淺談 QR Code

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QR Code 的起源與架構

什麼是QR Code？

- 於1994年由日本 DENSO WAVE 公司發明
- 研發負責人：原昌宏
- QR 來自英文「Quick Response」的縮寫
  - 原本是用來記錄工廠生產線資訊的一種二維條碼
  - 在2000 年獲得ISO 國際標準採用
    - ISO/IEC 18004:2006

DENSO

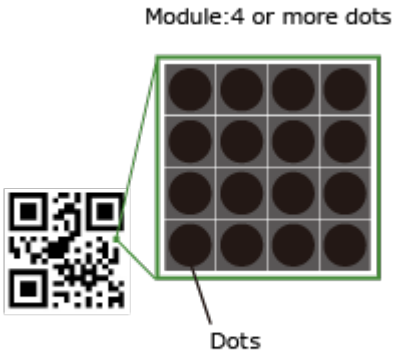
原昌宏

QR Code 基本架構

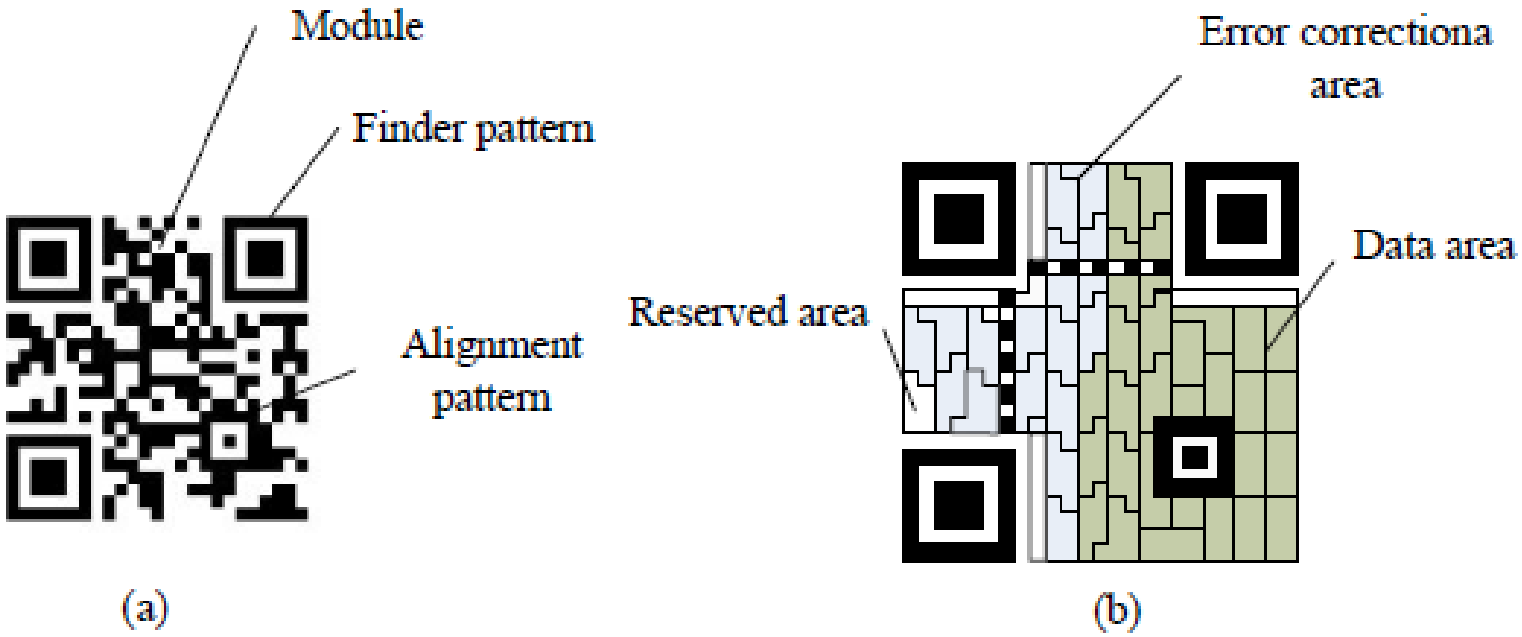
- 定位圖案(position detection patterns)
  - 目地是快速在影像中找到 QR Code 的位置

QR Code 基本架構

- 碼元(module)
  - QR Code中最小的基本單位，黑色表示 1，白色表示 0

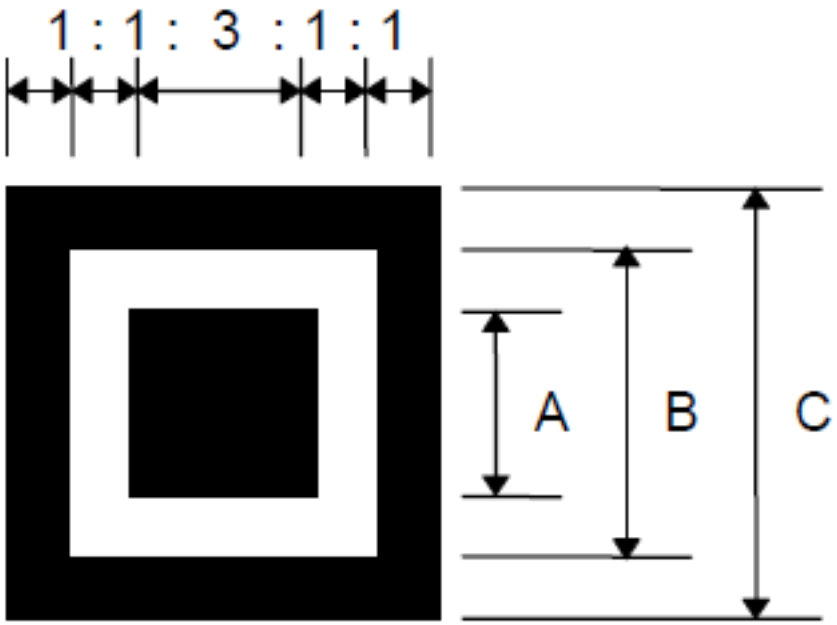


QR Code 基本架構



Chang et al., ISMW '07, 2007

Structure of finder pattern

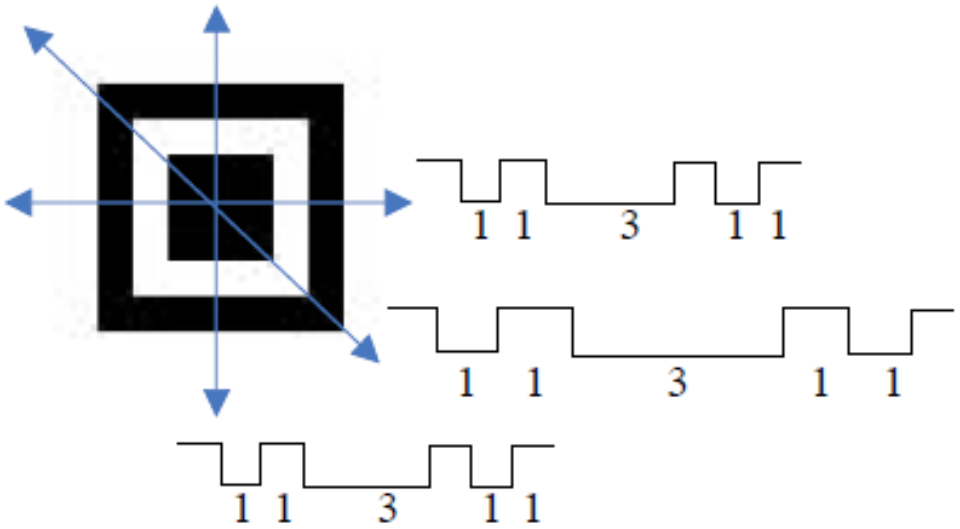


A: 3 modules

B: 5 modules

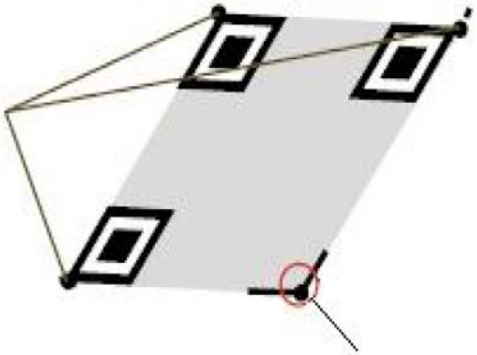
C: 7 modules

即使拍照時沒對正也能找到

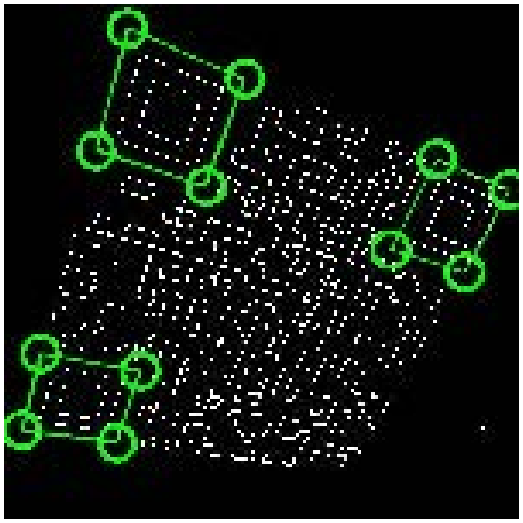


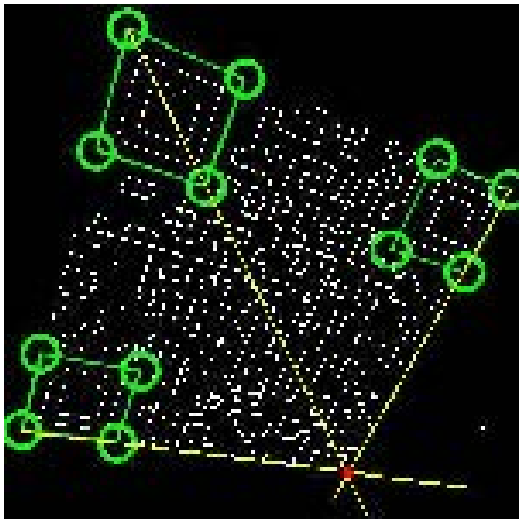
Sun et al., ICCSA 2007

Three real existing corner points.



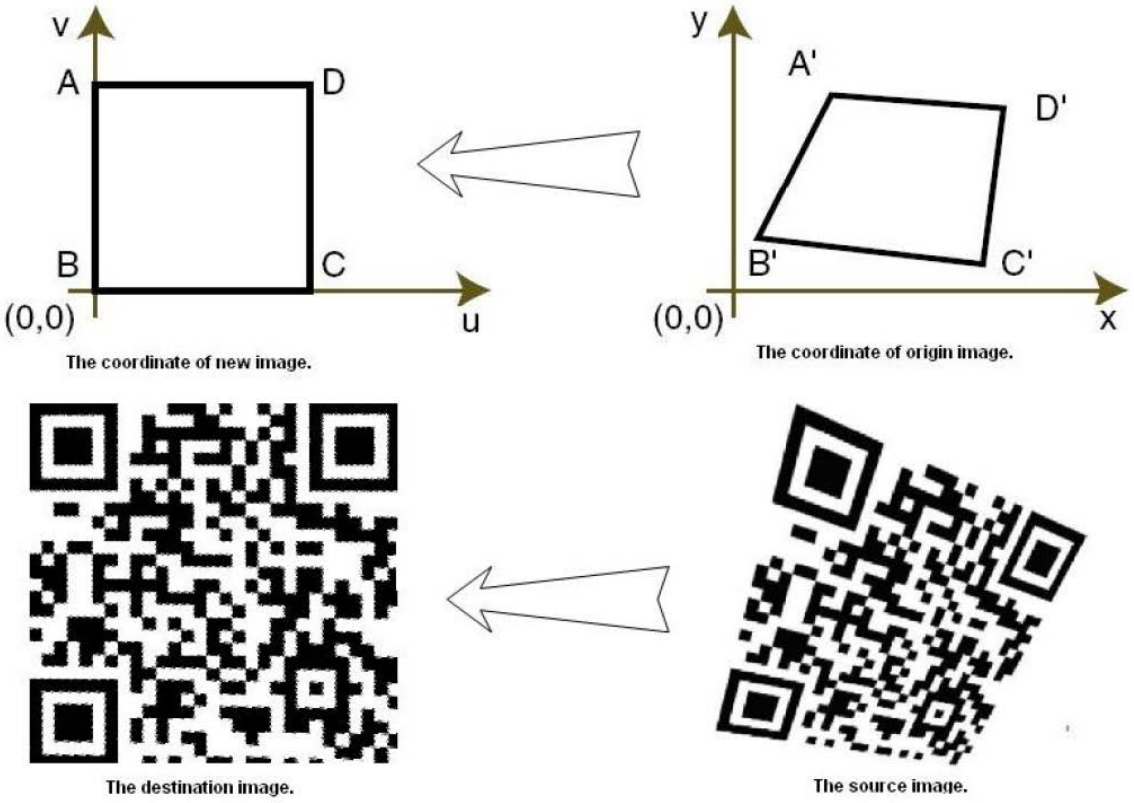
This corner point is usually a virtual one.





Sun et al., ICCSA 2007

Inverse perspective transformation



Sun et al., ICCSA 2007

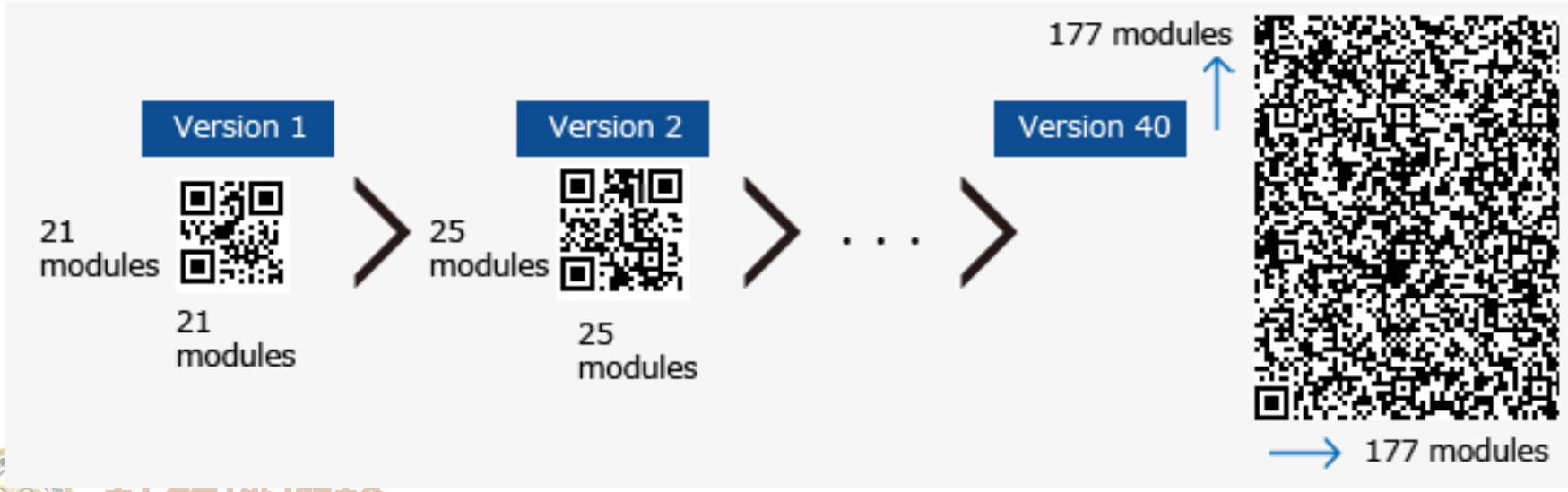
(a) (b) (c)

Chang et al., ISMW '07, 2007

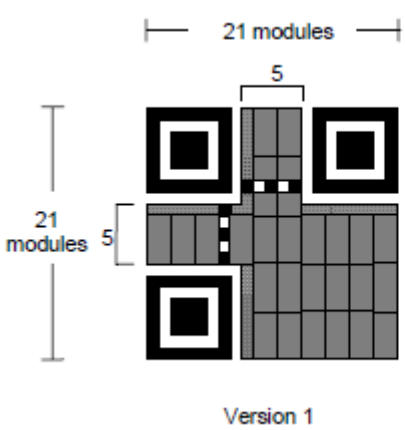
Alignment Pattern

各種不同的版本

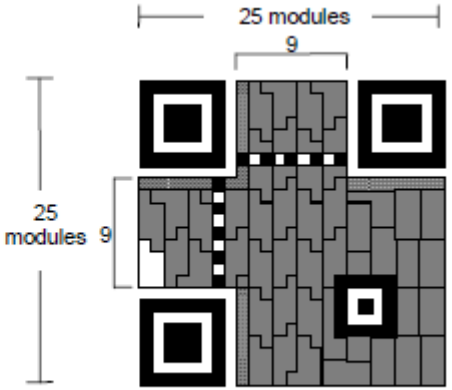
- 共 40 個 Version
  - 最小 Version 1 (21 × 21 modules)
  - 最大 Version 40 (177 × 177 modules)
  - 每1個 Version 增加 4 個 modules



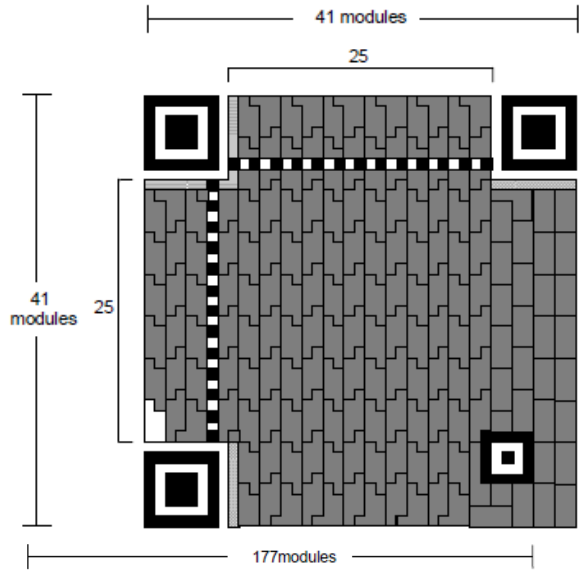
各種不同的版本

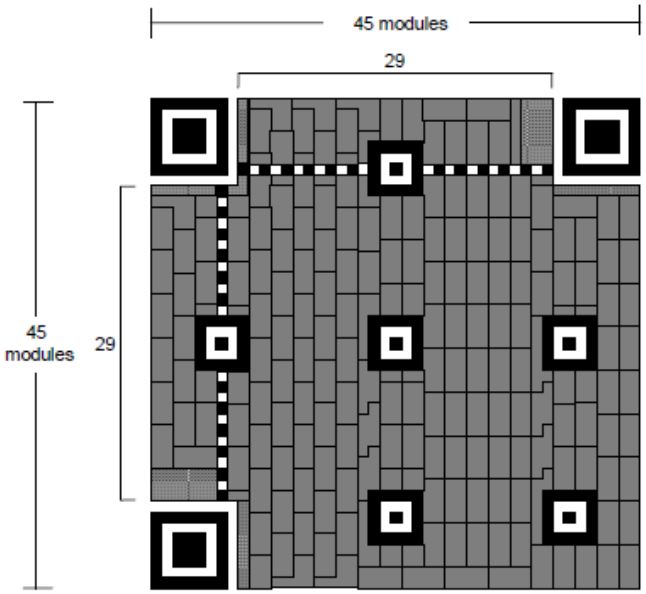


Version 1

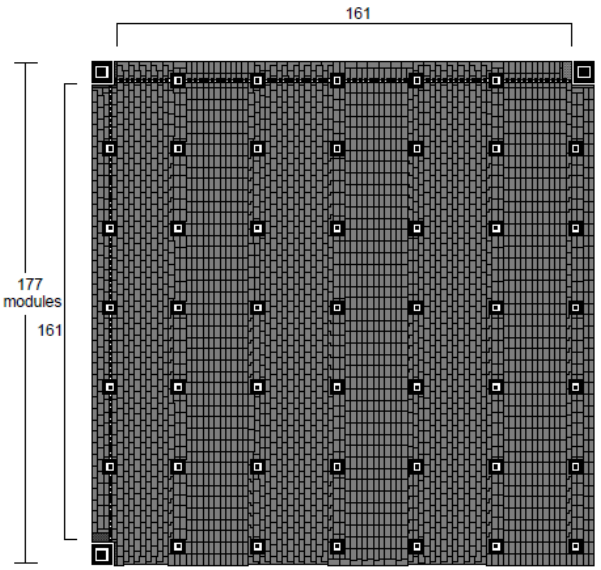


Version 2



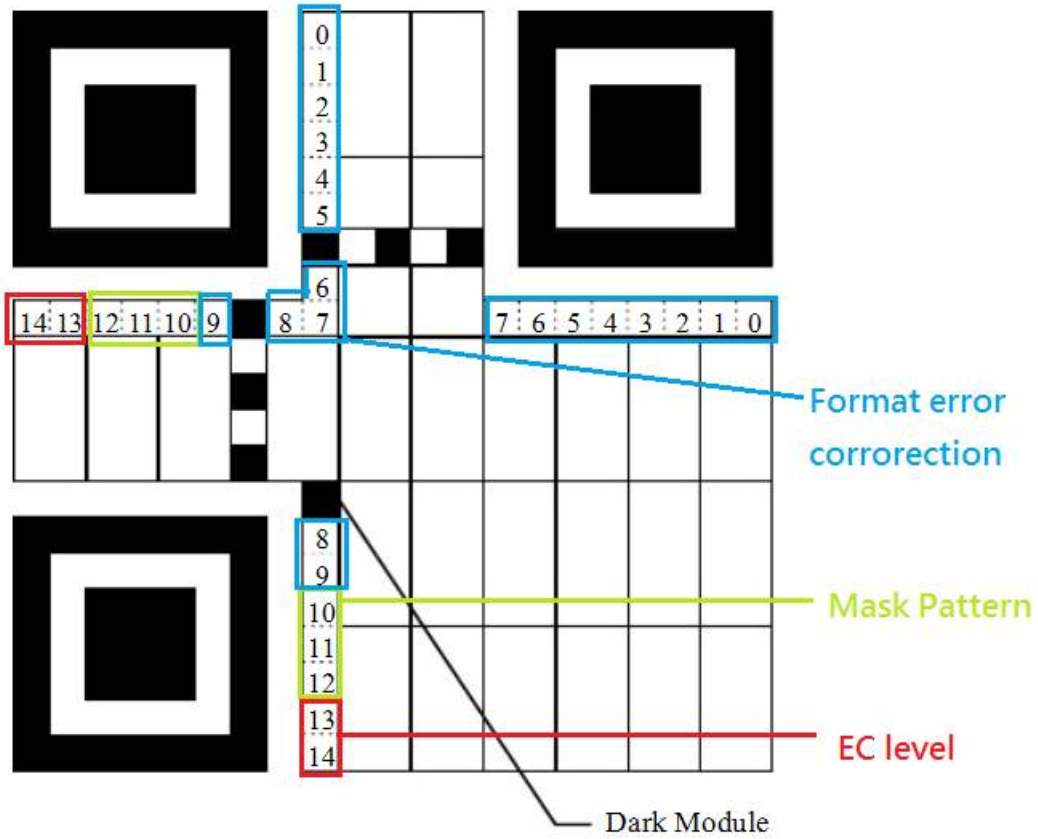


Version 7



Version 40

QR Code 資訊位置



EC LEVEL **Mask pattern** **Format error correction**

容錯等級

二進制表示	容錯等級	容錯率
01	L	7%
00	M	15%
11	Q	25%
10	H	30%

Soiled

Damaged

QR Code資料容量

資料型別	編號位元串例	可儲存容量
數字	0001	7089字元
英數字	0010	4296字元
位元組	0100	2953字元
日語漢字	1000	1817字元

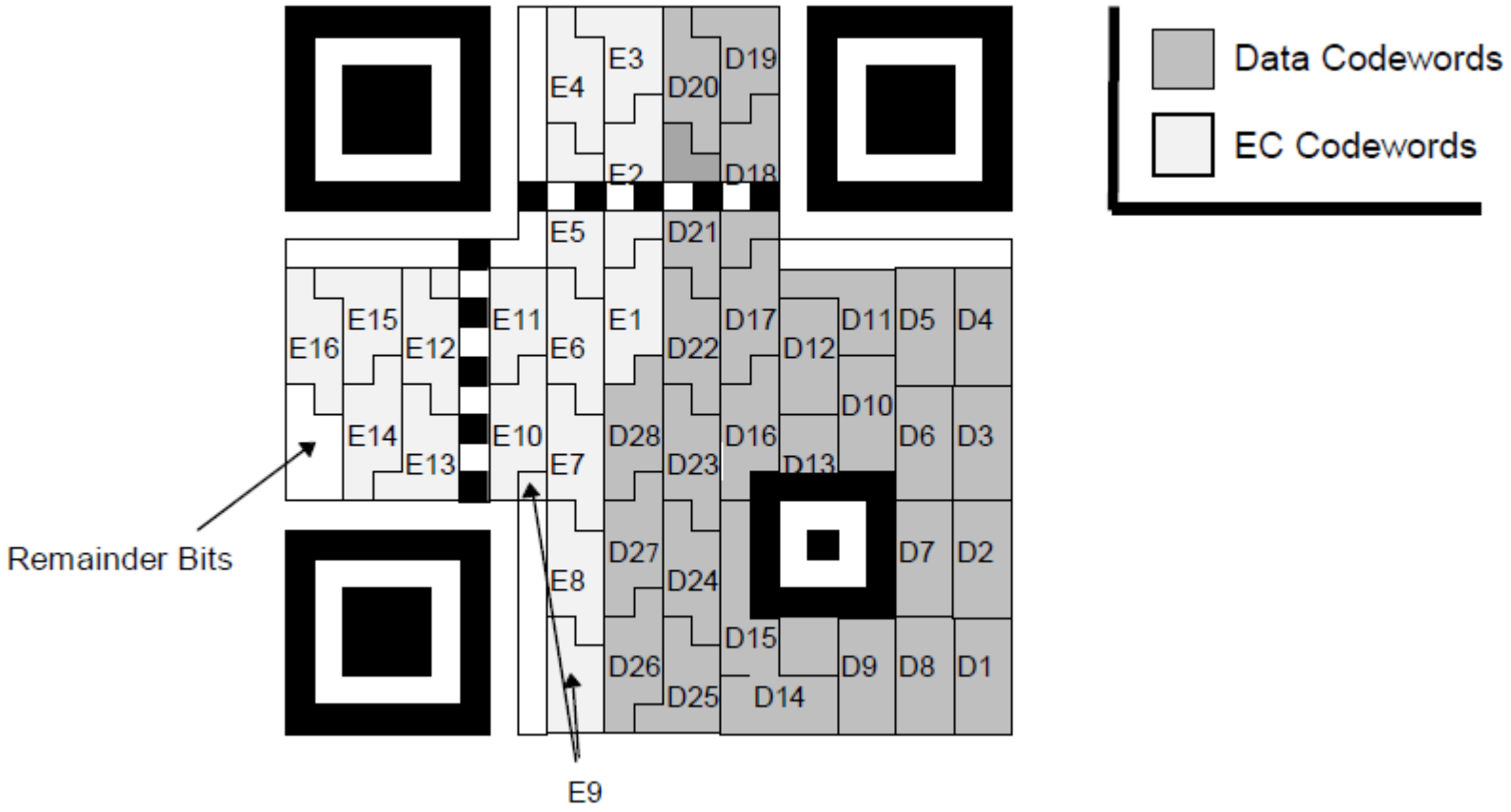
英數字

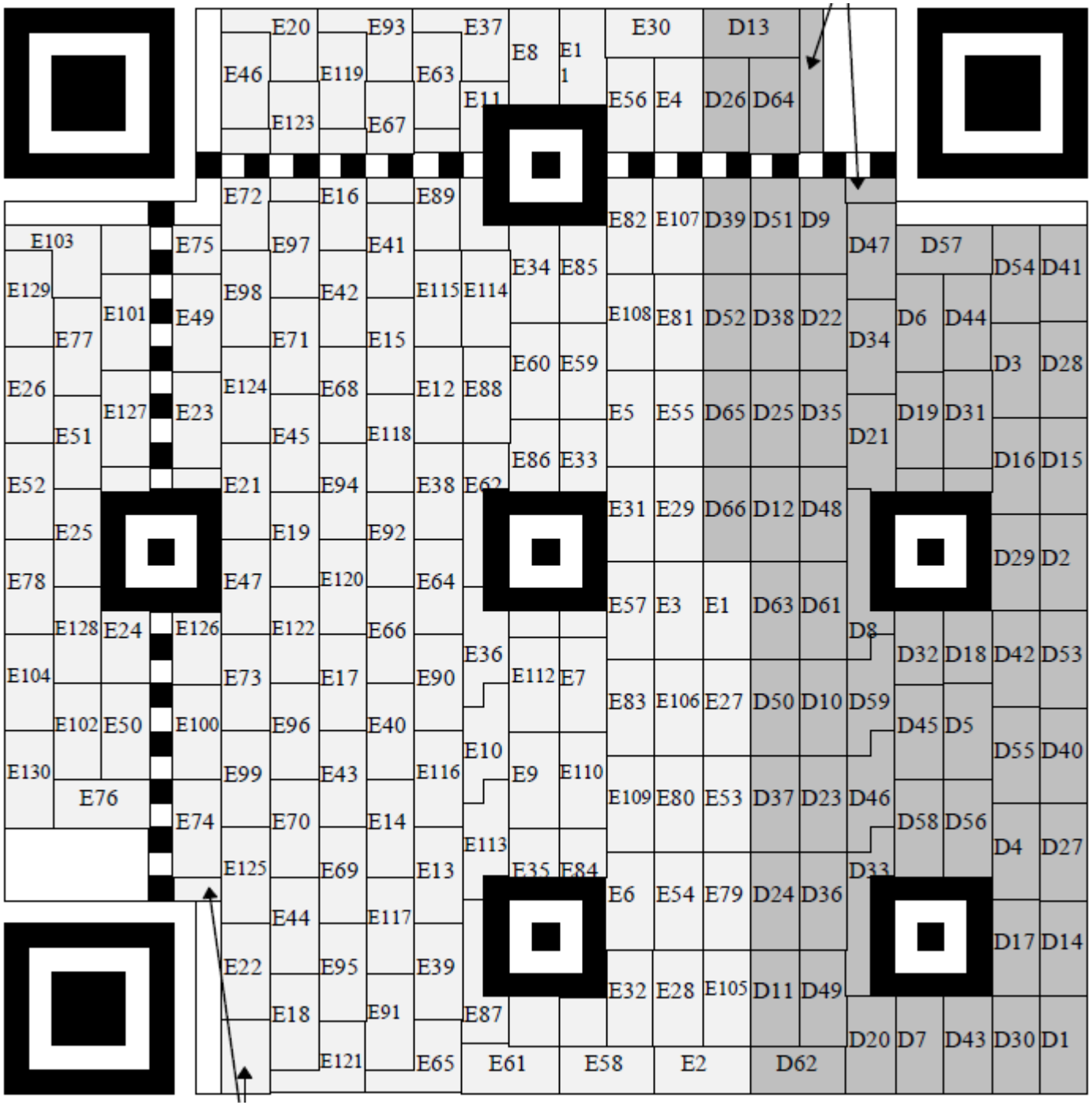
Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value	Char.	Value
0	0	6	6	C	12	I	18	O	24	U	30	SP	36	.	42
1	1	7	7	D	13	J	19	P	25	V	31	$	37	/	43
2	2	8	8	E	14	K	20	Q	26	W	32	%	38	:	44
3	3	9	9	F	15	L	21	R	27	X	33	*	39		
4	4	A	10	G	16	M	22	S	28	Y	34	+	40		
5	5	B	11	H	17	N	23	T	29	Z	35	-	41		

資料區及錯誤修正區排列

	Data codewords					Error correction codewords			
Block 1	D_1	D_2	.....	D_{11}		E_1	E_2	.....	E_{22}
Block 2	D_{12}	D_{13}	.....	D_{22}		E_{23}	E_{24}	.....	E_{44}
Block 3	D_{23}	D_{24}	.....	D_{33}	D_{34}	E_{45}	E_{46}	.....	E_{66}
Block 4	D_{35}	D_{36}	.....	D_{45}	D_{46}	E_{67}	E_{68}	.....	E_{88}

QR Code 資料區塊排列




E20 E93 E37 E8 E1 1 E30 D13
E46 E119 E63 E11 E56 E4 D26 D64
E123 E67
E72 E16 E89 E82 E107 D39 D51 D9 D47 D57
E103 E75 E97 E41 E34 E85 D54 D41
E129 E98 E42 E115 E114 E108 E81 D52 D38 D22 D6 D44
E101 E49 E77 E71 E15 E60 E59 D34 D3 D28
E26 E124 E68 E12 E88 E5 E55 D65 D25 D35 D19 D31
E127 E23 E51 E45 E118 E86 E33 D21 D16 D15
E52 E21 E94 E38 E62 E31 E29 D66 D12 D48
E25 E19 E92 D29 D2
E78 E47 E120 E64 E57 E3 E1 D63 D61
E128 E24 E126 E122 E66 D8
E104 E73 E17 E90 E36 E112 E7 D32 D18 D42 D53
E102 E50 E100 E96 E40 E83 E106 E27 D50 D10 D59 D45 D5
E130 E99 E43 E116 E10 E9 E110 D55 D40
E76 E74 E70 E14 E109 E80 E53 D37 D23 D46 D58 D56
E125 E69 E13 E113 E35 E84 D4 D27
E44 E117 E6 E54 E79 D24 D36 D33
E22 E95 E39 D17 D14
E18 E91 E32 E28 E105 D11 D49
E87
E121 E65 E61 E58 E2 D62 D20 D7 D43 D30 D1
Upwards
Downwards
0 1
2 3
4 5
6 7
6 7
4 5
2 3
0 1
2 3 4 5
0 1 6 7
0 1 2 3
4 5
6 7
CHAR. 2
CHAR. 1
Upwards
0
1 2
3 4
5 6
7
0
1
2
3
4 5
6 7

實際例子

Content: 20160329

Mode: 0001

Length: 0000001000

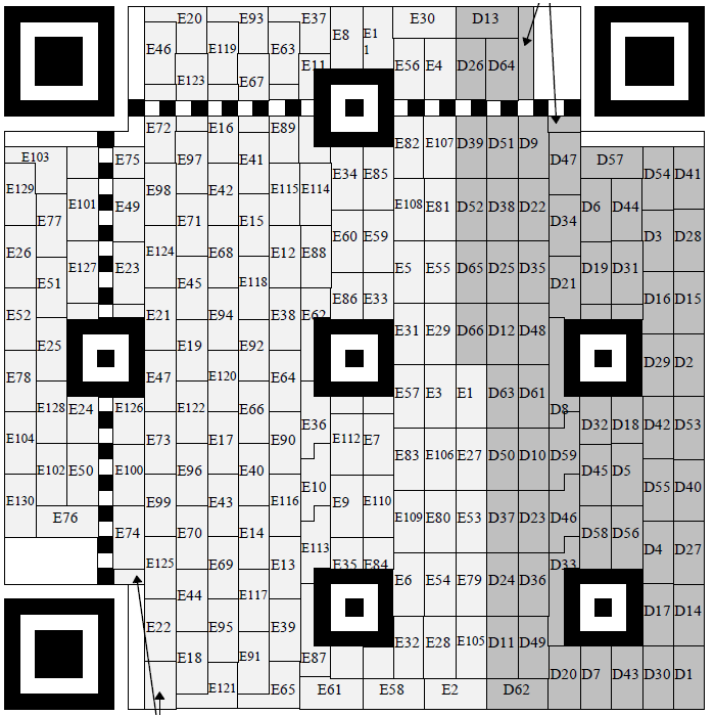
Data: 0011001001 1001011011 0011101

terminator: 0000

padding to 8 bits: 000

pad codewords: 11101100 00010001

D1=00010000
D2=00100000
D3=11001001
D4=10010110
D5=11001110
D6=10000000
D7=11101100
D8=00010001



D1=00010000

D2=00100000

D3=11001001

D4=10010110

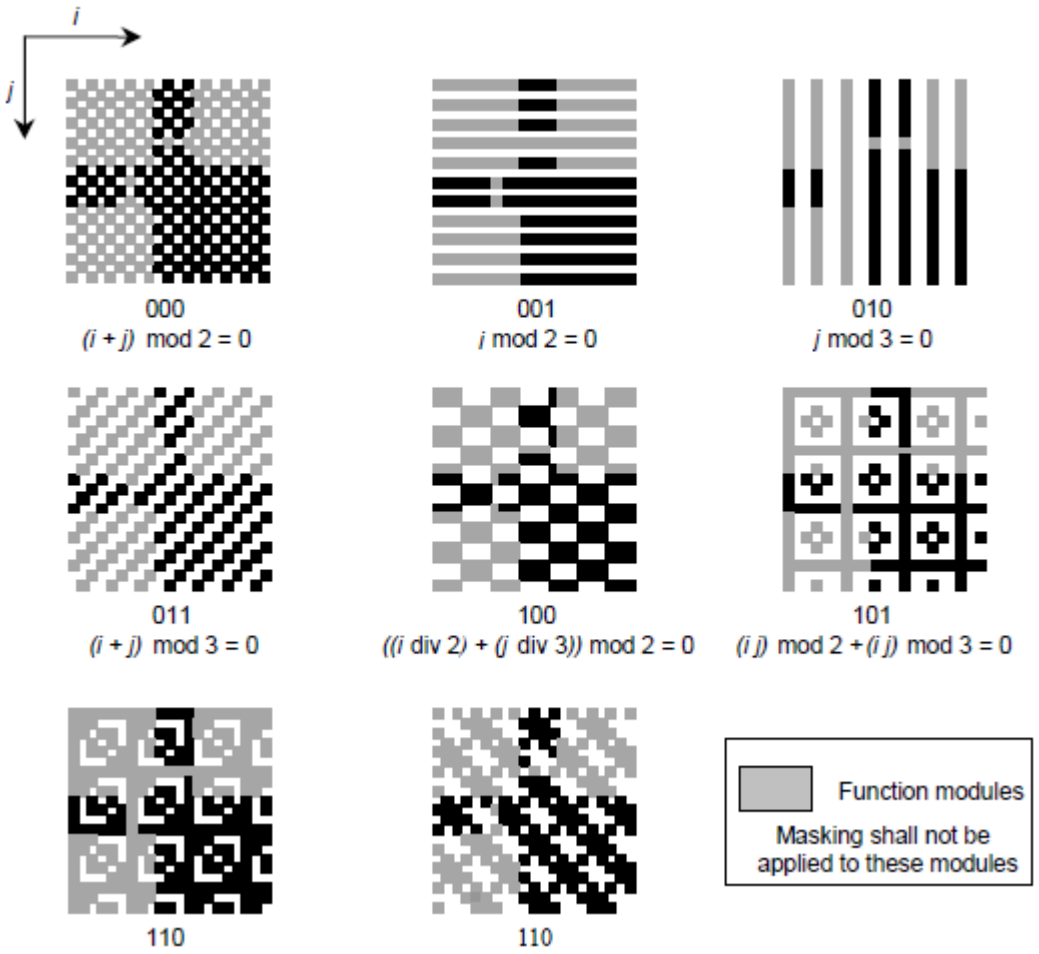
D5=11001110

D6=10000000

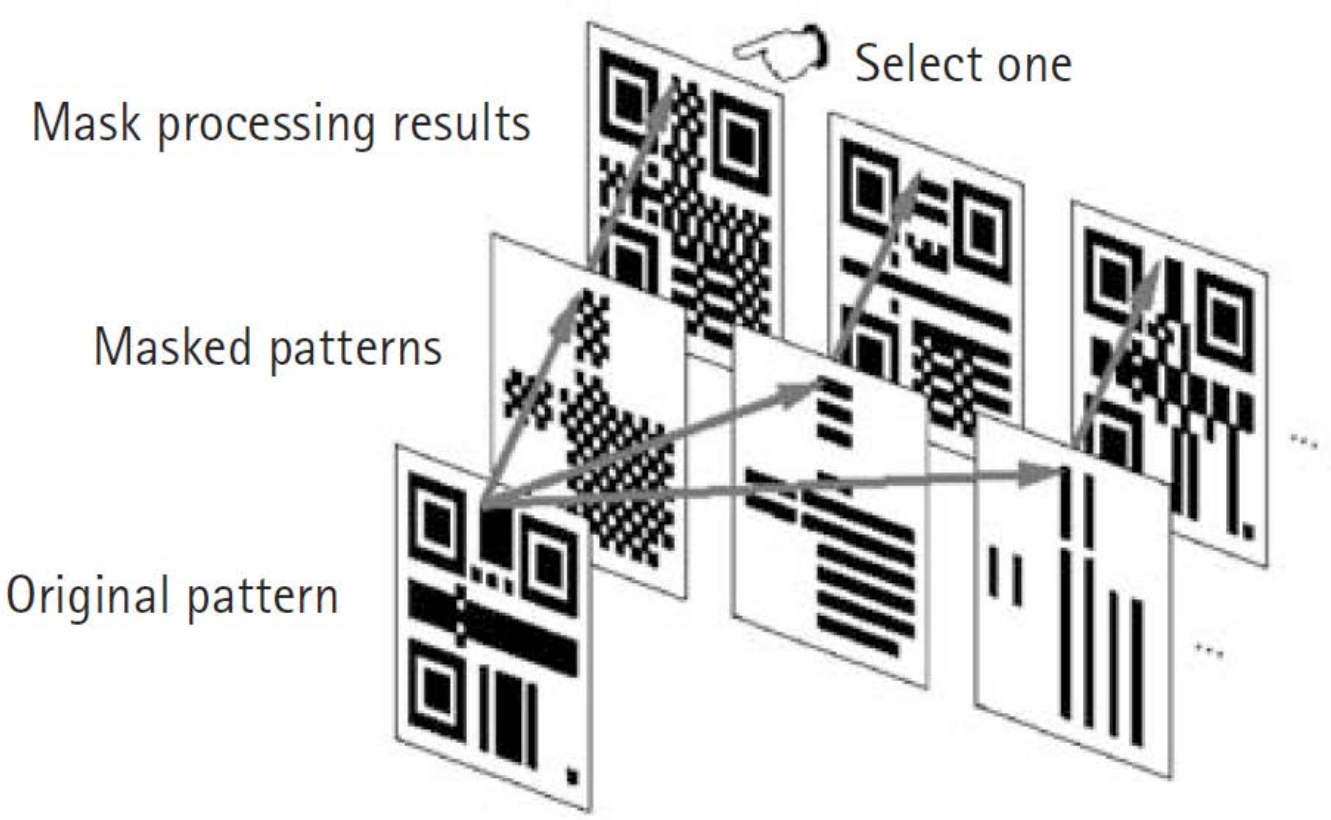
D7=11101100

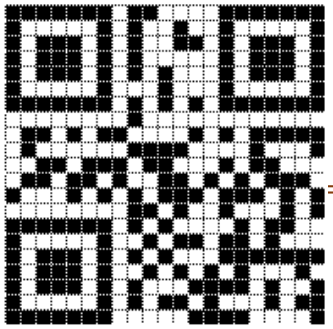
D8=00010001

Mask Pattern

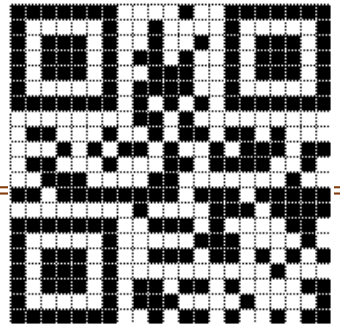


Mask Pattern

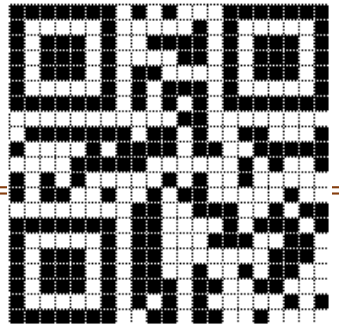




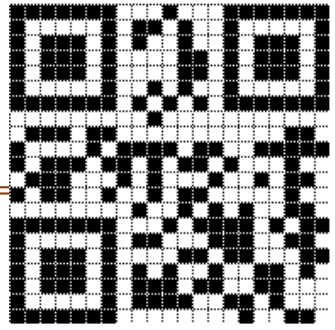
Mask Pattern 0
Penalty 1: 180
Penalty 2: 90
Penalty 3: 80
Penalty 4: 0
Total: 350



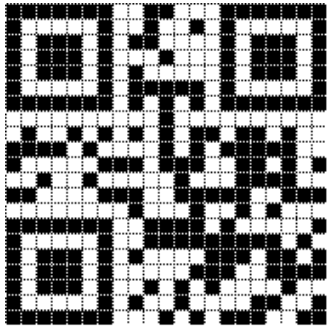
Mask Pattern 1
Penalty 1: 172
Penalty 2: 129
Penalty 3: 120
Penalty 4: 0
Total: 421



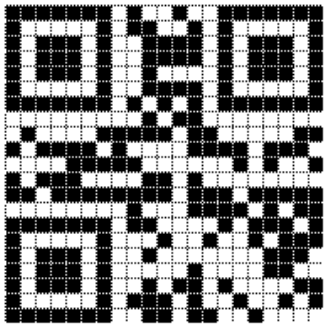
Mask Pattern 2
Penalty 1: 206
Penalty 2: 141
Penalty 3: 160
Penalty 4: 0
Total: 507



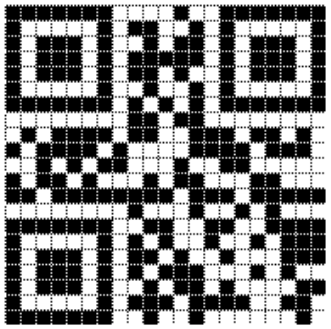
Mask Pattern 3
Penalty 1: 180
Penalty 2: 141
Penalty 3: 120
Penalty 4: 2
Total: 443



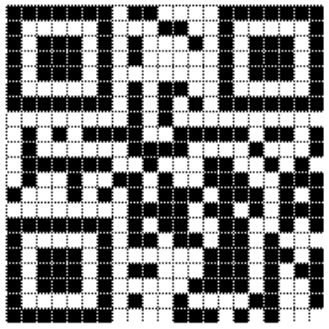
Mask Pattern 4
Penalty 1: 195
Penalty 2: 138
Penalty 3: 200
Penalty 4: 0
Total: 553



Mask Pattern 5
Penalty 1: 189
Penalty 2: 156
Penalty 3: 200
Penalty 4: 2
Total: 547



Mask Pattern 6
Penalty 1: 171
Penalty 2: 102
Penalty 3: 80
Penalty 4: 4
Total: 357



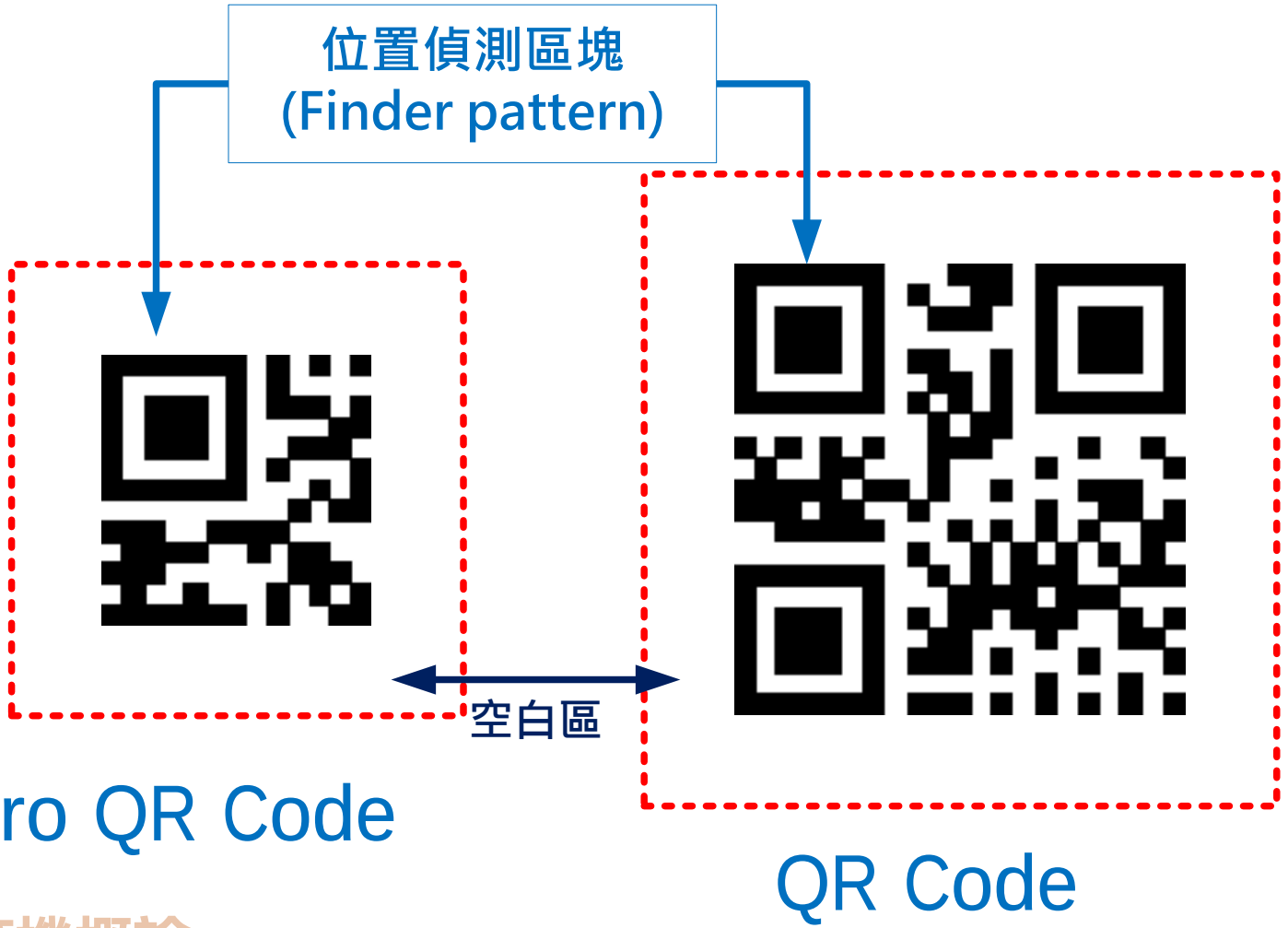
Mask Pattern 7
Penalty 1: 197
Penalty 2: 123
Penalty 3: 200
Penalty 4: 0
Total: 520

QR-Code 的發展

- Micro QR Code (1998)
- Security QR Code (2007)
- iQR Code (2008)

QR Code Model 1and Model 2	Micro QR Code	iQR Code	SQRC	Frame QR
				

Micro QR Code

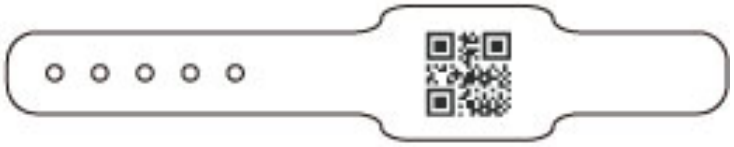


SQRC

- Security QR Code

SQRC 應用

①發出腕帶
在入院時發出一個含有SQRC的腕帶



②手術時身份核對
口頭確認困難時，做更進一步的核對

③用藥指示
防止用藥錯誤

SQRC內容編碼
編號：900177
名稱：洪阿滿
性別：女
年齡：55
血型：B
加解密部分

iQR Code

	iQR Code	QR Code（Micro QR）
Type	Square, Rectangle	Square
Version	Square : 1(9x9 Cell)～61（422x422 Cell）	QR Code：1(21x21 Cell)～40（177x177 Cell）
	Rectangle : R1(5x19 Cell)～R15(43x131 Cell)	Micro QR：M1(11x11 Cell)～M4(17x17 Cell）
Incorrection Modification	L(7%),M(15%),Q(25%),H(30%), S(50%)	L(7%),M(15%),Q(25%),H(30%)
Character	Numeric,Alphabet, Text（Mode A/B/C), Kanji,Binary	Numeric, Alphabet, Kanji, Binary
Combination	16 Division (Only Square)	16 Division (Only QR Code)
Type	Square, Rectangle	Square
Special Code	Two Sides Inversion, White Black Inversion, Dot Pattern	White Black Inversion,Dot Pattern
Others	GS1 Support , Data Compression	GS1 Support
Margin	2 Cell	4 Cell(Micro QR: 2 Cell)

iQR Code

Store **more information** with same size as current QR code

QR Code

Numeric 34 Digit

80%
Increasing

iQR Code

Numeric 63 Digit

Print **less space** with same sized information

QR Code

25×25 Cell

30%
Decreasing

iQR Code

21×21 Cell

iQR Code

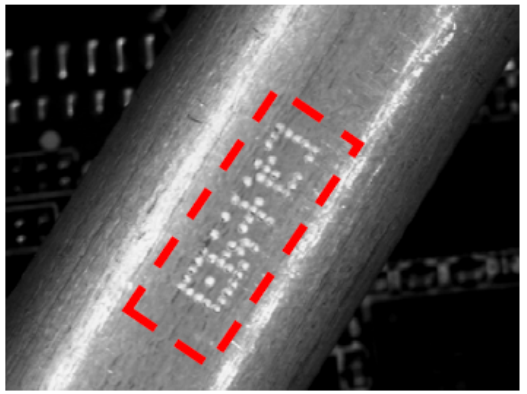
- 矩形的設計可將 iQRCode 印製在原來 barcode 的位置，或是印製在圓柱體上

<Rectangle Code>

5×19 Cell

7×29 Cell

13×35 Cell



Beautify QR Code

(a)

(b)

(c)

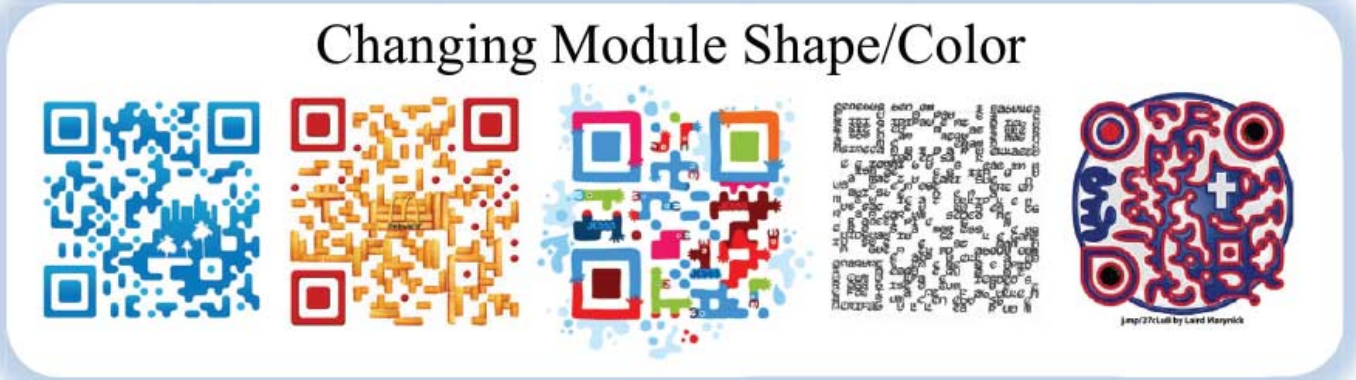
(d)

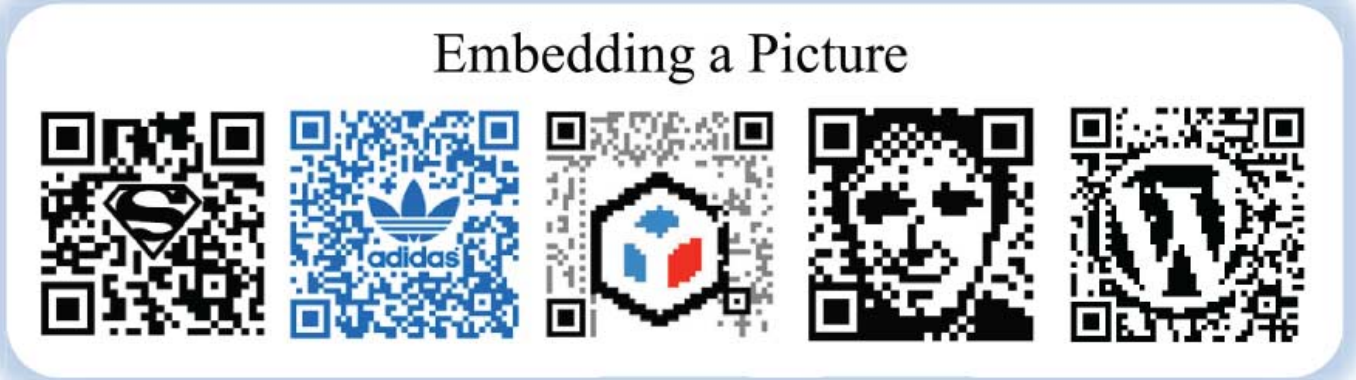
(e)

(f)

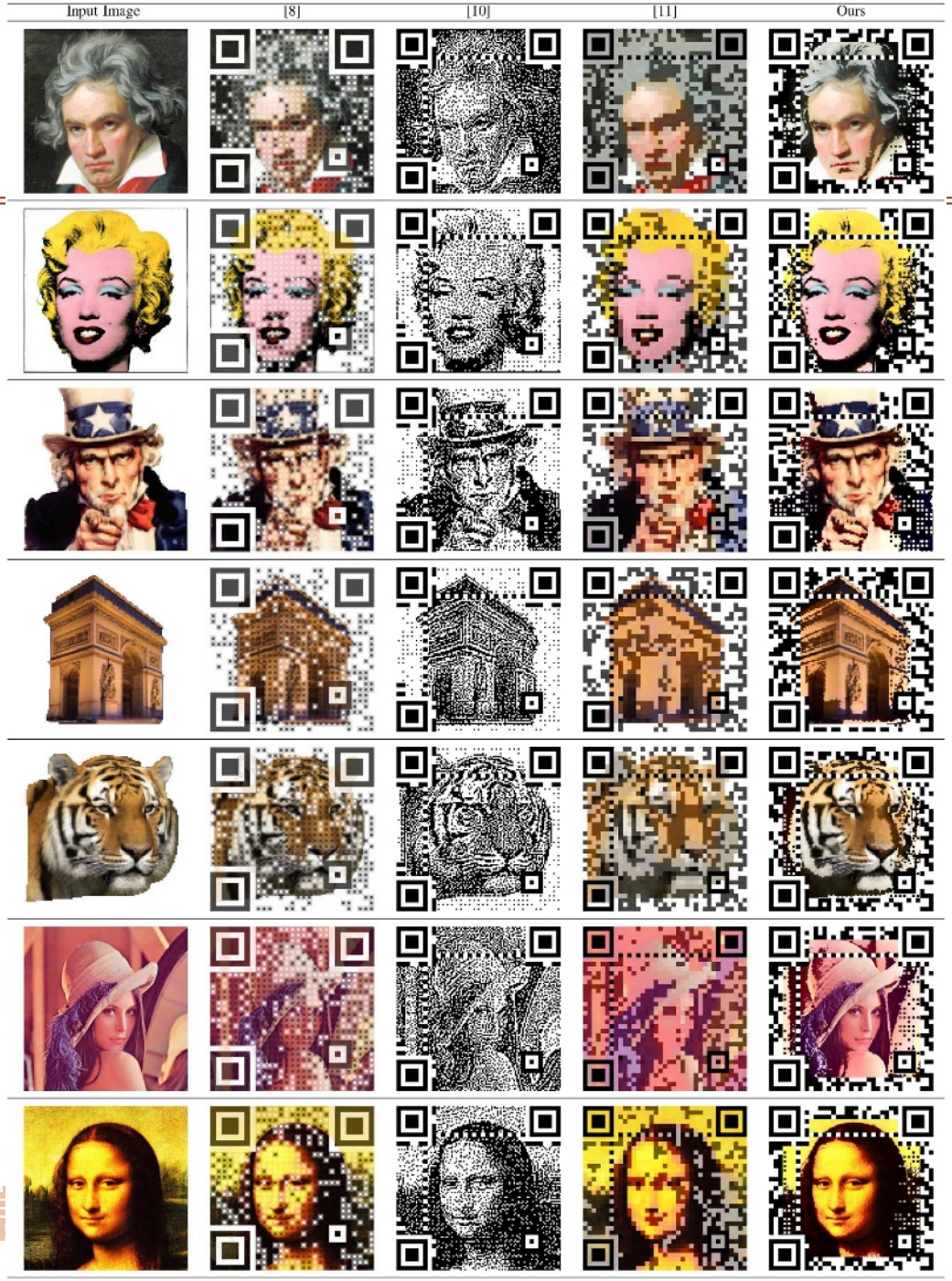
Garateguy et al., IEEE Trans. Image Process, 2014

Beautify QR Code





Lin et al., IEEE Trans. Multimedia, 2015


Input Image
[8]
[10]
[11]
Ours

作業一

作業一

- 請以QR Code 介紹一個新的軟體、新的網路服務或構想未來QR Code的前瞻性應用
- 內容如下
  1. 官方網址
  2. 軟體名稱
  3. 介紹文字 (可中文或英文) 字數不限

作業一 - 內容格式

- 將上的介紹文字內容以下面的格式製作成QR Code

[網址] http://xxxxx/
[名稱] XXXXX
[介紹] XXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXX

作業一 - 繳交方式

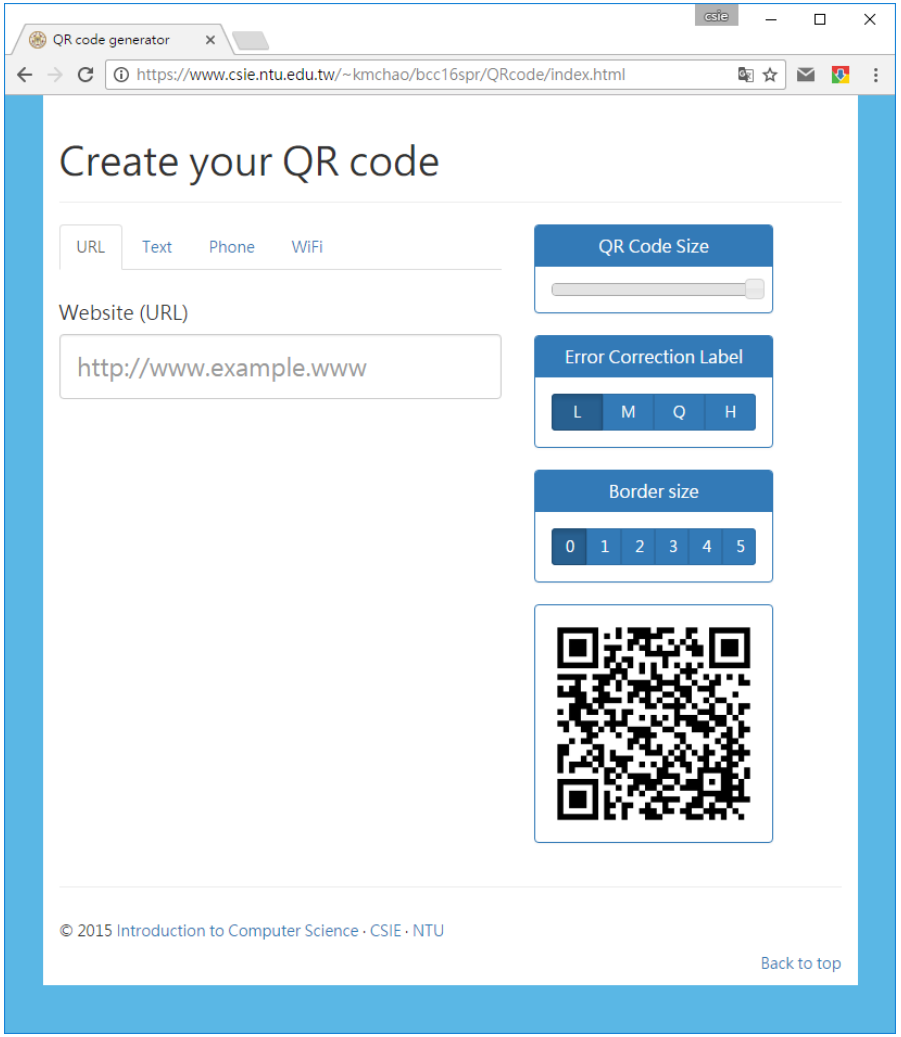
- 上傳網址：
  - http://bit.ly/2GNYNpU

作業評分方式

- 評分時會將所繳交的 QR Code 顯示在螢幕上，然後再用智慧型手機拍攝，看是否能讀的出內容。
- 分數依據：
  - 內容：所介紹的內容敍述
  - 美化：美化的可看性

QRCode Generator

- https://goo.gl/DQneUc

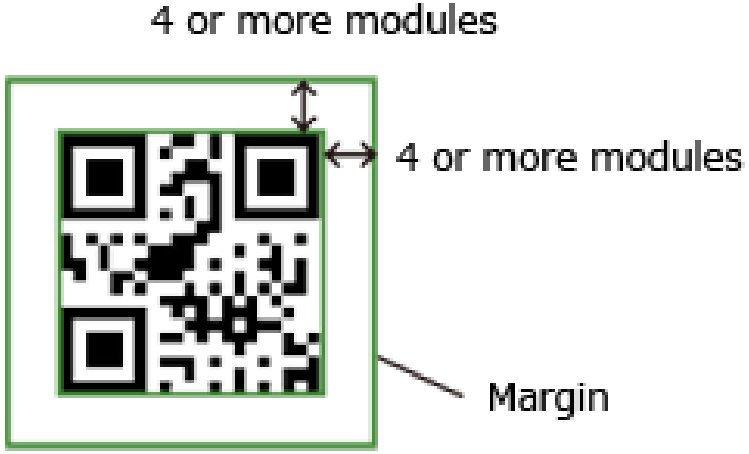


Credited by kChen

計算機概論

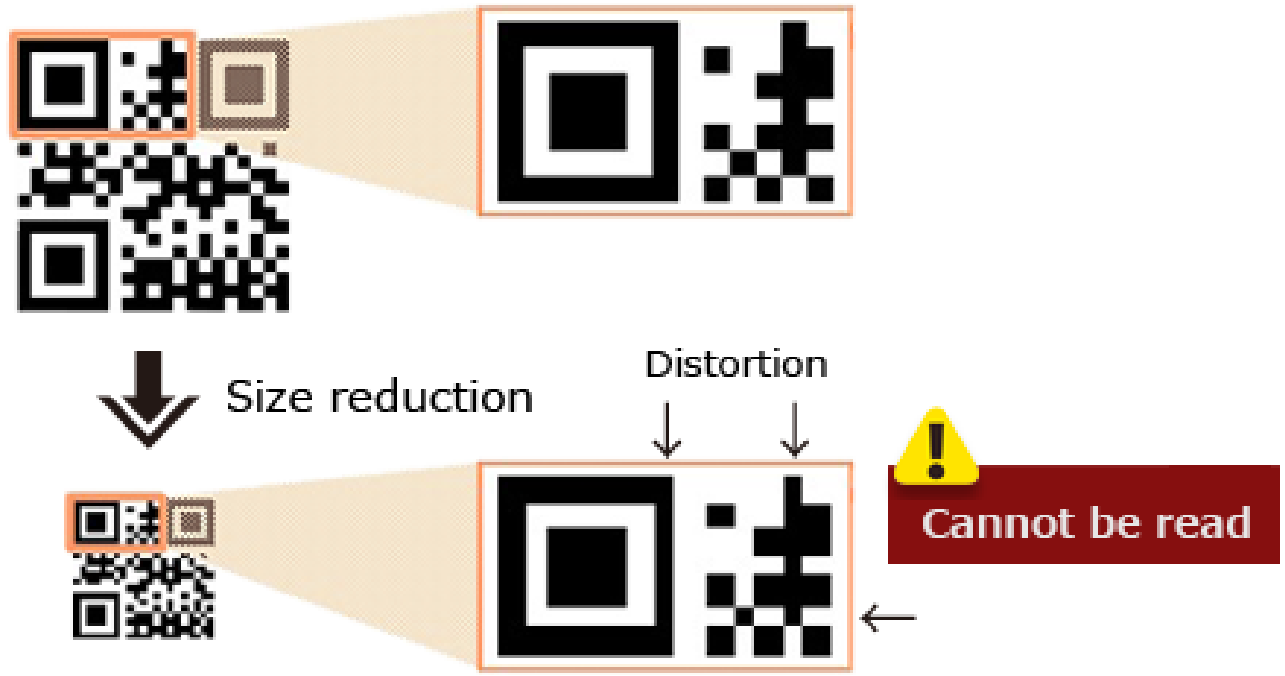
設計原則

Margin of QR Code



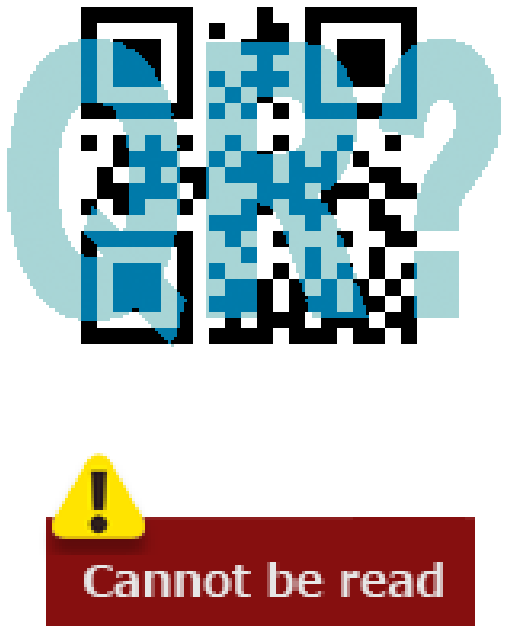
4-module wide margin is required around a symbol.

設計原則



設計原則

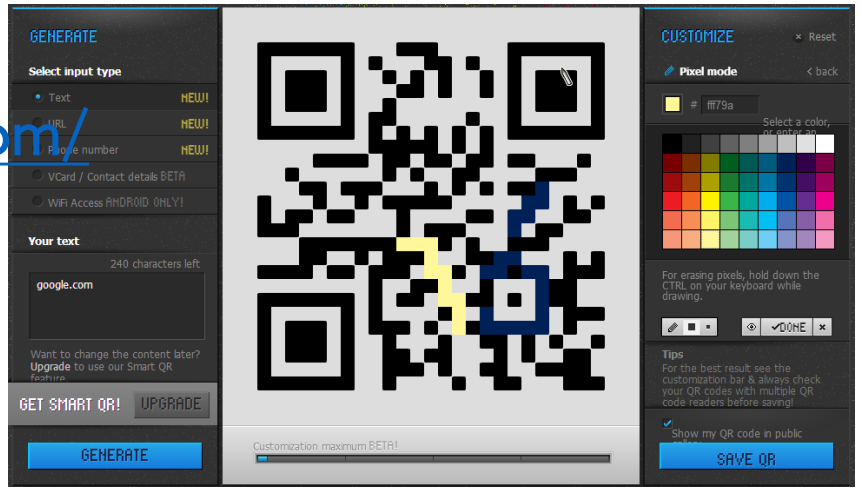
設計原則



線上製作QR-Code

- 彩色QR code產生器
  - http://color.quickmark.com.tw/

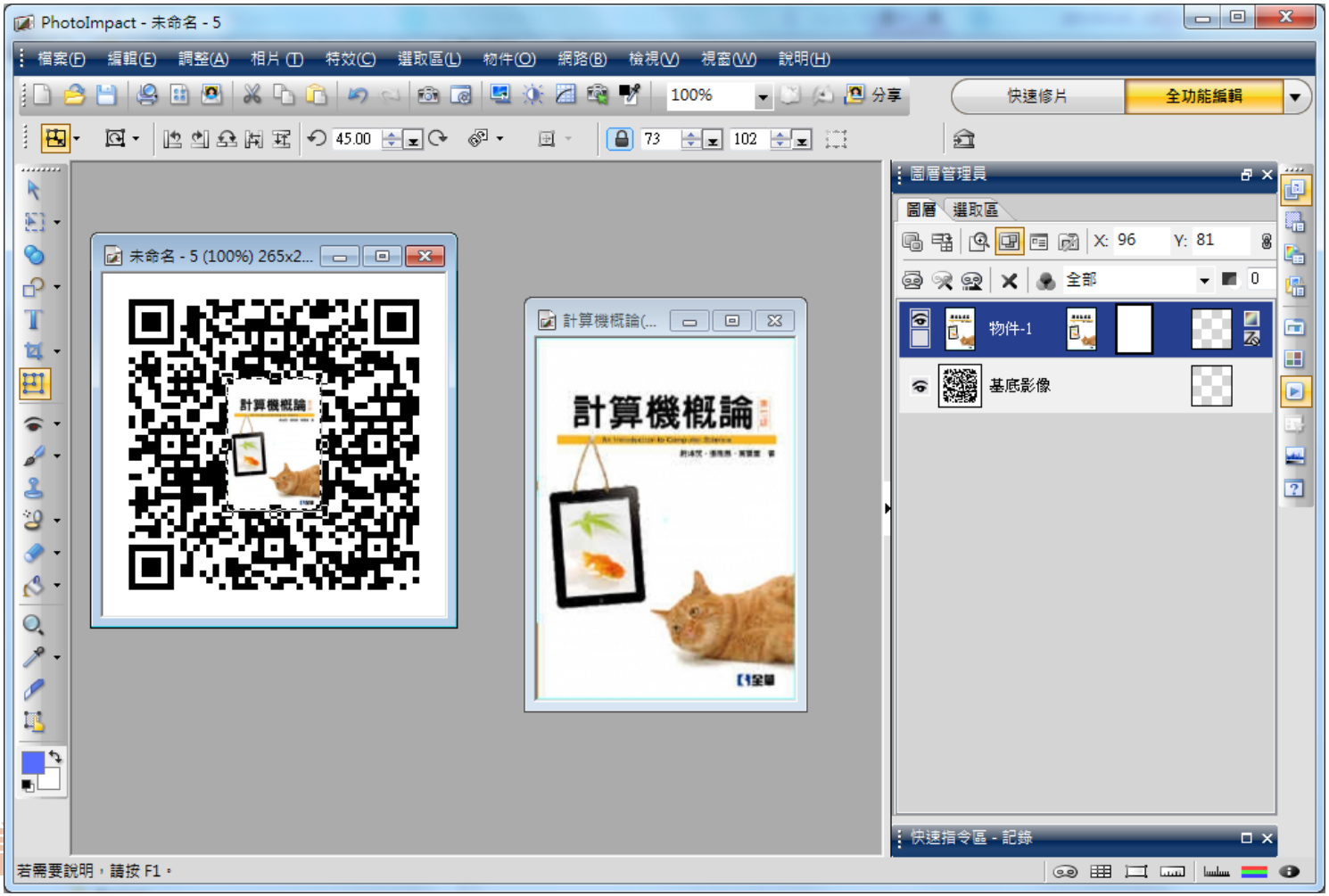
- QRHacker
  - http://www.qrhacker.com/



PhotoImpact

- http://download.cc.ntu.edu.tw

請用學校信箱登入



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