

Embedding 2d Barcode By Using Aztec Barcode

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ABSTRACT

Nowadays, 2D barcodes have been widely used as an interface to connect potential customers and advertisement contents. PiCode is designed with careful considerations on both the perceptual quality of the embedded image and the decoding robustness of the encoded message. Comparisons with the existing beautified 2D barcodes Aztec code 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. Aztec code has been implemented in the MATLAB on a PC and some key building blocks have also been ported to Android and iOS platforms. Its practicality for real-world applications has been successfully demonstrated.

Keywords: Quick Response (QR) Codes, Half Toning, Ordered Dithering, Gray Scale Image, Binary Image

I INTRODUCTION

A QR code is a 2D barcode that can encode information like numbers, letters and binary codes. QR code holds a considerably greater volume of information than a 1D barcode[1]. QR code contains information both in vertical and horizontal direction. Maximum storage capacity of QR code is 4296 characters. There are 40 versions of QR codes and are used in a variety of applications[2], 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[3]. The customised 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[4].

PiCode is a new form of the 2D barcodes. It aims to show not only machine-readable data, but also show human-recognisable 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[6]. 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[7]. 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.

Function Pattern Region

This region contains all the necessary information to successfully detect and sample the information bits of the code. Finder and alignment patterns are the most essential modules in the region and are key to locate, rotate and align the QR code as well as to correct for deformations in the printing surface. In addition to finder and alignment patterns, timing patterns also aid in the determination of the sampling grid especially for large code sizes.

2.1.1 Finder Pattern

Finder patterns are easily identifiable as three concentric square structures in the corners of the code. They are designed to have the same ratio of black and white pixels when intersected by a line at any angle, allowing determining its centre even if the code is scanned at arbitrary angles[8]. Finder patterns are surrounded by two guard zones of one QR 10 module wide called the separators. These zones aid in the separation of finder patterns from the encoding region and in the identification of the proper sequence of black and white pixels further improving the location accuracy.

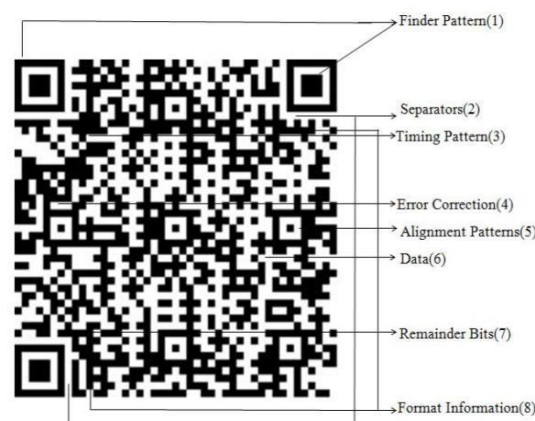


Fig1. Structure of QR code

2.1.2 Separators

The white separators have a width of one pixel and improve the recognisability of the finder patterns as they separate them from the actual data[9].

2.1.3 Error Correction

Similar to the data section, error correction codes are stored in 8 bits long code words in the error correction section.

2.1.4 Alignment Patterns

Alignment patterns on the other hand are used to determine the sampling grids from which code words are extracted and to correct for possible deformation of the printing surface.

2.1.5 Timing Patterns

The standard also defines two zones consisting on one row and one column of alternating black and white QR modules, denoted as the timing zones and located between finder patterns.

2.2 Encoding Region

The code area delimited by finder patterns is denoted as the encoding region. where data, parity modules and decoding information is stored. This area is divided into code words consisting of blocks of 8 QR modules[10]. Two dimensional shapes of these code words depend on the version of the code and are designed to optimize area coverage.

INFORMATION HIDING USING QR CODE

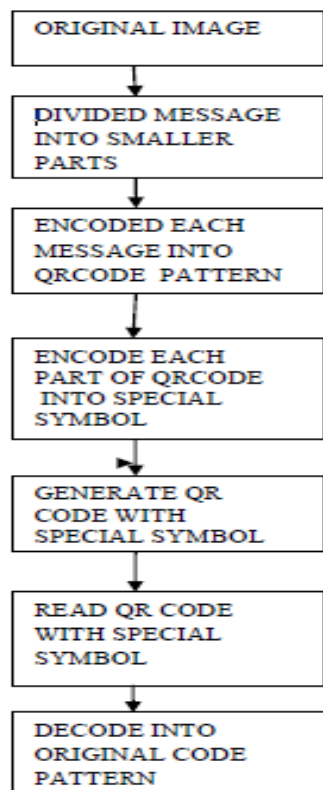


Fig 2. Architecture of information hiding using QR codes

The original message is divided, to form a string of characters into smaller parts, where smaller part is the number of QR code pattern that can be formed by a string of characters. The data in each part is encoded into ordinary QR code corresponding to that part of data[11]. The architecture of information hiding using QR code is shown in Fig 2.

At the receiving end, this QR code with special symbols is decoded to give back the number of QR code patterns that was encoded. After that, when this QR code with special symbols is scanned or read by optical device such as a scanner or a camera phone, the picture image can be analyzed. Using this picture image original information can be read and the decode the information from single QR code with special symbols and split the data back to their QR code pattern where these QR code pattern can be read by ordinary QR code reader[12]. The data in each QR code pattern were recognized and concatenated back to form its original information.

PREVIOUS WORK :

PI CODE:

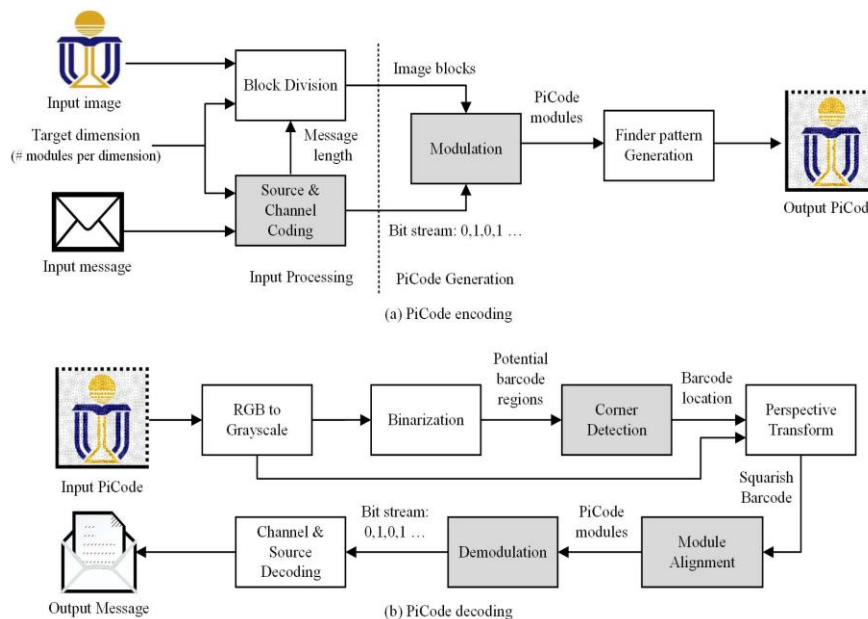


Fig-3 pi code encoding and decoding

A novel approach picture-embedding 2D barcode, called PiCode system proposed. PiCode system mainly emphasis on the new kind encoding and decoding algorithms. 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[13] 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.

PiCode decoding process contains key three 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 achieve higher accuracy, the proposed coarse-fine corner detection scheme exploits[14] the prior 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. Demodulation scheme will be used to retrieve the data bit resulted from module alignment step. Three demodulation schemes are proposed: contrast-based demodulation[15], matched filter-based operation, gradient-based operation. In the proposed work the decoding performance comparison is evaluated in terms of demodulation bit error probability (BEP) for three demodulation techniques

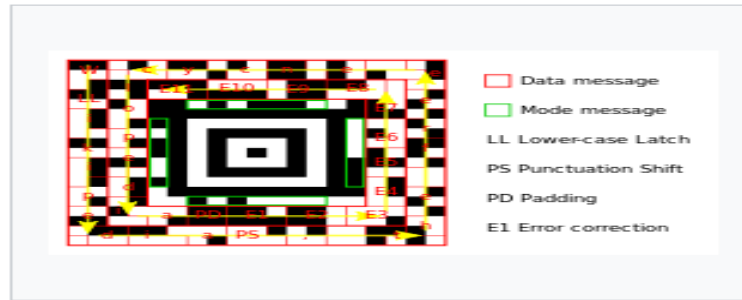
PROPOSED WORK

Aztec code:

The compact Aztec code core may be surrounded by 1 to 4 layers, producing symbols from 15×15 (room for 13 digits or 12 letters) through 27×27 . There is additionally a special 11×11 "rune" that encodes one byte of information. The full core supports up to 32 layers, 151×151 pixels, which can encode 3832 digits, 3067 letters, or 1914 bytes of data. In fig Whatever part of the symbol is not used for the basic data is used for Reed–Solomon error correction, and the split is completely configurable, between limits of 1 data word, and 3 check words. The recommended number of check words is 23% of symbol capacity plus 3 codewords[16]. Aztec Code is supposed to produce readable codes with various printer technologies. It is also well suited for displays of cell phones and other mobile devices.

The symbol is built on a square grid with a bulls-eye pattern at its centre for locating the code. Data is encoded in concentric square rings around the bulls-eye pattern. The central bulls-eye is 9×9 or 13×13 pixels, and one row of pixels around that encodes basic coding parameters, producing a "core" of 11×11 or 15×15 squares. Data is added in "layers", each one containing two rings of pixels, giving total sizes of 15×15 , 19×19 , 23×23 , etc.

The corners of the core include orientation marks, allowing the code to be read if rotated or reflected. Decoding begins at the corner with three black pixels, and proceeds clockwise to the corners with two, one, and zero black pixels. The variable pixels in the central core encode the size, so it is not necessary to mark the boundary of the code with a blank "quiet zone", although some bar code readers require one.



Message data is placed in a spiral pattern around the core. The mode message begins "01011100", indicating $01_2+1 = 2$ layers, and $011100_2+1 = 29$ data codewords (of 6 bits each).

Fig-4 Aztec code basic operation

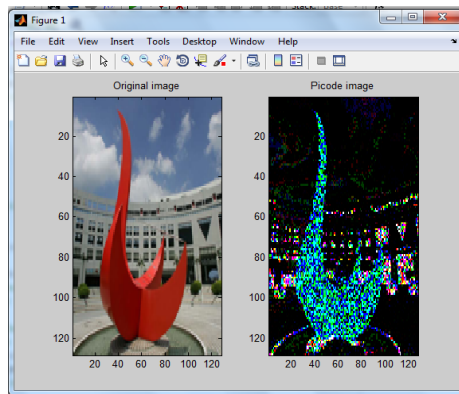


FIG-5 Previous Method of PI-code

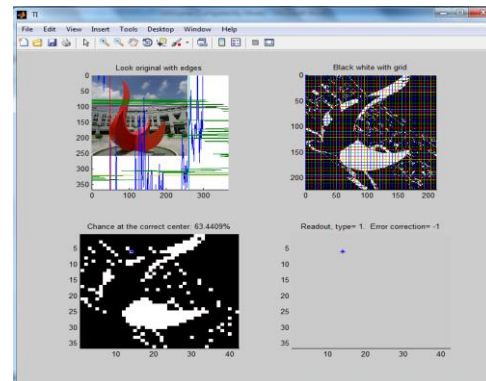


FIG-6 Proposed Method of Aztec code

The core of the compact Aztec code (red ascending diagonal hatching), showing the central bulls-eye, the four orientation marks (blue diagonal cross-hatching), and space for 28 bits (7 bits per side) of coding information (green horizontal hatching). The first ring of data begins outside that (grey descending diagonal hatching) show in fig-5. The core of the full Aztec code. 40 bits are available between the orientation marks for encoding parameters Show in fig-6

CONCLUSION

This paper has designed a novel picturesque 2D barcode, named the Aztec code. Comparing with existing beautified PI 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 Aztec code 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.

Comparisons with the existing beautified PI codes by experimental results show that Aztec code has maintained a better trade-off between the perceptual quality and the decoding robustness (or normalized data capacity).

To evaluate its practicality, the Aztec code system has been implemented in Matlab on a PC, and as mobile application softwares in Android and iOS platforms. The perceptual quality and the decoding robustness of the Aztec code system have been successfully demonstrated. In the future, the unobtrusive pilot symbols will be embedded into the Aztec code center to serve as center alignment pattern and training symbols for the camera response function.

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