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Comparing VR and Desktop 360 Video Museum Tours

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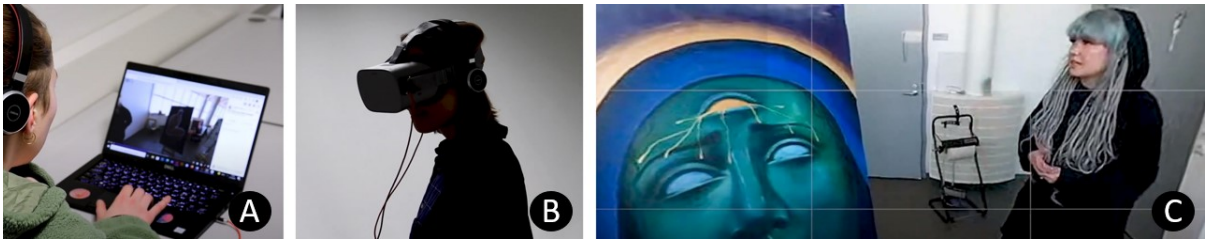

Fig. 1. Remote art museum tour with the artist as a guide (C) experienced with a 360 video viewed on a laptop screen (A) and using a head mounted display (B).

We investigate the user experience of taking a remote museum tour with 360 video technologies. We compare the experience of viewing a 360 video feed on a laptop screen vs. a 360 virtual reality (VR) video experienced through a head-mounted display (HMD). Our salient findings from a user study (n = 10) highlight that HMD VR provides a better immersion and sense of control for users. However, the HMD VR user experience suffers from the lack of personal contact, such as eye contact with the guide, discontinuities in the visual presentation, and missing multimodal contextual cues. The research contributes to the design of remote tourism services.

CCS Concepts: • **Human-centered computing** → *Empirical studies in collaborative and social computing*.

Additional Key Words and Phrases: virtual reality, 360 video, remote tourism, remote guide, user experience, museums

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1 INTRODUCTION

Museums and exhibitions are increasingly taking advantage of digital technologies; among these, virtual reality (VR) technologies have emerged in the cultural heritage field [1]. The escapism and aesthetics that can be provided by a VR tour have been found to positively impact the museum experience and, consequentially, the intention to visit a museum [4]. Additionally, VR exhibitions are particularly suitable for remote attendance [13]. The Covid-19 pandemic, with its requirements for social isolation and restricted mobility, gave a kick-start to the

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development of ways to attend art exhibitions and museums remotely [7, 9]. There is a growing demand to further improve the user experience of such remote services, and to further evaluate and develop virtual tours [5].

Virtual tours are an increasingly important form of remotely attending museums and exhibitions [2], and prior work has demonstrated a vast amount of different solutions utilizing 360 photo or video materials or 3D models. A *virtual tour heuristic evaluation scale* with four dimensions, authenticity, interaction, navigation, and learning, has been proposed as a methodology to assess such tours [5]. In the context of tourism, Wagler and Hanus studied visitors taking a guided audio tour of a state capitol building, and report that the immersive 360 video tour and the physical tour both outperformed the experience with a 2D video tour [12]. Pasanen et al. compared the experience of 360 nature tourism videos shown on a tablet to the same videos shown on a VR headset. They report that, whilst both solutions increase the desire to travel, with a VR headset the experience is more immersive and content should be optimized for each approach [6]. Kelling et al. have developed guidelines for designing 360 video experiences, and point out that with 360 videos, guiding the user's attention requires consideration, as the user has only a limited field of view to the 360 video. For example, methods such as 3D sound cues could be used to direct attention [11]. In a study on methods of guiding users when viewing 360 video, following an object was the preferred approach, and following a person was the second preference [10]. In a user study exploring augmented reality (AR) headset-based museum guidance, a realistic virtual guide and a real human guide outperformed an abstract virtual guide and an audio guide, in terms of visitors' comprehension [8].

In our research, we explore the differences between two approaches to create virtual museum visits, Figure 1. We compare two lightweight VR technologies, which require no or little development skills, 360 video viewed from a laptop screen, and 360 video viewed using a VR headset.

2 STUDY SETUP

To explore the impact of viewing method on the experience of VR tours, a virtual tour was set up in an art studio, where an artist guided a visitor around an exhibition of their works. The tour was recorded as 360 video using an Insta360 X2 camera. The user study experiment was divided into two parts (not counter-balanced), each based on a 2-minute long 360 video, where participants had the possibility to look around the scene:

- **Laptop**: watching the 360 video on social media (Facebook), with a laptop and headphones, with an artist being interviewed about the paintings standing still. Participants could look around the scene using the laptop's touchpad mouse.
- **VR**: standing up and using an Oculus Go VR headset to watch the 360 video (YouTube), with the artist moving around the virtual space and presenting the paintings. Participants could look around the scene using natural head movement.

After providing informed consent, participants completed a background questionnaire, giving information on their prior experience with VR / 360 technology. During the test, participants were asked to describe their experience out loud. At the end of the test, participants completed an end questionnaire and described their experience freely to a researcher. The qualitative data were analyzed using an open-coding approach by three researchers. The study lasted for approximately 30 minutes per participant. The study included 10 participants (4 women) between the ages of 22 and 57 (median 28.5). One participant had prior experience of VR, but overall, the participants had limited experience of VR, with a mean score of 2.7 on a scale from 1 (not at all) to 7 (very much).

3 FINDINGS

3.1 Sensory Experiences - Immersion and Technical Aspects

Figure 2 shows the participants' preferences for comfort and ease of use. Many of the participants' comments related to the sensory experiences, which were commented especially in the context of technical aspects and the feeling of immersion. Immersion was often mentioned, 11 times in total. Particularly, the VR headset was

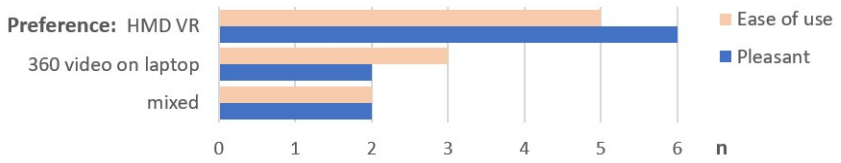

Fig. 2. Preferred method for ease of use and pleasantness for the 360 art museum tour.

commented as feeling immersive (P1, P7, P8). In four answers, the experience was described as disruptive, which was affected by the editing of the video and its low quality (P5), or because of the viewing perspective and image distortion inherent in the 360 technology (P3). The physical surroundings, including the interaction and environment, affected the participants' immersion. For example, some participants felt that while VR looked real, it could not provide a fully immersive experience without multisensory feedback. This sparked comments related to remote tourism more generally: "If you play a video of the Arctic winter and I'm in a warm room, in a way the experience will be really incomplete" (P3). Overall, contrary to 360 video on a laptop screen, 360 video viewed with a VR headset was perceived as an experience on its own.

Technical aspects proved to be critical to the immersion of the experience. Altogether 9/10 participants felt negatively about disturbances in the sound, visual presentation or resolution, or other technical aspects, such as the internet connection. Here, the most mentioned theme was the visual aspects (20 occurrences). This related to factors such as the perspective and scale of the visual experience. P1 and P3 mentioned the experience of VR being confusing for them, and P8 felt dizzy. Another sensory and technical issue raised was sound, which was noted in five comments.

3.2 Interaction, Guidance, and the Feeling of Control

The feeling of control and whether the user had the ability to interact with the virtual tour experience affected the user experience. As one participant commented during the end discussion, "I was just an observer in the world. I was not really present..." (P3). Out of the ten participants, 4/10 mentioned interaction with the guide or other people in VR to influence the user experience, e.g. "If I smile and something, I show my body language to that person, [but] then they don't react to it in any way. They just continue their speech." (P3). The lack of eye contact with the guide and not returning a smile were also mentioned. The participants also wished to explore more of the surroundings than the live-recorded videos could provide. As one participant commented: "At the moment, the possibilities to influence are really limited only to what you want to look at during the [test] situation. Maybe [the remote] person's possibilities to affect the surroundings could be increased, for example, by allowing more free movement" (P10).

The user guidance was a topic both within the actual tour experience and outside of it, such as with setting up the VR headset or navigating the 360 experience. P5 perceived that "at first, the 360 video on a laptop touch-pad was a bit tricky, it would have been worth using the mouse" (P5). P2 commented that they did not need explicit guidance as long as they were familiar with the platform, and P8 wished for basic guidance for the VR equipment.

4 DISCUSSION

Overall, the findings from our study revealed some cross-cutting themes, which the participants perceived as important in the 360 video tour experience. Generally, the desire for immersion and supporting multi-sensory experiences arose at several points of the study. The perception of immersion is highly influenced on one hand by the technology, its seamless use and technical quality, and, on the other hand, the interactive features and

ability (or inability) to interact with the guide. Our study was preliminary in its nature and is limited by its small sample size, recorded video content, and non-counterbalanced study setting.

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