The Virtual House of Medusa: Playful Co-located Virtual Archaeology

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Abstract. In our submission we introduce a co-located virtual archaeology installation for a museum context, called Virtual House of Medusa. It was developed in collaboration with the Federal Monuments Authority Austria. The Virtual House of the Medusa illustrates several fragments of Roman wall paintings, which are archaeological artefacts that were found at Lorch near Enns in Upper Austria. The installation is conceptualized as a playful installation with multiple virtual workstations, including one VR player and up to four fellow co-players that are equipped with mobile devices. The players slip into the roles of archaeologists and experience the fascination of their work through interacting with the virtual workstations. Furthermore, co-players and the VR player have the possibility to get in contact with each other via the devices provided by the installation. Our work deals with the issue that existing research projects and installations in virtual archaeology are mainly designed as a single user VR experience. We argue that the interaction between the VR player, the co-players and the spectators has the potential to foster the feeling of being together in the game world, and adequately addresses the museum design space.

Keywords: Virtual Archaeology, Co-located Play, Asymmetric Player Roles.

1 Introduction

The fields of applications for Virtual Reality (VR) are manifold and widespread, ranging from entertainment computing to architecture and health. Virtual archaeology [1, 2] forms one of these application areas, including digital archives, scientific visualizations, and knowledge transfer. Relevant use cases for virtual archaeology are installations embedded in the museum context, like computer animations, visualizing additional information, or novel forms of experiencing scientific data. VR-based installations grant many advantages in comparison to analog techniques and methods to communicate scientific information, as they may feature playful elements, feature diverse forms of user interactions, and provide an immersive experience for the visitors. Although there are many beneficial aspects of VR-based solutions in the context

of archaeology, several design challenges have to be tackled. One of the challenges can be identified in the fact that a majority of VR installations, in particular installations using head-mounted displays (HMDs), are designed as a single user experience. In some cases, a second screen is provided that allows spectators to watch the virtual experience. Because of this limitation, single user VR installations do not fit well in a museum context. Thus, we propose a solution that provides various forms of mutual interactions between the spectators and the VR player, and that fosters the feeling of co-presence [3] (being together in the same virtual environment).

2 Related Works

Virtual archaeology emerged in the mid-1990s [1] and comprises the use of computer based visualization and simulations in archaeology. In the last two decades various research activities, conferences and platforms on virtual archaeology evolved [4–8]. Current tools, like surface scanning, image-based modeling, and modular surface generation, enable generating detailed 3D reconstructions of archeological findings from small objects to large sites [9]. These reality-based virtual models offer many fields of applications for virtual archaeology: documentation, conservation, restoration, reconstruction, scientific visualization, analysis and queries, or dissemination of information, teaching, info- and edutainment [9, pp. 112]. 3D models can not only serve as a basis for computer animation and virtual simulations, such as visualizing the changes over time or the simulation of variations of reconstructions for science [2], but also for the tourist and entertainment industry and for museums [9]. According to [2], virtual archaeology utilizes the same technology employed in the entertainment industry and has become an established discipline. Surprisingly, virtual archaeology faces the problem that, although there are many 3D models and simulations, only few of them are accessible to the public [2].

Virtual museums open up great possibilities to disseminate scientific content on archaeology, and have been well documented by a number of researchers [10–12]. Virtual museums emerged in the 1990s, using state-of-the-art technologies, such as VR, Augmented Reality (AR) and web technologies. They can take various forms [10, 12] and offer benefits for museum curators (digital preservation and presentation) and for the visitors by providing an entertaining and educational experience [10, 11]. Virtual museums can be part of a physical museum as an installation or exist independently, for example as a virtual copy in the Web of a physical museum or as an independent collection [11].

VR museums are 3D immersive and interactive virtual worlds and offer thrilling experiences, and enable journeys to far-off or inaccessible places. Furthermore, they allow to see details and different perspectives on ancient objects, and even grant touching virtual artefacts. [13, 14] demonstrate how so-called “enhanced VR museums” can provide a more engaging experience for the visitors including an educational value. Depending on the system, VR applications can be used by a large number of

players (co-located experience), for instance the CAVE [15] systems. The Multi Mega Book [16] can be considered as one of the first co-located VR museum installations in the context of virtual heritage. This multi-person, room-sized, VR environment is a journey through a virtual renaissance city, where users can interact with various historical artefacts. Current VR headsets, like the Oculus Rift [17] and the HTC Vive [18], offer an interesting alternative to the CAVE system [19]. One disadvantage is that these VR devices offer single user experiences. Thus, the players cannot share their experiences in VR to others, as seen at recent examples [19, 20]. Ishii et al. calls this problem "Perspective Gap" [21]. Although research on collaborative VR settings started in the 1990s [22, 23] current research on shared VR experiences with HMDs is still in their infancy [21, 24]. The use of games to support cultural heritage purposes is very promising to engage people in archaeology [19, 20, 25]. However, the application of virtual archaeology games at museums is still at a very early stage, and there are only a few case studies on co-located playful settings using current VR devices [25–28]. In this regard, asymmetric gameplay is a key factor to foster the gaming experience and to actively involve spectators or rather co-players [29, 30].

3 Our Approach

The previous section should have shed some light on the current trends and research approaches of playful VR in the context archaeology. As it was shown, existing research mainly deals with single user VR experiences. On a first glance, this fact appears to be quite surprising, as many exhibits and installations in museums are tailored for multiple participants. The lack of VR installations for multiple players may be due to the fact that these installations are difficult to maintain in a museums context. Furthermore, the technical challenges multiply, when more than one VR device is employed. Additionally, not all visitors are keen in wearing VR devices, but want to contribute to the gaming experience with means that better fit their needs. Thus, a shared VR experience with multiple co-located players with different roles appears to be a very promising approach. Unfortunately, fairly little is known about a co-located playful VR experience in archaeology for multiple players, as until now, and to our best knowledge, few research has been carried out to investigate this design problem area. In general, we argue that the interaction between the VR player and other co-players (in our case: players equipped with mobile devices) and spectators has the potential to foster the feeling of co-experience, and adequately addresses the museum design space. To support our claims, we conceptualized and developed an interactive installation which has the following unique features and will be further described in the next section:

- **A playful VR installation** about an archaeological finding for a museum.
- Support of **different player roles**: VR player (VR device), up to four co-players (tablet with VR tracker), spectators (second screen).
- **Co-located interaction** between the VR player, up to four co-players, and spectators.

- **Co-players can observe the VR space** with a tablet, and may interact with the VR player via tablet interactions.
- **Dissemination knowledge** of the subject archaeology.

3.1 The installation: The Virtual House of Medusa

The Virtual House of Medusa (VHM) is a co-located VR installation for a museum context that was developed in collaboration with the Federal Monuments Authority Austria [31], to illustrate several fragments of Roman wall paintings. These archaeological artefacts were found at Lorch near Enns in Upper Austria and are one of the most important finds of provincial Roman wall paintings in Austria [32]. The VHM was firstly introduced during the exhibition "The House of Medusa" at the Kunsthistorisches Museum Wien (KHM) [33], and will be exhibited at the Museum Lauriacum Enns [34] and the Ars Electronica Center Linz [35] in the spring of 2018.

The VHM is a co-located playful installation with multiple virtual workstations, including one VR player and up to four fellow co-players (see Fig. 1). The players slip into the roles of archaeologists and experience the feeling that the past is being brought back to life piece by piece from a pile of shards. The fascination of their work is carried from workstation to workstation.

Due to the limitations found at museums and public spaces for VR settings (space, security, abrasion of the hardware, etc.), VHM was designed as a seated VR installation. The user is surrounded by four platforms in a virtual museum and can choose between four virtual workstations by looking at one of these platforms.

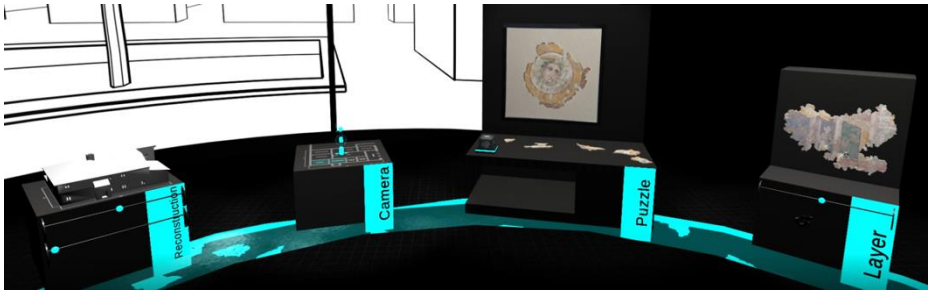

Fig. 1. The VR player can choose between four virtual workstations. The stations are arranged from right to left (*Layer*, *Puzzle*, *Camera*, and *Reconstruction*).

At the first station, called the *Layer* station, the player learns how the frescoes (layers) overlap. In the *Puzzle* station these three layers can be reconstructed by the VR player. By choosing one out of six puzzles, the VR player can put the fragments together, the spectators can interact with the virtual world by using tablet devices. Spectators can also highlight fragments to support the VR player. Afterwards he/she can look at the reconstructed building where the fragments were found in the floor plan (*Camera*). As a last stop, the player has the opportunity to investigate a miniaturized

model of the reconstructed building (*Reconstruction*). Regarding the inclusion of multiple players, one major challenge proved to be the simplification of the communication between the VR player and the co-players. The main problem was the virtual/real barrier between the VR player and the spectators. Initial tests of the installation showed, for instance, that viewers wanted to give the VR players advice in the reconstruction of the puzzle pieces by pointing, which the VR player could not see. Verbally describing the puzzle piece was also difficult for the co-players. We, therefore, tried to find solutions to simplify the communication between the two roles. The idea was to use known devices and mechanics to integrate them to the VR application. Via tablets the co-players could look into the VR world, and through touch the co-players could show the VR players their currently focused puzzle piece.

3.2 Technical setup

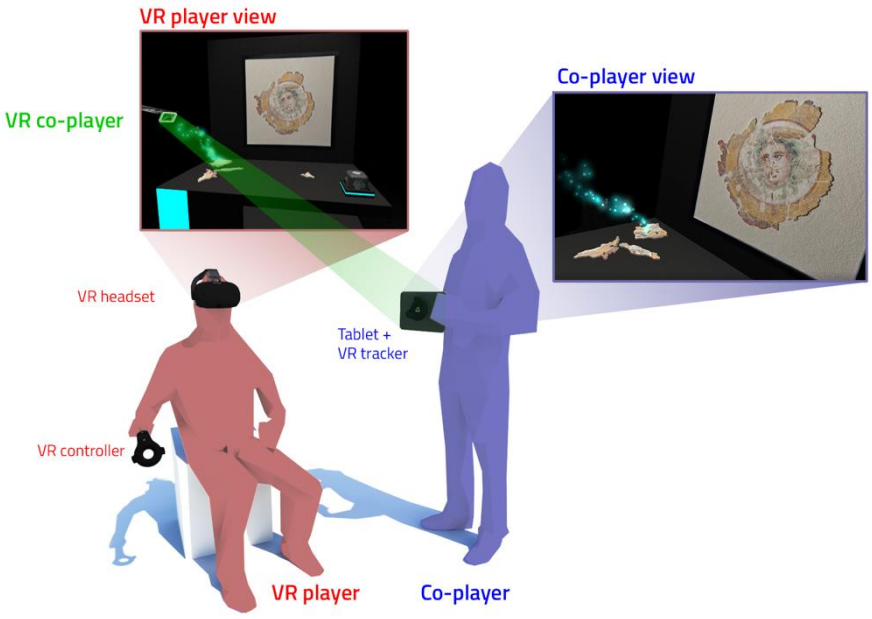

Fig. 2. Technical Setup: VR player (red) – seated experience with a VR headset (Vive) and VR controller; Co-player (blue) – up to four co-players can look into the virtual world with a tablet, equipped with a VR tracker; co-players can highlight objects in VR by touching the tablet screen. VR co-player (green): Co-players are visualized in VR as rectangles.

Regarding the VR part, the technical setup was designed as simple as possible by focusing on the basic components of the VR headset (HTC Vive): a seated experience was opted, and only one Vive controller could be used, which was controlled solely by the trigger button. For the co-players a Vive tracker, mounted on a standard tablet, informed the application about the physical location of the tablet device. The co-

players could move around in the tracked space and could visit the VR experience of the VR player from each direction. Figure 2 shows the physical devices of the two roles and the rendered screen view of each device. The tablet was visualized for the VR player to show him/her where the co-players were located. By touching the tablet screen, a particle beam from the virtual tablet to the selected artefact was shown to indicate an area of interest for the VR player.

4 Conclusion

In this paper we proposed a playful and co-located virtual archaeology installation for a museum context, called Virtual House of Medusa, which is conceptualized as a playful installation with multiple virtual workstations, including one VR player and up to four fellow co-players equipped with mobile devices.

Regarding the next steps, a study in the KHM in January and March 2018 will be carried out focusing on the co-playing experience emerging between the VR player and the spectators, to find out how the audience can be a part of the installation, and how the communication can be established between the player and the spectators. The goal is to find out if the overall experience for the VR player and the spectators, the audience involvement, and the communication among participants are increased via the integration of tablets. Via observations and questionnaires, it is anticipated that the presence of the tablet device will have a positive impact on the social experience.

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