

**QUICK RESPONSE CODE WITH SUPPLEMENTARY DATA
WRITTEN THEREIN AND METHOD FOR READING INFORMATION
CONTAINED IN THE SAME**

5 1. Field of the Invention

The present invention relates to two-dimensional (2D) codes and a method for reading information therefrom, more particularly, to quick response (QR) codes with supplementary data written therein and a method for reading information contained in the QR codes.

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2. Description of the Related Art

To be more specific, 2D codes here are referred to quick response (QR) codes. With reference to Fig. 7, each conventional QR code includes three position detection patterns 71-73, at least one alignment pattern 74, two timing patterns 75, a data area 76, format information, and version information in a square area. The three position detection patterns 71-73 are located on three corners of the square area. Each position detection pattern 71-73 takes the form of a square bull's eye with alternating black and white lines for identifying a square area and recognizing orientations of the square area. The two timing patterns 75 are stripe-shaped and are respectively located between opposite two of the position detection patterns in the horizontal direction 71, 73 and opposite two of the position detection patterns in the vertical direction 71, 72 for the purpose of positioning.

The data area contains data and error correction keys. The availability of the

error correction keys means that QR code has error correction capability to restore data when the code gets dirty or damaged. There are four error correction levels L, M, Q and H corresponding to 7%, 15%, 25% and 30% of missing or obscured codewords that can be restored.

5 The applications of QR codes are widespread in many areas, such as electronic ticketing or information linking. Given information linking as an example, when users use smart phones with camera to scan QR codes, decoding procedures built in the mobile phones decode the QR codes to acquire corresponding information. Suppose that the decoded information indicates a
10 website address. After acquiring the website address, users can enter the website by directly connecting to the website address.

 Despite increasing and extensive applications of QR codes, QR codes can only provide fixed and unchangeable information after being generated because QR codes are done by writing information for just once. In other words,
15 conventional QR codes are only readable but not writable after being generated. As a result, information storage capacity and application flexibility of the conventional QR codes are thus limited.

 An objective of the present invention is to provide a quick response code with supplementary data written therein and a method for reading information
20 contained in the QR code, allowing supplementary data to be written in the QR code after original data are written in the QR code, so as to expand information capacity and application scope of QR codes.

 To achieve the foregoing objective, the QR code with supplementary data written therein includes multiple position detection patterns and a data area.

Each position detection pattern has a no-data area serving as a data-write area for supplementary data to be written in the data-write area.

The data area serves for original data to be written therein.

The QR code utilizes the no-data area of each position detection pattern as
5 the data-write area for users to add new information to the QR code after the
original data are written in the QR code. The benefits of the QR code resides in
higher information capacity and application flexibility of the QR code. For
example, if the original data written in the QR code is a website address
“www.***.com”, users can access to a directory, such as
10 “www.***.com/*.html”, which is one level down the website address, by writing
supplementary data again in the QR code. Additionally, if the supplementary
data is involved with an ID of an object, more detailed information in association
with the object can be scanned and read out after the ID of the object is written in
the QR code.

15 To achieve the foregoing objective, the method for reading information
contained in a QR code is performed by an electronic device and includes steps
of:

scanning a QR code; wherein the QR code allows supplementary data to be
written therein and has a data area and multiple position detection patterns, and
20 each position detection pattern has a data-write area;
positioning the QR code;
reading original data in the data area of the QR code;
determining if the data-write area of each position detection pattern has
supplementary data;

decoding to acquire the supplementary data in each position detection pattern when the supplementary data is determined to be present in the data-write area; and

performing data processing on the original data in the data area and all the
5 supplementary data in the multiple position detection patterns to combine the original data and all the supplementary data and to decode and acquire final information.

Given the foregoing method, the supplementary data written in the data-write area of each position detection pattern in the QR code can be read out
10 and further combined with the original data in the data area of the QR code in generation of newly combined data. Accordingly, users can employ the QR code to write new data in the QR code and utilize the foregoing method to read out the original data and supplementary data in the QR code and further generate the combined data, thereby enhancing information capacity and functionality of
15 conventional QR codes, lowering operation cost, and effectively expanding the application scope of QR codes.

Other objectives, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

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IN THE DRAWINGS

Fig. 1 is a schematic diagram of a version 1 QR code;

Fig. 2 is a schematic diagram of a version 2 QR code;

Figs. 3A to 3C are schematic diagrams of position detection patterns of a

QR code in accordance with the present invention;

Figs. 4A to 4C are schematic diagrams illustrating the writing of supplementary data into a data-write area of a QR code in accordance with the present invention;

5 Fig. 5A is a front view of an intelligent chip combined with a QR code in accordance with the present invention;

Fig. 5B is a rear view of an intelligent chip combined with a QR code in accordance with the present invention;

Fig. 6 is a flow diagram of a method for reading QR codes in accordance
10 with the present invention; and

Fig. 7 is a schematic diagram of a conventional QR code.

With reference to Fig. 1, a quick response (QR) code in accordance with the present invention includes a data area 10 and three position detection patterns 11
15 in a square area. Besides the data area 10 and the position detection patterns 11, the QR code also includes alignment pattern, timing patterns, format information, and version information, which are not elaborated here as not related to the technical characteristics of the present invention.

Currently, QR codes have 40 versions which are size-dependent. With
20 reference to Fig. 1, the version 1 QR code takes the form of a matrix including 21 x 21 modules in the matrix. With reference to Fig. 2, version 2 QR code takes the form of a matrix including 25 x 25 modules. Each next higher version QR code increases by 4 x 4 modules. In other words, the version 40 QR code has N x N modules, in which N is defined as $(40-1) \times 4 + 21 = 177$.

The technical characteristic of the QR code in accordance with the present invention resides in a bare area 12 provided in each position detection pattern 11 of the QR code. The position detection pattern 11 takes the form of a bull's eye with alternating black and white modules arranged in elements of a matrix. With reference to Fig. 3A, no matter what the version of the QR code is, the position detection pattern 11 takes the form of a square matrix with 7 x 7 modules as the elements of the square matrix. Outmost bordering modules and a central portion with 3 x 3 modules are in black. A square ring in white located between the bordering modules and the central portion is the bare area 12 that is formed by two horizontal sections and two vertical sections. Each of the two horizontal section and the two vertical sections has 5 modules. The two modules at two ends of each horizontal section are respectively overlapped with the module at a corresponding end of one of the vertical sections and the module at a corresponding end of the other vertical section. The bare area 12 actually has 16 modules and it is the no-data area taken by the present invention as the data-write area for supplementary data to be written therein.

The quantity of the modules in the bare area 12 for writing supplementary data therein depends on the version of the QR code. For higher version QR code, with reference to Fig. 3B, the four modules 121-124 located on four corners of the bare area 12 in the position detection pattern 11 are used to write supplementary data therein. In other words, each bare area 12 has four modules available for writing supplementary data therein, and each QR code has three position detection patterns 11 and three bare areas 12 provided in the position detection patterns 11, such that each QR code has 12 (4 x 3) modules available

for writing supplementary data therein. For lower version QR code, with reference to Fig. 3C, besides the foregoing modules 121-124 in the bare area 12 of each position detection pattern 11 for writing supplementary data therein, the center modules 125-128 at the horizontal sections and the vertical sections of the bare area 12 are used for writing supplementary data therein as well. In other words, the bare area 12 of each position detection pattern 11 has at most 8 modules available for writing supplementary data therein, and each QR code has at most 24 (8 x 3) modules available for writing supplementary data therein. Whether the center modules 125-128 are used for writing supplementary data therein depends on the actual size of the displayed or printed QR code.

Suppose that each QR code has 24 modules available for data write. The 24 modules can be allocated to writing of data and error correction keys. For example, 12 modules out of the 24 modules can be configured for writing data and the rest of 12 modules are configured for writing error correction keys, or 8 modules out of the 24 modules are configured for writing data and the rest of 16 modules are configured for writing error correction keys. For higher version QR code, as there are 12 modules available to data write, 4 modules can be configured for writing data and the rest of 8 modules are configured for writing error correction keys, or 6 modules are configured for writing data and the rest of 6 modules are configured for writing error correction keys.

As can be seen from the foregoing description, the position detection patterns 11 are relatively smaller in higher version QR code due to relatively more information contained in the QR code. Accordingly, only the four modules 121-124 at the four corners of the bare area 12 are taken for writing

supplementary data therein. With reference to Figs. 4A to 4C, to facilitate description, the four modules 121-124 of one of the position detection patterns 11a are sequentially marked by A, B, D, C, and the eight modules of the remaining position detection patterns 11b, 11c are respectively and sequentially marked by E, F, H, G and I, J, L, K. If the modules in the upper half of the data-write area of each position detection pattern 11a, 11b, 11c are allocated to writing of error correction keys while the modules in the lower half of the data-write area are allocated to writing of data, a corresponding relationship between the modules for writing of error correction keys and the modules for writing of data is expressed as follows.

$$C, D, G, H, K, L = F, E, J, I, B, A$$

For the safety reason, the module for writing of data and its corresponding module for writing of error correction keys can not locate in the same position detection pattern 11.

As for digital expression of writing data, the module marked indicates that 1 is written therein and the empty module or in white indicates that 0 is written therein.

According to the foregoing analysis, a frequency of writing data in different combinations of the modules of the bare area 12 can be expressed by the following equation:

$$C_n = n + (n-1) + (n-2) + \dots + (n-(n-1))$$

where n is the number of the modules available for writing data therein.

According to the above equation, the frequency varies with the number of

the modules available for writing data therein, namely, $C4 = 10$ times, $C6 = 21$ times, $C8 = 36$ times and $C12 = 78$ times.

Given 4 modules (C4) in the bare area 12 for writing data therein as an example, the 10 times associated with C4 is obtained according to the following combinations of the modules for writing data therein.

A. If data are written in one module at a time, there are 4 times of data write in the modules.

B. If data are simultaneously written in two modules for the first time, there are 3 times of data write in the modules (including the first time).

10 C. If data are simultaneously written in three modules for the first time, there are 2 times of data write in the modules (including the first time).

D. If data are simultaneously written in four modules for the first time, there is one time of data write in the modules.

Hence, a total frequency of data write in the module can be obtained by adding the frequencies for different writing combinations A, B, C, D, which is equal to 10 times ($4 + 3 + 2 + 1$).

In the foregoing embodiment, each bare area 12 at most has eight module available for writing data therein, and the frequency of correcting or writing data can be obtained as mentioned. Nevertheless, in case of higher demand on QR code arising from issue of version or supplementary data, the number of the modules available for writing data in the data-write area is not limited to 16 modules. As mentioned earlier, each data-write area includes two horizontal sections and two vertical sections and each of the horizontal section and the vertical section can be divided into a range of module, which is more than one

module and less than five modules, for writing data in the modules. Alternatively, each of the horizontal section and the vertical section can be divided into multiple modules, which are more than five modules, for writing data in the modules. Thus, the frequency of correcting or writing data in the modules can be
5 increased.

Applications of the QR code in accordance with the present invention may includes, but not be limited to, the following implementations.

Example one:

Assume that data scanned and decoded from the data area 10 of the
10 foregoing QR code are related to a website address “www.***.com” and supplementary data associated with a directory “/*.html”, which is one level down the website address, is written in the bare area 12 after the QR code is generated. By scanning the data written in the bare area 12 of the QR code, a specific directory of the website, namely, “www.***.com/*.html” can be read
15 and can be accessed by connection to the directory.

Example two:

Assume that data scanned and decoded from the data area 10 of the foregoing QR code are related to a model number or an ID of a particular item in a database and supplementary data associated with further information or a
20 storage address of detailed information is written in the bare area 12 after the QR code is generated. By scanning the data written in the bare area 12 of the QR code, the further information can be directly read or the detailed information can be read through the designated storage address.

The aforementioned examples are some of the feasible applications of the

present invention and shall not be considered as the applications limiting the scope of the present application.

The QR code in accordance with the present invention may be combined with, attached to or displayed on a carrier including but not limited to goods, buildings, items for display or auction, antiques, works of art, presents, free gifts and so on. For example, the carrier may be a printed matter, a packing box, a bulletin board, an advertisement board, a memory card and the like or an electronic product, such as a computer, a tablet computer or a display panel of a mobile phone. Besides, the carrier may be an intelligent chip. With reference Fig. 5A and 5B, a front surface of an intelligent chip is shown in Fig. 5A and has a QR code with supplementary data written therein, and a rear surface of the intelligent chip is shown in Fig. 5B and has an RF (Radio frequency) tag 21. The QR code and the RF tag 21 on the intelligent chip can record a corresponding piece of information, such as an ID. Under the circumstance of multiple reads and writes on the intelligent chip 20, the QR code and the RF tag 21 can be collaborated through their respective information flows to constitute a multiple-in-one tag, which can be applied to occasions demanding fidelity, traceability, safety and security and logistics, historical relics, calligraphy and painting, works of art and antiques. For a museum application, the multiple-in-one tag can be affixed to an object. Users can download APP (application) software to their smart phones, can read information in the QR code attached to the object through the use of the smart phones, and can interact with other users. Museum staffs can write more specific and appropriate information in the intelligent chip, such that advanced users can perform information reads and writes on the intelligent chip through a

combination of device or equipment and smart phone. On the museum side, instant positioning, safety and security and intelligent logistics management can be performed on corresponding historical relics. Authors of contemporary art and craft, calligraphers and painters, and collectors can perform reads and writes, such as input of information pertinent to name, time, artistic appreciation, circulation, transaction and the like on the multiple-in-one tag through a device or equipment, and directly affix the multiple-in-one tag on an object to synchronize the written information with that in the external server. Thus, buyers can retrieve corresponding information by using smart phone to scan the QR code. The RF tag may be an RFID (Radio frequency identification) tag.

The foregoing carrier may be a single one intelligent chip or a combination of multiple intelligent chips, and includes but is not limited to RF tag, smart card or SIM card. The combination of multiple intelligent chips includes but is not limited to a combination of an RF tag and a SIM card or a combination of a smart card and a SIM card.

The present invention further provides a method for reading information contained in the foregoing QR code, which is performed by an electronic device and includes the following steps as shown in Fig. 6.

Step S11: Scan a QR code. The QR code includes the data area 10, the multiple position detection patterns 11 and the multiple bare areas 12.

Step S12: Position the QR code.

Step S13: Read original data in the data area 10 of the QR code.

Step S14: Determine if the bare area 12 of each position detection pattern 11 has supplementary data. If the bare area 12 has the supplementary data, perform

step S15. Otherwise, perform step S16.

Step S15: Decode to acquire the supplementary data in each position detection pattern 11.

Step S16: Perform data processing on the original data in the data area 10
5 and all the supplementary data in the multiple position detection patterns 11 to combine the original data and all the supplementary data and to decode and acquire final information.

In step S14, if the bare area 12 of each position detection pattern 11 is determined to be empty with no supplementary data therein, then perform data
10 processing on the original data in the data area 10 only to decode and acquire the final information.

The foregoing method not only reads the original data in the data area 10 of the QR code but also determines if the bare area 12 in each position detection pattern has any supplementary data. If the supplementary data do exist, the
15 supplementary data are combined with the original data for analysis and acquisition of the final information. What it means is that the final information is decoded and acquired according to only the original data read out in the data area 10 when the QR code is scanned before the supplementary data are written in the bare areas 12 and according to a combination of the original data and all the
20 supplementary data in the bare areas 12 after all the supplementary data are written in the bare areas 12.

For example, suppose that the original data in the data area 10 of the QR code is a website address “www.***.com”. Users can write supplementary data in the bare area 12 of one of the position detection patterns 11. Suppose that the

supplementary data written in the bare area 12 is a directory “/#.html”, which is one level down the website address. When the QR code is scanned before the supplementary data is written in the bare area 12, the final information read out from the QR code is the website address “www.***.com”. When the QR code is scanned after the supplementary data is written in the bare area 12, the final information read out from the QR code is “www.***.com/*.html”.

The supplementary data in the foregoing method can be read out through various approaches, such as through a preset lookup table. For example, supposing that the bare area 12 has four modules for supplementary data to be written in, the readout of the supplementary data is in a range of 0001-1111 and each number in the range is mapped to corresponding information as follows:

0001 stands for information for a first-level sales discount, such as 10%;

1001 stands for information for a linked directory that is one level down, such as “*.html”.

The numbers 0011, 0111, 1111, 1011 and 1101 can be also mapped to other information. Although the least significant bits in 0001 and 1001 are the same, different information are mapped with 0001 and 1001 because what 0001 and 1001 represent are two different pieces varieties of supplementary data.

Modifications of supplementary data written in the bare area 12 increase in number with the modules of the bare area 12 allowing supplementary data to be written therein. In other words, more information can be read out after more supplementary data is sequentially written in the bare areas 12 of the QR code.

Even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details

of the structure and function of the invention, the disclosure is illustrative only. Changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended

5 claims are expressed.

CLAIMS

1. A quick response (QR) code with supplementary data written therein,
comprising:

- 5 multiple position detection patterns (11), each position detection pattern (11)
having a bare area (12) serving as a data-write area for supplementary data to be
written in the data-write area; and
a data area (10) serving for original data to be written therein.

- 10 2. The QR code as claimed in claim 1, wherein the data-write area of each
position detection pattern (11) takes the form of a square ring and is formed by
two horizontal sections and two vertical sections, each of the horizontal section
and the vertical section is divided into multiple modules for the supplementary
data to be written therein.

- 15 3. The QR code as claimed in claim 2, wherein each of the two horizontal
section and the two vertical sections has five modules, the two modules at two
ends of each horizontal section are respectively overlapped with the module at a
corresponding end of one of the vertical sections and the module at a
20 corresponding end of the other vertical section, the overlapped modules of the
horizontal sections and the vertical sections are located at four corners of each
position detection pattern (11) and bare area (12) serves for the supplementary
data to be written therein.

4. The QR code as claimed in claim 3, wherein the module centered at each of the horizontal sections and the vertical sections serves for the supplementary data to be written therein.

5 5. The QR code as claimed in claim 4, wherein each module centered at each of the horizontal sections and the vertical sections serves for the supplementary data to be written therein.

6. The QR code as claimed in claim 1, wherein the supplementary data is
10 decoded to a digital format.

7. The QR code as claimed in claim 6, wherein the module of the data-write area is digitalized as one when the module is marked and is digitalized as zero when the module is empty.
15

8. The QR code as claimed in any one of claims 1 to 7, wherein the QR code is located on a carrier.

9. The QR code as claimed in claim 8, wherein the carrier is a display panel
20 and the QR code is displayed on the display panel.

10. The QR code as claimed in claim 9, wherein the carrier is at least one intelligent chip, the QR code is combined with the at least one intelligent chip, and both the QR code and the at least one intelligent chip record corresponding

information.

11. A method for reading information in a QR code performed by an electronic device and comprising steps of:

- 5 scanning a QR code, wherein the QR code allows supplementary data to be written therein and has a bare area (12) and multiple position detection patterns (11), and each position detection pattern (11) has a data-write area;
- positioning the QR code;
- reading original data in the data area (10) of the QR code;
- 10 determining if the data-write area of each bare area (12) has supplementary data;
- decoding to acquire the supplementary data in each bare area (12) when the supplementary data is determined to be present in the data-write area; and
- performing data processing on the original data in the data area (10) and all
- 15 the supplementary data in the bare area (12) to combine the original data and all the supplementary data and to decode and acquire final information.

12. The method as claimed in claim 11, wherein the final information corresponding to the supplementary data is mapped with the supplementary data
- 20 through a lookup table.