"Stories of Montanistika" in the World of Virtual Reality

The main objective of the interdisciplinary research was a VR interpretation of natural heritage, i.e. natural stones, that decorate the interior of the Montanistika building, which also houses the Department of Geology (Faculty of Natural Sciences and Engineering, University of Ljubljana). The aim of the study was to interpret and narrate stone heritage in 360 storytelling and virtual reality (VR). The VR solution was made for Oculus GO headgear. With an user centred approach for VR interactivity, VR gives the user an insight into the mysteries of the Montanistika building. 360-degree presentation of spaces contains information about geological characteristics of stones, their appearance and significance. Narration and screen play were design considering individual premises of Montanistika building. 360 storytelling was implemented based on spatial orientation of the physical building and its premises. The result of the research is a VR solution that offers to the visitors a 360-degree experience, virtual and interactive walks through the building and learning about rocks from presentation canvas. Moreover, the experience enables the immersion in the stories of Montanistika's stones and an attractive insight into the world of Slovene natural heritage.

Keywords: natural heritage, virtual reality, interaction design, 360 storytelling, Montanistika building, rocks

Introduction

The notion of inheritance is extremely broad and encompasses everything that previous generations have preserved for the present generation, and seems to be worthy of a larger share to be protected by our successors as well. Originally, the term heritage meant the legacy of the deceased, but later it was given various designations, such as cultural, natural, spiritual, archaeological etc. heritage. Today, very often the term heritage is first thought of as cultural or natural heritage (Jezernik 2005, Muršič 2005, Troha 2019).

In the Official Gazette of the Republic of Slovenia, the heritage is divided into material and living or intangible heritage; material heritage consists of movable and immovable heritage. Movable heritage is considered movable property or collections of movable property with heritage values. One of the types of tangible heritage are also stones and geological artefacts incorporated as a natural heritage in object of cultural heritage (walls, furniture, buildings etc.) (ZVKD-1 2019).

Awareness of the importance of preserving heritage and its necessity for determining our identity emerged only in the modern age. Based on the preserved heritage, we can understand the development of past civilisations and, whether it is in terms of architecture, urbanism, live style, social and political organisation, customs, art and culture or any other area of heritage (Troha 2019).
A very big part in preserving the heritage has the UNESCO organization that emerged after the end of World War II to raise awareness of the importance of protecting cultural heritage (Ţarnić 2012). “Heritage is the legacy that we receive from the past, that we experience in the present and that we will pass on to future generations.” (UNESCO 2019).

The digital preservation of cultural heritage is very important both from an educational and preventative point of view. One of the main motivations is certainly the protection against the dangers and risks to which cultural heritage goods are exposed. These threats can be of natural or socio-social origin. Natural impacts on the heritage can be long-term effects caused by weather and climatic factors, biological organisms, geological conditions and other stresses. Moreover, heritages can also be devastated by sudden natural disasters. Socio-social impacts include risks related to misconduct, wars, vandalism, wrong decisions, etc. (Ţarnić 2012).

The digital preservation is of an great benefit for the museum collections in a form of an additional supportive presentation mode of heritage or even for virtual museums. Digital information (reconstructions and reproductions) is used as replicas intended either for exhibitions for the purpose of preserving originals, for the reconstruction of damaged objects or for the production of souvenirs. Often, cultural heritage originals are difficult to access or even inaccessible or removed from museums for a longer period due to restaurant work. Such collections with geometric information and texture properties are therefore very convenient as they can be displayed or replaced in various ways and provide a quality and interesting alternative for educational purposes (Gomes 2014, Pieraccini 2001, Troha 2019).

**Virtual Reality and Cultural Heritage**

Extended realities (XR), i.e. virtual reality – VR, augmented reality – AR, mixed reality – MR), etc., have completely found their worth in the virtual heritage field. These interactive technologies and presentative modes are strongly collaborative also with 3D technologies, web platforms, user interfaces, animations and computer (dynamic) simulations. As implementation of 3D technologies in cultural heritage also XR persistently gain attention of the researchers and the professionals. Some of the positive aspects of their usability are that with their constant development they are gaining accuracy and accessibility, they are reliable and non-invasive, go hand in hand with sustainability. Moreover, XR solutions are attractive and they augment user experience (Ioannides 2014, Gabrijelčič Tomc 2019).

In the museums and galleries the implementation of VR enables the heritage artefacts and objects to be better contextualize and multisensorial presented, they also provide a experiential space where personal and social experiences emerge in relation to artefacts. Virtual experience technology is also becoming more and more mature to facilitate learning about cultural heritage. We are increasingly moving away from traditional experiences where
in a museum or gallery a visitor just watches an exhibition and is not fully engaged in the experience (Ch'ng 2017a, Ch'ng 2017b).

Paladini et. al (Paladini 2019) demonstrated that the advantages of the the implementation of VR in cultural heritage beside the attractiveness, simulation and perspicuity, is especially the effectiveness for observations of details of heritage objects, recognition of the materials and state of conservation. The VR presentations enable also the contribution to greater understanding of feature and dimensions of object of heritage. When VR content is presented in games, the interest for the heritage and the awareness about its preservation increase. Nevertheless, VR presentations benefit also research work and can be used as working and researching tool (approach), helping especially conservations experts. With the use of interactive technologies such as VR, there was a shift in the perception about the role of museums and galleries in the society and these spaces have opened up to a new audience. Technology and tourism are the key components in promoting this process. The trend is seen as increase in the number of tourists seeking adventure, culture, history, archaeology and interaction with local people (Ulisa 2015, Ozebek 2019, Digital meets Culture 2019).From an architectural point of view, the Montanistika is a remarkable building and is inscribed in the register of cultural heritage. Although the building itself may not be the most original, its peculiarity is reflected in its inside construction, with imaginative and quality craft details in wood, wrought iron and stone. The interior decoration of the building with the natural stone emphasizes its monumentality, carries important information on the extraction and use of natural stone in the past and enables experienced and narrative learning of rocks. Various polished natural stones were used to decorate and construct certain elements, which emphasized the monumentality of the buildings.

The main objective of the research was a presentation of geological material, i.e. natural stones that decorate the interior of the Montanistika building in an interactive educational presentation with 360-degree storytelling. The aim was to implement VR solution that presents geological stories and according to user-centred design communicate about the Slovenian stone heritage.

**Experimental Part**

From a geological point of view, the hallways and lobby of the Montanistika represent a special geological museum, which thus combines natural and cultural heritage.

The interior of the building is decorated of mostly local architectural stones (Slovenian and Croatian) and two newly built foreign, but geologically interesting rocks (Fig. 1). The rocks used are also interesting because they cover representatives of all three basic rock types and can thus be used as a tool in the presentation and teaching of geological content. Sedimentary rocks are represented by very diverse limestones, metamorphic marble, and some
examples of intrusive igneous rocks. Interpretation and presentation are possible from several perspectives that give as the facts for narrative learning. The composition (minerals, fossils), color and other properties of rock describe the processes and environments of their formation, their architectural names can usually be linked to the excavation sites (locations of quarries), and the use can be compared with our own experience already seen. Such representations can lead to a greater degree of interest, understanding and knowledge sustainability.

Figure 1. Rock decorations in the walls, on the floor and in the stairs of Montanistika building (photos by Katarina Mlakar, Gavranović Sara, Kodelja Nana and Voršič Anemari)

VR solution was designed and implemented with the user-centred design (UCD) approach, which phases involved the definition of the strategy and the scope, designing the structure and skeleton level and in the last phase planning and developing the surface and sensory level of VR.

In strategy level target groups, needs and product objectives were defined. The partner in the process were the employees of the Department of Geology that is situated in Montanistika building. The problem to be solved with interactive solution were from the technical point of view digitisation and preservation of natural heritage (stone walls) that is constructed in the interior
of Montanistika and from the communicative and educational point of view promotion of and education about the building with the immersive technologies. Target groups included representative academia (students, teachers, researchers), visitors and tourists, and representatives of national institutions and cultural organisations (national Parliament, museums, galleries, etc.).

In **scope level** functional specifications and content requirements were defined. Functionalities were limited to VR touring. Defined content elements were: text descriptions with the explanation about the natural heritage, image elements with the facts about the stones, 360 recordings of the rooms and 360 recordings of representative stones.

In **structure and skeleton level** information architecture was defined that led to interaction and information design including development and design of 360 viewing and interaction of entering in the rooms.

Information structure (Fig. 2) is showing the organisation, hierarchy and links between each part of VR solution. The user is guided through the VR solution via text boxes and subtle graphic elements. In each room user can click on small bluish circles and see more information about specific rock he/she is observing via 360-degree photography/VR view. In that way the user is presented with video, pictures and more information (item 1, 2 and 3) about specific rock.

**Figure 2. Information architecture of VR solution**

Last phase of UCD was the developing of **surface and sensory level** of VR with the colour pallet presented in Fig. 3.
Colour scheme consists of four colours. Main colour is light yellow and is used for main menu, neutral texts etc. Light blue represents sedimentary rocks, soft orange is for metamorphic rocks and light red for igneous rocks. The last three colours are used for video and text background when representing specific types of rocks. There is only one font used (in different sizes) and that is Liberation Sans.

Figure 3. Colour Scheme of VR Solution

Narration and screen play were design considering individual premises of Montanistika building. 360 storytelling was implemented based on spatial orientation of the physical building and its premises. Content was prepared including geologically significant texts, graphic presentations, informative canvas, 360 video presentations of stones and premises of the building.

360 Recordings of Stones

Figure 4. Selected Rocks and the Process of Filming
The Department of Geology provide us with the samples of representative sedimentary, metamorphic and igneous rocks used as decoration in the building (Fig. 4 left). The recordings of stones rotating in 360-degree took place in photo studio. The stones were placed on green screen and on turntable that enable the recordings from different angles (Fig. 4 right). Each stone sample was filmed, with camera Sony a7sii and Sony 24-70 2.8 lens, when rotated for 360-degree simultaneously.

In post-production the green background of each rock was changed according to colour scheme of VR solution (sedimentary rocks blue, metamorphic rocks orange, igneous rocks red). The colour key effect needed to be used multiple times in order to change the colour of the background. The last step was exporting videos to loop when played. The results of the recordings are shown on Fig. 5.

**Figure 5. 360-degree Videos of Rocks**
360 Recordings of Building’s Interiors

For spherical images (Fig. 6), a Ricoh Theta SC camera with two lenses was used. While shooting, it is important to keep in mind that when photographing it is necessary to pay attention to the light source. It can happen that the camera illuminates only the one side of the image sensor, if it is pointing directly at the source. Consequently, the result can be unevenly lit image. The images were processed in a photo editing software, where the visible parts of the camera stand were removed.

Figure 6. Example of 360-degree Photo Sphere

Results and Discussion

For the development of VR solution, the chosen VR device was Oculus Go. We’ve chosen to work on open game and application development platform Unity in combination with Adobe Create Cloud. Inside Unity workspace we’ve created a 3D project with final media Android VR. User interface of Unity is presented on Fig. 7.
Figure 7. Placement of Information Inside the 2D Canvases

Developing the app required us to use 360-degree images as *skyboxes* and arrange them through the *scenes* according to information architecture. Additionally, to achieve the highest user immersion and application quality, the skybox setup requires some additional manipulations to remove seams done at image border merging.

Inside the scenes we have used text, photographs and videos. That material was used inside the user interface on so-called 2D canvases arranged through user’s 3D worldspace. When placing the canvases forced perspective came into use to achieve perceived distance between user camera, buttons, text and other visual media. That was used since if an object is too far from the player camera, at certain view-angles the content becomes cut out of the view area, as the camera renders only what it sees, and we get loose user immersion. Canvases also include “keyed” 360-degree recordings of stones through rendered texture function since the video playback requires real-time rendering and not just a static image texture. After the scenes were finished, we had to arrange movement (through buttons) according to information architecture and setup the controller with which the user views the rooms and move among them. Fig. 8 presents placement of visual content inside of 360-degree panoramic shots inside Unity.
Figure 8. Placement of Content Inside 360-degree Panoramic Shot Skyboxes with user Camera

With the final VR reality settings, it was necessary to perform several testing phases, which enabled the correction of technical and performance errors such as cutting, button unresponsiveness, layout optimization, text styles and the use of more appropriate image content. Fig. 9 presents final scenes and stories of Montanistika in the VR environment.

Figure 9. Final Scenes and Stories of Montanistika in the VR Environment
Conclusions

VR presentation that includes Stories of Montaniatika was presented to the audience as part of the main project event European Researchers Night in September 2019, a pan-European project aimed at bringing research work closer to the general public. With a strong emphasis on the impact and importance of research in everyday life, it encompasses many smaller events (also project named Humanities Rocks!) that enable researchers present their research work and innovation.

The audience accepted VR solution enthusiastically and rated the experience as a perfect upgrade to a physical walking through Montanistika building. In addition, the developers were offered some further research opportunities in terms of implementing VR technologies on other buildings of national importance, which also include the heritage of stones in interiors or exteriors.

Workflow definition, design and development of the presented VR solution was also evaluated in terms of a starting point for further improvements. The project was performed by the students of graphic design
and interactive communication, who during this project first encountered this type of technology. It is estimated that major upgrades to the solution could be carried out at the level of interactivity and use of different VR device, which would include besides the transitions between Montanistika rooms, additional interactions of experiencing rocks (interactive virtual rotation, etc.). In addition, we believe that the implementation of the audio narrative would increase the accessibility.

However, the results of the research and development of VR Stories of Montanistika with the contents of natural heritage of rocks are in Slovenia the first example of the exceptional value of these technologies for digital preservation, presentation and, nevertheless, considering the geological value, a greater recognition of Slovenian stones in architecture.

References


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