Presenting Bulgarian Cultural and Historical Sites with Panorama Pictures

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Abstract. The paper presents the application of panorama pictures for presenting cultural heritage sites in an attractive way. High-resolution interactive spherical panorama pictures of several famous locations (churches, museum, bridges) in Veliko Tarnovo region, Bulgaria, and presentation tools on both – mobile application and web pages, were created in a cooperation of MTA SZTAKI and IMI BAS under a joint research project. The paper introduces the latest developments related to the integration of the panorama picture viewer on multiple platforms and specific implementations of panorama pictures presentations.

Keywords: Mobile Application, Panorama Picture, Virtual Reality

1   Introduction

The Institute of Mathematics and Informatics at Bulgarian Academy of Sciences (IMI-BAS) and Institute for Computer Science and Control of Hungarian Academy of Sciences (MTA SZTAKI) conducts an extensive joint research and development work for presenting Bulgarian cultural and scientific assets (Kaposi, et al., 2013).

During the visit of colleagues of MTA SZTAKI to IMI-BAS, high-resolution spherical panorama pictures were prepared in Veliko Tarnovo and Arbanasi, which belong to the most relevant historical sites and popular holiday resorts of Bulgaria. Altogether 17 panorama pictures were taken on 7 famous sights (churches, museum, bridges).

The interactive high-quality photo panorama pictures represent an attractive and impressive presentation technique to discover the details of a site. Due to the developments, the panorama pictures can be viewed on different platforms (Web and mobile). The panorama pictures on Bulgarian churches were integrated into the Web site of the Bulgarian Iconographical Digital Library (BIDL) and the related mobile application (BOOK@HAND BIDL).

The paper introduces the panorama pictures, the latest developments related to their presentation, the integration of the panorama picture viewer on multiple platforms and specific implementations to present the panorama pictures which were created on Bulgarian cultural and historical sites.

2 An Overview of Panorama Pictures

The panorama pictures provide possibility to present sights both indoors and outdoors, in real and virtual environments in an interactive way. The panorama pictures have been present in painting for centuries. Nowadays, the digital photography and information technology facilitates to create and present the panorama view of landscapes, monuments, buildings, rooms, etc.

The panorama pictures provide an attractive and informative way to present cultural heritage sites. The exploration of the selected sights and their surroundings is largely supported with the help of high-resolution spherical panorama pictures. The main benefit of using panoramas is that the details on the image can be easily explored without visiting the site. The panoramas disclose details that the visitors cannot see even on the site. Visitor can look around in the presented environment with the help of panorama pictures. The panorama pictures can be arbitrarily rotated, zoomed in and out, or tilted up and down. The view direction and the zoom rate can be continuously adjusted in the dedicated viewer.

The panorama pictures can be real (or photo) panoramas and virtual panoramas. The real panorama pictures are created from photos taken on the site. Virtual panoramas represent virtual environments. For example, virtual exhibition room can be presented by using panorama pictures where the paintings hang on walls created by computer graphics. We applied 2D virtual panorama pictures to present Bulgarian icon collections in BOOK@HAND BIDL mobile application, which was introduced in DIPP 2015 conference (Márkus, Kaposi, Szkaliczki, Luchev, & Pavlov, 2015). Another application possibility for virtual panoramas can be found in GUIDE@HAND Esztergom mobile application where the mobile device displays the segment of a painting depicting the medieval view of the landscape at the proper direction as the user turns around with the device.

We distinguish two main categories of digital panorama pictures: cylindrical (2D) and spherical (3D) panoramas (Fig.1). In case of cylindrical panoramas, the panorama picture covers a cylinder wall. The user can look around in the cylindrical environment but the top and the bottom is missing from the picture. In case of spherical panoramas, the user can look at any directions including upwards and downwards.

a)

b)

Fig. 1. a) Cylindrical virtual panorama; b) Spherical photo panorama

The spherical panorama pictures have two main formats: equirectangular and cubic. The equirectangular projection is a standard method originated from cartography for mapping the surface of a sphere to a rectangle. The cubic panorama pictures consist of six cube faces containing images and the viewer can look around from the middle of the cube.

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3   The Technology of Preparing and Presenting Panorama Pictures

MTA SZTAKI elaborated and continuously develops further its own methodology for creating, presenting and disseminating panorama pictures. There are several ways to create real panorama pictures:

- The panorama pictures are created from a series of photos. The photos are taken by using a high resolution photo camera, high quality photo lens, Panoramic Head and tripod.. To create spherical panorama, two more pictures are taken in upward and downward directions.
- In a more complex version of the above method, the series of pictures are taken in several rounds, where the camera is tilt upwards or downwards with different angles in each round.
- Cameras with built-in panorama picture functionality can produce a panorama photo in one shot.

After taking the photo series, MTA SZTAKI experts use graphical software to stitch the images into one panorama picture. The result of stitching results in an equirectangular panorama picture. Then it is transformed to a cubic panorama picture, which can be efficiently displayed. We create high-resolution panorama pictures where the size of the cubes is 4096x4096.

We can present the panorama pictures of a sight on multiple platforms including Web sites, Facebook, Google maps, own developed mobile applications and VR glasses. We developed an own panorama viewer in all referred platforms. The viewer was developed in OpenGL for mobile devices (smart phones and tablets) under Android and iOS platforms. The panorama viewer on the Web uses WebGL.

The panorama viewer was developed in Unity and OpenGL for VR glasses. We applied VR glasses in Tourist Information Office in a Hungarian town Miskolc to present inner and outer panorama pictures about some prominent tourist sights and their surroundings (Nagy, et al., 2016). We selected Samsung Gear Headset as VR glasses that can be used with Samsung Galaxy S7 smart phone. The visitors wearing the glasses have the impression as if they would look around at the real place of the sights.

MTA SZTAKI panorama viewer has the following functions which are available on multiple platforms:

- *Display full 360° spherical panorama pictures.*
- *Offline panoramas*. The panorama pictures can be presented without any Internet connection.
- *Hotspots*. The user can set different viewing locations by selecting a hotspot within the panorama picture. The hotspot can load a different panorama picture simulating navigation between panoramas or open a description pane for the specified area of the panorama.

- *Change panoramas from list.* The list is automatically built from the panoramas loaded to the device. The user can change between these panoramas anytime using the list.
- *Music.* Background music can be played while the user is watching the panorama picture.
- *High resolution offline images.* This allows compatibility for high resolution displays and supports zoom functionality.
- *Zoom.* The user can magnify the panorama picture to explore the details.

The same panorama pictures that can be presented in mobile applications, on the Web and on VR glasses can be up uploaded to Google Maps as well. We published panorama pictures created in town Miskolc. We found Google Maps an effective tool in dissemination of panorama pictures.

4 Panorama Pictures on the Web Pages of Bulgarian Iconographical Digital Library

4.1 Bulgarian Iconographical Digital Library

The Bulgarian Iconographical Digital Library (BIDL, available at http://bidl.math.bas.bg) is an web-based environment. Iconographical objects of different kinds and origins have been documented, classified, and "exhibited" in order to be widely accessible to both professional researchers and the wide audience. Services for registration, documentation, access and exploration of a practically unlimited number of Orthodox iconographical artefacts and knowledge are provided by BIDL. The end users can use this rich knowledge base through its interactive preview, complex object search, selection, and grouping. The organisation of the media databases, the representation and description of the digital objects, and the classification of the artefacts in BIDL, are developed according to the recommendations of the international group of museum experts of East-Christian Art (UNESCO/I.DB.I) and the standards of CIDOC/MICMO (Pavlov, Paneva-Marinnova, Goynov, & Pavlova-Draganova, 2010) (Pavlova-Draganova, Georgiev, & Draganov, 2007). The icons, presented in BIDL, originate from the end of the twelfth to the beginning of the twentieth centuries.

The panorama pictures created in Veliko Tarnovo region were integrated into the BIDL Web page. Descriptions were also prepared for the locations in Bulgarian and English languages.

4.2 Technological Solution for the Integration

Implementation was done by altering the existing MVC (model-view-controller) concept of the BIDL platform to allow creation of new static views with rich content.

A new controller for static content management was introduced in the library. This controller manages all of the static pages within the BIDL platform and allows the library to be used as a standard web site.

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For each panorama, in BIDL was created separate page (from MVC perspective – separate view). Integration with Panorama pictures was done through the HTML feature iframe by directly relating the panorama page to its main source (at http://guideathand.com/)

Example for MVC view:

```
<iframe frameborder="0"
src="http://img.guideathand.com/panora-
mas/bidl/Church_of_St_George_in_Veliko_Tar-
novo/Church_of_St_George_in_Veliko_Tarnovo_panorama.html"
style="position: absolute; left:0; width:80%;
height:calc(100% - 130px)" frameborder="0"></iframe>
<h2 style="margin-left:80%; padding:10px 10px 0 10px">
    Church of St. George in Veliko Tarnovo
</h2>
<p style="margin-left:80%; padding:10px">
The current church of St. George was built in 1616 on the
foundations of an older church, which was probably active
during the Second Bulgarian Kingdom, when Tarnovgrad (Ve-
liko Tarnovo) was the capital. Up to the present the tem-
ple is kept. Two layers of wall-paintings are preserved
on the walls. (<a target="_blank" href="http://muse-
umvt.com/en/church-of-st-george-in-veliko-tar-
novo/">more</a>)
</p>
```

Additionally, description of the presented object was added, with reference to its main source at http://museumvt.com/

Design and positioning of the elements within the web page is done using the latest HTML5 and CSS3 features and is supported by the newest versions of the web browsers.
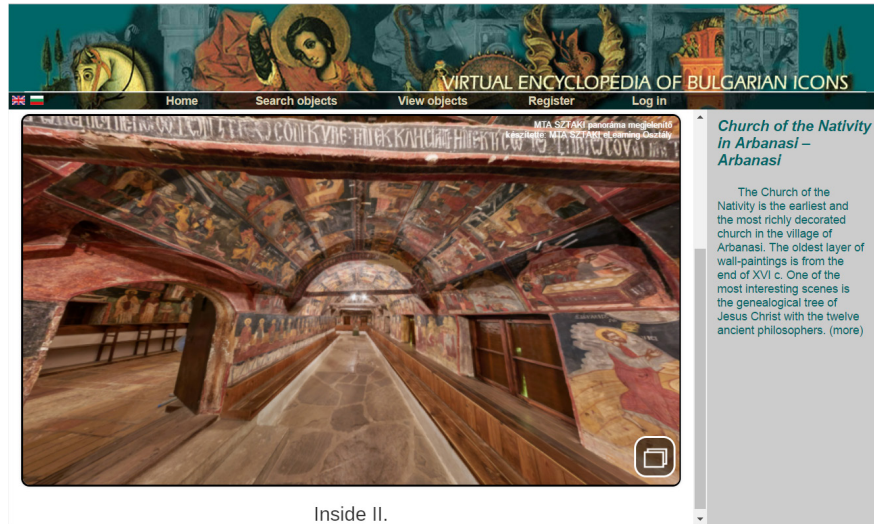
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Fig. 2. Panorama picture of Church of the Nativity in Arbanasi

5 Panorama Pictures in the BOOK@HAND BIDL Mobile Application

The mobile application BOOK@HAND BIDL presents offline the Bulgarian Iconographical Digital Library on mobile devices. The application can present user generated collections which was developed originally in GUIDE@HAND Veliko Tarnovo (Kaposi, et al., 2013). It includes options to present icon collections as virtual panorama pictures and provides interactive games to deepen the users' knowledge on Bulgarian icons (Luchev, et al., 2016). The application is available in two languages (Bulgarian and English).

The high quality photo panorama pictures usually require a large amount of storage. For this reason, they can be downloaded to the mobile device on demand. The mobile application was extended with panorama walks which contain one or more real panorama pictures taken on the same locations (Fig.3). The panorama walks should be downloaded separately before presenting the panorama pictures on mobile devices.

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Fig. 3. Panorama walks in BOOK@HAND BIDL

The mobile devices provide new way of interactions with panorama pictures by using the mobile device's motion sensors. The visible part of the panorama can be automatically moved as the user turn with the smart phone by using the mobile device's motion sensors. This presentation mode provides a realistic impression where the proper part from the panorama picture is presented on the screen, which belongs to the current view direction of the user (Fig. 4). Several new details become available about the sights by tapping the "i" (information) icon above the panorama picture.

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Fig. 4. Screenshots from panorama pictures in BOOK@HAND BIDL

6   Conclusions

High-resolution photo panorama view proved to be an attractive way to present cultural and historical sites. Interactive spherical panorama pictures on several famous locations (churches, museum, bridges) in Veliko Tarnovo region, Bulgaria, were created and are available through BIDL Web page and BOOK@HAND BIDL mobile application. The plan for joint research include a continuously development of the panorama viewer for presenting the locations in an informative and entertaining way and for providing the same panorama picture on multiple platforms. More high-resolution interactive spherical panorama pictures from further locations will be created for enrichment of BOOK@HAND BIDL and Bulgarian Iconographical Digital Library content.

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