



The generation and recognition system of QR code basing on android

Teng Lin-lin¹, Tong Chun-ya^{1*}, Shao Shi-wei^{2,3}, Zhong Qiu-bo^{1*}, Shi Jing-jing¹, He Ke-jia¹
and Zhang Hong-mei¹

¹School of Electronic and Information Engineering, Ningbo University of Technology, China

²School of Resource and Environmental Sciences, Wuhan University, No.129, Luoyu Road, Wuhan, China

³Wuhan Land Resource and Urban Planning Information Center, No.13, Sanyang Road, Wuhan, China

ABSTRACT

With the development of Information Technology, the application field of QR Code has become wider and wider. This paper is mainly about its encoding. When users input strings, 2-dimensional bar code will be formed; recognizing the shaped 2-dimensional bar code through Android Mobile Phones; users can know the goods and its new information in circulation.

Key words: Android; QR Code; Generation; recognition

INTRODUCTION

Two-dimensional code which is also called two-dimensional bar code utilizes specific geometrical figures, according to the encoding rules point, empty and white graphics in small area to mark data symbol information. It can express a large amount of information in a very small area. ^[1] 2D barcode also can express information in the horizontal and vertical so that its storage density is very high. In addition, it has lots of advantages such as good correction capability, expressing information of kinds of figures and characters capability, high privacy, anti-fake and so on^[4].

With the increasing of Android mobile phones' occupancy in mobile internet, the applications of 2D barcode in Android is wider and wider. Phones can not only be the input terminals of forming 2-dimensional bar code, but also the cameras to sweep and recognize 2-dimensional bar code. Mobile phone 2D barcode has been applied and popularized by major mobile phone manufactures recently. The main content of this paper is about two-dimensional bar code Recognition System which aims at encoding QR Code, whose development bases on Android.

THE GENERATION SYSTEM OF QR CODE BASED ON ANDROID

1. Characteristics of QR Code

2D barcode can be divided as encoding methods into The linear stacking type two-dimensional code(such as Code 16K、Code 49、PDF417); Matrix type two-dimensional code(such as Aztec、Maxi Code、QR Code、Data Matrix).^[8] Compared to one-dimensional barcode, 2D barcode has characteristics such as large data storage, high privacy, good trace; good damage resistance, low cost, strong interaction, good embodiment and so on. ^[2] The part functions of the most popular 2D barcode are given in the following Table 1.

QR Code (Quick Response Code) was Matrix type two-dimensional code which was manufactured in September, 1994 by Denso, Japan. It exists as matrix form and it uses dark module to represent number 1, light module to represent number 0, permutation and combination to confirm meaning of code in the matrix of corresponding position. ^[3] As Table 1 show that compared to the other 2D barcode, QR Code has advantages in high recognition speed, large data storage and so on. It is worth mentioning that except Japanese, English, QR Code is also able to use digital compression to express Chinese, and just use 13bit, which increases 20% space comparing to expressing

Chinese methods of the other 2D barcode. Therefore, QR Code has plenty of potential in China.

Table 1. The part functions of the most popular 2D barcode

Index	PDF417	Data Matrix	QR Code
Maximum information storage	1106(Byte)	1556(Byte)	2953(Byte)
The reading speed	3/sec	2~3/sec	30/sec
Chinese Compatible	No	Yes	Yes
Max error correction capabilities	46.2%	25%	30%
Min error correction capabilities	0.2%	14%	7%

2. The introduction of the ZXing library

ZXing is an open source 1D / 2D bar code library which developed by Google company, using ZXing library can be achieved on the 1D / 2D bar code's encoding and decoding. The data encoding mode used in this paper can be divided into two modes: Chinese characters mode and alphanumeric mode. Chinese character mode namely each double byte character is represented by 13 bits binary codes. Alphanumeric mode namely alphanumeric mode on 45 character set encoding. Usually, the two input characters will be expressed by the 11 bits.

Below will use alphanumeric mode as an example to introduce the QR Code coding process:

- (1)The input data is divided into two characters in a group, data AB01, for example, will be divided into AB 01;
- (2)Each group will use the value of previous character *45 and plus the value of latter character, then converted to 11 bits binary, if the last group has only one character, then this character encoding is a 6 bit binary number;
- (3)The character count indicator is converted to binary, and the digits according to table 2^[5];

Table 2. The digits of QR Code character count indicator

QR Code version	Alphanumeric mode	Digital mode	Chinese character mode
1-9	9	10	8
10-26	11	12	10
27-40	13	14	12

- (4)According to Table 3, select the corresponding mode indicator;

Table 3. The mode and indicator map table

Mode	Indicator
ECI	0111
digital	0001
8 bit byte	0100
terminator	0000
alphanumeric	0010
Chinese character	1000
Structure of the link	0011
FNCI(the first position)	0101
FNCI(the second position)	1001

- (5)The binary data which have added mode indicator and character technology indicator, finally form digits and the total number of digits as shown in Fig.1 (in Chinese characters, for example)^[6].

$$\begin{array}{ccccccc}
 \text{B} & = & 4 & + & 4 & + & \text{C} & + & 13\text{D} \\
 \downarrow & & \downarrow & & \downarrow & & \downarrow & & \downarrow \\
 \text{Bit stream} & & \text{Mode indicator} & & \text{Chinese indicator} & & \text{Charactor count indicator} & & \text{Each Chinese of 13 bit}
 \end{array}$$

Fig.1 The Chinese characters encoded bit stream total number format

The method based on the open source ZXing library to generate QR code is proposed in this paper, the concrete steps are as shown in Fig.2.

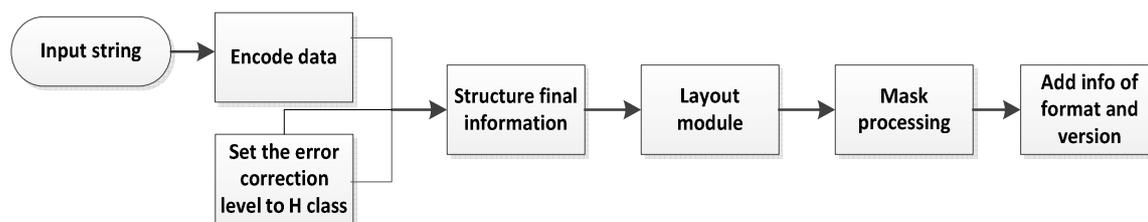


Fig.2 Schematic diagram of the process of generating 2D bar code

This paper's main research process of generating QR Code is described as below:

- (1) Firstly, turn the string data that user input into utf-8 format to make coding more convenient, then format coding the data after the conversion;^[10]
- (2) Secondly set the error correction level to H class and store the above information in a array Bit Matrix which is binary stream format;
- (3) Then, get values of pixel. After that, turn the two-dimensional Bit Matrix data information into one-dimensional pixel information;
- (4) Finally, calling the `Bitmap.createBitmap ()` method of Android, the parameters in turn are pixel information, width and height of the bitmap, and the configuration information of bitmap, to constitutes a two-dimensional code in Bitmap format.

In order to improve the reliability of QR code recognition, we should allocate dark or light colors module reasonably at the process of generating QR code. Therefore, this article will get the data in Bitmap format mask treatment so as to obtain the final QR code.

THE RECOGNITION OF TWO-DIMENSIONAL BAR CODE BASED ON ANDROID

1. Using the android camera to obtain the graphics

Obtaining the graphics is a most important step to realize the recognition of two-dimensional bar code, this paper get graphics by using the Android camera's call. The specific steps are described as below:

- (1) Add use camera and phone vibrate permissions, and add the following permissions in the file of `AndroidManifest.xml` to open the camera;

```

<uses-permission android: name="android.permission.VIBRATE" />
<uses-permission android: name="android.permission.CAMERA" />
  
```

- (2) Open multi thread service to scan image, according to relative width 1:1:3:1:1 of the probe location dark - light - dark - light - dark elements to get view finder graphics of QR code to be identified, whose format is as shown in Fig.3. Because the three view finder graphics of QR Code distributed in the upper left, the upper right and the lower left, this paper will get width and height of picture from view finder graphics firstly, thus to obtain QR Code graphic. Decoding the acquired graphic, if decoding is not successful then continue to scan, if decoding is successful, then call background program to recognize graphic, cycle calls in turns.

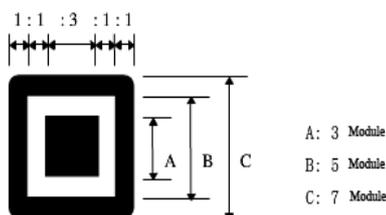


Fig.3 View finder graphics of QR code

2. Using the android camera to obtain the graphics

Recognition and generate two-dimensional bar code are reverse process^[7]. The main processes of recognition of QR code are as shown in Fig. 4:

More detailed processes can be described as follows:

- (1) Binary encode the graphic obtained by camera, the dark and light colors can be identified as "0" and "1" array, then to build Bit Matrix format of data information;

- (2)According to experiment's QR Code format to read format and version information, determine the version of graphical;
- (3)Remove the mask of the graphic and the mask that experiment used by XOR, then read the data information;
- (4)Using the error correcting code to inspect data, if found errors, then error correction;^[9]
- (5)Divide data according to the mode indicator and character count indicator data information;
- (6)Decode by the mode of used, finally get the encoded data and output.

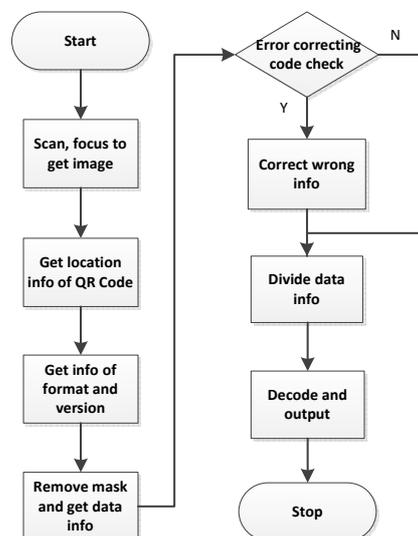


Fig.4 The recognition process of two-dimensional bar code

ANALYSIS AND EVALUATION OF EXPERIMENT RESULTS

In this paper's design of generation of QR Code, store the data that contains the two-dimensional bar code version and error correction information in the hashes. Compared to the data dictionary, optimized the data structure; Although a pixel in The configuration information of bitmap using ARGB_8888 accounted for 32 bits that costs a lot of memory, high pixel image is more abundant; Secondly, considering about the good users' experience, users can input data whatever they want to generate QR Code pictures; this paper use the ImageView widget to display in the main interface; In the design of recognition of QR Code, the interactive use of camera and the background process and the automatic focusing of camera can improve the recognition speed. The experimental processes are shown in Fig.5 and Fig.6:

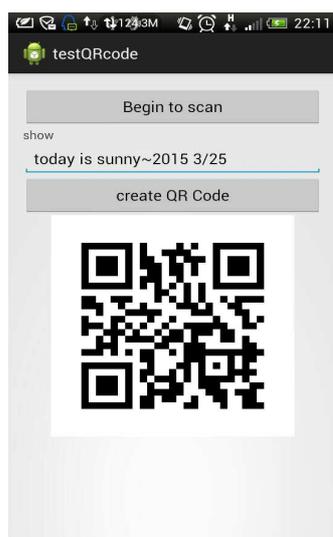


Fig.5 Customize generate QR Code

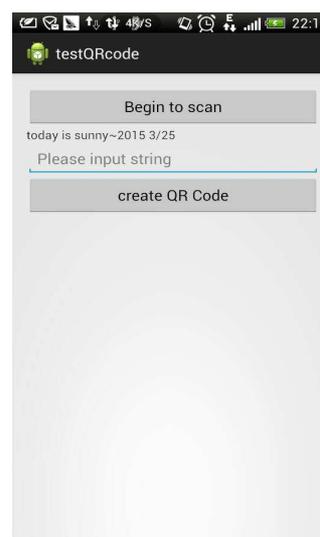


Fig.6 Results of recognition

Fig.5 and Fig.6 show that in this paper, users can use digital, Chinese characters, letters and special symbols to encode to generate QR Code, and decoding is rapid and accurate. But in repeated experiments, there are some deficiencies. Because we cannot use vertical screen (portrait layout) normally to load camera in the SDK

(android.hardware.Camera), so when loading with vertical screen mode, it will be generated the camera imaging left 90 degrees or wrong length or width of camera imaging.

CONCLUSION

With the arrival of the big data time, applications of two-dimensional bar code are wider and wider. The QR Code with its accommodating a large amount of information, quick response and efficient representation of Chinese characters, become a mainstream code in matrix two-dimensional code. QR Code will have a wider and wider application prospect in the market of Chinese country. This paper mainly using the open source ZXing library to achieve the generation and recognition of QR Code, Experiments shows that it will have certain promotion effect for Two-dimensional bar code.

Acknowledgements

This material is based upon work funded by Natural Science Foundation of China under Grant No.61203360, Zhejiang Provincial Natural Science Foundation of China under Grant No.LQ12F03001, LQ12D01001, LY12F01002, Ningbo City Natural Science Foundation of China under Grant No.2012A610009, 2012A610043, State Key Laboratory of Robotics and System (HIT)Foundation of China under Grant No.SKLRs-2012-MS-06, China Postdoctoral Science Foundation under Grant No.2013M531022.

REFERENCES

- [1] Yu Wang, Design and implementation of food traceability system in QR Code[D].Xi'an:Xi'an Electronic and Science University.2013:8-10
- [2] Quanzhong Guo, *News and writing*,2013,(07):22-23
- [3] Qingqing Long, Research of Android intelligent mobile phone guide system based on two-dimensional code recognition[D].Hangzhou: China Metering University.2013:8
- [4] Lei Sun, The application of QR Code identification algorithm on mobile phone.[D].Shenyang:Northeastern University.2007:1-4
- [5] Li Liu, Study of two dimensional QR Code barcode decoding system based on image processing[D].Shenyang:Northeastern University.2010:12-14
- [6] Yue Liu, Mingye Liu, *Journal of Beijing Institute of Technology*, 2005, 25(4):252-254
- [7] Fengmei Liang, *Development and application of computer*,2002,15(5):13-16
- [8] Chunying Kang, *Natural Science Journal of Heilongjiang University*,2009,26(2):216-218
- [9] Dong Liu, Xiquan Gao, *Information technology*, 2004, 28(1):61-63
- [10] Ming Ma, Haibo Li, *Computer recognition and technique*, 2012, 8(26):6354-6355