

4D Virtual Reconstruction of White Bastion Fortress

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Abstract

White bastion fortress has been standing in defense of Sarajevo since medieval period. In time it was changing together with various dominations upon the city. 4D virtual presentation aims to display the historical development of this cultural heritage object through digital storytelling combined with interactive 3D models of the Bastion in various time periods. These models contain digitized findings from the site and their 3D reconstructions. In this paper we present a new method of interactive digital storytelling for cultural heritage and its initial user evaluation.

Categories and Subject Descriptors (according to ACM CCS): J.5 [Applied computing]: Arts and humanities—Media arts H.5.1 [Information systems]: Information systems applications—Multimedia information systems

1. Introduction

Living in age of interactive communications changes the expectations of people. Digital technologies penetrated in every aspect of human life, introducing a new language and ways of conveying information. Cultural heritage, as a represent of countries' history, does not remain in museums any more. It seeks to be communicated to the people using the state-of-the-art communication methods and tools.

Museum exhibitions containing storytelling are richer and more attractive to the visitors, offering them the context and purpose of exhibited objects. Virtual reconstructions of archaeological remains become complete only after they are adjoined with stories about the objects, characters and events from their past.

After introduction of digital humanities field, scientists from different disciplines are in search for the best method of communicating cultural heritage. Historians, computer scientists, archaeologists, writers, psychologists and visual artists are working together in discovering the most attractive, immersive, educational and entertaining method in virtual presentation of cultural monuments. This paper recounts our experience in this quest through the 4D interactive multimedia presentation of White Bastion.

In Section 2 we mention the methods and related projects we used as inspiration for creating our application. In Section 3 we elaborate our new method of interactive digital storytelling. Section 4 describes the workflow of White bastion case study. Section 5 presents the first user experiences and comments. We conclude the paper summarizing the research results and future work directions.

2. Related work

First concepts of interactive storytelling were introduced in [Gla04]. Glassner defined some basic storytelling structures and considered relations between stories and games.

As stated in [Cam07] "The emergence of new powerful technologies has created an extended moment of transition and reevaluation, in which the ground assumptions of the museum and of the knowledge communities devoted to preserving and representing the cultural heritage must be reconsidered, newly theorized, reimagined.". This is exactly our goal in developing a new interactive digital storytelling method for communicating cultural heritage.

Story structure in CHES project [Vay14] is mainly developed around physical exhibits in Acropolis Museum in Athens and their locations within the Museum. It is a pity that such a great idea has not yet been implemented on the site. User interaction in immersive virtual learning environments, focusing on the role and the effect of interactivity on conceptual learning is described in detail in [MR06].

Etruscanning 3D project [PPR13] offers an interesting combination of storytelling with 3D environment of Regolini-Galassi tomb and interactive models of artefacts found there. Livia's Villa Reloaded [PFR15] is an innovative virtual reality installation introducing a novel approach in storytelling, combining different media and languages: real time exploration, cinematographic paradigms, use of real actors and virtual set practices. The final exhibition of V-MusT.net project, Keys to Rome [PdFV] was created through a combination of physical exhibitions from four selected museums

and digital content connecting all locations through online virtual heritage applications. One of the setups, called Admotum, was designed as a serious game where the visitor, through natural interaction user interface, is performing a walk around virtual models of buildings from Roman period, following the stories about objects from those buildings (virtual models of museum artifacts found in the archaeological sites) [PC15]. Virtual cultural heritage application set up in Civic Museum of Schifanoia in Ferrara [II15] presents the historical development of the Schifanoia Palace through virtual models of the Palace in various time periods combined with narration about the main events that took place within and around it.

3. The new interactive digital storytelling method

Experiences from many virtual cultural heritage applications and projects show that these projects are much more successful and appreciated by the users if they contain storytelling. What still exists as a research question is how to tailor digital stories' scenarios and implementation to satisfy all user categories.

Our research of digital storytelling for cultural heritage has started with virtual reconstruction of the Church of the Holy Trinity in Mostar [HR13], where we introduced a live storyteller recorded against the green screen and incorporated in an interactive 3D environment, telling stories about the Church destroyed during the war in Bosnia and Herzegovina. We implemented digital storytelling also in our Isa bey's endowment project [RSZ*14]. Stories start when the user approaches particular objects in that environment. A part of that application is the interactive computer animation of derwish* ritual, which used to be performed in one of the reconstructed objects. This way we introduced interactivity in our storytelling implementations which was proved to be attractive and engaging by the users. Interactive digital storytelling in various forms was also implemented in our Virtual Museum of Sarajevo Siege (Sarajevo Survival Tools) [SR12], where digital story guides the visitor through the exhibition, as well as the Virtual Museum of Bosniak Institute [Slj12], where audio stories increase immersion of the virtual visitor into the collection.

Overwhelming use of Internet and social media shows that people have no time or patience to read long text or watch long movies. Users like to have some presentation structure displayed in advance, such as within HTML pages. Therefore we divide our story into story units, or sub-stories and offer users to watch them on demand, after they are introduced with all content elements in an intro story.

This concept has been implemented in our Taslihan project [SR15], presenting the largest inn in Sarajevo during the Ottoman period, out of which only one wall is still standing. We implemented that project in three forms: a documentary, interactive digital story and a serious game. Last two implementations are sets of sub-stories interconnected with each other as well as with the interactive 3D model of the object.

In White Bastion project we created different combination of

*Derwish – A member of any of various Muslim ascetic orders, some of which perform whirling dances and ritual prayers as acts of ecstatic devotion

digital stories and interactive 3D environments (IVE). The structure of the project is shown in Figure 1. Intro story presents an overview of the object's history, while stories about medieval, Ottoman and Austro-Hungarian period give more details on the object's transformation during these historic periods. There are also 6 interactive models of different phases of the fortress which as well contain digital stories about particular objects, events and characters from its history, as well as reconstructions of archaeological findings from the site. Here we have two kinds of navigation: from a story to IVE and from an IVE to the story. Our goal is to explore how users perceive this communication form and whether it increases their immersion in the past of this cultural monument.

4. White Bastion case study

White bastion case study aims to present the historical development of this cultural heritage object using virtual reality and interactive digital storytelling, in order to support archaeological research of the site and raise awareness of general public.

4.1. The object

White Bastion fortress stands at the outskirts of Sarajevo overlooking the city (Figure 2). The archaeological excavations of the site have found remains from the medieval, Ottoman and Austro-Hungarian period. The findings are registered and conserved for the purpose of the exhibition hosted in Museum of Sarajevo.



Figure 2: White Bastion - present appearance

4.2. Materials collection and application design

In consultations with historians and archaeologists, all available literature from historical sources was studied and drawings and blueprints of the archaeological remains were collected. Chief archaeologist has sketched 6 assumed appearances of White Bastion in medieval, Ottoman and Austro-Hungarian period.

Main topics for digital stories have been identified. Based on our previous interactive digital storytelling research, we designed a new concept of stories content and distribution and their relations with interactive 3D environments of the fortress. Archaeological findings from the site, kept in the Museum of Sarajevo, were analyzed and most significant ones were selected for digitization and virtual reconstruction.

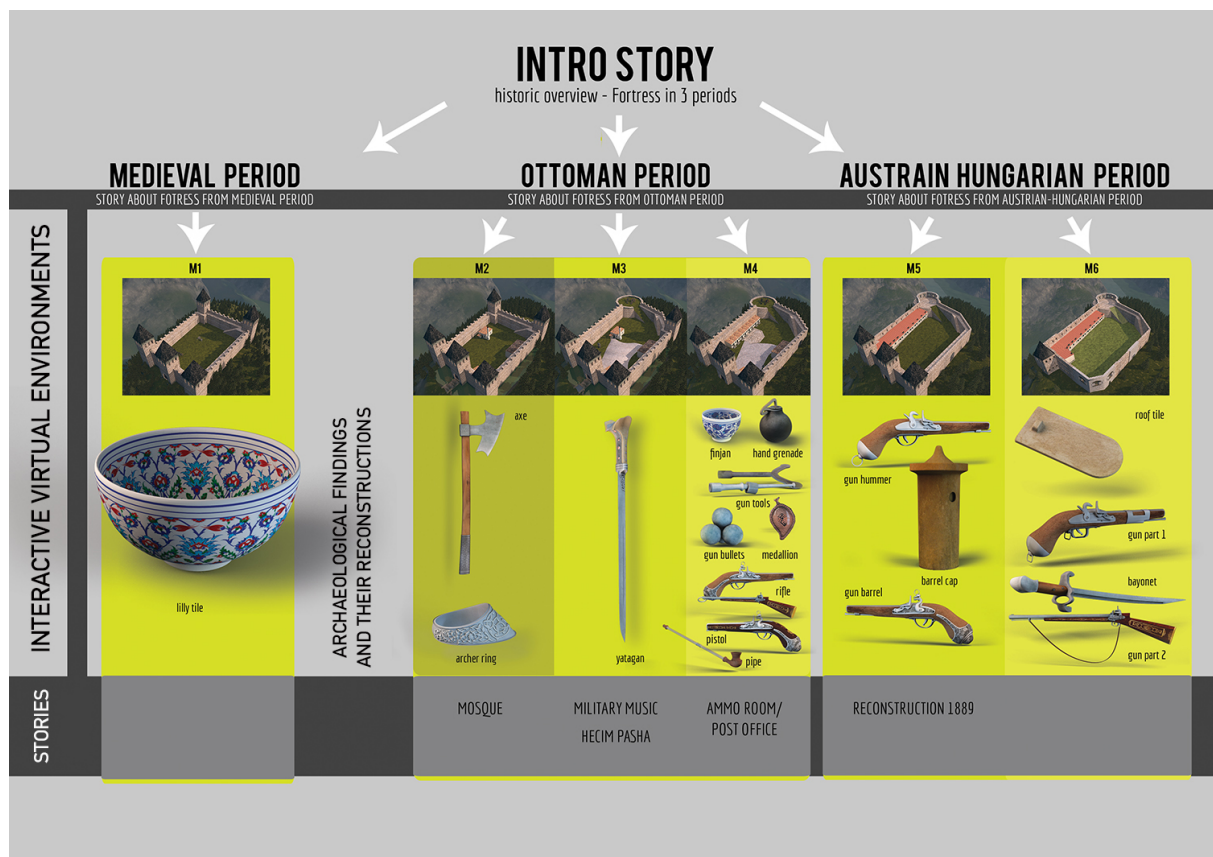


Figure 1: Structure of the virtual presentation

4.3. Digital content creation

Museum exhibits were digitized using structure from motion (SfM) photogrammetry algorithm. Obtained models were cleaned and adjusted. Geometry was exported as low and high quality meshes in OBJ format. Based on digitized findings, virtual reconstruction of each object was created in order to offer the users insight in their original appearance. Six 3D models of White bastion were created in Cinema 4D, modelled using classic modeling techniques and mapped with textures created from original photos from the site.

Digital stories were created in coproduction with BH Radio television. Scenarios were written by a famous Bosnian writer. Original music was composed. Preproduction phase included location planning, creation of book of shooting, collecting archive footage and actor casting. Costumes for the actor were selected from the National Theatre in Sarajevo fundus. Shooting of footage for the stories was done at the location of the fortress remains as well as at the hill across and a graveyard nearby. Particular attention was paid to the shots which will serve as backgrounds for video effects of fortress reconstruction, as blue/green screen technique was not used. Production phase also included drone shooting, voice-over recording, graphics design and computer animation, animation of drawings and editing. In postproduction we did the sound produc-

tion and color correction. Finished 10 stories were edited together as TV documentary and uploaded on Youtube for use in the online application.

3D models of the fortress with terrain were exported from Cinema 4D and imported in Unity 3D, to add interactive functionalities and stories. Interactive virtual environments in Web GL contain digital stories and virtual reconstructions of archaeological findings.

4.4. Content integration

Online interactive application of White Bastion is implemented through a web site which, apart from the previously mentioned digital content, contains some information on the project and an interactive animation of White Bastion in time.

All digital stories, interactive environments and virtual reconstructions are accessible through the project web site. Project contains 10 digital stories, 6 interactive virtual models of the fortress and presentations of 22 selected digitized and virtually reconstructed archaeological findings [tab].

5. User Evaluation

The aim of our user evaluation study was to learn how much information users perceive through stories told in this form, how much immersion they feel in the past of the object and is the proposed navigation structure clear and efficient enough for all user categories.

At this point we performed only an initial user evaluation study. We selected a group of 12 users, 8 from Bosnia and Herzegovina and 4 non-Bosnians. Three of them were under 25, seven between 26 and 50 and two over 50 years old. One reported poor computer literacy, six medium one and 5 declared themselves as expert computer users. Six of them sometimes play computer games, four of them do not and two are gamers. Seven users visit museums occasionally and 5 are regular museum visitors.

The users were requested to visit the web site of the project, explore its content and, upon completion, fill out an online survey questionnaire. Using qualitative user experience methodology, we established the following hypotheses:

H1: Users learn about cultural heritage objects from virtual cultural heritage presentations

H2: Through interactive virtual cultural heritage presentations users feel immersion in the past

H3: Users prefer interactive cultural heritage presentations over documentary movies

Majority of both Bosnian (62,5%) and non-Bosnian users (100%) answered correctly the questions about topics mentioned in the stories. From these results we can conclude that our hypothesis H1 has been proven.

Eleven out of 12 users reported they had a feeling of immersion in the past, which confirms our hypothesis H2. Ten out of 12 users prefer interactive virtual cultural heritage presentation over a sequential presentation in form of a documentary movie, which confirms our hypothesis H3.

In their comments a number of users expressed some advantages and drawbacks of this approach. Most of them reported to feel more engaged and pay more attention in interactive presentations. They appreciated the possibility to explore the IVEs which they could not do in a movie. They like the combination of digital stories and models because "models are described by stories and can display the information from stories".

Two users noted that in this kind of presentation information is scattered and they are not sure if they missed something. They prefer to be offered an already tailored story then to tailor it themselves through interaction.

6. Conclusion

White Bastion case study added another element in the mosaic of our interactive digital storytelling research. Having in front of us the goal to satisfy all user categories with adequate information communication, easy and natural navigation and high edutainment value, we need to consider their comments and adjust our storytelling method.

According to the initial user evaluation, less computer literate users had problems to find stories and interactive models of archaeological remains in IVEs. Therefore we need to work more on navigation and story structure.

The most encouraging result is the high overall user satisfaction with use of interactive storytelling to communicate information about cultural heritage.

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