From barcode to QR code applications

László Várallyai[1]

A B S T R A C T

This paper shows the Zsohár Horticulture Company in Nagyrákos, how they want to change their barcode identification system to QR code. They cultivate herbaceous, perpetual decorational plants, rock-garden, flower-bed and swamp perpetuals, decorational grasses and spices. A part of the perpetuals are evergreens, but most of them has special organs - such as onions, thick-, bulbous roots, "winter-proof" buds - so they can survive winter. In the first part of the paper I introduce the different barcode standards, how can it be printed and how can it be read. In the second part of the paper I give details about the quick response code (QR code) and the two-dimensional (2D) barcode. Third part of this paper illustrates the QR code usability in agriculture focused on the gardening.

1. Introduction

This paper shows how Zsohár Horticulture Company in Nagyrákos wants to change their barcode identification system to QR code.

Zsohár horticulture cultivates herbaceous, perpetual decorational plants, rock-garden, flower-bed and swamp perpetuals, decorational grasses and spices. A part of the perpetuals are evergreens, but most of them has special organs - such as onions, thick-, bulbous roots, "winter-proof" buds - so they can survive winter (I1).

In general, those perpetuals that have flowers on them - except a few plants - bloom only in a short period of time that is why called them "season indicator" plants. Although they have a variety of leaves so they are beautiful part of the garden from spring till autumn. With careful selection a decorative, nice flower-bed can be created almost for the entire year.

It has been said: "they are the intelligent, lazy people's plants". Important to know a few things about them, but they do not need too much care, so they can be pretty for years. They grow their plants in special containers (rigid walled plastic ones) based on their size and growing parameters, therefore they can safely be planted in their final location in the entire year without any damage. They grow most perpetuals in 9x9 cm pots with underplate, the mid size ones go to 11x11 cm and diameter is 14 cm pots, the big plants go to 2 litre or 3-5 litres pots. The spice plants take their place in 10.5 cm diameter brown, round pots with underplate (I1).

They have a little webshop, where the customer orders different kind of plants. They need correct identification in transport and delivery of the plants (I1).

2. The barcodes

As far back as the 1960s, barcodes were used in industrial work environments. Some of the early implementations of barcodes included the ability identify rail road cars. In the early 1970s, common barcodes started to appear on grocery shelves. To automate the process of identifying grocery items, UPC barcodes were placed on products. Today, barcodes are used for identification in almost all types of business (Fig. 1).

---

[1] DEbreceni Egyetem,varal@agr.unideb.hu

BARCODE12345678

Figure 1. Type of barcode

If barcodes are used in the business process, the processing can be automated to increase productivity and reduce human error. Whenever there is a need to identify or track something accurately, barcodes should be used. In traditional working environment, workers are required to enter an enormous amount of data into a customer database system. Instead of manually typing the customer identification number into a database of information, contained in a barcode, a data entry maybe scanned easily. This increases the automation and reduces the human error.

The type of barcode to use for a particular situation depends upon:
- the actual application;
- the data encoded in the barcode;
- the printability of the barcode.

There are several different types of barcode standards for different purposes, which are called symbologies. Each type of symbology is a standard that defines the printed symbol and how a device - such as a barcode scanner - reads and decodes the printed symbol. When multiple parties or companies are involved in the ID process, industry standards are usually established. Note that the standard is not necessarily the same as the barcode symbology. If an industry standard has been established for the customer's use of barcodes, there will not be a choice in selecting the barcode symbology.

Barcode standards define how to use the barcode symbology in a particular situation. For example, ISBN is a standard for labelling books and periodicals that uses the EAN-13 symbology.

Some established barcode standards can be seen in Table 1.

Table 1. Barcode standars

Established standard	Common use	Symbology
AIAG	Automotive item identification	Data Matrix
EAN 8 EAN 13	Items for sale worldwide	UPC/EAN
MIL-STD-130L	US department of defence	Data Matrix
SSCC-18	Shipping cartons	Code 128

The best type of the used barcode depends on the environment, requirements, application, and printer. Regarding barcode fonts, there are two types:
- fonts that require encoding with use of a font tool (Code 128, UPC, Data Matrix, Code 93);
- fonts that do not require encoding. Self-checking fonts (Code 39, Codabar).

For fonts that require encoding such as Code 128, Data Matrix, UPC, and Code 93, a font tool must be used. A font tool is a product that is used to format data for a barcode font. This may include calculating start/stop characters, a check character, and in some cases prepare data so that it can be altered for the specified barcode symbology. It should be noted, if somebody is not a technical user or programmer, try to use self-checking barcode fonts such as Code 39 or Codabar. Self-checking fonts have checking code built-in, so there is no need to calculate check characters. Check characters are used in more dense symbologies, so the barcode scanner can verify it and reads the barcode correctly.

2.1. Products available for printing barcodes

Determining the best product to use for printing depends on the environment, requirements, application and printer. Several methods for printing barcodes are as follows:
- barcode Fonts,

- applications,
- components,
- hosted Services (Dynamic Barcode Generator Service or XML Barcode Webservice).

2.2. Reading barcodes

One of the most common tools for reading barcodes is the hand held barcode scanner (Fig 2.). All of the barcode scanners recommended and sold by IDAutomation have built-in decoders that can read several different bar code types. There are some low priced scanners available on the market, but they require complicated decoders. In the long run, after ordering and programming a decoder, more time will be spent using the decoder than if ordering a scanner with a built-in decoder.

Most of the scanners sold by IDAutomation receive their power from the PC keyboard or USB port so no external power supply is required. When a barcode is scanned, the data is sent to the PC as if it was typed using a keyboard. Not all scanners can scan barcodes that are printed at very small x dimensions (the x dimension is the width of the narrow bar in the code), so it is advisable to check the barcode scanner manual to make sure the scanner can read the small x dimension barcodes. Also, make sure the printer can accurately reproduce small x dimension barcodes. The IDAutomation Plug 'n Play Barcode Scanner will scan linear bar codes consistently. It scans linear bar codes that are up to 4.2" wide from near contact to about 10".Their speeds are 200 scans per second.

The barcode pen-scanner (Fig. 3.) is a simple product that reads, stores, and organizes barcodes (I2). It is excellent for keeping tabs on any barcode-based inventory, books, DVDs, and so on. It comes in a pen-like shape, with small scanner at its point. Once a barcode is scanned, it's kept within the device's 128MB built-in storage, which is apparently small, but actually stores up to a million items. Categories can be assigned for efficient management. It can be used with PC or Mac, where can be stored and synced each barcode to a proper item name and category.

Figure 2. Barcode scanner

Figure 3. Barcode pen-scanner

3. The QR codes

Quick response code (QR code) is a type of two-dimensional (2D) barcode that can be read using a QR barcode reader or camera enabled smartphone with QR reader software (Fig. 4.). A QR code is able to carry information in both the vertical and the horizontal direction, which is why it is called a 2D barcode. The QR Code is a registered trademark of Denso Wave Inc. in Japan and other countries (Lyne, 2009).

QR Codes are popular with mobile phone users as the barcode can be used to store addresses and URLs. With a camera-enabled smartphone, users can scan the QR Code which has been coded to do things like display text, provide contact data or even open a webpage in the browser on the smartphone. The QR Code specification outlines data types or services for this information. By using the standards it ensures QR Code software can correctly read the code.

QR Codes can be printed and displayed anywhere a mobile phone user might scan the code such as in a magazine or displayed at a cash register. It can be displayed also online (Waters, 2012).

There are a number of online services that will generate a QR Code based on the information is specified when mapping the QR code.

Figure 4. QR code sample

The QR code developed formerly only for industrial uses, but it become common in consumer advertising and packaging in recent years, because the popularity of smartphones "has put a barcode reader in everyone's pocket for the first time (Fig. 5.). As a result, the QR code has become a focus of advertising strategy, since it provides quick and effortless access to the brand's website (I3, I4). Beyond mere convenience to the consumer, the importance of this capability is that it increases the chance that contact with the advertisement will convert to a sale by coaxing qualified prospects further down the conversion funnel without any delay or effort, bringing the viewer to the advertiser's site immediately, where a longer and more targeted sales pitch may continue. Although initially used to track parts in vehicle manufacturing, QR Codes are now used over a much wider range of applications. These are the followings: included commercial tracking, entertainment and transport ticketing, product/loyalty marketing (Korhan, 2011) mobile couponing where a company's discounted and percent discount can be captured using a QR Code decoder which is a mobile application or storing a company's information such as address and related information alongside in-store product labelling. It can also be used in storing personal information for use by government (Philippines National Bureau of Investigation where clearances now come with a QR Code). Many of these applications target mobile-phone users. Users may receive text, add a vCard contact to their device, open a Uniform Resource Identifier (URI), or compose an e-mail or text message after scanning QR Codes (Sansweet, 2011). They can generate and print their own QR Codes for others to scan and use by visiting one of several pay or free QR Code-generating sites or apps. Google has a popular API (application programme interface) to generate QR Codes (I5), and apps for scanning QR codes can be found on nearly all smartphone devices (I6).

Figure 5. QR code reading with smartphone

QR Codes storing addresses and Uniform Resource Locators (URLs) may appear in magazines, on signs, on buses, on business cards, or on almost any object about which users might need information. Users with a camera phone equipped with the correct reader application can scan the image of the QR code to display text, contact information, connect to a wireless network, or open a web page in the telephone's browser. This act of linking from physical world objects is termed hardlinking or object hyperlinking. QR Codes may also be linked to a location to track where a code has been scanned. Either the application that scans the QR Code retrieves the geoinformation by using GPS or the URL encoded in the QR Code itself is associated with a location (I7).

3.1. QR code storage

The amount of data that can be stored in the QR Code symbol depends on the data type, version and error correction level. The maximum storage capacities occur for 40-L symbols (version 40, error correction level L), are as follows:

- numeric only max 7089 characters (0-9),
- alphanumeric max. 4296 characters (0–9, A–Z [upper-case only], space, $, %, *, +, -, ., /, :),
- binary/byte max. 2953 characters (8-bit bytes) (23624 bits),
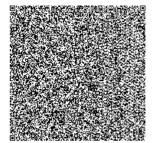- Kanji/Kana max. 1817 characters.

Some examples of QR codes to show the stored character numbers:

| 33x33 | 57x57 | 177x177 |
| max. 50 character | max. 174 character | max. 1817 character |

Figure 6. Some examples of QR codes

3.2. Encryption and error correction

Encrypted QR Codes, which are not very common, have a few implementations. An Android application (I8), for example, manages encryption and decryption of QR codes using the DES algorithm (56 bits) (I9). Japanese immigration office uses encrypted QR Codes when placing visas in passports

Codewords are 8 bits long and use the Reed–Solomon error correction algorithm with four error correction levels. The higher is the error correction level, the less storage capacity. The following table lists the approximate error correction capability at each of the four levels (I10):

Table 2. Error correction levels at QR codes

Level L (Low)	7% of codewords can be restored
Level M (Medium)	15% of codewords can be restored
Level Q (Quartile)	25% of codewords can be restored
Level H (High)	30% of codewords can be restored

Due to the design of Reed–Solomon codes and the use of 8-bit codewords, an individual code block cannot be more than 255 codewords in length. Since the larger QR symbols are contain more data, it is necessary to break the message up into multiple blocks. The QR specification does not use the largest possible block size instead; it defines the block sizes so less than 30 error-correction symbols appear in each block. This means that at most 15 errors per block can be corrected, which limits the complexity of certain steps in the decoding algorithm. The code blocks are then interleaved together, making it less likely that localized damage to a QR symbol will overwhelm the capacity of any single block.

Using this type of error correction makes possible to create artistic QR Codes that still scan correctly, but contain intentional errors to make them more readable or attractive to the human eye, as well as to incorporate colors, logos and other features into the QR Code block (I11, I12).

4. The QR code usage in agriculture and gardening

Many fields in the agriculture are covered by QR codes (Hansen, 2012) as it can be seen in Fig. 8. The main goal in most cases is the traceability or monitoring of the system. In this case the most important point of view is the horticulture. Accordingly, I will introduce some application possibilities of QR codes in gardening area.

For advanced gardeners, things like growing hybrids and/or a special genus of plants can be remarkable and also educational process. It is becoming a more common site to go to botanical gardens and find a QR Code identifying the plant you are admiring. These QR Codes bring instant enlightenment to the curious onlookers.

So many wonders come from the soil, but they could also be growing something that has potential dangers to it, as well. Some plants are poisonous and adding a QR Code that explains the potential hazards of dangerous plants, people can educate themselves on the proper identification, use, and handling of these plants.

By adding a QR Code near price tags, it can give potential customers recipes, preparation tips and allergy information, instantly. By describing allergy symptoms and advices what to do if it occurs to customers the peace of mind of knowing that they are safe.

The QR codes has to print on virtually indestructible, waterproof paper in the garden that provide in-depth plant information directly to iPhones, Blackberrys, Androids and other smartphones. Embedded in the QR code has to be the common name of the plant, the Latin name and pronunciation, zone information, size dimensions, bloom time, sun and soil preferences and direct links to Wikipedia articles and images of the plant.

The QR codes in the agriculture could serve a number of purposes. One of the most common uses for QR codes is to direct the user to a website. What types of websites might we consider? We can think about the potential to lead the user to a mobile-ready site to sign up for a newsletter, email list, or loyalty program. Maybe we want to send them to a discount coupon or a product description. Almost any web-based content (videos, images, Facebook, or Twitter pages, etc.) can be conveyed on a mobile device, so the possibilities are tremendous. We have to think strategically about how we want to use your QR codes (Branden, 2011).

Farmers' market vendors have other options. QR codes could be used to lead visitors to the vendor's website where they can find information about the farm's location, a list of products grown or available at a particular time, or days/ times and location of other markets in which the farmer participates.

Depending on our objective, QR codes might be placed on brochures and other marketing materials, trucks/trailers, product packaging, or signs. To decide where to place them, we need to understand how our customers behave (Weir, 2010). Place the QR codes where our customers (or potential customers) are. Keep in mind, though, that not all consumers use mobile devices, so QR codes should be used to supplement other promotional tools, not replace them. We may find, though, that some users have a mobile device but simply do not know how to use it to scan QR codes. It's possible that their device came with a scanning application installed.

Figure 7. Gardening QR code in gardening

Figure 8. Some applications of QR codes in agriculture
Sources: (I13, I14, I15, I16)

Conclusion

This paper gives information about Zsohár Horticulture Company in Nagyrákos how they want to change their barcode identification system to QR code one. The goal of this horticulture to realize a similar QR code system as can be seen in Fig. 7. The contents, which can be seen on the QR code are the followings: common name of the plant, the Latin name and pronunciation, zone information, size dimensions, bloom time, sun and soil preferences. Later they can put pictures about the flowers on it and so on. Using this new technology the partners can be monitored and traced the appropriate and bought flowers during and after the transportation.

The QR codes in this horticulture could serve more purposes. One of them use the QR codes to direct the user to a website, where is a functional webshop. They can lead the user to a mobile-ready site, to sign up for a newsletter, email list, or other programmes (loyalty programme). The other possibilities through this connection can send discount coupon or a product description to the customers. Almost any web-based content (videos, images, Facebook, or Twitter pages) can be conveyed on a mobile device, so the customer's possibilities are tremendous.

From the market vendors point of view have more options, how they lead visitors to the vendor's website where they can find information about the horticulture's location, a list of products grown or available at a particular time, or days/ times and location of other markets in which the gardener participates.

References

Branden C., 2011. QR Codes, The Ultimate Guide Book, Published by QReative Studios.

Hansen J. P. 2012. Using QR codes for context specific support around the farm. AFITA/WCCA 2012 Taipei/Taiwan 3-6 of September, pp.1-5.

Koran, J. 2011. 5 Steps to a Successful QR Code Marketing Campaign. Social Media Examiner [Online]. Available at http://www. socialmediaexaminer.com/5-stepsto- a-successful-qr-code-marketingcampaign/. Accessed 11/8/11.

Korhan, J. 2011. How QR Codes Can Grow Your Business. Social Media Examiner [Online]. Available at http:// www.socialmediaexaminer.com/howqr- codes-can-grow-your-business/. Accessed 11/8/11.

Lyne, M. 2009. What is A QR Code And Why Do You Need One? Search Engine Land [Online]. Available at http://searchengineland.com/whatis-a-qr-code-and-why-do-you-needone-27588. Accessed 11/8/11.

Sansweet J., 2011. Introducing the QR code. The reality & the magic, Published by ProofreadNZ Ltd,, Auckland, New Zealand

Waters J. 2012. QR Codes for Dummies – Portable Edition, Published by John Wiley and Sons Inc. , Hoboken, New Jersey.

Weir M., 2010. Mobile marketing for the small business owner, Published by CreateSpace Independent Publishing Platform.

I1: http://www.zsohar.hu/start.asp?KatalogusID=1&KatalogusID2=0&Ny=A

I2: http://www.techfresh.net/keep-tabs-on-your-items-with-barcodes-scanner

I3: http://www.mobilemarketer.com/cms/news/software-technology/11930.html

I4: http://blogs.vancouversun.com/2012/01/04/tescos-cool-qr-code-advertising-campaign/

I5: http://code.google.com/apis/chart/infographics/

I6: http://www.708media.com/qrcode/qr-code-readers-iphone-android-blackberry-windows-phone-7/

I7: http://qrd.by

I8: https://play.google.com/store/apps/details?id=la.droid.qr

I9: http://qrdroid.com/encrypted-qr-codes-share-secret-messages.html

I10: http://www.tec-it.com/de/support/knowbase/symbologies/qrcode/Default.aspx

I11: http://blog.360i.com/emerging-media/creative-qr-codes

I12: http://mashable.com/2011/04/18/qr-code-design-tips/

I13: http://www.freshplaza.it/images/2012/0705/Cuoredolce_QR01.JPG

I14: http://www.blog-agri.com/ticagri/wp-content/FS-Green-Plan-Solutions-pomy-QR.jpg

I15: http://thefonecast.com/portals/1/blog11/t-mobile_qr_code_cow.jpg

I16: http://4.bp.blogspot.com/-PHYDObQhhkE/TefSq-iEuoI/AAAAAAAAC9M/cvUdGuE-QFs/s1600/2011-05-27+15.43.17.jpg