VRPassport: Travel the world in Virtual Reality for people with Dementia

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The loss of autonomy that comes with being in the care of others has a significant impact on the emotional well-being of people with dementia (PwD). Our research aims to investigate key design factors when creating Virtual Reality (VR) non-pharmacological interventions to improve their emotional wellbeing and enhance their interactions with caregivers. This paper, presents the iterative design and initial evaluation of a VR system aiming to enhance the procedure of admitting VR interventions.

CCS Concepts: • **Human-centered computing** → **User studies**; **Virtual reality**.

Additional Key Words and Phrases: Virtual Reality, Dementia, Long-Term Care, Locked Psychiatric hospital, Patient-Centered Design, Person-Centered Care

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1 INTRODUCTION AND BACKGROUND

The quality of life of People with Dementia (PwD) is often negatively impacted when they live in restricted care facilities, such as care homes and secure hospital environments, as they frequently rely on others to care for them. This can lead to depression for some PwD in the early and middle stages, affecting their emotional well-being and prognosis. Reminiscence Therapy (RT) is a non-pharmacological intervention to manage and improve depressive symptoms in PwD. RT focuses on discussing past events and experiences in order to awaken memories, stimulate mental activity, and provide the ability to re-experience past emotions [15]. Traditionally, this is accomplished through the use of visuals, music, or physical objects [5, 11]; however, past work demonstrates that engaging as many senses as possible is more beneficial [6]. Since emotions are directly affected by the surrounding environments, providing multiple familiar stimuli could potentially enhance emotional, cognitive, and behavioural responses [10]. Moreover, emotions are often expressed, regulated and interpreted in social settings [14], hence, eliciting social interactions in RT, could in turn resurface similar past feelings for PwD.

Because of its ability to "teleport" users to existing and new worlds, Virtual Reality (VR) is used in a variety of domains [12]. In the field of dementia care, it has been explored as a non-pharmacological way of helping PwD, for example as a psychological-therapy [3] or rehabilitation [9] tool. The feasibility of VR within this context has been

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assessed on multiple occasions, using 3D environments [4], social interactions [8] and images [7]. Studies have also shown that the use of RT in VR can effectively improve memory recollection [2] and produce cognitive improvement [1]. By triggering emotions more effectively, VR can stimulate emotional responses of PwD, therefore enhance the conventional RT and enhance their mental wellbeing. Indeed, a recent study assessing the use of VR to improve the wellbeing of individuals with moderate to severe dementia in a locked psychiatric hospital [13], found that exposure to virtual scenarios can have a positive impact on the observed emotions (pleasure, alertness) of PwD. Nevertheless significant limitations emerged including a) the provided scenarios were not positively received by all participants; b) during the data collection, each time a new video was selected, the headset had to be removed by the caregiver, impacting the experience of the PwD.

The goal of our research is to investigate key design factors for VR-mediated non-pharmacological therapies that can contribute to improving the emotional wellbeing of PwD, as well as enhance their interactions with their caregivers, hence fostering better social connections. In this paper, we briefly describe the iterative design and initial evaluation of a prototype VR system aiming to extend previous work by enhancing the procedure of admitting VR interventions and improving the user experience for the PwD and their caregivers. This is achieved by: a) enabling the use of such systems remotely, therefore, allowing families and caregivers to potentially use them even if they are in different locations; b) providing a greater selection of virtual scenarios aimed for different users and; c) removing the need to take off the headset every time an interaction needs to take place.

2 ITERATIVE SYSTEM DESIGN

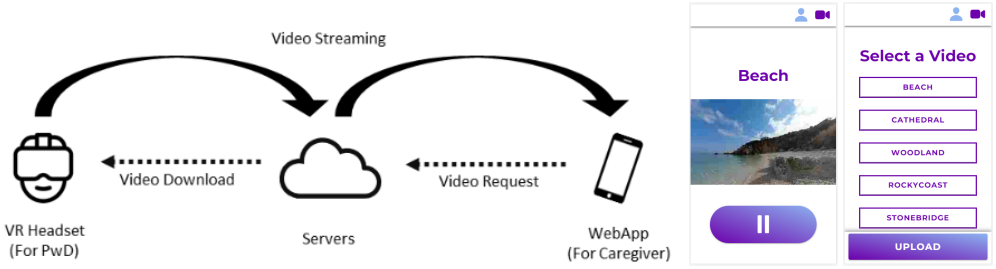

Fig. 1. System Diagram (left) and screenshots of the caregiver application (right)

Our prototype application (see Figure 1) was developed in collaboration with staff at a psychiatric hospital, following an iterative design process (see Table 1). The system was created using Unity and Firebase for the Oculus Quest and consists of two components: (1) a caregiver application used on a handheld device to upload and select 360 videos for the PwD to watch – what the user sees is streamed to them in real-time [1]; (2) a video player application used within the VR headset to download and play the selected videos. Our system is intended for patients and caregivers to utilise wirelessly, without the need for a computer connection, hence providing opportunities for remote use. Moreover, it allows the caregiver to preview and control everything that is happening in VR without the need for user input, therefore minimising the frustration that comes when taking on and off the headset which can break immersion.

Once the initial prototype was designed, research staff at the test site trialed the system amongst the caregivers and provided feedback. Several issues were raised by the study team and clinicians during the procedure, such as streaming

[1]Real-time streaming is available when using an Oculus Quest, however this requires action from the user, which is not convenient if the user is a PwD.

Table 1. Iterative design process

Stage	Objectives (Ox.x)	Major Tasks (Tx.x)	Outcomes (Rx.x)
1	O1.1 Design a user-friendly system for PwD and their caregivers	T1.1 Develop an application to be used on a VR headset T1.2 Develop an application to be used by staff members to select videos for PwD	R1.1 Initial prototype system produced with user registration, video selection/control and 360 video synchronisation between VR and the caregiver application
2	O2.1 Identify possible problems which may occur during VR intervention	T2.1 Receive feedback on site with staff before using system with PwD	R2.1 Positive feedback - "Easy to use and serves as a meaningful activity" R2.2 Personalised content for individuals would be more meaningful R2.3 Videos watched were "blurry" - Less immersion to evoke emotions
3	O3.1 Optimise quality of videos	T3.1 Increase resolution of the videos T3.2 Balance the quality of video and size of the video file	R3.1 Resolution of video player and videos were increased
4	O4.1 Enhance streaming aspect to allow better conversations	T4.1 Implement head tracking to see the point of view of user from the caregiver application	Achieved real time synchronous video streaming allowing caregivers to share the experience with user
5	O5.1 Optimise video running smoothly in VR and app	T5.1 Modifications to the information transfer between video player and streaming destination so video runs smoother	R5.1 Finalised version of the system, working well on site with minimal issues
6	O6.1 Testing and Execution	T6.1 Run the intervention with PwD, supported by caregivers and gain their feedback	R6.1 5 PwD was involved in the interventions (2 of which used it again)

and overall quality of video experiences. These factors were important for the users to share experiences together and to immerse the user in VR. The system was then iteratively improved based on the input of the hospital staff, until they found it appropriate to be used for PwD.

3 PRELIMINARY USER EVALUATION

Five PwD with capacity to consent were recruited to participate in the user evaluation. Prior to the sessions, videos that participants would likely enjoy were uploaded to the system, with the aim to increase engagement. The sessions were run by hospital staff and each participant spent approx. 30 minutes in VR with breaks throughout. An initial conversation took place to determine what kind of videos they would like to watch. While in VR, participants were encouraged to speak with the caregiver regarding what they were viewing. After the session, the PwD and caregivers were interviewed regarding their experience and what could be improved in future designs. All sessions were audio recorded and transcribed for analysis.

Initial thematic analysis revealed high level of engagement and reminiscence by the users. They demonstrated a greater arousal of emotions during and after the experience as well as a strong sense of presence – feeling that they were physically there, rather than watching from a third person perspective. Despite the lack of interactivity of the 360-video, PwD described the VR experience in words which implied a high level of immersion and positive emotional engagement. For example one participant talked about *"visiting"* a place and another one mentioned that *"there is something by my feet"*. In addition, the diverse environments provided plenty of conversation material, often prompting the participants to be more chatty than usual. The caregivers also reacted positively to the technology. One of them commented how *"it is very engaging, I think he really enjoyed it, it was nice to have different options and things he would*

enjoy". However, limiting factors when adopting such technologies in clinical environments were also indicated, such as funding and staff availability for *"the instructions and the time to do it and doesn't just get locked away in a cupboard "* Overall, VR was seen as a unique opportunity to *"go outside"*, rather than it being an indoor-based RT. Nevertheless, there is still work to be done to improve the experience of those using it and those administering it.

4 CONCLUSION AND FUTURE WORK

This paper presents the iterative design and evaluation of a VR system aimed at improving the user experience and emotional engagement of PwD during VR interventions. The features of our system enabled for seamless interaction between PwD and the caregivers, making the overall experience positive for both sides and enabling the participants to experience a variety emotions. Future work will include expansion of our current study and in-depth analysis of the results, to better understand how to improve the design of VR interventions for dementia care, considering both the PwD and their caregivers (whether that is family or care home staff). Additionally, we will investigate how to further personalise VR experiences for PwD, as well as what levels of personalisation are most effective for different stages of dementia. Lastly we would like to explore how to broaden the use of VR for PwD outside of hospitals and care homes.

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