MemoryVR: Collecting and Sharing Memories in Personal Virtual Museums

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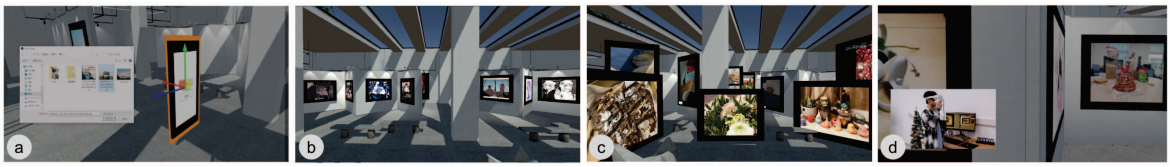

Figure 1: Illustrations of *MemoryVR*: (a) adding and editing media components of memory moments to the virtual museum; (b-c) PC screenshots of environments created by participants; (d) a participant visiting a personal virtual museum using a VR HMD.

Abstract

We present *MemoryVR*, a virtual museum system designed to preserve and share personal memories. This system enables users to create customized virtual museums within a spatial enclosure, providing an immersive and enriched way to experience personal memories. We invited participants to use *MemoryVR* to create their own personal virtual museums and visit those created by others. Results from evaluation studies showed a positive impact of *MemoryVR* on their experience of memories. Participants reported that their experiences within the personal virtual museums were fulfilling, invoking a sense of ritual, ownership, curiosity, and engagement.

Index Terms: Human-centered computing - Human computer interaction (HCI) - Interaction paradigms - Virtual reality Human-centered computing - Human computer interaction (HCI) - Empirical studies in HCI

1 Introduction

Due to the role of museums in collecting social and cultural memories, people often associate them with collective memory [4], and some scholars have referred to museums as memory institutions [7]. During the Web 2.0 era, customized virtual museums (VMs) were once very popular [2]. Early in 2006, researchers examined the possibility of developing computer systems and integrating media types that digitally index, store, and retrieve personal memories with the development of information and communication technologies [5]. Over the past decade, advancements in 3D graphics and virtual reality (VR) hardware have spurred the development of novel immersive and interactive applications. However, relevant research on customized personal VMs is still limited.

In this study, we sought to expand the practice and research of customized VMs that host personal memories in digital forms. Specifically, we designed a personal VM system, *MemoryVR*, and proposed the following research question: *Do personal virtual museums contribute to the user experience of memories? MemoryVR* facilitates collecting and sharing memories in VMs using personal computers (PCs) or VR head-mounted displays (HMDs). We invited participants to *create* personal VMs using PC and evaluate their experience when they *visit* others' VMs. The results demonstrated that users had an overall good experience when creating their own VMs and an excellent experience when visiting others' VMs. These findings indicate a positive effect of personal VMs on the user experience of memories.

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2 Design and Implementation of *MemoryVR*

MemoryVR supports two basic features.

1. **Create and Customize**. It allows users to create a new VM and edit it, including uploading images and videos they want (see Figure 1a);
2. **View and Share**. It allows users to view their furnished VM and visit VMs shared by others. The VMs can be viewed using PCs (see Figure 1b-c) or VR HMDs (see Figure 1d).

The system was developed using Unity (version 2020.3.21f1). It supports the use of PCs and the Meta Quest 2 VR headset with two controllers. We created databases using *phpMyAdmin* to record users' account information and the personal VMs they created.

2.1 *PC Create* Mode

In this mode, users can create a personal VM using a standard PC setup with a monitor, mouse, and keyboard. Four actions are supported: (1) users can press `WASD` keys to **move** forward, left, backward, and right; (2) users can press and drag the mouse to **change viewing angles**; (3) by pressing the `Esc` key to exit the view and trigger the menu, users can click on the `Add Model` button to add a *photo* frame and upload `.jpg` and `.png` images, or a *video* frame to upload `.mp4` videos; (4) by clicking on the media frame, users can press `Q`, `E`, or `R` keys to enable the movement, rotation, or scaling to **edit the media frame**.

2.2 *PC Visit* Mode

In this mode, users can (1) **move** in the VM environment and (2) **change viewing angles** using the same operations in *Create* mode. In addition, users can (3) **play/pause video** by clicking on the play icon on the video frame; and (4) **take snapshot** using `Alt + A` keys.

2.3 *VR Visit* Mode

In this mode, the four actions in PC *Visit* mode are also supported in VR. TeleSteer [8] is used so that users can (1) **move** in the scene using both continuous and discrete locomotion techniques. By turning their body or the controller joystick, they can (2) **change viewing angles**. Users can use controllers to touch (collide) the play icon on the video frame to (3) **play/pause video**. In addition, they can grab the camera in the scene and press the trigger to (4) **take a photo**.

3 Evaluations

We conducted two laboratory studies to evaluate *MemoryVR*. The first study evaluated the *PC Create* mode. Participants were asked to prepare images and videos to create a personal VM when they signed up for the study. Twenty participants (11 females and 9 males) aged between 18 and 26 ($M = 21.90, SD = 2.51$) joined the study. Each participant started with a standard gallery setup with no

2024 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW) | 979-8-3503-7449-0/24/$31.00 ©2024 IEEE | DOI: 10.1109/VRW62533.2024.00307

frames placed in the scene and created a personal VM by uploading the prepared images and videos and editing the layout. In the second study, participants visited VMs created in the prior study using both PC and VR. Another twenty participants (11 females and 9 males) aged between 19 and 26 ($M = 21.25, SD = 1.92$) took part in this study. Each participant visited at least three VMs using a PC and at least three VMs via a VR HMD. In both studies, participants filled out the System Usability Scale (SUS) [1] and the short form of the User Experience Questionnaire (UEQ-S) [6] and joined an interview.

4 Results

PC Create showed satisfactory usability, with a SUS score of 71.50 ($SD = 11.85$) that exceeded the threshold value of 68. Compared to the UEQ benchmark [3], *MemoryVR* showed *above average* (top 50% to 25%) pragmatic quality, *excellent* (top 10%) hedonic quality, and *good* (top 25% to 10%) overall experience (see Figure 2a). Both *PC Visit* and *VR Visit* modes showed satisfactory usability. The SUS scores were 76.75 ($SD = 8.43$) for PC and 79.88 ($SD = 11.99$) for VR. In addition, both *PC Visit* and *VR Visit* demonstrated *Excellent* (top 10%) user experience in the pragmatic quality, hedonic quality, and overall experience (see Figure 2b). Paired samples t-tests showed no statistically significant difference in usability or user experience between the two *Visit* modes.

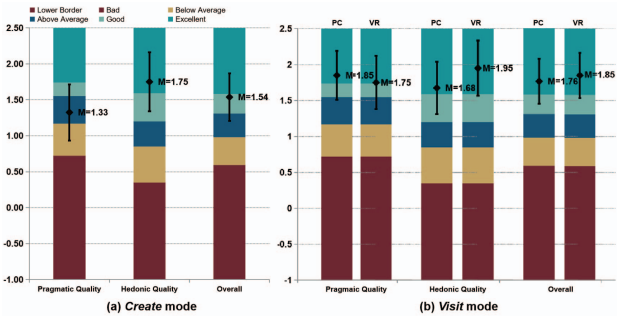

Figure 2: UEQ-S scores of (a) *Create* and (b) *Visit* modes.

MemoryVR was found to be a novel approach compared to common ways of storing memories. For example, P14 stated that *"other platforms are (of) flat (displays). This system makes me feel like I'm really creating a personal museum, and it's owned by me. The feeling is kind of amazing."* Besides, participants mentioned that they recalled and reorganized their memories when creating their personal VMs, which rarely occurred when sending social media posts. *"I especially liked the process of recalling when creating my own VM. It was great to review my experiences and then display some of my achievements"*, said P9. When viewing VMs, participants showed strong curiosity even when certain areas appeared empty. They actively searched for hidden surprises or unexpected elements, especially within the VR scenes.

5 Discussion

Overall, our studies showed positive results in the usability and user experience of *MemoryVR*. The results indicate that personal virtual museums contribute to users' experience of memories. Memories in the digital forms of images and videos are accumulating and becoming an inseparable part of users' daily lives. Users often record, store, and share these memories on social media platforms. Providing a spatial layout for users to host and re-experience memories in personal VMs can motivate them to organize memorable moments, provide a comprehensive perspective of significant life events, and foster accomplishment. Two potential improvements could be made to the *Create* mode in *MemoryVR*. The first is to include various environment layouts and enhance the customizability of VMs. For example, allowing modifications to image frame colors, wall positions, adding decorations, etc. Participants emphasized the benefits of flexible customization for their VMs. The second improvement is optimizing 3D operations. It is conceivable that users unfamiliar with 3D software may find these operations challenging in *Create* mode. An effective solution is needed to align with users' mental models. Alternatively, users could be allowed to edit media and layouts in VR directly.

Visit mode in both PC and VR were well received by participants, indicated by their usability and user experience ratings. From the observations and user comments, we found the sense of ownership and curiosity bolstered their engagement with *MemoryVR*. Despite the overall positive feedback, we observed that many participants attempted to pick up the picture frames or sculpture decorators in the *VR Visit* mode. Upon realizing that they could not interact with them, some participants showed a slight sense of disappointment. Enhancing support for perceived affordances is an area for future improvement. Our current results did not show significant differences between PC and VR in the viewing of VMs. Future research can further explore the use of immersive media, such as 360° videos, to investigate if it enhances users' experience of personal memories.

6 Conclusion

This paper presents the design and evaluation of *MemoryVR*, a personal virtual museum system for PC and VR use. Two laboratory studies confirmed that *MemoryVR* contributes to user experience of memories. Participants provided high ratings for the pragmatic and hedonic qualities of the user experience when creating and visiting personal VMs. Interview comments showed that *MemoryVR* evoked a sense of ownership, curiosity, and user engagement. Our study demonstrates a successful use of customized virtual museums that engaged users in collecting and sharing personal memories. In the future, we plan to conduct follow-up studies to understand the way users record, store, and share personal memories and their revisit intention of personal virtual museums.

Acknowledgments

This work is supported by the National Natural Science Foundation of China (62207022, 62272396), the Natural Science Foundation of the Jiangsu Higher Education Institutions of China (22KJB520038), and the Xi'an Jiaotong-Liverpool University (RDF-20-02-47).

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