

Experience and Sociocultural Aspects of Using QR code in Green Areas

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Abstract

QR code or quick response code, or matrix code, is the information storage system, used for different purposes since 1994. The code contains information (text, digits, internet links, any other information), which is read by using QR scanners or mobile phones. Changing needs of the society and developing technologies determined the emergence of QR codes formats. However, for the day being the code under discussion is dominating by the popularity of its use (identification of goods, information provided on notice boards, leaflets, business cards, advertising brochures, information stands). One of a more interesting ways is encountered in green areas of cities, which can be of different kind: educational, recreational, artistic. The article deals with the ways of using QR (quick response code) in green areas and introduces the research data.

Key words: QR code, green areas, socio-culture, education, recreation.

Anotacija

QR kodas, kitaip „greitojo atsako“ arba reagavimo matricos kodas – informacijos laikmena, naudojama įvairiais tikslais nuo 1994 metų. Kode užšifruota informacija (tekstas, skaičiai, internetinė nuoroda, bet kokia kita informacija), skaitoma naudojant QR skaitytuvus arba mobiliuosius telefonus. Besikeičiantys visuomenės poreikiai ir tobulėjančios technologijos lėmė naujų QR kodo formatų atsiradimą. Jais yra identifikuojamos prekės, skelbimų lentose, lankstinukuose, vizitinėse kortelėse, reklaminiuose bukletuose, informaciniuose stenduose pateikiama informacija. Vienas įdomesnių kodo naudojimo atvejų pasitaiko miestų želdynuose, jis gali būti įvairaus pobūdžio: šviečiamasis, auklėjamasis, rekreacinis, meninis. Straipsnyje yra apžvelgiami QR greito atsako kodo naudojimo želdynuose būdai bei tyrimo duomenys.

Reikšminiai žodžiai: QR kodas, želdynai, sociokultūra, švietimas, rekreacija.

Introduction

The use of rapid response code (subsequently QR code), which emerged slightly more than twenty years ago, ranges from different school assignments to complicated processes of machine regulation and intercommunication. The purpose of the use itself is analysed in several aspects, basically as a simplified way of rendering information and advertising, as well as a teaching aid, a part of marketing or simply as a possibility for investigating information storage system.

According to IT analyst Brain Morris, QR is likely to evolve in the future. Therefore, one should not be astonished by the fact that possibilities of using QR code have been increasing each day. In green areas of foreign countries QR code allows providing audio, video and textual information. It also enables institutions to observe and regulate flows of visitors. Interrelated equipment (machine-to-machine, M2M) individually decides what and when to do and, thus, is employed in maintenance of parks and squares.

The use of QR code in urban green spaces of the world is quite diverse: it carries educational, recreational or even artistic meaning. In this way, it is gradually becoming a sociocultural part of modern society.

However, in Lithuanian green areas QR code is rarely encountered and, as a result, it is of crucial importance to collect information and share the positive experience of foreign countries. The aim of the research is to assess sociocultural aspects of using QR code in green areas.

Research methodology

When analyzing the aspects of QR use in green areas, analysis of scientific methodological literature was taken as the basis. Scientific articles, which deal with the structure of the code, its operation principles and ways of employment, were analyzed.

The most popular method of empiric research was selected, i.e. internet survey. Although it is often determined by the internet access, this is one of the most advanced ways to gain sociological information, because it ensures the feedback. The survey was designed by using *Google Form* tool and uploaded onto the internet. In Lithuania, the employees of five institutions, (that published online articles about the use of QR codes in greenery), were interviewed. In Italy, the data was collected in five parks as well as from the customer database of IT Flornetworkcompany.

Investigation results and their interpretation

Background: QR code is the system of information storage. The combination of letters QR stands for quick response code, which is also a substitute for barcode used for rapid scanning and data processing (Parra, 2010).



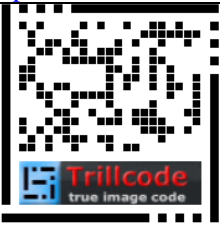

The traditional codes (bar codes) can carry maximum 20 characters, while QR code has a much higher capacity because can encode 7 089 numeric data or 4 296 alphanumeric data (Rinkalkumar, 2014). It can store different data, i.e. digits, letters, symbols, binary codes, kana, kanji, hiragana (Japanese writing system), etc. The capacity of the code depends on the version, which is marked by numbers from 1 to 40. The code of version 1 is comprised of 21×21 elements while the extension of the version by one is equal to the increase by four units in each direction, i.e. version 2 – 25×25 , version 3 – 29×29 , version 4 – 33×33 , version 5 – 37×37 ..., version 40 – 177×177 elements. One QR code of version 40 can code up to 7.089 digits; 4.296 text data, 2.956 (8 bits) symbols or 1.817 kanji/kana characters while in the code of version 1 the corresponding amount of the data makes up only 41, 25, 17, 10. Black and white squares are used for coding of information. The code is read at a high speed at any direction (360°) using corner position identification elements (markers) (DENSO Wave Inc.).

1. History of QR code development.

The Japanese company “Denso Wave” was commissioned to create something to surpass the barcode, which could store too little information. In addition, it was coded only one-way. The barcode was characterized by a relatively low speed of scanning. The creative team under the guidance of Masahiro Hara within the period of 6 months conducted numerous researches until they found a solution how to code information and avoid errors of code position reading. In 1994 “Denso Wave” (then DENSO CORPORATION department) announced about its QR codes to the press. The company “Denso Wave”, which was a branch of Toyota Company, started to use the results of the team work in the same year in production of cars for storage and transportation of parts. It all added to efficient work management, acceleration of production process and conformed to recent tendencies of the society. A rapid spread of the code was determined by several “Denso Wave” decisions: the code was registered as a trademark; everybody was granted unrestricted permission for use without any protection of the patent. Such policy was pursued in order to honour the creators’ wish to see their product used worldwide. In 2002 in Japan the code gained popularity very fast. This tendency was promoted by the emergence of mobile phones with the possibility to read QR code. Convenience, speed, attractiveness have become an irreplaceable tool in companies and everyday life, from identity card to electronic flight tickets. As the use of the code was free of charge for producers and consumers, it became so popular that it even gained the name as “society’s code”. Since then the new period of creating 2D barcodes has started.

Changing needs of the society and developing technologies determined the emergence of new QR formats (Table 1): DataMatrix, Aztec Code, Trillcode, ShotCode, MaxiCode, Cool-Data-Matrix, mCod, etc. The more popular ones are displayed in the table below.

Table 1. Alternatives of QR barcodes

Example of the code	Title of the code	Description
 http://www.barcode.de/	DataMatrix	The code has a rectangular shape. It consists of square cells, i.e. bits. Light means 0 while 1 is dark or vice versa. Codes are scanned in a horizontal and vertical direction. Capacity can range from several to 1556 bits. The area of the code is 2 – 3mm ² . It is intended for marking of small objects and can be used without license. The use of the code is defined and described by ISO standard ISO/IEC 16022:2006.
 http://www.barcode.de/	Aztec Code	The type of 2D barcode (authors Andrew Longacre and Robert Hussey). The code was created in 1995 and announced in 1997. The use of the code is defined and described by ISO standard ISO / IEC 24.778: 2008. Full core can sustain up to 32 layers, 151×151 points, which can code up to 3832 digits, 3067 letters or 1914 bytes of data. It got its name due to similarity to Aztec pyramids.
 http://www.trillcode.com/	Trillcode	Trillcode is the first type of 2D barcode, which allows one to include a logo, a picture or simple animation. It is adjusted to mobile phones. The first version was developed in 2006. The code can vary in size and store from 8 to 210 symbols (digits, letters, signs).
 https://en.wikipedia.org/wiki/ShotCode	ShotCode	ShotCode is a round type of 2D barcode, developed in 1999 at Cambridge university. The code does not store the data but relates the available information to URL address. The code can store about 17 kb of data.

The codes described above are being read using a mobile phone in such a way, that one can get specific information of a different kind (text messages, descriptions of products, links to the webpage, advertisements, audio, video recordings, etc.). Codes are mostly used for identification of goods, in the shop windows, on notice boards, leaflets, business cards, commercial brochures, information stands, etc.

2. Experience and socio-cultural aspects of using QR code in green areas of foreign countries.

The concept of socioculture includes public communication norms, customs, traditions, and the most important social values, human relationships, lifestyle, non-verbal expression of identity and other similarities (Anužienė, Stancikas, 2013). Having in mind urban green areas abroad, the use of the code becomes a new tradition, a simplified form of communication that is acceptable for all age groups.

When used for educational purposes, the code is one of mostly simple and convenient ways to provide various types of information (text, video, audio) about plants in several languages. In traditional stands it would require too much space, while technically it is also impossible to fit

everything. The tradition of using smart and modern devices, which was a fashion, not so long ago, also stands for the popularity of this method.

The use of QR code in green areas of the cities worldwide varies from educational, recreational to even artistic approach. Coding for educational purposes is developed best of all.

“Developing plant identification skills using QR code is an important part of the curriculum of any botany course in higher education“ (Conejo et al., 2016). In Poland, at the Botanical Garden of Adam Mickiewicz University in Poznan, QR code is being used for education sessions of different age visitors. Information about botanical collections, local ornitofauna (having scanned QR code one can listen to birds’ voices, watch video material) and different events (competitions, art workshops, educational days, excursions, etc.) is obtained this way (Ogród Botaniczny Uniwersytetu im. Adama Mickiewicza w Poznaniu).

In a well-known Scuola di Minoprio (Italy) QR codes are intensely used in the process of dendrology studies. In the territory of the park students are introduced to assortment of plants and their description (information is provided in six languages) as well as changes of plant appearance in the course of the year. Learners can also watch introductory films in three languages, namely Italian, English and French. 200 different species of plants have been coded in the park so far. They are illustrated by botanical cards related to the learning platform, which enables teachers to observe their students during practice at a distance, give questions and check answers. The project was undertaken in 2014 whereas the teaching system has been active since May 2015.

As in contemporary society much is being discussed about the significance of nature and its impact on human being from physical and moral point of view, the use of code in educational programs for school students plays an important role as far as environment protection is concerned. It encompasses formation of behavior as well as introduction of world outlook, moral, ethic and aesthetic values.

The aims of being familiar with the socio-cultural environment are as follows: to help one know the world and its variety, feel its beauty; perceive real values and standards of moral behavior. When pursuing the aims mentioned, students are being taught how to treat animals, plants. One is encouraged to foster nature and manage the environment. „In May 2012, students from the Centre for Urban Sustainability and Resilience, Chelsea College of Art and Design, University of the Arts London collaborated in a public engagement initiative aimed at using art to communicate engineering concepts. Students from each institution formed teams and devised a series of entries competing to win funding to turn their design into an installation for exhibition in the high profile location at the parade ground of Chelsea College, next to Tate Britain.




The winning design transformed the existing grass square into a twelve meters squared QR code made entirely of grass and soil. The aim of the installation was to address concerns about the volume of information available to people about how to live a greener life, which can become overwhelming and make decision-making even more difficult“ (Chelsea College of Art Competition, 2012).

In recreational territories for intended physical and psychological rest, QR coding of information is also popular. The use of this code in state, regional, botanical, zoological and city parks provided the possibility to avoid huge information and advertising stands by introducing a significant part of information via code link to the webpage.

Artistic solutions in green areas of foreign countries by using QR code as a certain symbol or element of decoration are not scarce as well (Table 2).

In 2012 QR codes arrived at The Royal Horticultural Society Chelsea Flower Show in the form of a show garden. The QR Code garden had won a Bronze Medal in the Fresh Garden category which showcases experimental and innovative design concepts and the creative use of materials. The code symbol was created from a wall of vertical planting and resolves to a website giving more information about the garden, including a plant list. Garden was designed by landscape architects Jade Goto in collaboration with Shelley Mosco.

Table 2. QR code as an esthetic element of green areas

<p style="text-align: center;">THE QR GARDEN, 2012</p> 	<p>THE QR CODE GARDEN – RHS CHELSEA FLOWER SHOW 2012, London. The code has been created from a wall of vertical planting and resolves to a website giving more information about the garden.</p>
<p style="text-align: center;">KRAAY FAMILY FARM 2013 (https://www.kraayfamilyfarm.com/)</p> 	<p>LACOMBE, ALBERTA, Canada Corn maize with a placed QR code, which opens a link to the webpage of the farm (Brown, 2013).</p>
<p style="text-align: center;">PLACE STANISLAS 2013 (http://greensideup.ie/2013/01/)</p> 	<p>Temporary garden in Place Stanislas, Nancy, France using over 1,700 plants. The code linked back to a website containing information about the garden and upcoming events (Scully, 2013).</p>

In 2016, in Canada (Alberta, Lacombe), the biggest QR green code of the world was created. It was opened on the occasion of 14th farm birthday. It is a huge corn maize with QR code inside, which opens the link to the webpage of the farm. This piece, composed of the area of 29.000 square meters has been included in Guinness World Records Book (Brown, 2013).

Potential of QR code in the field of green area maintenance in Italy

QR codes in green areas have been successfully used in Italy. The software developed on the basis of QR use by Italian company “Flornetwork” is intended to both amateurs and professionals (it is suitable for teaching, work and tourism). As it is too expensive for each park or a garden to have arborist or gardener, the software enables one to have a consultation on maintenance and formation of green areas as well as identification of diseases. Sensors, which observe the height of grass, soil moisture, etc., are arranged in parks that have been using the software. Sensors are stationary and electricity-driven or use solar energy. One sensor can observe the field of 40 meters in diameter. The data of the sensors can be used by landscape architects because the processed information can help appropriately select the plants (the soil is examined by point method, the location is assessed with regard to sunshine amount; about 7000 plants can be filtered).

When working with visitors (students, tourists), QR codes are used to provide information about plants. As continuous monitoring of the software use occurs, information about how many visitors have been using the data of information base, what languages have been used and what plants have been observed is traced. Such observations allow regulating the flow of visitors. If it is too large, information is blocked and visitors are pointed towards the other direction.

Using a unique code for each point of interest it is possible a precise tracking through an analytics process. Each QR code is a reference or tag, managed by a proprietary platform to perform a short code. Such code comes unreferenced and is linked by software through a database to any object. Since this link is held on a platform, it can be easily modified and can react in different ways given some parameters. This is the case of Scuola di Minoprio, Parco del Grumello and Villa Erba on Lake Como, Parco di Cantù, Parco di Varese (all in Italy). Some new installations as commercial solutions allow to offer both free and paid contents for parks, or three different levels of information to plant nurseries customers, according to their needs (retail, wholesale, maintenance).

Since objects are disconnected from the tags, each code can be recycled or, using the platform, contents can automatically change during some events.

The platform supplies some analytics, like enquirer's idiom and nationality, operating system and browser, timestamps, IP, etc. Using apps is also possible anonymous path tracking while ensuring privacy. Such a solution leads to better marketing and organizational strategies. One example has been Orticolario 2016, maybe the most important consumer gardening event in Italy. Using data collected the previous year, there has been a smarter booths allocation and people has spread almost uniformly around the park, offering the same opportunities to all exhibitors.

Even if a QR code could hold several thousands characters, almost no one uses this opportunity. QR codes are mostly small texts or numbers or links to web pages.

The side effect is this solution requires an Internet connection. While usually this is not a problem for domestic users it can be very expensive for foreign visitors. The most used answer is a WiFi access point, but it is not always affordable, especially when there are thousands simultaneous users, like at a popular event, or when there is a wide and uneven area. A different approach is under development, combining both QR codes and sensors (Flornetwork R&D).

Experience of using QR code in Lithuania

In Lithuanian green areas the use of QR is not widespread. It started as early as 2014 in territories of Vilnius University Botanical Garden and Curonian Spit National Park. In 2016 its use was undertaken in Plunge Manor and the green area of Kaunas State Musical Theatre (Table 3). Codes usually mark objects such as trees, bushes, and flowers.

Even 2000 objects are marked at Vilnius University Botanical Garden. When opening the link, particular information about a plant, namely the number of the sample, its Latin name, author of the species name, etc., is provided. In the area of Plungė Manor links to the garden of herbal plants are active (the herb garden as an object with separately marked plants). Links towards historical pages and introduction into plant life could be found at former M. Oginskis Residential Manor. The administration of Curonian Spit National Park has marked different recreational equipment by codes (bicycle stands, wooden tracks, and information boards). In such a way visitors are being directed to the webpage, where they can find all relevant information.

In the green area of Kaunas State Musical Theatre QR codes were used only as a temporary measure (only for one month) during the event “*Good morning, city's green areas!*“ which was opened on October 12th, 2016.

The aim of the project was to get acquainted people with plants that grow within the area, to explain the possibilities of their usage, their importance to individual's life and significance in urban areas. During the event Kaunas city inhabitants and city guests were invited to taste natural teas (using their own flasks). With the help of smart technologies (QR code) they were introduced to assortment of woody plants, growing in the green area of Kaunas State Musical Theatre. Information about the plants was provided in segments according to their interests: for professionals (cultivators), etc. All respondents of the survey point out, that the use of QR code in their institution has been somehow related to activities, which encompass education and recreation. A representative of Plunge Manor additionally highlighted community establishment and historical aspects.

Table 3. QR code in Lithuanian green areas

VILNIUS UNIVERSITY BOTANICAL GARDEN (VUBG)		
		QR code used since 2014
		Marked: trees, bushes, and flowers. (2000 pcs.)
		http://www.botsodas.lt/qr
		The number of appeals to the page by the code ~ 3000
CURONIAN SPIT NATIONAL PARK		
		QR code used since 2014
		Marked: recreational equipment
		http://www.nerija.lt/lt
		No monitoring
PLUNGE PARK		
		QR code used since 2016
		Marked: trees, bushes, flowers, garden and orangery (19 pcs.)
		http://www.plungesparkas.lt
		The number of appeals to the page by the code ~19000
GREEN AREA OF KAUNAS STATE MUSICAL THEATRE		
		QR code since 2016
		Marked: trees and bushes (50 pcs.)
		http://www.kmaik.lt/
		No monitoring

Information on webpage's is provided in Lithuanian or Lithuanian and English. If compared to Italian green areas, information there is translated even into four or six foreign languages. In Plungė Manor and Vilnius University Botanical Garden the monitoring of visiting is conducted via internet access. 19000 visits have been recorded in Plunge. In Vilnius University Botanical Garden links to plants have been opened 3000 times. In comparison, the highest number of QR code reading recorded in Italy Minoprio Park has reached even 38000 times.

Efficiency of QR code as the information storage system was assessed within ten-point scale. Respondents evaluated it positively by choosing the values from 7 to 10 points. As well as this, everybody claimed that they were planning the subsequent development of QR codes in the future.

In summary, it should be stated that the use of QR codes is not popular in Lithuania, although as a tool for educational and recreation institutions it is acceptable.

Conclusions

1. QR codes are ubiquitous. They are everywhere, and they can perform multiple tasks, ranging from simple strings to complex hyperlinks.
2. QR codes are not expensive. They can be printed on every material or used as a digital image without using paper and ink. Also a display can show them. They do not need any particular equipment for their production. Even reading is very inexpensive. Since there are API (Application Programming Interface) and libraries for almost any programming language and operating system, all smartphones and tablets can read them. People already know what a QR code is, and how to read it, so no specific training needed. This makes those codes the simplest and cheapest solution for sharing information when tickets, links, cards, website addresses, products datasheets, etc. needed.
3. Integration between QR codes and proper software applications can widen opportunities and open new opportunities. Today there are many possible alternative uses, and their reading can lead to generation of precise analytics which can be crosslinked with other sources for the creation of new databases, from which new knowledge can derive.
4. Use of QR code in green areas of the cities worldwide varies from educational, recreational to even artistic approach. Coding for education purposes is developed best of all. In recreational territories intended for physical and psychological rest, QR coding of information is also popular. The use of this code provided the possibility to avoid huge information and advertising stands by introducing a significant part of information via code link to the webpage. The use of the code becomes a new tradition, a simplified form of communication that is acceptable for all age groups of the population. In this way, it is gradually becoming a sociocultural part of modern society.
5. QR codes in green areas have been successfully used in Italy. Software, developed on the basis of Italian “Flornetwork” company QR coding system, is intended to both amateurs and professionals (it is suitable for teaching, work and tourism). It’s useful for landscape architects, arborists and gardeners. The software enables to have a consultation on maintenance and formation of green areas as well as identification of diseases, the processed information can help appropriately select the plants. When working with visitors, QR codes are used to provide information about plants. As continuous monitoring of the software use occurs, information about number of the visitors using the data of information base (for example: what languages have been used and what plants have been observed) is traced. Such observations allow regulating the flow of visitors. If it is too large, information is blocked and visitors are pointed towards the other direction.
6. In Lithuanian green areas the use of QR is not widespread. It started as early as 2014 in territories of Vilnius University Botanical Garden and Curonian Spit National Park. In 2016 it was used in Plungė Manor and the green area of Kaunas State Musical Theatre. They were planning the subsequent development of QR codes in the future. The device is efficient and easy to use, it works really fast and today's youngsters enjoy it.

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QR kodo naudojimo želdynuose patirtis ir sociokultūriniai aspektai

(Gauta 2017 m. sausio mėn.; atiduota spaudai 2017 m. balandžio mėn.; prieiga internete nuo 2017 m. gegužės 8 d.)

Santrauka

QR kodas šiuo metu pasaulyje naudojamas ypač plačiai: įvairiose mokymo užduočių pateiktyse, sudėtingu mašinų valdymo, žmonių tarpusavio komunikacijos procesuose, kultūros, mokslo, miestų želdynų erdvėse ir t. t. Kode užšifruota informacija skaitoma naudojant QR skaitytuvus arba mobiliuosius telefonus.

Užsienio miestų želdynuose kodo naudojimas palaiapsniui tampa šiuolaikinės visuomenės sociokultūros dalimi – naujai susiformavusia tradicija, supaprastinta bendravimo forma, priimtina įvairaus amžiaus žmonėms. QR kodas miestų žaliosiose erdvėse yra naudojamas gana įvairiai: švietimo, auklėjimo, rekreacijos, meno tikslais. Labiausiai išplėtotas įvairių tipų informacijos kodavimas švietimo tikslais (botanikos, zoologijos soduose, miestų parkuose, nacionaliniuose, regioniniuose parkuose. QR kodai želdynuose daug metų sėkmingai naudojami Italijoje. Italų firmos Flornetwork QR sukurta programa, skirta tiek mėgėjams, tiek profesionalams (tinka mokymui, darbui bei turizmui). Pavyzdžiui, Italijos Scuola di Minoprio mokyklos parke QR kodai intensyviai naudojami studijų procese. Studentai susipažįsta su augalų veislių asortimentu, atskirų augalų aprašymais, augalo išvaizdos pokyčiais, vaizdo medžiaga. Parke šiuo metu yra koduota apie 200 skirtingų rūšių augalų. Įvairios rūšys, iliustruotos botaninėmis kortelėmis, susietomis su mokymosi platforma leidžia dėstytojams nuotoliniu būdu sekti studentus praktinių užsiėmimų metu, užduoti klausimus bei tikrinti atsakymus.

Italijos miestų parkuose veikia „išmaniosios“ želdinių priežiūros, formavimo, ligų identifikavimo konsultacijos. Davikliai stebi žolės aukštį, dirvos temperatūrą, drėgmę ir t. t. Gautus duomenis naudoja kraštovaizdžio architektai, sodininkai, arboristai.

Lietuvos želdynuose QR kodas, kaip informacinė priemonė, nėra populiarus. Viešojoje internetinėje erdvėje galima rasti informaciją apie kodo naudojimą: Vilniaus botanikos sode, Kuršių nerijos nacionaliniame parke, Plungės dvare, Kauno muzikinio teatro sodelyje. Apklausoje dalyvavę respondentai priemonę įvertino teigiamai, nuo septynių iki dešimties balų (pagal dešimtbalę sistemą). Plungės dvaro ir Vilniaus BS objektuose yra vykdoma internetinių apsilankymų stebėseną. Plungėje fiksuota ~19000 apsilankymų, Vilniaus BS sode nuorodos apie augalus atidaromos po ~3000 kartų per metus. Priemonė patraukli, patogi, ypač mėgstama jaunimo. Visi apklausos dalyviai nurodė, jog ateityje planuojama tolimesnė kodų naudojimo plėtra nežiūrint skeptikų nuomonės, esą QR kodas jau „nueinanti technologija“. Pasak užsienio IT analitiko Braino Morriso, QR ateityje sėkmingai evoliucionuos, o panaudojimo galimybės sparčiai plėsis.