

QR Codes Telling the Story about the History of Niš

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Abstract. Contemporary visitors expect to interact and get more information about exhibitions that they visit by using information technologies. Therefore, in this paper we discuss a system that we developed to enable an improved presentation of some of the most famous cultural monuments in Niš using QR codes. The system allows to easily add interactive content for cultural and historical objects, in the form of text, images, sounds, or 3D models. These contents can be accessed by using QR codes. The QR codes are implemented as purposely-designed plates, in accordance with requirements by professionals from the heritage protection institutions. Scanning of the codes using mobile devices (smart phones, tablets, etc.) provides additional information to visitors in multiple languages and in a variety of multimedia formats. The provided data are about facilities, personalities, and events that monuments mark. The discussed solution is, using web technologies, made to be cross-platform and adaptable to any resolution.

Keywords: Cultural heritage, QR codes, Niš history, mobile applications, historical monuments, historical buildings.

1 Introduction

Current trends in information technology contribute to the tourist expectations during visits to cultural heritage sites. Aside from printed booklets or textual panels, contemporary tourists require more information which can be provided using modern technologies during the visit of museums, archeological sites, and other historical places. They expect to interact with historical objects of their interest, see multimedia content, search and get more information about it. Therefore, in order to attract and inform visitors, cultural institutions need to create innovative solutions according to recent information technology (IT) trends [1] [2] [3].

In recent times, smart mobile devices became the standard information platform used in presentation of historical sites [4]. Creating dynamic content that can be used in interaction between the tourists and historical objects using mobile devices can lead to attracting larger audiences at cultural exhibitions. When the cultural heritage site is presented in this way, tourists can inform themselves according to their particular interests and in an appealing way [5]. They can walk through and see interactive sce-

narios in form of video, audio, and 3D models, using only screens of their mobile devices [6].

Numerous applications and technologies for mobile devices have been developed with intention to create fast and interesting content to tourists. A typical approach for the realization of these applications is to embed all content in the application. In that case, tourists must download and install the application before visiting cultural heritage sites. In this way, all virtual content becomes available during visits and there is no waiting time for servers to respond. A drawback of this approach for presentation of cultural heritage, in which applications have to be downloaded and installed in advance, is that this requires additional time for the preparation of visits.

Another way is to download only the application without content. During the visit, tourists on demand download content from the server for certain sphere of interest. In this way, only parts of the application are transferred. A disadvantage of this approach is the time needed for the download, which also affects visit and relies on the type of network connection.

Therefore, in this paper we present a system based on quick response (QR) codes, in which we tried to respond to user's interests without any installation and preparation needed. The system is based on web technologies, which makes it easy to be viewed on any mobile platform. By scanning the QR code, visitors get the information about the historical monuments in the city of Niš.

The paper is organized as follows. In section 2, we describe the functionalities of the system. Section 3 discusses the implementation of the system. The final section offers some conclusions and directions for future work.

2 Functionalities of the System

Our solution is based on the fastest and the easiest way to provide virtual information about the history of the city to visitors. This is realized with the QR codes which represent the standard for quick accesses of virtual content. Visitors nowadays are mostly aware of this kind of interfaces which represent objects of interaction. Upon scanning this kind of codes, visitors get the multimedia information about the monuments of interest on their mobile devices. Multimedia information about historical data is in the form of text, audio, video, or 3D models. All this historical data are presented as HTML5 elements, so that they can be easily viewed on any device, therefore, representing a cross platform solution. The structure of the system is presented in Figure 1.

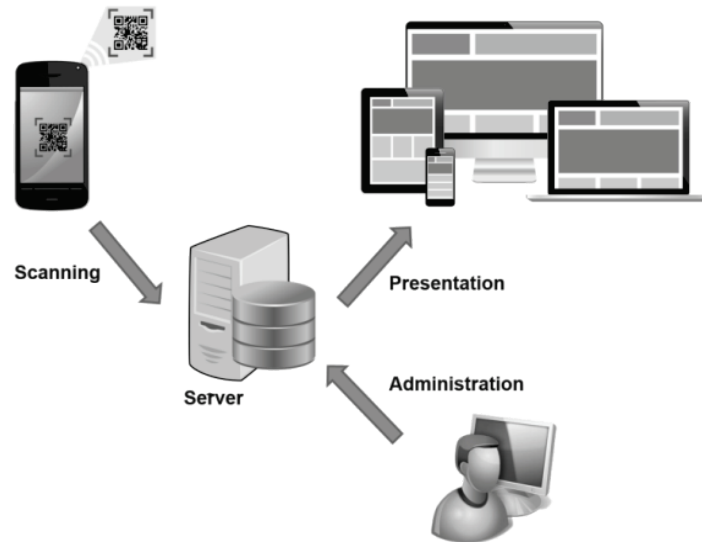


Fig. 1. Structure of the system.

Historical content is defined using administrator panel of the system. This panel uses simplified insertion of data that will be presented to the visitor. Through this panel, layout of the final page is also defined. In this way, editing of content is also enabled so that it can be easily changed or deleted. All multimedia elements are connected with the webpage by the paths to the repository folder. Repository is well organized with the multimedia folder placed on the external server. After creation of webpage elements like paths to virtual content, layout and link of a webpage are stored in the MySQL database. Afterwards and based on the created link of the web page, QR code is generated.

Upon its creation, a QR code is inserted into specially designed plates which are positioned in the open space near the monument or attached to the monument. Accordingly, the code is formed to be readable from reasonable distance which is comfortable for the visitor to scan from. After scanning the QR code on the monument plate, a visitor can read the link using his mobile device. This link connects visitor's browser with the corresponding server which provides previously generated historical content. As responsive design is implemented, content adapts to the resolution of the mobile device. Implemented multimedia elements are streamed immediately from the repository after webpage is loaded. The virtual content has to be optimized for faster downloading and smooth viewing. In particular, it is important that 3D models are render in a low number of polygons with materials and textures selected and applied to serve the same purpose. This also assumes that the resolution of photos and videos is reduced and adjusted to the typical screen resolutions for mobile devices. Number of monuments, which can be displayed, is unlimited with respect to the fact that all data are downloaded from the server and the multimedia content has been optimized for fast downloading.

3 Implementation of the System

The system is designed so that it can be easily adapted to requirements of the Institute for the Protection of Cultural Monuments Niš, which is responsible for the implementation of QR codes on the cultural heritage objects. According to the requirements specified by the experts from this institution, we had to create specially designed plates for presenting the virtual content. Besides the creation of plates that correspond to specific design requests, we had to choose materials that are resistant to various weather conditions. Positions of the plates had to be set at a reasonable distance and dimensions had to be set so that visitors can notice them and scan without special effort. According to the type of an object, two types of plates have been designed: monuments and facades of buildings.

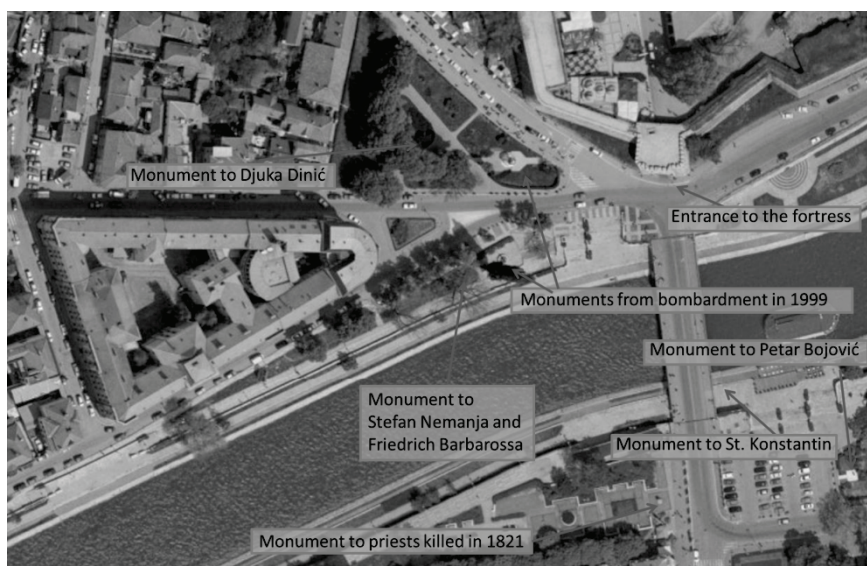


Fig. 2. Monuments on the University Square.

Viewing the information about historical monuments is done on the visitor's mobile device using multimedia technologies. Upon scanning, webpage offers visitors possibilities to choose, depending on their affinities and available time, information about the objects. In this way, visitors can choose between audio, video, or text in the selected language or interact with implemented 3D models in order to see reconstruction of cultural heritage that existed at their current location.

Multimedia content requires special preparation for mobile devices. Audio materials are prepared in the MP3 format with 44.1 kHz bitrate and 64 kbps because only narrative voice was recorded. Video is done in the MP4 format with the H.264 codec in the resolution of 720 by 480 pixels and using the bitrate of 768 kbps. Generated 3D models have a low number of polygons (about 1000 to 4000 polygons) and are stored in the .OBJ format.

3.1 Monuments

At this small square, there are several monuments from different periods of the Nis history. These monuments are: monument to Djuka Dinić, Stefan Nemanja, and Friedrich Barbarossa, Petar Bojović, Monument to the priests killed in 1821 and two monuments to the victims of NATO bombardment in 1999.



Fig. 3. Plate in front of the monument to the Field Marshal Petar Bojović.

Considering environment and type of the monuments, we were instructed to place plates near monuments. Therefore, we created aluminum plates that have special foil resistant to the snow, rain, heat, and violence. The monument to the Field Marshal Petar Bojović and the way the plate is placed is presented in Figure 3. After scanning the QR code, a visitor can download the content inside browser, as shown in Figure 4. The content is presented in Serbian and English. Visitors are able to read the story about this monument and see the pictures, but they can also choose the audio story about the monument.

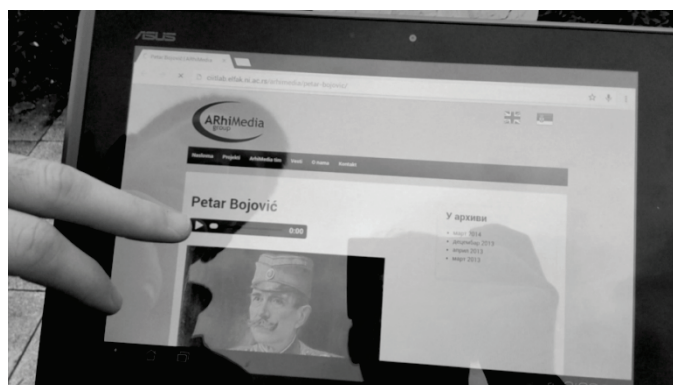


Fig. 4. Content becomes available through browser after scanning the QR code.

3.2 Building Facades

With intention to create virtual information for the historical buildings in Niš, we had to create special plates that would be neutral in the architectural sense, i.e., not to affect the facade of the building. In order to satisfy that requirement, we created transparent plates with gravure QR codes that are resistant to weather conditions. The plates are currently placed on the following historical buildings in Niš: the Courthouse, the National Theater, the Main Post Office, the University of Niš, and the Synagogue. Figure 5 shows the Courthouse and the implemented plate. After scanning and downloading the multimedia material from the server, a visitor is able to hear or read the story about the building. Also, a video begins streaming after the activation of the video player. Visitors are also able to see how trams once use to cross the street in front of the building or see the building as it looked with two floors instead of the three floors that it now has.



Fig. 5. Design and position of the plate for historical buildings on the example of the Courthouse in Niš.

4 Conclusions

Presenting national heritage to the visitors using information technologies is a challenging task. Therefore, showing content to the visitor in the most appropriate way should be considered from the view of his interest and available time.

In this paper, we presented a system based on QR codes which are used to provide virtual information immediately upon scanning. The content is adaptable and can be viewed from different platforms and in various resolutions. Different multimedia forms like audio, video, text and 3D models, can be included and arranged in presentations using administrator panel of the system. Numerous presentations of cultural heritage and monuments can be generated, since data are stored at the server. It is necessary to add plates with QR codes on monuments in order to provide information.

The presented solution was verified at the historical monuments on the University Square and on some of the historical buildings in the city of Niš, Serbia. The application of QR codes in the presentation of cultural monuments was conceived as a web-oriented solution, since its ease-of-use and the common practice of interaction with QR codes.

In the next phase, it is planned to create stand-alone applications to solve the problem of those visitors who do not have Internet access. In that case, a visitor should prepare in advance, i.e., download the desired content before visiting historical sites. In order to go further with the implementation of this solution, we are preparing content for 100 facades of historical buildings in Niš, in cooperation with the Society of Architects of Niš. It is also expected that the system will be used at the monuments in the Niš Fortress, in cooperation with the Institute for Protection of Cultural Monuments Niš and the Historical Archives of Niš.

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