retrieve the data bit resulted from module alignment step slicing operation is used. Three demodulation techniques are given below:

I. Contrast Based Demodulation operation
II. Matched Filter-Based Demodulation operation
III. Gradient-Based Demodulation operation

Input: Picode P

Output: Squarish barcode

Procedure:

For image Pi convert RGB to grey.

Pi = {Pg1,Pg2,Pg3, … ,Pgn}

Apply binarization over Pgi

P= {B1,B2,B3,….,Bn}

Apply corner detection to perspective transform to find out text using demodulation by reading bitstream i.e.

I= B=Im+T For all Im i.e. Im1,Im2,Im3, ……,Imn

Separate out text from image.

Figure 4: PiCode Decoding Algorithm

a) RGB to Gray scale

The block diagram of the PiCode decoding process. For the conversion of an, the captured PiCode image is converted to grayscale. The potential barcode regions which are then checked against the detection criterion. If the check is passed, the four corners are obtained otherwise, the image will be rejected and the decoding process will be re-initiated with another image frame. Based on the barcode corner locations, the perspective distortion is then estimated and compensated on the gray level image.

b) Binarization

Binarization is process of converting pixel image to binary image.

c) Coarse-Fine Corner Detection

The corner detection algorithm locates four extreme corners of the barcode from the captured image. The candidate regions are checked against the detection criterion which contains a set of restrictions on the number of black and white alternations between each pair of corners.

d) Demodulation

The demodulation process is the reverse of the modulation process by inspecting the intensity differences between the inner and outer parts of each module. The modulated bit in each module is retrieved by the demodulation operation. Finally, the message is obtained by applying channel and source decoding to the demodulated bits. In this part, we mainly cover the corner detection, module alignment and demodulation steps which reflect our major contributions.

e) Perspective Transform

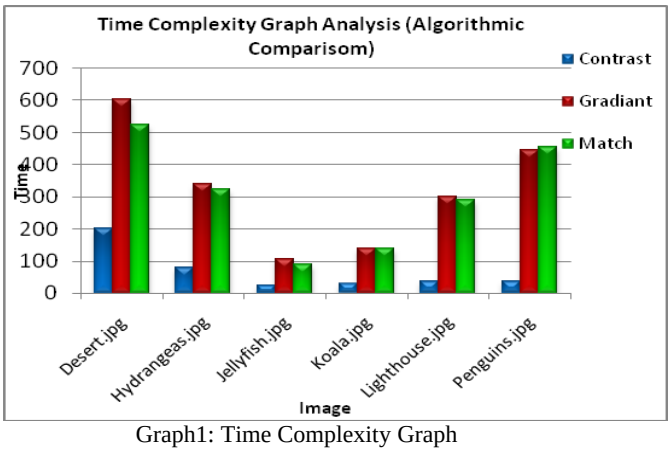
It converts 3D world into 2D images through location of the barcode

4. Experimental Result

Table1 shows the execution time required to process different images Test is made on various images which includes both standard and natural images

Time Complexity Graph Analysis (Algorithmic Comparison)				
Dataset	Image	Contrast	Gradient	Match
File1.txt	Desert.jpg	202	603	525
File2.txt	Hydrangeas.jpg	79	340	325
File3.txt	Jellyfish.jpg	25	106	90
File4.txt	Koala.jpg	30	140	140
File5.txt	Lighthouse.jpg	37	300	290
File6.txt	Penguins.jpg	37	446	454

Table1: Time Complexity

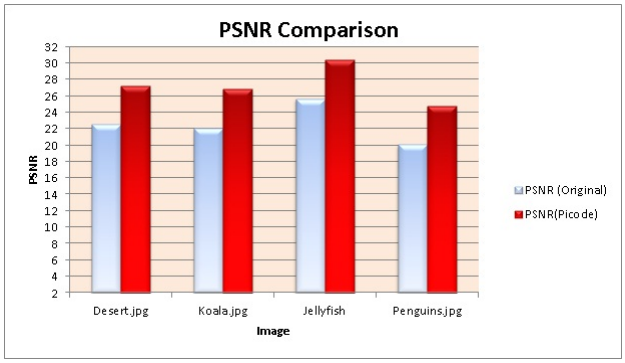


Graph1: Time Complexity Graph

Graph 1 shows time complexity comparison for three demodulation techniques. Contrast demodulation technique requires less time to decode an image.

PSNR		
IMAGE	PSNR (ORIGINAL)	PSNR(PICODE)
DESERT.JPG	22.5285	27.2817
KOALA.JPG	22.0411	26.8011
JELLYFISH	25.6937	30.3825
PENGUINS.JPG	20.086	24.7335

Table 2: PSNR Original image vs. Picode image

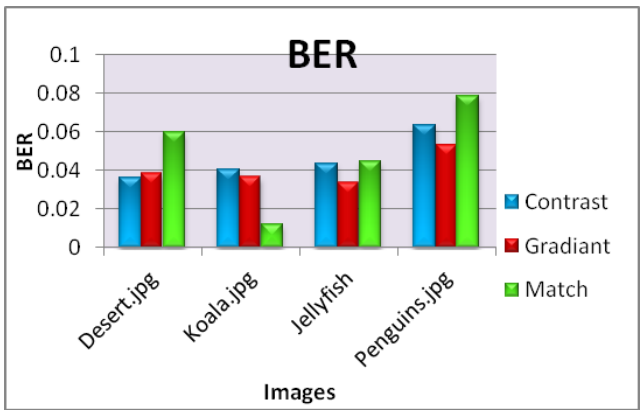


Graph 2: PSNR Original image vs Picode image

Graph 2 indicate ratio of input image & decoded picode image. Here Picode image having higher PSNR value because we applying gradient filter to improve quality of input image. Higher PSNR is the indication of higher quality of image.

BIT ERROR RATE			
IMAGE	CONTRAST	GRADIENT	MATCHED
DESERT.JPG	0.0362	0.0382	0.0598
KOALA.JPG	0.0405	0.0365	0.012
JELLYFISH	0.0433	0.0334	0.0446
PENGUINS.JPG	0.0633	0.0527	0.0783
AVERAGE	0.045825	0.04022	0.048675

Table 3: Comparison of 3 demodulation technique for BER



Graph 3: Comparison of 3 demodulation technique for BER

Graph 3 shows BER of different techniques. Average BER of gradient is 0.04022. It shows gradient filter works efficient rather matched & contrast.

5. Conclusion

This paper has designed a novel picturesque 2D bar-code; picode is very efficient technique for many applications i.e. automobile industry, marketing, retail application etc.Comparing with existing QR codes, PiCode provides unique perceptual quality for preserving the visual appearance of the embedded image and also to maintain the decoding robustness. We analyse our method using various filtering techniques to improve & to set constant intensity i.e. in our paper we focusing on gradient, matched & contrast, after analysing output of system we conclude gradient is best technique to work with image processing applications because gradient gives average results BER is 0.04022.But time required for decoding PiCode image through contrast demodulation technique is less as compare to gradient and matched filtering technique. To assure the decoding robustness that will include module alignment method with barcode structural information, the coarse-fine corner detection, and demodulation with information from all pixels in each module. Experimental result shows that picode has maintained a better trade-of between the perceptual quality and the decoding robustness.

References

[1] Changsheng Chen, Member, IEEE, Wenjian Huang, Baojian Zhou, Student Member, IEEE, Chenchen Liu, and WaiHo Mow, Senior Member, IEEE "PiCode: A New Picture-Embedding 2D Barcode", IEEE transactions on image processing, vol. 25, no. 8, August 2016

[2] Shih-Syun Lin, Min-Chun Hu, Member, IEEE, Chien-Han Lee, and Tong-Yee Lee, Senior Member, IEEE, "Efficient QR Code Beautification With High Quality Visual Content", IEEE Transactions on Multimedia, vol. 17, no. 9, September 2015

[3] C. Chen and W. H. Mow. (Jan. 2015). "A systematic scheme for measuring the performance of the display camera channel" [Online]. Available: http://arxiv.org/abs/1501.02528

[4] Student member and senior member IEEE, "QR Images: Optimized Image Embedding in QR Codes", IEEE transactions on image processing, vol. 23, no. 7, July 2014

[5] Y.-H. Lin, Y.-P. Chang and J.-L. Wu, "Appearance-based QR code beautifier," IEEE Trans. Multimedia, vol. 15, no. 8, pp. 2198–2207, Dec. 2013.

[6] National TsingHua University and University College London," Halftone QR Codes", ACM Transactions on Graphics, Vol. 32, No. 6, Article 217, November 2013

[7] "Binarization of Low-Quality Barcode Images Captured by Mobile Phones Using Local Window of Adaptive Location and Size" IEEE Transactions on Image Processing, vol. 21, no. 1, January 2012

[8] S. Ono, K. Morinaga, and S. Nakayama, "Two-dimensional barcode decoration based on real-coded genetic algorithm," in Proc. IEEE Congr. Evol. Comput., Jun. 2008, pp. 1068–1073.

[9] Student member and senior member IEEE, "Image Quality Assessment: From Error Visibility to Structural Similarity", IEEE transactions on image processing, vol. 13, no. 4, April 2004

[10] Aby Sebastian & Kareem Bonna, "Reed-Solomon Encoder and Decoder", Under Prof.PredragSpasojevic Electrical and Computer Engineering Department Rutgers, the State University of New Jersey

[11] Ms.Arati P. Patil,Mr.C J. Awati,"A Survey on PiCode: Picture-Embedding 2D Barcode",IJRITCC December 2016, Vol. 4 Issue: 12