

A Mobile QR Code Application for an Article: QR-ticle

Esra Erođlu¹, Esmā Ergüner Özköç²

¹ Department of Computer Engineering, Hacettepe University, Ankara, Turkey

² Management Information Systems, Baskent University, Ankara, Turkey

Correspondence: Esra Erođlu, Department of Computer Engineering, Hacettepe University, Ankara, Turkey.

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Abstract

With the developing technology, innovations have been started in many areas of life. New solutions based on technology have to be produced for new needs. The Internet has become an indispensable element of life with smartphones and mobile devices. People can access information faster, less costly and independent of time and place by using mobile devices. As a requirement of the Internet era, many businesses support their business processes, services and products with their mobile applications. Academic institutions and publishers also need to keep up with this mobile transformation. In this study, a mobile application (QR-ticle) has been developed which provides reliable and fast access to the publication related to the references given in academic publications by using QR code. With this application, scientists will be able to create QR code for their own articles and will be able to access any of the articles by scanning the QR code.

Keywords: quick response code, mobile application, article citation, security, hash algorithm

1. Introduction

1.1 Definition of QR Code

QR codes have been used in the industry for many years in the form of classical barcodes and product tracking. After that, with the developing technology, the classic barcodes remained insufficient to meet the increasing needs. Barcodes are one-dimensional codes and can encode data of 20-40 characters, but QR codes can contain higher capacity and different types of data (Taveerad & Vongpradhip, 2015). Therefore, QR code technology has been developed and it can be coded as high capacity.

Data types as well as their size is small and fast to decode even if it is damaged, usage area is increasing day by day (Chatterjee et al., 2018). Especially in media such as books, magazines, posters, web sites, etc. web pages are used to enable users to be redirected to pages without typing the long URL address. It helps to establish a connection between real and virtual world in order to communicate with users in printed media tools (Shin et al., 2012).

The QR code is a 2-dimensional barcode system developed by the Denso-Wave company in Japan, which is the initial letter of the Quick Response. Firstly, it was used to drive traces of automobile parts produced during vehicle production. Later, it has been opened for free use in order to increase the area (Chatterjee et al., 2018). It is possible to transmit many different types of content, such as text, video, images, to QR code. With the development of technology, it provides easy access to daily life events such as bank transactions, advertising, surveying, product information control and address finding. Especially with the increase of mobile applications, QR code usage is becoming more widespread. According to the statistics provided by ScanLife, the use of QR codes reached a limit of 3.1 billion in the third quarter of 2017. In addition, this ratio is expected to reach 5.3 billion in 2022 (ScanLife, 2018).

1.2 Related Works

In the literature, the QR code is based on 2-D standard barcoding. In this method, data is encoded using specific parameters within an aspect dimension area. 2-dimensional barcodes are developed as one-dimensional coding algorithm and it is aimed to symbolize more information. Therefore, it has the capacity to store 7.089 characters digital data and 4.296 alpha numerical data (Rikala & Kankaanranta, 2012).

Unlike barcodes, there are 30 known types of QR codes (Liu et al., 2018). However, the commonly used QR code structure consists of 5 basic areas and sample codes used in these areas are shown in Figure 1.

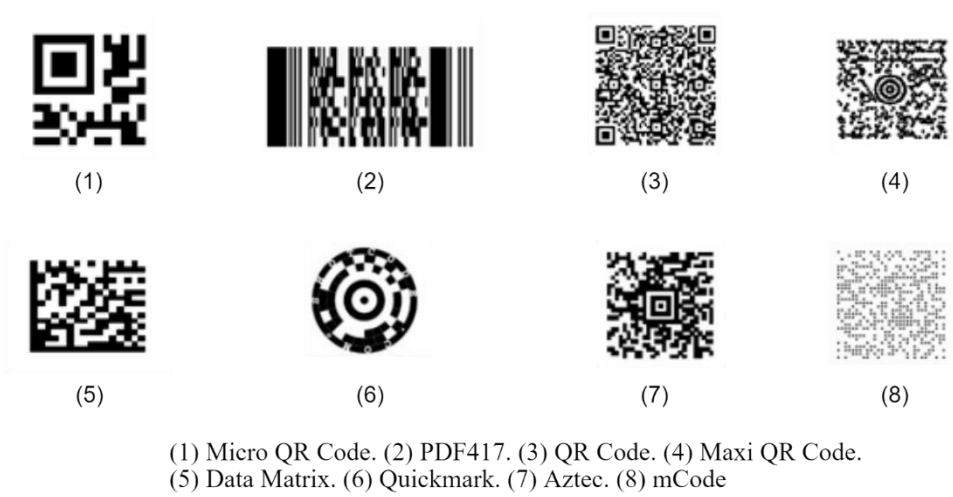


Figure 1. Types of QR codes. (Liu et al., 2018)

Figure 2 shows the structure of the QR code. The first region has represented to identify the version of the QR code. The second zone has error correction levels and the information in the second zone is read firstly. Data is stored in the third region. The fourth region consists of finder, alignment, and timing pattern. The Finder pattern is located on three corners of the QR code and is the detection model required to read the QR code. The alignment pattern is used to correct a possible error in the code. The timing pattern is important for correcting the code and correcting the coordinates. The fifth region is an empty field for correct reading of the code (Thomas & Goudar, 2018).



Figure 2. QR code structure (Thomas & Goudar, 2018)

QR code usage has placed in magazines which is one of the printed media tools and it has ensured that the content of the code has read by mobile devices. It allows to access information without being time dependent. It provides transformation to digital media via QR codes from traditional communication tools. For this purpose, it is not enough to find the QR code in any documents, also the QR code readers need to be installed on their mobile device. In addition to the complete and undamaged production of the QR code, the size of the paper and the size of the code are important. The reason for this is that the cameras of the smart devices are affected by light when the code is read (Pandya & Galiyawala, 2014). The QR code is associated with the scanning distance

between mobile devices (Böhmer & Ruthardt, 2014).

One of the QR code examples used in academic field is the library of the University of Bath. Users can quickly access information about the book by reading QR codes in the catalogue search of books (Chang, 2014).

A journal in which QR code is used in scientific journals, is the Journal of Bone & Joint Surgery. In this journal, a QR code has been added to the title page of each article and when the reader scans this code, it accesses an accompanying video. Then the journal reader can watch the surgery performed with the background music (Figure 3) On the last page of the article with another QR code to additional material, the reader can display additional material that is not included in the PDF file.



Figure 3. QR code example of the Journal of Bone & Joint Surgery

Moreover, previously developed QR journal mobile application generates the QR code of only the URL information of an article (QR Journal, 2018).

It is a fact that QR codes usage is increased with the development of technology. In this study, proposed mobile application is not provides only the URL link to the article, it also shows the brief information about the article such as title, abstract and URL that is differs from previously developed mobile applications. Another important difference is proposed application makes integrity check of the URL link which details are given in the next section.

2. Method

2.1 Tools and Library

Science is a process that is developed following the oral or written presentation of studies by scientists, and in this process, the analysis of the actual studies on which new developments plays a major role in the development of science. In scientific articles, the importance of the content as well as the cited articles in the article, the usage of electronic resources, the language of the article, and many other factors are of great importance (Fahimnia et al., 2015).

In this study, we have developed a mobile application for academic articles by taking advantage of the QR code method. The application is implemented using the Java programming language and ZXing library (Ohigashi Oasay, 2011, ZXING QR Code Library, 2010) under the Android studio platform. Furthermore, we have benefited from hash functions for URL addresses of articles within the QR code to make the application reliable for users.

Cryptographic Hash functions produce an output with a specific length, regardless of the size of the input they receive (Rivest, 2011). Hash functions are One-Way Algorithms which means it is not possible to return to the original text from the result of the algorithm (Ratna et al., 2013).

The output produced is specific to the input supplied. The same input produces the same output and cannot be identical with the output of two different inputs (collision resistant). For these reasons, SHA1 hash algorithm was used to ensure integrity of the URL in proposed application. SHA1- Outputs a fixed length of 160 bits (Pamungkas et al., 2006).

There are some basic security rules for QR codes. The first rule to be considered is that QR codes, which are untrusted are not downloaded to mobile devices. It is more useful to preview such QR codes. The other prevention is that users should not give their personal information to every website because the user information is likely to be stolen after scanning the QR code, even if the QR code does not show an abnormal condition. Therefore, the QR code generated by the application must ensure that the information contained in the code must be given to users.

In addition to these, if the QR code contains URL information, the https statement must be added especially for the e-commerce sites. Another precaution is that if the QR code is intended to be used publicly, such as advertising, promotion, etc., the creation of the QR code with the trademark symbol of the company will be more accurate in terms of reliability (Narayanan, 2012).

2.2 Proposed Model

In our study, we propose a secure mobile application for article access by using QR codes. An application has two main phase which are:

- (i) generation of QR code
- (ii) scanning of the QR code.

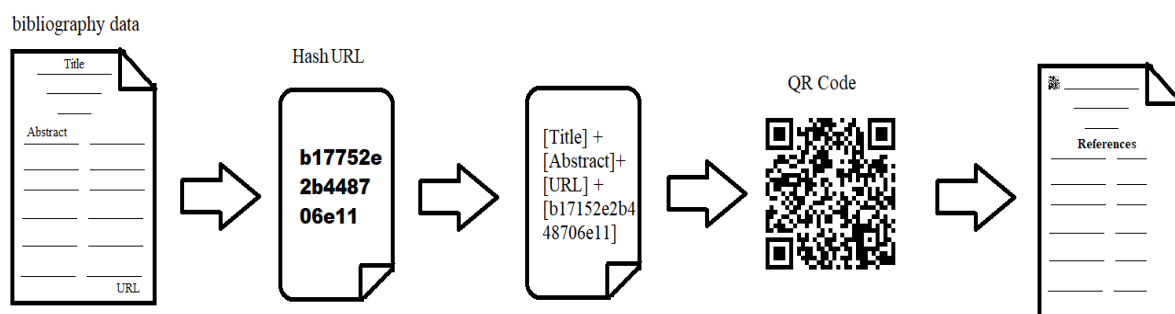


Figure 4. QR code generation in QR-ticle

(i) Generation phase - In the generation of QR code phase, the information required for the creation of the QR code is entered by the user and the QR code is generated. As seen in Figure 4, an article with URL information is used for this model. URL information is processed with the hash function. The title, abstract, URL and hashed URL information of the article are added to each other to be used in the application and saved as a new string. Creation of the QR code is done using this new string. The resulting QR code belongs to the related article and this code can be scanned by the QR code reader. For this reason, the QR code created is placed in the related article.

1. User clicks on the "Generate" button to generate QR code for the article
2. User types the title, abstract and URL information of the article
3. Application calculates the hash of the URL information which is entered by user in previous step
4. Application creates the QR code by using title, abstract, URL and hashed URL
5. User saves the generated QR code as an image in the gallery on mobile device

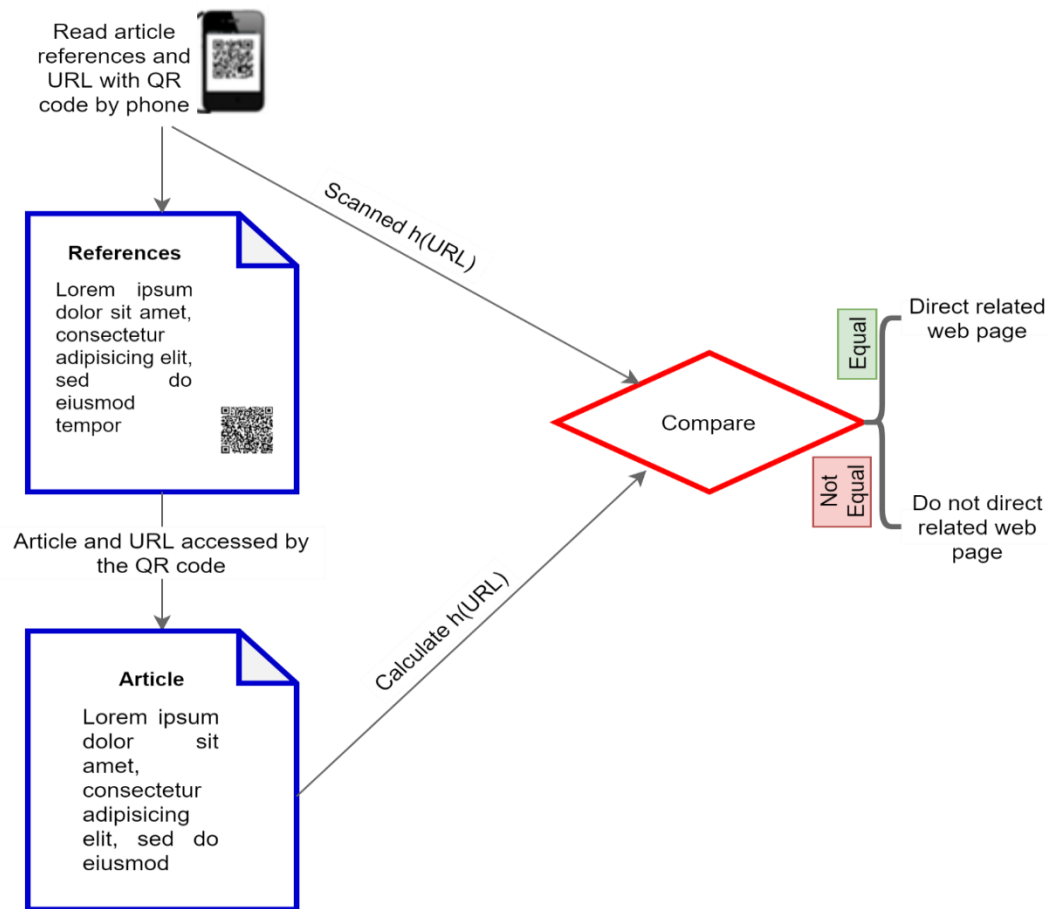


Figure 5. QR code scanning in QR-ticle

(ii) Scanning phase - In the Scanning QR code phase, the previously created QR codes which also can be in references of the article or article itself are read and the information of the relevant article is presented to the user. At this stage, the integrity of the previously entered URL information is checked and if it is approved, the user is given access to the article link, as seen Figure 5.

1. User clicks on the "Scan" button on the start screen
2. Application displays the title and abstract of the article
3. User clicks on the link button to redirect URL of the article
 - 3.1. Application calculates the hash of the URL and checks with the hashed URL which is created on generation phase
 - 3.2. Application redirect the user if both hashed of the URL are identical
 - 3.3. Application gives the alert if calculated hash and scanned hash are not equal. And application does not show the URL of the related article

The content of the QR code to be generated by the application consists of the title, abstract, URL address of the related article and hashed URL address. This allows quick access to the article when the generated QR code is scanned. The purpose of using hashed URL is to ensure the integrity of the URL link that the user enters. Application detects changes in the entered URL that can be done by malicious people by checking the hashed URL.

4. Conclusion

The purpose of the mobile application is to help scientists gain access to articles faster, easier and reliable. With the QR-ticle, scientists can create and share QR code for their own articles, as well as access to an article they want by scanning the QR code. While the QR-ticle facilitates access to the article, it also checks the integrity of the access link. The generated QR code contains the title, abstract and access link of the article. In order to maintain the

integrity of the access link, the hashed link is also included in the generated code. Thus, if the link is changed by malicious people, the link will not be given to the user by QR-ticle as it will not match the previously created hash. The citation analysis is a numerical analysis of the publications produced by individuals or institutions in a given topic in a given period and in a given region. It examines the connections between cited articles. In addition, as a result of analysis, the frequency of cooperation between institutes and authors and the links between the subjects studied can be revealed. For future work, our application will be structured to support cite-analysis.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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