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Presenters in Virtual Reality in Slideshow Presentations

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Abstract: Slideshow presentations have become ubiquitous in our everyday life, and are used for communicating information of different kinds. In this paper, we consider two different concepts that include both slides and VR technology in one presentation, *mixed presentations*, and *virtual presentations*, and examine the role of the presenter in these concepts. We conducted three user studies which indicate that it is not necessary that presentations need to be held completely in VR as both virtual and mixed presentations were accepted by our participants, and that our participants preferred immersed presenter integrations.

Keywords: Short Virtual Reality Experiences; Slideshow Presentations; Game Engine Integration; E-Learning

1 Introduction

Presentation software, such as PowerPoint, has become a standard tool in different environments of everyday life, such as work, home or education, and supports communicating information. Such software already supports different established resources, such as text, images, sound, and video. Virtual Reality (VR) is not among these established means, even though head-mounted displays (HMDs) for VR are becoming affordable and applicable concerning the costs and the ease of use. Therefore, VR is no longer reserved for expert use and becomes more and more a part of daily life (e.g., within E-Learning approaches). However, there exist challenges that must be considered before using VR among other resources in slideshow presentations. While the audience takes the active part of a VR-mediated presentation and uses HMDs to experience the virtual content, presenters still need basic control over the presentation procedure (e.g., switch to next/previous slides) to comply with prescribed constraints, such as time limitations. Another challenge relates to the technical integration of VR technology in common presentation software. How can a switch from a common PowerPoint slide to a VR experience be realized?

In this paper, we make the following contributions: We investigate how presenters can be integrated into *mixed presentations*, where a regular slide presentation switches to

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and from VR applications, and *virtual presentations*, where slides are adopted within a virtual environment. We implemented three prototypes to explore the user role of the presenter and show how short game-engine-based VR experiences can be integrated within established presentation software. We discuss aspects of our implementations, show how VR applications can be triggered from a PowerPoint presentation, and use our prototypes to draw conclusions on how the audience perceived the attendance and influence of presenters.

2 Related Work

In the literature, there exist examples for VR applications where one user has to guide another user through the virtual world. A remote instructor guides persons to repair complex machinery [Od15], or a researcher conducts a virtual demo [HD18, HD19].

Fuhrmann et al. [Fu01] contribute technical work about presentation systems that use VR technology. They adopt the slide concept of slideshow presentations in their system and transfer it into a VR environment. In a frontal presentation or a combined setting, they enable presenters to show 3D content to the audience. The presenter takes over the active part of a presentation and the audience can see both the presentation and the presenter in both of their settings. It remains open how the audience could take the active part and make use of the interactive VR technology. Their evaluation is based on technical feasibility.

Steed et al. [St02] suggest the user role of a virtual presenter in their 'ante-room'. It is a virtual representation of the experimenter during a study or a demo and can give participants instructions. The presenter is visualized by a virtual puppet that is controlled from a desktop PC. A study shows that the users' sense of traversal could be reinforced when a transition was provided for the VR users that also included visually transitioning the presenter from the physical to the virtual world.

Price [Pr08] proposes UnrealPowerPoint as a new learning and teaching methodology. The author describes the usage of common PowerPoint slides within a computer game. Both learners and teachers can participate within the presentation by using a desktop PC interface and both user groups are represented by humanoid avatars. Single slides are not presented separately but can also be visualized simultaneously. According to the authors, the Unreal slides also have additional functionalities that can go beyond common slides, which makes their concept more specific. Learners are granted the freedom to explore these slides in a non-linear way, which supports their educational purposes. Since the paper is oriented towards educational sciences, technical details are not considered here.

3 Presenter and Virtual Reality Integration

Both mixed and virtual presentations can integrate presenters in different ways using available devices. While the audience uses HMD-based VR to benefit from the immersive

3D technology, presenters may (1) not interact with the virtual content at all and let the audience explore the VR scene, (2) interact through a desktop interface (*asymmetric integration*) or (3) be fully immersed using HMD-technology (*immersive integration*), as well. The connection between VR and presentation software can serve as a foundation for these integrations. We implemented three prototypes:

- PowerPoint integration (*PP*) – This prototype serves as a foundation for connecting presentation software and VR technology. As a use-case, it implements a presentation about forestry and forests for both a complete virtual and a mixed presentation.
- Asymmetric presenter (*AP*) – The AP prototype provides an asymmetric interface for presenters to interact with the virtual world and VR users. It uses a presentation about the solar system.
- Immersive presenter (*IP*) – The IP implementation represents an immersive interface for presenters. This prototype presents content about different sights on the world (e.g., the Eiffel Tower and the Chichén Itzá)

The PP implementation connects PowerPoint with a Unity game engine application. This feature is fundamental for mixed presentations, as game-engine-based VR is to be inserted at specific points during the slideshow. Based on using an existing PowerPoint presentation and enriching it with VR experiences, we identified three possibilities for realization. First, the Microsoft Office Interop interface provides the possibility to react on the advancing of a slide from a running C# application, so that a running Unity application can process these events for example to switch to certain Unity scenes. But an identifier would be needed to support using different VR experiences at different points within the presentation. Secondly, APIs such as OpenXML provide functionalities to search slides with a specific layout for keywords. This mechanism can be used to trigger certain Unity events when a keyword is found on the currently active slide. However, this option would restrict authors of the slides to comply to a necessary slide-layout/structure. Finally, Interop allows to query the number of the current slide independent of the layout. This information enables a running Unity application to start the VR or turn it off when a specific slide of the presentation is set as an active slide. Before using this connection in a presentation, a mapping from VR experiences to PowerPoint slides must be performed during the authoring process. Therefore, the slideshow should be finalized before the mapping process, as inserting or removing slides would destroy the intended flow of the transitions. We implemented this third method for our prototype. Since PowerPoint is a software that can be opened multiple times, or even outside our use case on the same machine, we use a controller script that knows both the path of the .pptx-file and the corresponding Unity application. This script establishes a connection between them and can be used to start the applications as well. This ensures that VR is only triggered by the correct PowerPoint instance.

The PP prototype also included usual PowerPoint slides within the virtual environment itself to implement a virtual presentation. We identified two methods to integrate slides within a Unity application with low additional effort for presenters/authors. At first, a digital screencast or a webcam that records the physical presentation can be used to stream the slide content on a texture within the virtual environment. This requires additional soft- or hardware and can be difficult to set up, especially for webcam technology. As a result, visual quality may suffer and is directly dependent on the additional components. Secondly, each slide can be integrated within the VR as a separate image. These can be exported automatically with the mentioned Interop API. The images are used as textures on the virtual projection plane. They can be loaded by a running Unity application when they are exported to the 'Resources' folder within the assets. The drawback of this method is the absence of animations. Finally, we chose to implement an image-based workflow within our prototype. Necessary animations could be included in this method by using multiple slides to approximate the visual animation. We designed a separate virtual room with a projection plane for all slide adoptions (Fig. 1 top left) and changed the position of the VR users when a switch from a slide adoption to a VR experience (Fig. 1 bottom right and left) was intended. Events to change the positions or swap the slide images can be implemented using the Interop events as described. Presenters only have to interact with the original PowerPoint software in this prototype. All virtual rooms were implemented in one scene in this case (Fig. 1 top right). A simple webcam stream of the presenter was visualized during the slide adoptions to reflect the experience of a common slide presentation, where the presenter can be seen by the audience. Both the following AP and IP implementations share features described for the PP prototype and will therefore not be mentioned again.

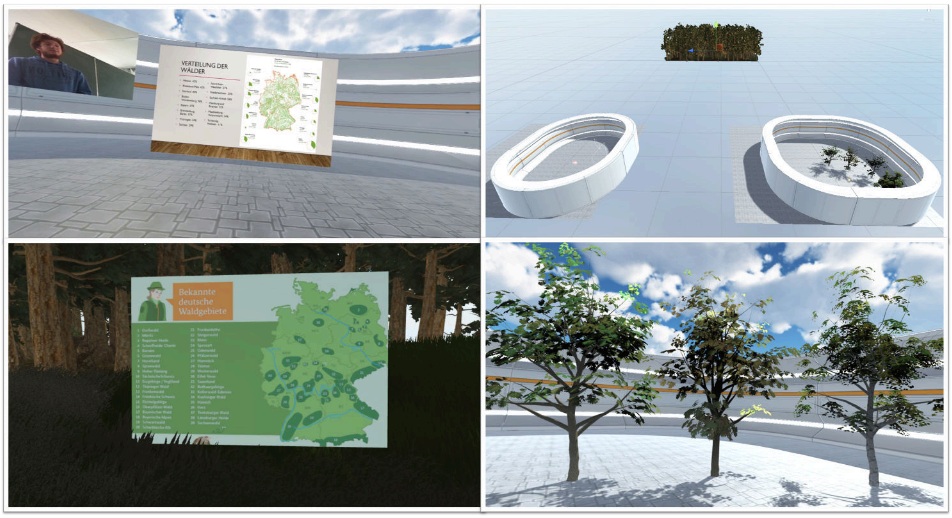

Fig. 1: Screenshots from the PP prototype presentation.

The AP prototype provides presenters a desktop PC interface to interact with the virtual environment during the VR experiences between the slides (Fig. 2). We provide presenters a top-down view on the virtual scene of the VR users. This view includes buttons for adjusting the participants' position, resizing predefined objects, and system interactions (e.g., switching to next slides/VR experiences). The interface was implemented using Unity UI components and an orthographic camera.

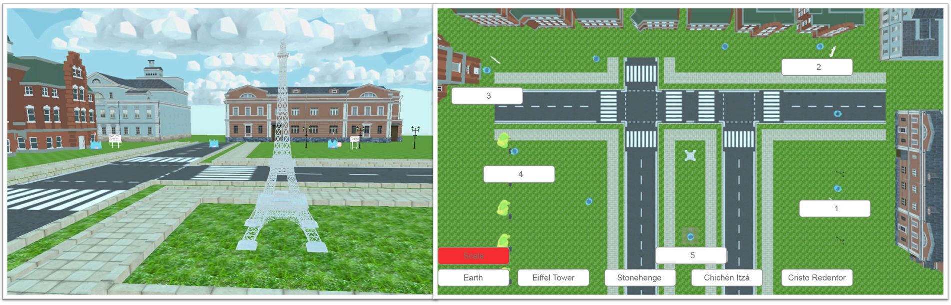

Fig. 2: Screenshots from the AP prototype presentation.

The IP implementation provides presenters an immersive interface to the VR experiences of the VR users (Fig. 3). Presenters are integrated within the virtual environment with a first-person view. It provides them with similar interactions as the AP prototype, with the additional functionality to invite VR users to a quiz about the slide content and to rate slides. It also enables them to point with a laser pointer within the scene to guide the VR users through the scene. VR users are represented with a minimalistic humanoid avatar. The same representation is used for presenters, with the difference that they wear a crown to indicate that they have capabilities beyond the ones for VR users (Fig. 3 left). Avatars and interactions are implemented using Steam VR components.

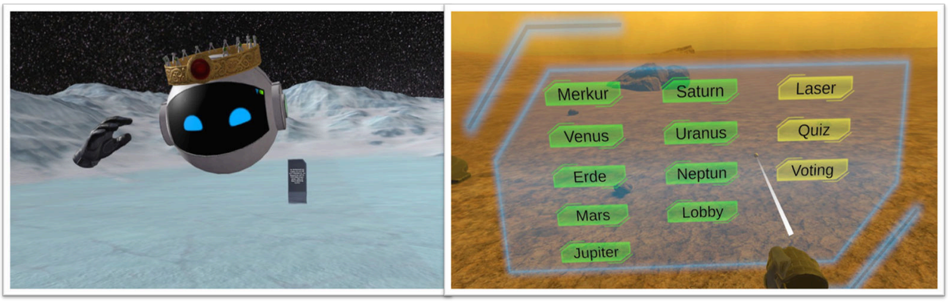

Fig. 3: Screenshots from the IP prototype presentation.

4 Evaluation

We evaluated the proposed presentation techniques and presenter integrations in three distinct user studies – one with each prototype (PP, AP, and IP). We call the corresponding studies *PP study*, *AP study*, and *IP study* respectively. Each prototype incorporated different content but with comparable quality of the assets (e.g., 3D models and textures). Overall, the user studies involved 35 unpaid, voluntary, and experienced participants. Their VR experience was captured on a 0-3-point scale, where 0 means they had never used VR technologies and 3 means they regularly use VR. PP study involved 11 participants (Ø 26,7 years, 3 females) with Ø 2.0 experience. AP study involved 14 participants (4 female, Ø ~21,5 years) with Ø 2.0 experience. IP study involved 10 participants (2 female, Ø 23,5 years) with Ø 1.9 experience. The procedure of each study took place as follows: The participants were briefly introduced to the user interface of the prototype and the VR hardware. Then an experimenter took the role of the presenter and gave a presentation to the participants using the distinct prototype for each study. In the AP study, we divided a longer presentation into two experiments which were executed in a randomized order: AP-1) Participants experienced the VR parts of the presentations by themselves and AP-2) the participants were guided by the experimenter using the desktop interface. Similarly, we divided the PP study into two experiments with randomized order: PP-1) The presentation was held using a mixed presentation methodology and PP-2) the presentation was held using a fully virtual presentation.

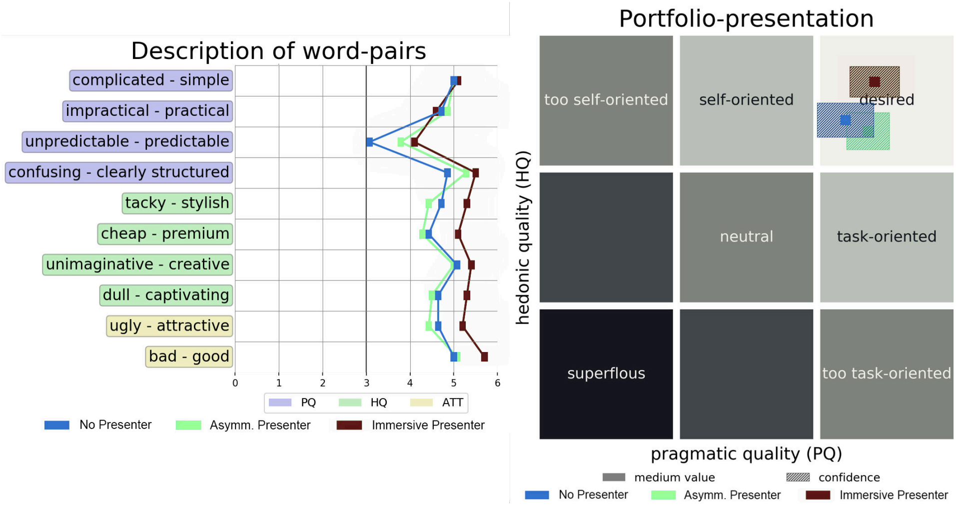

Fig. 4: AttrakDiff analysis [HBK03] that compares an immersive presenter interface (IP), an asymmetric interface (AP-2), and an interface that does not offer direct interactions with the virtual scene (AP-1). Left: Description of word pairs. Right: Portfolio presentation.

After each experiment/presentation, the participants were asked to fill out a questionnaire, which was translated into their native language. The AP and the IP questionnaire consisted of an abbreviated version of the AttrakDiff questionnaire [HBK03]. The questionnaire for the PP study included eight questions that utilized a 7-point semantic differential scale: Q1: Would you like to stay longer in the virtual world? Q2: Did the virtual rooms help in understanding the content of the presentation? Q3: Were the texts, drawings, graphics easily recognizable? Q4: Would you like more interaction with the presentation? Q5: Did you find the HMD unpleasant? Q6: Did you find your way around the VR well? Q7: How did you feel about the different VR rooms? Q8: Would you recommend this type of presentation to others?

The results of the AttrakDiff questionnaires for the AP and IP studies are illustrated in Fig. 4. The charts show that all three presentations (no presenter, asymmetric presenter, and immersive presenter) were perceived positively by our participants. Presentations without a presenter or with an asymmetrical presenter integration performed similarly well, with the difference that the asymmetric presenter was perceived more task-oriented, whereas the scores for the absence of a presenter tended towards self-orientation (Fig. 4 right). The immersive version was perceived best regarding hedonic and pragmatic qualities. Only one of its items did not get the highest score ('impractical-practical', Fig. 4 left).

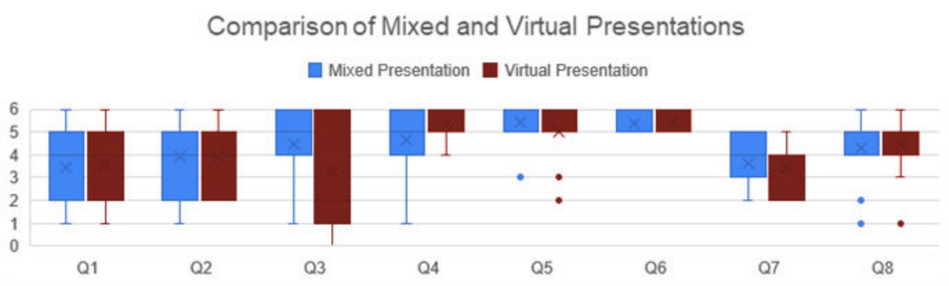

Fig. 5: Box- whisker plots comparing mixed (PP-1, blue) and virtual presentations (PP2, orange).

The chart in Fig. 5 illustrates differences between mixed and virtual presentations drawn from the PP study. The bar chart shows similar scores and distributions among the two modes (PP-1 and PP-2) for Q1, Q2, Q5, Q6, Q7, and Q8. We performed Wilcoxon Signed-Rank tests [WW64] on the items Q3 and Q4 with a threshold for statistical significance of 5% to analyze further differences between mixed and virtual methodology. The tests could not confirm a statistically significant difference between the two conditions. The absolute differences for Q3 indicate that our participants preferred to view common slides in the physical world as they stated to recognize drawings, graphics, and texts more easily there. Even though both presentations were perceived similarly positive, the scores for Q4 indicate that our participants expressed the desire to have more interaction possibilities with virtual slides than it would be possible with usual slides in the physical world.

5 Conclusions and Future Work

In this paper, we explored possibilities to integrate presenters when VR is used within a slideshow presentation. As a technical foundation, we have shown how game-engine-based VR technology can be used to implement these concepts and how game engine VR can be connected to established slideshow presentation software, such as PowerPoint. Our user studies indicate that both virtual and mixed presentations were accepted by our participants and that an immersed presenter was preferred.

Finally, we will explore transitioning techniques between physical slideshows and short VR experiences within mixed presentations. Current work targets rather extensive and complex transitioning to VR to improve the experience of VR users. As participants of mixed presentations may put on and take off VR HMDs frequently within a single presentation, such elaborate transitions could be disproportionate concerning our VR experiences in-between slides. This will be addressed in future research directions. Furthermore, we evaluated the presenter integration from a VR user's perspective, but expert presenters must be included in future studies, too, in order to create the best possible experiences for both presenters and the audience of VR-enriched presentations.

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