Utilizing QR Code / Micro QR Code

1. Information Volume

QR Code can represent the information volume for approx. 100 times of a linear symbol. One usage example for representing high-volume information is to use the QR Code as a high-volume data file. Specific examples of such usage are encoding the descriptions on ID cards or driving licences, or encoding the contents of delivery documents, invoices, receipts or contracts. These usages are rarely represented by numerical characters only. Addresses, names, company names, and product names would usually be described in the language of that country; English in the U.S. or U.K., French in France, Chinese in China (Chinese characters), and Japanese in Japan (Kanji characters, Katakana, and Hiragana). Naturally, internationally common usages such as passports will be described in English. However, even in internationally common usages such as in the case of a passport, it is normal to use the launguage of that country when the passport holder makes a description for the holders information. This means that the capability for supporting various languages used in each country would become very important.

Unless explicitly specified so, the following description regarding QR Codes would include the case for Micro QR Codes.

2. Information Density

The inforamtion density for QR Codes / Micro QR Codes is 10 time higher or more when compared with linear symbols. This means that if the information volume is the same, the information can be represented in an area 10 times smaller or more. Usages where linear symbols were not avilable may be able to have QR Codes / Micro QR Codes used. For example, Micro QR Codes are suitable for attaching small tags to jeweleries or contact lenses or pirinting upon small cases.

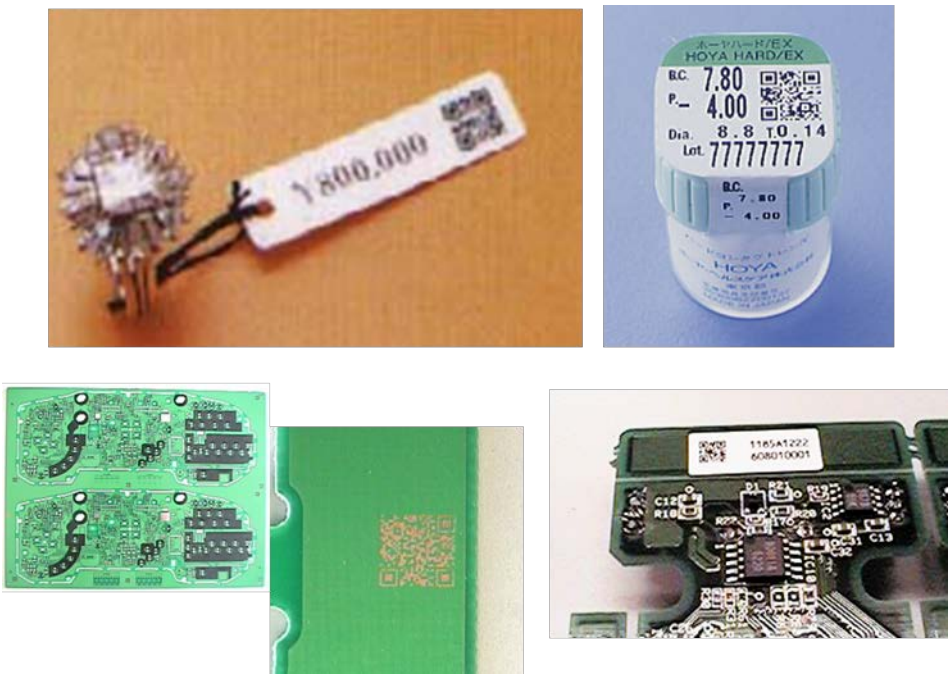

Fig. 1 Printing Requiring Less Space

3. High-speed Reading

Two-dimensional symbols are categorized into multi-row symbols and matrix symbols. Matrix symbols are more suitable for high-speed reading. This is partially due to the symbol system and partially due to the reader characteristics. Matrix symbols are normally read by readers with an area sensor (CCD) mounted. It is normal to have multi-row symbols read by operating a laser type reader (some readers may have area sensors mounted). There is no doubt that the operational speed of electrical operation is faster than the speed of manual operation. Additionally, QR Code has been developed with the special intention of being able to read the symbols at a high speed. QR Code has a unique finder pattern. Additionaly to having mounted a processing method enabling to have the target pattern rapidly searched from among the sensor view field, high-speed reading is realized by having a unique finder pattern that can be easily distinguished from other patterns existing within the sensor view field.

4. Error Correction Functionality

A functionality that is uniquely equipped for two-dimensional symbols and is not equipped for linear symbols is the error correction functionality. Two-dimensional symbols commonly utilize the error correction functionality called Reed-Solomon developed by NASA (National Aeronautics and Space Administration) as its basic technolgoy. Error correction functionality is a functionality for cases where a part of the symbol had been missing due to being smudged etc. that restores the missing data part based on the data part that had been successfully read. Two-dimensional symbols basically do not have any human-readable alphanumerical character attached as in the case for linear symbols. Therefore it is important to have this error correction functionality as a method for making recoveries for when the symbols are smudged. The error correction ratio allowed for each two-dimensional symbol type is different, but it is not recommneded to focus on the error correction ratio when selecting the symbol type. By having higher error correction ratio, the data volume available will become less in exchange, so we cannot simply say that having higher error correction ratio is the best solution for all cases. Error correction ratio should be set according to the conditions of that specific usage environment. QR Code has 4 different types of error correction ratio, so the user can select the appropriate error correction ratio according to the users' usage enviornment.

5. Missing Finder Pattern

Although it had been suggested together during the course of establishing international standards for two-dimensional symbols (ISO/IEC JTC1 SC31) to specify the finder pattern missing ratio, the suggestion had not been adopted. The reason is that since finder patterns for two-dimensional symbols are characteristic according to each symbol type, simply having the missing ratio specified against the total finder pattern area would make larger symbols superior and differentiated as a result, which is not a good idea. However, missing parts of the stored data can be restored by using the error correction functionality, but the missing finder patterns cannot be restored. If there is any missing part in the finder pattern, that will significantly impact the reading speed. QR Code has 3 different finder patterns, so even if 2 finder patterns are missing, the QR Code will still be readable.

6. Encryption

Two-dimensional symbols can be easily encrypted to have their security level improved when compared with linear symbols. This is due to being able to represent many types of information.

7. QR Code Implementation Procedure

QR Code implementation procedure is mainly made in the order of; determining the data to be stored, determining the printing area, determining the QR Code version, determinig the QR Code cell size, determining the equipment to be used, and creating the application software. The procedure is illustrated in Fig. 2.

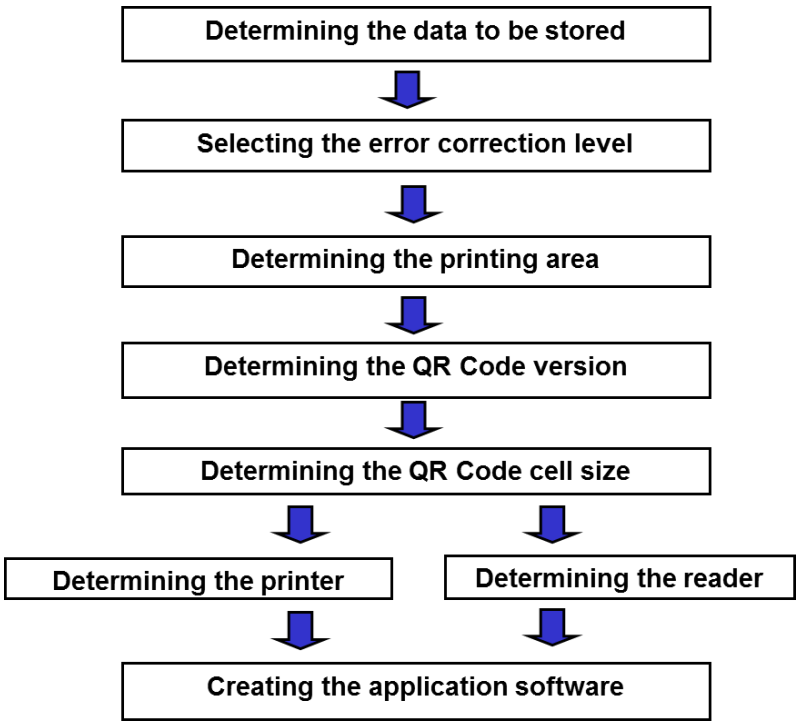

Fig. 2 QR Code Implementation Procedures

7-1. Determining the Data to be Stored

In this stage, you will be determing the data volume and the character code to be used for the necessary data. The data amount will be different according to the database management method of the application system. For a database-concentrated system, only the minimum necessary number of digits for the identification will be required. For a database-disbributed system, if there are several sections (locations) using QR Codes, each section would need to have the entire dataset for the necessary data. In general, no site using QR Codes would be accessing to the database via the network every time the QR Code is being read. The entire dataset necessary for the work at the site using the QR Code needs to be stored into the QR Code. If the character type to be used is alphanumerical characters, then the character code ISO/IEC 646 is to be used. When using any other launguage than alphanumerical characters, then the character code ISO/IEC 10646 is to be used. You will have to confirm in cases where specially specified character codes (such as those for Japanese or Chinese) are to be used.

7-2. Determining the Error Correction Ratio

QR Code has a functionality for restoring the data to a readable level even if the label is smudged or damaged. There are 4 error correction levels (level L, level M, level Q, and level H). The error correction level needs to be determined according to the users' usage environment. For general purposes, it is recommended to select level M.

7-3. Determining the Printing Area

In this stage, you will have to determine the printing space upon the user component or product where the QR Code is to be printed. Small components or products may not have enough printing space. When there is limited printing space only, you may have to either reduce the data volume or reduce the cell size as described later. It is recommended to print the code onto a flat area, but if you have to print upon a curved surface, make sure to sufficiently confirm the printing sample. If targeted reading is available for a small QR Code, you will be able to get better reading results by reducing the quiet zone rather than reducing the cell size.

7-4. Determining the Version

QR Code versions are configured from version 1 to 40. Each version has the number of cells predefined. Version level is incremented by adding 4 cells on each side where version 1 is set to 21x21 cells, version 2 to 25x25 cells, and version 40 to 177x177 cells. The user will have to determine the most appropriate version according to the data's number of digits, character type, and the error correction level.

7-5. Determining the Cell Size

Even if you may have selected the same QR Code version, the symbol size will be different depending on the cell size. The symbol size would become different depending on the printing size (mm) of the cell (the minimum unit composing the QR Code, and is equivalent to a single bit for information processing). The larger the cell size, the better the reader reading results are. On the other hand, this will mean that the symbol size is preferred to be larger, which therefore requires larger printing area. It is recommended to print as large symbol as possible within the range of the printing area allowed. The recommended cell size for general purposes is 0.25mm or larger.

7-6. Determining the Printer / Reader

The resolution of the printer and the reader needs to be superior to the cell size. The recommended resolution of a laser printer is 600dpi (Dot Per Inch) or more, and for a thermal transfer printer is 300dpi or more. Printers are categorized into a type where the data is submitted from the PC to the printer in bitmap and a type where the data is submitted in character codes. Those printers which has the data sent in character codes have QR Code generation software installed within the printer. There are various QR Code generation software in the market, but it is recommended to use printers with genuine QR Code generation software installed. Readers have the minimum resolution specified; it is necessary to set the QR Code cell size sufficiently larger than the reader's minimum resolution.

7-7. Creating the Application Software

For applications using QR Code, no QR Code generation software will be necessary if you use a printer with a QR Code generation software installed and a QR Code reader. However, when you plan to use a printer model with no QR Code generation software installed or when you plan to transfer the QR Code image via the network, you will have to install the QR Code generation software into the application software. There are 2 types of QR Code generation softwares; Qrdraw AD and Qrmaker AD.

7-7-1. Qrdraw AD

Qrdraw AD is a software that can easily generate QR Codes, Micro QR Codes, and various linear symbols or two-dimensional symbols using the PC. Qrdraw AD is a program for creating symbols by drawing them, and it supports OLE compound documents / automation server functionality. Its execution enviornment is as listed below.

OS: Windows2000 Professional, Windows XP Professional/Home Edition, Windows Vista
CPU: Celeron 800MHz or more
Memory: 128MB or more
Disk space: 10MB or more required

7-7-2. Qrmaker AD

Qrmaker AD is a software that can generate QR Codes, Micro QR Codes, and various linear symbols and two-dimensional symbols using the PC. Qrmaker AD is an ActiveX control (OCX program), and is also called as OLE control. When the character string to be stored into the symbol and the cell size are specified, the image (in metafile format) will be generated and will be returned to the application program. Its execution environment is as listed below.

OS: Windows2000 Professional, Windows XP Professional/Home Edition, Windows Vista
CPU: Intel Pentium1GHz or more
Memory: 64MB or more for Windows2000 Pro, 128MB or more for Windows XP
Disk space: 3MB or more required