

Identifying QR Code

Chanon Skawattananon, Mahasak Ketcham and Sartid Vongpradhip

Abstract— Bit error rate or BER is the basic idea of comparison between two pictures to perform the number of bit errors divided by the total number of transferred bits during a studied time interval. In image processing, we use to compare two images in order that measure quality of them. In this paper propose method by use adaptation of brightness in image to get lower BER. We focus on QR Code image compare with QR Code is overlapped by a portrait and test by decode them. In our approach we implement to build Identifying QR Code.

Keywords—QR Code, Bit error rate, Error Correction

I. INTRODUCTION

QR Code is a type of 2D barcode. QR Code holds a considerably greater volume of information than a 1D Barcode. QR Code developed by Denso Wave [1] (a division of Denso Corporation) and release in 1994. It contains information in both the vertical and horizontal directions, whereas a 1D (one dimensional). The interesting characteristic of QR Code is error correction. Error correction is techniques that enable reliable delivery of digital data over unreliable data. Scratch and stain on QR Code in over limitation abort incident of decode QR Code. Recently, there have many advertises develop an image overlaps QR Code for marketing to promote their product. In this paper we implement an image overlaps QR Code that can decode QR Code correctly by adapt brightness of overlapped QR Code. [3]

In the next section, we describe the method description in detail. In Section III, experimental results and analysis. In Section IV, conclusions and future work.

II. METHOD DESCRIPTION

A. QR Code

Each QR Code symbol shall be constructed of nominally square modules set out in a regular square array and shall consist of an encoding region and function patterns, namely finder, separator, timing patterns, and alignment patterns as follow. [1]

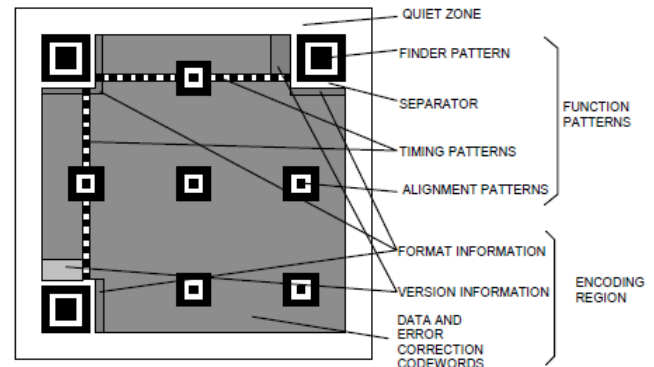


Fig. 1 Symbol structure of QR Code

QR Code has four levels of Reed-Solomon error correction (referred to as L, M, Q and H in increasing order of capacity) as follow.

1. Level L is about 7% or less errors can be corrected.
2. Level M is about 15% or less errors can be corrected.
3. Level Q is about 25% or less errors can be corrected.
4. Level H is about 30% or less errors can be corrected.

B. Thresholding

There are many thresholding methods. In this paper we use algorithm to adjust brightness as follow.

Let (Dark/Bright image) = (A personal image) * a.

If (overlapped QR Code = brighter pixel)

$$a \geq 1;$$

Else

$$0 < a < 1;$$

Whereas a is a threshold to adjust brightness of overlapped QR Code. In this paper we determine a Global Threshold by taking a reflectance value midway between the maximum reflectance and minimum reflectance in QR Code standard. Convert the QR Code to a set of dark and light pixels using the

Global Threshold. [1] We represent QR Code is painted and then adjust Global Threshold as follow.

Chanon Skawattananon is with the Department of Computer Engineering Faculty of Engineering, Chulalongkorn University Bangkok, 10330 Thailand. (e-mail: 54701702@chula.ac.th)

Mahasak Ketcham is with Department of Media Technology, King Mongkut's University of Technology Thonburi, Thailand. (e-mail: maoquee@hotmail.com)

Sartid Vongpradhip is with the Department of Computer Engineering Faculty of Engineering, Chulalongkorn University Bangkok, 10330 Thailand. (e-mail: sartid.v@chula.ac.th)

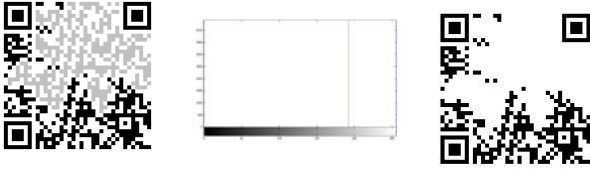


Fig. 2 Overlapped QR Code in before and after use Global Threshold

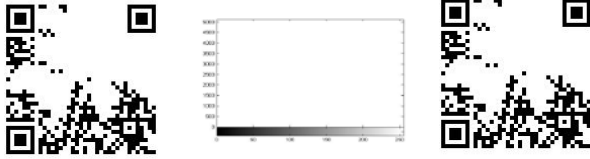


Fig. 3 Overlapped QR Code in before and after increase brightness 1.3 time

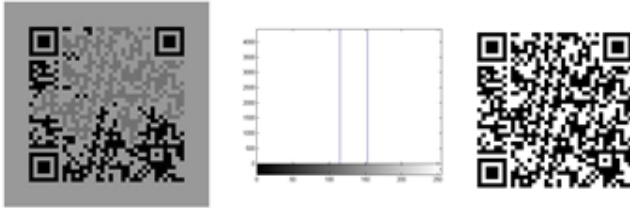


Fig. 4 Overlapped QR Code in before and after decrease brightness 0.6 time

In figure 2 show that brightness has affected to decode QR Code. When we used Global Threshold, painted QR Code produce an effect by change gray pixel turn into white pixel. In our approach, we permit overlapped QR Code similar with QR Code original by adjust brightness in Global Threshold. When overlapped QR Code was proper brightness, it can decode QR Code to get characters from it.

C. Measure quality

This paper use bit error rate to measure between original QR Code and overlapped QR Code in W_b and W_b' respectively. M_w and N_w represent size of QR Code. Symbolic \oplus refer to Exclusive-OR. The quality of overlapped QR Code alters with BER.[2] Less BER is better. The equation as follow.

$$BER = \left(\frac{1}{M_w \cdot N_w} \cdot \sum_{b=1}^{M_w \cdot N_w} (W_b \oplus W_b') \right) \cdot 100\% \quad (1)$$

III. EXPERIMENTAL RESULTS AND ANALYSIS

In Identifying QR Code we use QR Code with error correcting level L or 7% in 512 x 512 pixels and set colormap to grayscale that represent 8 bit or 256. The size of personal image is 198 x 270 pixels in RGB mode.[4] We set

brightness scale 15 levels as follow 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 (increase 10% per step) for bright in personal image and 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 and 5 (increase 5% per step) dark in personal image. The original image as follow.

Content		Detail
QR code	Data	Alphanumeric < 195 Characters
	Version	6)
	EC Level	Level L
Display Tool		Dell 5110 (15 inch)
Phone		Samsung Galaxy S Plus i9001
Editor Software		Matlab 7.9.0 (R2009b)
Reading Software		BarcodeScanner4.1
Characters to encode QR Code		Name : Mr.Chanon Skawattananon Position / Sect : Production Starting Date : 22/02/2012

Fig. 5 Description of our experimental



Fig.6 A personal image and QR Code from encode Fig. 5

The method procedure is as follow.

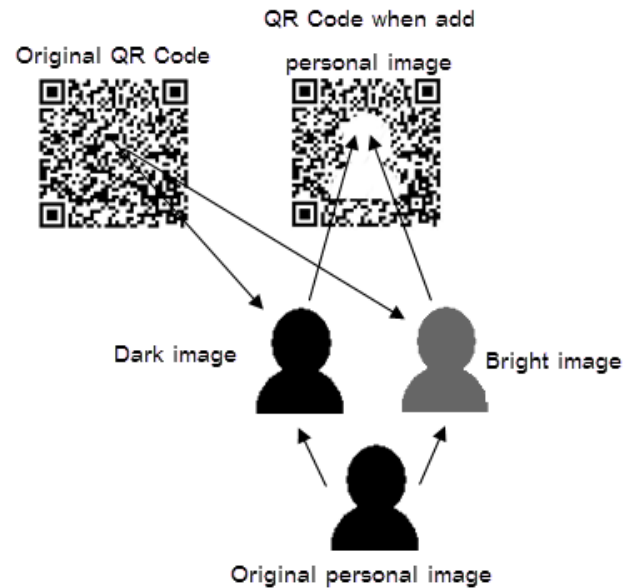


Fig. 6 The procedure replace dark and bright image in QR Code

Whole QR Code we cut some pixel to represent this method to perform comparison before and after procedure as follow.



Fig. 7 Represent 2x2 pixels in original QR Code with after procedure

Next, we represent the value of adjust bright and dark in 1-10 level as follow.

TABLE I.
THE NUMBER OF BIT ERROR RATE FROM ADJUST DARK AND BRIGHT
IN ALL LEVEL

Bright Dark	1 (10%)	2 (20%)	3 (30%)	4 (40%)	5 (50%)
1 (10%)	10.77	10.70	10.60	10.40	9.83
1.5(15%)	10.7	10.62	10.53	10.33	9.75
2(20%)	9.85	9.77	9.69	9.48	8.91
2.5(25%)	8.59	8.51	8.42	8.22	7.65
3(30%)	7.80	7.72	7.63	7.43	6.86
3.5(35%)	6.58	6.51	6.42	6.21	5.64
4(40%)	5.78	5.71	5.62	5.42	4.85
4.5(45%)	5.22	5.15	5.06	4.85	4.28
5(50%)	4.94	4.86	4.77	4.57	4

TABLE 2. (CONT.)
THE NUMBER OF BIT ERROR RATE FROM ADJUST DARK AND BRIGHT
IN ALL LEVEL

Bright Dark	6 (60%)	7 (70%)	8 (80%)	9 (90%)	10 (100%)
1 (10%)	9.00	8.34	7.95	7.65	7.32
1.5(15%)	8.93	8.26	7.87	7.57	7.24
2(20%)	8.09	7.42	7.03	6.73	6.40
2.5(25%)	6.82	6.16	5.77	5.47	5.14
3(30%)	6.03	5.37	4.98	4.68	4.35
3.5(35%)	4.82	4.15	3.76	3.46	3.13
4(40%)	4.02	3.35	2.96	2.66	2.33
4.5(45%)	3.46	2.79	2.40	2.10	1.77
5(50%)	3.17	2.51	2.12	1.82	1.49

The result from Table 4 shows when we increased brightness and increase darkness, we get less bit error rate and easier to decode QR Code correctly.

TABLE 3. (CONT.)
THE NUMBER OF BIT ERROR RATE FROM ADJUST DARK AND BRIGHT
IN ALL LEVEL

Bright Dark	11 (110%)	12 (120%)	13 (130%)	14 (140%)	15 (150%)
1 (10%)	7.02	6.83	6.71	6.63	6.63
1.5(15%)	6.95	6.75	6.64	6.55	6.48
2(20%)	6.10	5.91	5.79	5.70	5.64
2.5(25%)	4.84	4.65	4.53	4.44	4.38
3(30%)	4.05	3.86	3.74	3.66	3.59
3.5(35%)	2.84	2.64	2.53	2.44	2.37
4(40%)	2.04	1.85	1.73	1.64	1.58
4.5(45%)	1.48	1.28	1.17	1.08	1.01
5(50%)	1.19	1.00	0.88	0.80	0.73

Bit Error Rate

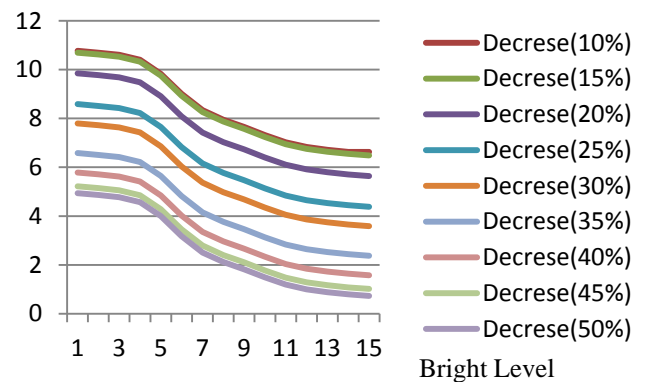


Fig. 8 The tendency of adjust bright in x axis and dark in y axis



Fig. 9 The overlapped QR Code image can decode QR Code

V. CONCLUSION AND FUTURE WORK

The best bit error rate in the Identifying QR Code with overlapped image approximately is 4.35% when increase brightness 100% and decrease brightness 30% in a personal image zone. Similarly with bit error rate is 1% when add brightness 40% and add 40% in brightness zone

References

- [1] ISO/IEC 18004:2000(E), "Information technology Automatic identification and data capture techniques Bar code symbology QR Code", 2000.
- [2] Xiong Zou,Guo-dong Liu,Jian-min Wang."Study on the Sequence of step in the QR code Image eprocessing"
- [3] QR Code Barcode Generator,
<http://www.racoindustries.com/barcodegenerator/2d/qr-code.aspx>
- [4] Damri SAMRETWIT, Toshihiko WAKAHARA "Measurement of Reading Characteristics of Multiplexed Image in QR Code"