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MONUMENT TO THE LIBERATORS OF NIŠ RELATES TO US THE HISTORY OF THE CITY

Abstract. Mobile devices, such as smartphones and tablet PCs, have become widely used modern-day information platforms. In this context, mobile devices can also serve as a convenient means of establishing interaction between historical sites and visitors, to enrich the cultural tourism offer. Providing precise multimedia-based information for a visitor at a historical location can be achieved by an augmented reality (AR) technology-based application on their mobile device. In this paper, we present an application based on AR technology aimed at providing information about historical events that took place on four specific years and which are inscribed on the four sides of the Monument to the Liberators located in the main square of the City of Niš, Serbia. By recognizing the reliefs at the bottom of the monument, each of which corresponds to an important event in the city's decades-long struggle for liberty, the visitor can be immersed in a historical context through specially prepared multimedia content. The technical aspects of the implementation of the application and the on-site informing of visitors on its availability are also briefly discussed.

Introduction

Institutions such as museums, archaeological parks, or tourist organisations are trying to attract visitors by presenting historical and cultural heritage in a contemporary way. Therefore, information technologies are widely included in the presentations of historical locations in order to enrich the cultural truism offer. This is the subject area of research of the ARhiMedia group which works under the auspices of the Laboratory for Computational Intelligence and Information Technologies (CIITlab) at the Faculty of Electronic Engineering in Niš, Serbia, and is engaged in the projects of the Mathematical Institute of SASA, Belgrade, Serbia. These projects in general deal with the digitisation of the historical, cultural, technical, and scientific heritage of Serbia [1, 2, 3]. Therefore, various IT solutions have been realised for the City of Niš, Serbia which is renowned for its long and rich history.

A part of the research activities of the ARhiMedia group are directed towards:
1. Reducing cost and maintaining the efforts of hardware components of systems for providing multimedia-based information content about the historical heritage of Niš.
2. Improving interaction and increasing the personal engagement of the users of such systems in getting information which is most relevant and best suited to their personal interest.

In addition, significant effort has been put into presenting different historical periods correctly and uniformly in the long history of Niš, from Neolithic times to date. For an illustration of the related activities of the group, we point out the following.

In August 2015, the Digital Mini Museum was set up in the building of the Turkish Arsenal near the main entrance of the Fortress of Niš [4]. The Museum is equipped with various purposely designed devices for different ways of projecting multimedia content. Efforts were made to reduce the cost of the devices by using inexpensive hardware. In that respect, it is worth mentioning that all the devices are based on Raspberry Pis and memory cards, which allows for a fast and easy exchange of information content to be projected. Still, some periodic maintenance is required, and the engagement of the visitor is reduced to watching the offered content with the freedom to select the order of the presentations according to their own preferences.

In a series of small projects, the monuments in Niš have been equipped with small plates presenting the names of important persons and dates of events to which the monuments are dedicated [5]. Each plate contains a QR-code, which when read leads to a web site with more detailed information for the user. The same was done for several important buildings in the City of Niš, which are also marked by corresponding plates providing information about their history. The cost of making and maintaining the plates is negligible, and the engagement of the user is slightly greater.

A step further in the same direction was taken in a recently developed application that is presented in this paper. The application provides information about the important events that took place on four specific years, engraved onto the Monument to the Liberators of Niš. No additional labels, QR-codes, or anything similar is required, since an AR-module directly recognizes the reliefs on the monument.

What follows is a detailed account of this application, starting from the motivation behind it, through the organisation related to it, the structure of the application itself, and its implementation.

The Monument to the Liberators of Niš

The valley of Niš was inhabited as early on as the Neolithic period. Located on the crossroads of trading routes from the North of Europe to Greece in the South of Europe, and from West Europe to the Middle East, the city of Niš was the subject of interest of many powers, from Roman times, through the Middle Ages, until the very recent past. Due to its geopolitical position, and due to related military and economic reasons, the city has been conquered, destroyed, liberated, and rebuilt many times.

There were several rebellions and struggles for liberation from Ottoman occupation. One of the most important events was the organization of the Liberation Committee in 1874, which led to the liberation of Niš in 1876. Less than four decades later, the First World War broke out, and Niš was once again occupied in 1915. Its liberation in 1918 looked to be an event promising a brighter future, and the citizens of Niš decided to erect a Monument to the Liberators of Niš, dedicated to the memory of all these who fought for its freedom.

The monument itself has an interesting decades-long history, from the initial idea to its final erection in the main city square named after King Milan, the leader of Serbian troops liberating Niš at the end of 1876 and beginning of 1877. Located at the front of the main bridge leading to the central gate of the Fortress of Niš, the monument, which in the local slang is referred to *kod konja* (or 'next to the statue of the horse'), is a very popular meeting point. This was the motivation behind developing an application which will provide related information through modern information technologies and mobile devices which are typically well-mastered by most of the younger citizens or visitors of Niš.

The Monument to the Liberators (Figure 1) was built on June 28, 1937, based on the designs of the sculptor Avgustin Augustinčić, sixty years after the liberation of Niš from Ottoman occupation. The monument, made of black marble, has on its top the sculpture of a Moravac soldier riding a horse, which symbolises freedom. Below the horseman sculpture, there are sculptures of warriors from different periods throughout history, symbolizing the struggle for liberty.

Figure 1. Monument to the Liberators

On the pedestal of the monument there are four reliefs (Figure 2) devoted to particular events that took place during four specific years of importance for the liberation of Niš:

- 1874 saw the beginning of the conspiracy against Ottoman occupation in Niš. The relief presents the priest Petar Ikonomović and a group of rebels taking the solemn oath for fight against the occupation by all means;
- 1877 is the year when Niš was finally liberated from Ottoman occupation. The relief shows King Milan Obrenović entering the liberated Niš with his army;
- 1914 saw the beginning of the First World War, and Niš was the war capital of Serbia until October 1915, which is the year engraved on one side of the monument. The relief shows King Aleksandar Karađorđević signing the Niš Declaration that specifies the war aims of the Kingdom of Serbia in the First World War, on December 7, 1914. The declaration states that the Serbian government will fight for the liberation of all South Slavs from foreign rule and will work towards establishing a common state after the war.
- 1918 marked the end of the First World War, and Niš was liberated on October 12. The relief displays King Aleksandar Karađorđević entering the liberated city of Niš with his army.

Figure 2. Reliefs of the Monument to the Liberators

Since these reliefs symbolise important historical events, the ARhiMedia group made an application for mobile devices, such as smart phones and tablet PCs, which after recognising the reliefs provides multimedia content with details about the related events. Therefore, AR technology was used as a narration tool for historical facts in multimedia form. A detailed description of the application is provided in the following sections.

Technologies

The application is realized as a Multimedia guide [6] with modified modules prepared in the style of treasure hunt games. Roughly speaking, the goal of these games is to unlock hidden content at a specific location. We borrowed the same principle in the sense that augmented reality is used to unlock the historical content at the location of the monument via interaction with the monument reliefs.

Unity software, as a leading multimedia and game engine, is used for the realization of the application. Also, this engine supports cross-platform publishing of multimedia projects, and we used it to export our solution as the application is for both Android and iOS mobile devices. The augmented reality module is realized by EasyAR SDK, where image tracking is used for relief recognition and to open the multimedia content.

Application modules

The application consists of three main modules that are realized as scenes in the Unity.
1. The Main Scene – the navigation module,
2. The AR Scene – the augmented reality module,
3. The Info Scene – the multimedia module.
    Each scene has a header and footer for a short text, an image thumbnail or a button, while the body is meant for the main content placement.
    The Main scene is presented when the application starts. The body of this scene consists of a text element and buttons. The text element contains preliminary information about the monument and short instructions on how to use the application.

Buttons on the scene help the user navigate through the application. Five buttons are placed on the body of the scene. The first button opens the AR module. The other four buttons are linked to the Info scene. These four buttons are disabled until the user unlocks the related content with the AR module. When the user recognizes a relief with the AR module, this enables the information about the event in the year engraved on this side of the monument to be activated. Therefore, this part is unlocked and made available through a button on the main scene.

The AR Scene realizes the augmented reality module which can be activated from the main screen. After the activation, the user needs to point the camera of their mobile device towards one of the reliefs on the monument. The body of the AR Scene presents the image captured by the camera. When the relief is recognized, the info button appears over the image of the relief. This button guides the user to interact and open the information about the relief stored in the Info Scene. After this interaction, the content is activated and can be viewed from the Main Scene.

The Info Scene defines a multimedia module that describes the content of the relief in multimedia format. This content can be accessed either through the AR module or from the Main scene if the button linked to this module is enabled. When the Info Scene is opened, the corresponding textual information about the recognized relief appears in the body part. Instead of reading, the same textual information is recorded as an audio file which can be activated by a button in the footer of the scene. The click of the button begins the reproduction of the narrator's voice. Also, the body part presents the image gallery in the form of thumbnails. By choosing a thumbnail, the image gallery is opened. Therefore, the user can view a larger size image and do a pinch to zoom. Other images in the gallery are opened by swiping the current image or via corresponding buttons.

The Application Structure

The application is freely available for download through the Google Play and App Store for Android and iOS mobile devices, respectively. When the application is installed and opened, the Main Scene appears with several visual elements on the screen. The header contains the title of the application, a language button, and an exit button, while the footer contains the button leading to the Impressum. The body contains brief information about the author of the monument and the year when it was built. Another shorter text explains how to use the AR module in the application. The AR button enables the start of the AR module, and below it there are buttons which open the multimedia information to the user. These buttons are disabled until the AR module unlocks the related content.

When the AR Scene starts, the user can scan a relief on the monument. The four reliefs that are a part of the monument are prepared as images for recognition by the AR module. When any of these reliefs is recognized, an information button appears on the screen. By clicking it, the multimedia content about the relief is presented via the Info Scene. Also, the button on the main screen dedicated to this relief is enabled. Therefore, if all four reliefs are scanned, all the related buttons on the main screen are unlocked and enabled, opening the multimedia content in the Info Scene. After that, the multimedia information about the relief can be accessed via the buttons from the Main Scene and the AR Scene.

The Info Scene contains the title and the back button in the header. The body of the scene contains textual information about the event presented in the relief. A button in the footer activates the audio player that reproduces the text recorded by the narrator.

Also, thumbnails of the images for the related year are provided. The thumbnails are intractable and can be viewed in the image gallery.

Use case

The Main Scene, shown in Figure 3, presents the menu of the application for the Monument to the Liberators. The first menu button starts the AR Scene for the recognition of the reliefs. The four buttons below it are links to the multimedia content related to the events represented by the reliefs. As noticed above, initially these buttons are disabled until the relief is recognized by the AR Scene.
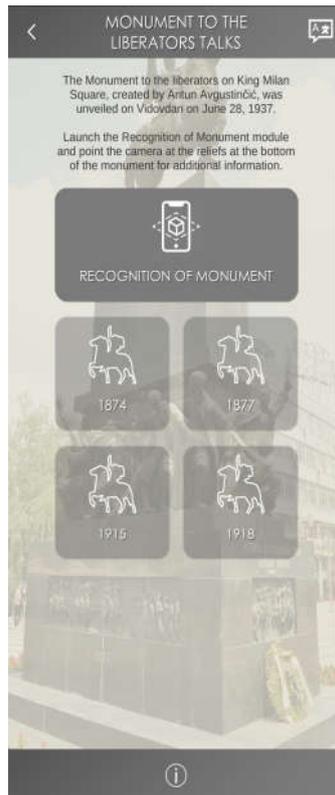

Figure 3. Main Scene of the application

Figure 4 illustrates how the multimedia information about a relief can be unlocked by clicking the info button.

Figure 4. The AR Scene of the application recognizing the relief for the year 1874.

Figure 5 (a) shows the layout for providing the textual information, the photo gallery as a series of thumbnails, and the sound icon in the footer used to reproduce the narration. By clicking on a thumbnail, the photo gallery opens (Figure 5b), offering an opportunity to zoom in.

a

b

Figure 5. The Info Scene of the application related to the year 1874 (a) and the gallery of the application (b)

When the user returns to the Main Screen, the button for the year 1874 is unlocked. Figure 6 (a) shows the screen of the mobile device with this button unlocked. Figure 6 (b, c, d) show the AR Scene for the other three reliefs.

a

b

c

d

Figure 6. The Main Scene with the unlocked 1874 button (a) and AR recognition for the other reliefs (b, c, d)

Figure 7 (a, b, c) shows the appearance of the information provided by the AR module after recognition of the reliefs, after all four buttons are activated, Figure 7 (d).
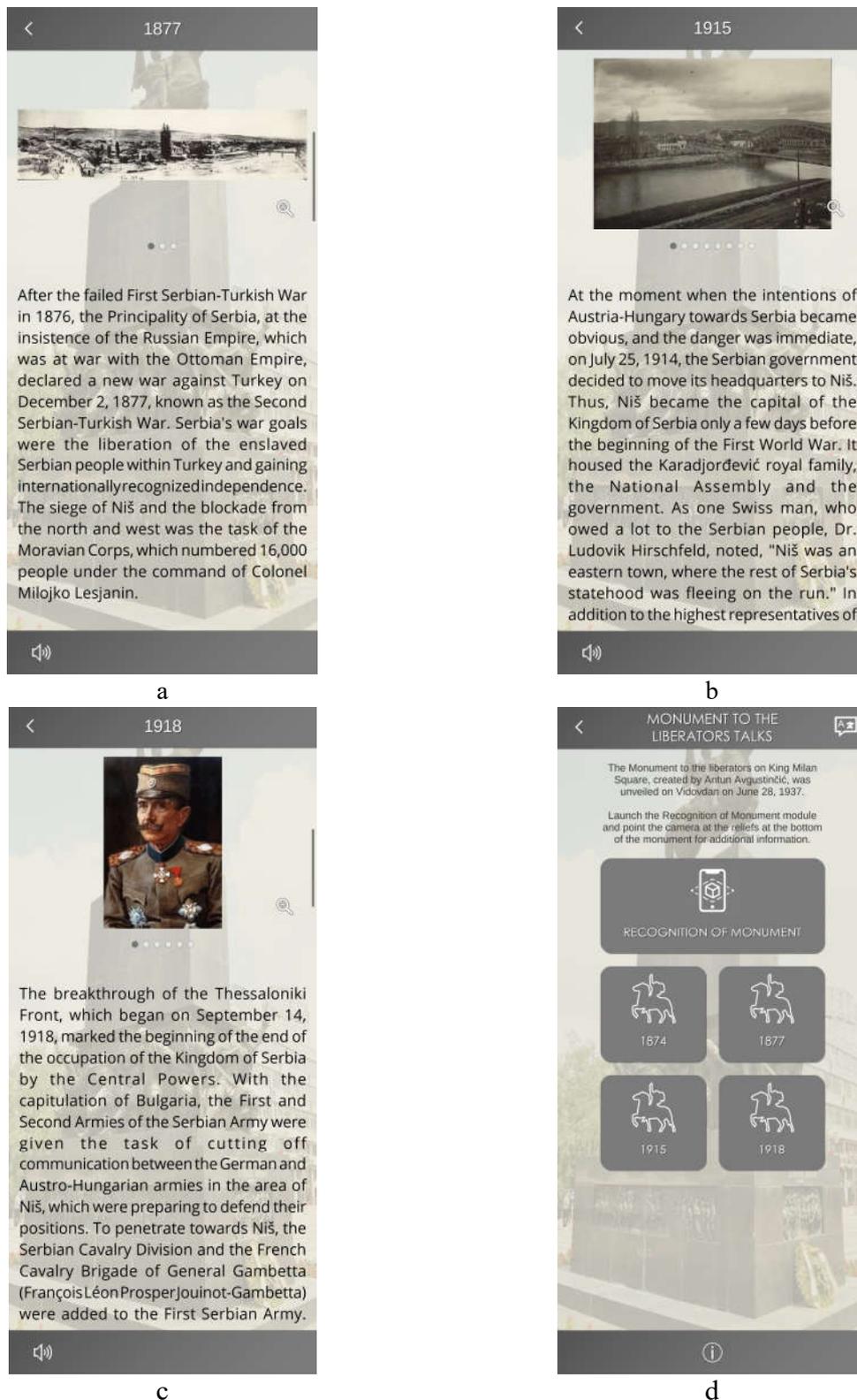

a

b

c

d

Figure 7. Information provided after augmented reality recognition (a, b, c) and the Main Scene with unlocked buttons (d)

Conclusion

Digitisation of cultural heritage is an important task due to the demands and expectations of contemporary visitors. Mobile devices are a convenient vehicle for bringing information to the users in an attractive and visually appealing manner.

On the other hand, it is the duty of everyone to learn from history and spread information about the events from the past. Combining these two ideas led to the development of mobile applications presenting historical events. The mobile application dedicated to the Monument to the Liberators located in the main square of the City of Niš is an example. The application is realised by using AR technologies to provide multimedia information about historical events, by recognizing the reliefs on the monument dedicated to particular years in the decades-long struggle for freedom. No information tables, additional labels, or other ways of conveying information to potential users are required. At the same time, the user takes an active role in getting the information in the way most convenient for them, in the form of a text, audio content, or photos.

Acknowledgments

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