

A Survey on Applications of Pi-Code

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Abstract: Growing a business is not an easy task. One needs to apply some right marketing strategies to fuel the growth, churning a profit and staying afloat. One has to market the product using online as well as offline ways. 1D barcodes, 2D barcodes and QR codes have become extremely popular all over the world for carrying product related data for marketing purpose. The advanced communication key of a picture could be integrated into a 2D barcode called as pi code. This technology is used for security of marketing or buying products, advertisement etc. In this survey paper, we discuss about various techniques of developing a pi-code using 2D barcode. Different implementations of pi code using different encoding and decoding processes give us the comparable results

Key words: 2D barcode, QR code, pi code, encoding, decoding

I. Introduction

In the advertisement of the business, barcode or QR technologies are being used for the security of marketing or buying products, advertisement etc.. In a barcode, the data is arranged in the form of widths (lines) and the spacing of parallel lines and may peruse as linear or 1 Dimensional barcode. A Barcode is an optical readable machine code which shows certain data associated with certain products.

1D Barcodes

Barcodes representing data in the widths (lines) and the spacing's of parallel lines such as Code128, Code 39, and UPC, are referred to as

Linear or 1D (one-dimensional) barcode symbologies.

- Holds less than 85 characters (symbology specific character limit).
- A majority of customers are set up to use Linear barcodes (Linear scanner).
- Creates a wide barcode.



Fig 1D Barcode

2D Barcodes

Two-dimensional (2D) barcodes, such as Data Matrix, PDF417, and QR Code, may have patterns of squares, dots, hexagons and other geometric patterns. While maintaining a fairly small size, these barcode types hold much more data than linear barcodes. 2D barcodes can hold hundreds of characters

- Encodes/holds hundreds of characters.
- Requires a 2D barcode scanner.
- Creates a smaller barcode than 1D.

The QR code

Short for quick response code, a QR code is a type of two dimensional (2D) barcode that can be read using a QR barcode reader or camera-enabled smartphone with QR reader software.

The QR code consists of black and white pattern which consist of fixed pattern to give the guarantee of detection decoding robustness. QR code contains position, alignment and timing pattern. The structure of QR code consists of Timing pattern, finder pattern, alignment patterns. The timing means small alternating black and white squares. Which are placed adjacent to finder pattern and alignment pattern. The finder pattern means large square of black and white pattern which is placed at top left, top right & bottom left corner. The total no. of finder patterns in QR code is 3. The alignment patterns are placed in bottom right region of QR code.

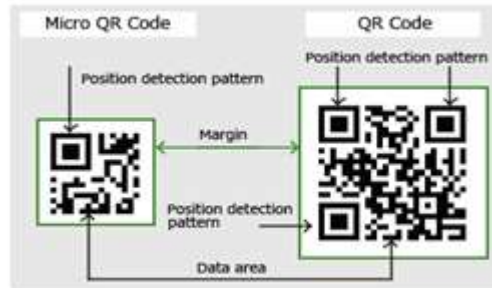


fig QR code

A **QR code** is able to carry information in both the vertical and the horizontal direction, which is why it is called a **2D barcode**. These 2D barcodes contain matrix-like patterns that can hold much more data than the ubiquitous striped barcodes.

Maximum storage capacity of QR code is 4296 characters.

There are 40 versions of QR codes and are used in a variety of applications, such as post information to social networks, accessing websites, download personal card information. This versatility makes them a valuable technique in any Industry that seeks to engage mobile users from printed materials. The customized barcodes typically 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. An important issue in QR codes is the square shapes and limited colour tolerance. This challenge has generated great interest for algorithms capable of hiding information in QR codes and embedding QR codes into images without losing decoding robustness.

PiCode: Picode is a new form of the 2D barcodes. It aims to show not only machine-readable data, but also show human- recognizable visual information or a picture, such as a company logo, a cartoon, a low resolution photo, etc. Since anyone scanning a barcode with his/her mobile phone must also look at it for seconds during the camera focusing process, it is a perfect opportunity to advertise the brand logo of a company or show a picture related to the promoted product. 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. However, since the size of the overwritten region is limited by the error correlation capability and the size of the barcode in use, the embedded picture is typically too small to preserve the (brand) image quality of the (company logo) picture. The Pi Code technology improves the aesthetic value of the picture embedded barcode by allowing the picture to be overlaid on almost the whole barcode area.[2]

II. Literature Survey

The generalized steps to encode a picture into the QR code are follows:

- Information hiding into QR code

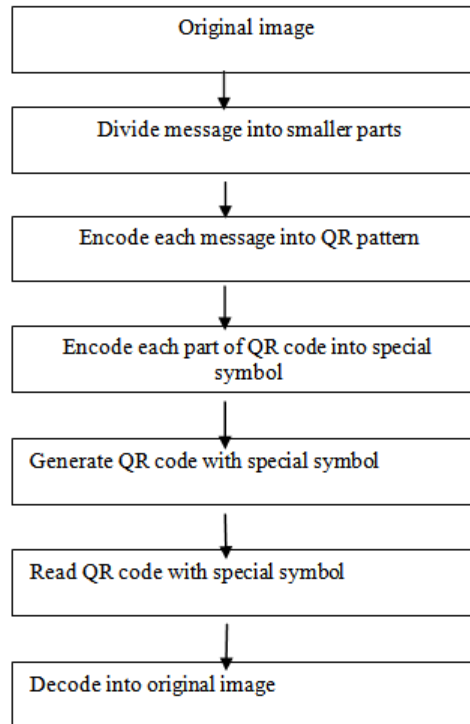


Fig: Steps of information hiding using QR codes

The various techniques to embed picture in QR codes have been invented. The researchers have suggested various applications of these pi codes in the field of marketing.

According to the Mehmet Emek et al [1], QR (Quick Response) code scanning allows the user to obtain in-depth information about the scanned item. Apps used for scanning QR codes can be found on nearly all smart phone devices. Travelers who have smart phone, equipped with the correct reader software, can easily access QR coded information (text, photo, video, web page, etc.) when it is available. Travelers can scan QR coded galleries, places, vineyards or monuments when they are visiting and reach the detailed information without using even a travel guide. The aim of this study is to explore the QR code usage opportunities in tourism sector in the Information Age.

According to the Dr. Stephen Brokaw [2], Quick Response codes, more commonly referred to as -QR codes are changing the way marketers and consumers view print media. QR codes are the seemingly perfect bridge to mending the gap between the tactile and virtual world. The focus of this study is an exploration and compilation of data and research regarding the current functionalities, benefits, limitations, and future expectations of Quick Response (QR) codes in print media. To enhance and build on the findings collected from outside research, a survey was administered solely for the purposes of this study at the University of

Clement Creusot, et al [3], the goal of this research is to recognize products in supermarket or shops using 2D videos analysis. Most sighted people use three kind of clues to recognize products. The global appearance or shape of the packaging, the text written on the packaging, and sometime the pictures or see-through windows to the package content. This is a classic problem for sighted people traveling abroad: the packaging might not have pictures; the brand is unknown and the alphabet unreadable. Appearance-based recognition of products is an exciting approach but relies on up-to date exhaustive appearance databases that do not exist. An alternative machine- friendly way of recognizing the product is to simply read its barcode. The inconvenience of barcodes is that they are small and very often at the back of the packaging. This means that the user has to find the barcode first. This is not difficult for sighted people but very difficult for visually impaired individuals, especially totally blind people, objective is to provide this localization capability to blind individuals. A blind person wears an egocentric wide angle camera and rotate an object in his/her hands in front of the camera. The system localizes the barcode and feedback the detection to the user. From a technical point of view, this means that the detectors need to capture very small barcodes in potentially blurry images since the product is likely to be in motion. The contributions of this paper are a new barcode detector based on a Parallel

Segment Detection (PSD) Technique, a fast method for barcode cropping along a candidate line and a new challenging dataset for product recognition. We insure the system is low computation so as to be ported to low-power low-heat-emitting devices. Our technique achieves state-of-the-art results on existing public datasets. A new challenging egocentric video dataset of dynamic product manipulations is made available.

This paper [4] has 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 maintaining 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.

Here are five ways [5] QR as well as Pi codes can benefit your business:

QR Your Business Card

Give your customers more than a bland business card with basic contact information; let them get to know you. Use a QR code on your business card to include more than just the standard name, title, phone number, address and email. Because QR codes can store much more data than a traditional barcode, add links to your website, blog, social media accounts, photo and other professional profiles. QR codes also show potential clients and others that you understand and appreciate how busy they are and you want to make things easier for them – one scan with a smartphone and all your information can be saved instantly in their contacts.

QR Your Print Advertisements

Promote more than just your latest sales and specials: Show your company's dedication to reducing waste. Instead of printing a multipage circular, shrink the size to just a few pages, highlight a few special offers, and include a QR-coded URL that links customers to product videos, spec sheets or –Buy Now! pages. Assigning a URL specific to the QR code in the ad with a re-direct is also great way to track how much traffic came to that page through your print ads.

QR Your Business Stationery and Invoices

Mistakes happen and you want to make the correction process as painless as possible for you and the consumer. Include a QR code on items such as your business stationery and invoices that leads directly to your customer service site for such helpful information as contact numbers, user guides, and (if needed) return labels.

QR Your Events

Use a QR code on event materials that leads to a virtual version of your event packet and allows attendees to travel light. Include an e- ticket, travel directions, map, handouts and any other relevant information your guests may need.

QR Your Inventory

Don't forget that QR codes and other 2D barcodes are important tools for inventory management and manufacturing and allow you to track more than just name and price of a product. The codes can also include information such as serial numbers, part numbers, lots and dates and other data points.

III. Qr Code Success Stories

Marketing, branding, and advertising campaigns that involve QR codes have become commonplace, and they've led to create success for many businesses.

- **Spotify, Facebook, Snapchat**, and other social media and streaming platforms are now utilizing QR-like codes in inventive ways. You can scan the Spotify Code of a friend's playlist to have instant access to that playlist, without searching manually for their name. Ditto finding people on FB and Snap. This is the same principle as QR codes in general—why waste time manually inputting information when a quick scan will do?
- **Nut Thins** and other specialty food products are increasingly adding QR codes to their boxes that lead consumers to more related information, such as recipes

and information about the company on an easy-to- navigate mobile site.

- **WeChat, WhatsApp** and other messaging services are helping small businesses around the world conduct small transactions via QR codes. This is currently most popular in places like China and India, but in the future, businesses everywhere may do away with costly POS terminals and NFC chip readers to favor of mobile payments via QR code.
- **Healthcare facilities** such as Clark Memorial Hospital use QR codes to help identify patients and keep updated records of delivered medicines, current vital signs, and doctor's orders. From triage to discharge, a quick scan can access and edit a patient's file in an instant without the potential hazard of medicinal handwriting.

QR codes are an easy-to-generate and inexpensive way to pack more information about your business, products, and services into a tiny space. There are plenty of other **creative ideas for how businesses, non-profits and municipalities can use QR and pi codes to market and communicate themselves better** to their stakeholders.

1. **QR Codes on bus stops, train stations and subway stations:** A quick scan would give you real time information on when the next bus, train or subway would arrive.
2. **Posted next to paintings and sculptures at museums.** Great for visitors who want to learn more about the artist, the time period, and the reaction to the photo. Could also include links to other work by the artist, related artists, and even the ability to buy the image on a mug or poster at the museum shop.
3. **As part of a personalized direct mail piece.** Each QR code can go to a PURL (personalized URL (Uniform Resource Locator)).
4. **On historical sites and on walking trails.** Sure, a plaque is fine for grandma, but I'd like to delve deeper, whether with a wikipedia entry, or an video of a local historian explaining the significance of the site.
5. **At video kiosks.** QR codes can appear as people interact with your kiosk, whether it's at the mall or your place of business.
6. **On For Sale signs.** Whether residential or commercial, for sale signs could include codes that had all the information a sell sheet includes, plus video walkthroughs.
7. **Email newsletter signups.** Build your subscriber base by having quick links to an email signup box.
8. **E-learning.** Have your QR code generate an email that starts an autoresponder, sending daily emails filled with lessons and related information.
9. **Next to packaged food in groceries.** Give shoppers quick access to recipes that include the ingredients they see on the shelf.
10. **In a jigsaw puzzle.** This would create some real engagement as the user would have to put together the puzzle before scanning the image.
11. **On produce.** You could include information about the farm, organic vs. conventional growing, best by dates, etc.
12. **Buying coffee (or anything else.)** Like Starbucks does.
13. **On tags for sustainable clothes.** Is that piece of clothing really sustainable?
14. **For conference signage.** Next to the name of the upcoming sessions in each room would be the QR code so you could get the full description, speaker bios, and see if there's any room left.
15. **On conference name tags.** SXSW has been doing this for at least a year or two. Why trade business cards when you can just scan them. Now, don't you feel all TSA?
16. **Written in calamari ink on diners' plates.** You can't make this stuff up.
17. **On jewelry.** Examples abound.
18. **As part of interactive maps.** Check out this example from Town Graphics.
19. **At the bottom of all newspaper and magazine articles.** Then you could quickly get to the online version and see the comments that other readers had left.
20. **On building permits.** New York City is already doing this.
21. **On the fliers that you find under your windshield wipers at the mall.** One example might be an offer for a car wash; the URL would give you the discount code and directions to the car wash offering the deal.
22. **On the safety bar ads on ski mountain chair lifts.** These days, everyone on the mountain seems to have a smart phone, and they're going to be a captive audience for 5 – 10 minutes, sitting on that chair going up the mountain.
23. **Inside elevators.** If I ran a dry cleaning service or something else that helped busy executives out I'd advertise inside elevators in tall buildings. Other good options might include flowers (for spouses left at home with the kids), discounts on take out food, etc.
24. **Within a video game console to share avatars.** Nintendo is already doing just that.
25. **To get more people to sign a petition.** Like the one for cleaning up the BP mess.

26. **At bars, clubs and anywhere else music is playing.** Sure, [Shazam](#) is a great tool for finding music, and often you can even buy the track you discovered at iTunes or Amazon. But in a loud club you may not be able to suss out the song. If a QR code appeared above the DJ's head, you could quickly scan the code and purchase that new song.
27. **On the backs of tractor trailers.** Because -How's My Driving? with an 800 number is so last decade.
28. **On wedding invitations instead of RSVP cards.** Scan a QR, save a tree. And a stamp.
29. **As a temporary tattoo.** Link it to your Facebook profile or Twitter account.
30. **On a laminated card for trade shows.** Instead of dropping a business card in a fish bowl. Booths win because they'll get all the pertinent info, and the event could give away prizes to the people who get scanned the most.
31. **To encourage community feedback.** The [library in Groton, CT](#), does just that.
32. **As wallpaper.** Well, it's better than the wallpaper in our bathroom when we moved in to our house.
33. **On the bottom of flip flops.** The imprint they make on the beach...until the tide comes in.
34. **On coffee cups from your local coffee shop.** Plenty of advertising opportunities here.
35. **On posters linking to free books.** 1st Bank is giving away free copies...of these [out-of-copyrighted classics](#). They also have other boards that link to free sudoku.
36. **On a ball field.** Have you seen what the groundskeepers can mow into the outfield these days? They're artists!
37. **On a human billboard.** Think -Eat at Joes.
38. **As wrapping paper.** [One company](#) is already customizing this with unique videos attached to QR codes.
39. **On trade show booths.** Scan a picture, (be entered to) win a free iPod.
40. **On recipes in magazines.** Quick link to videos, reviews and feedback at the website.
41. **For self-guided tours at factories.** Scan a code, learn what that dohickey does.
42. **Posted on car windows in dealerships.** Perfect for [after-hour shoppers](#).
43. **Scratch and Win cards.** It's not enough to have them scratch off the card, make them scan that card to see if they've won.
44. **On movie posters.** QR code takes them to a preview of the movie.
45. **On cocktail napkins.** The code could take networkers to the sponsor's site, the beverage's site, or some networking site with photos, so you can connect with people after the event.
46. **In TV ads to make them interactive.**
47. **Business cards.**

IV. Summary

The future success will not be attributed to simply linking to url's The real enterprise solutions are where the codes will be monetized and customization for business and commercial use will be at the forefront of intelligent and professional use, examples of which are; e-government, tourism, advertising and targeted marketing, packaging, supply chain management, brand management and brand protection, logistics, track and trace, anti-counterfeit or smuggling, id & passports, transport and ticketing, parking, disability, crm, cross media campaigns, m-ticketing, m-payments, e-learning, complete integration of localization, personalization, objects and other data.

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