Memory Journalist: Creating Virtual Reality Exergames for the Treatment of Older Adults with Dementia

Sebastian Rings*  
Universität Hamburg

Frank Steinicke†  
Universität Hamburg

Tobias Picker‡  
Hochschule Düsseldorf

Caspar Prasuhn§  
Universität Hamburg

ABSTRACT

In this poster we show the intermediate results of our first therapy exergame for older adults with neurological diseases, in particular, dementia and Alzheimer’s disease. It has been shown that regular exercises improve balance of older adults when performing everyday tasks. However, creating exergames for older adults with dementia leads to challenges when it comes to designing training tasks, which can be solved without the requirement to learn new modes and methods of interaction, since dementia patients are typically limited in acquiring new skills. Therefore, we co-developed novel virtual reality (VR) interactions together with patients and clinical experts, which can be easily performed by patients without extensive instructions. We introduce Memory Journalist, which is an exergame based on moderate complex motor-cognitive tasks. In this game patients need to memorize locations of landmarks and photograph them using a tracked 3D-printed wearable camera by exploiting simple motor tasks.

Index Terms: [Human-centered computing]: Human computer interaction (HCI)—HCI design and evaluation methods; User studies; [Human-centered computing]: Human computer interaction (HCI)—Interaction devices

1 BACKGROUND

The exergame Memory Journalist described in this poster is part of a larger project funded by the German government [4]. While therapies for balance disorders of older patients are already available in a broader spread, games with a focus on patients with neurological disorders often lack in motivational and cognitive training aspects [4]. Since secondary aging processes, as opposed to primary, can be improved through exercise and targeted rehabilitation, we specifically design our exergame to be suited for a defined group of patients [1, 5].

During the first year of the project we closely collaborated with multiple experts and patients at the “Hospital zum Heiligen Geist”, which is a hospital for seniors in close distance to our university. We discussed each prototyping stage in our development process in several focus groups and patients have evaluated the prototypes in different usability studies. All older adults and clinicians had previous experiences using Kinect® exergames on a large screen TV, but none of them were previously exposed to immersive VR.

2 ANALYSES OF USER REQUIREMENTS

Since the beginning of the project, we visited the hospital each month, and regularly held audio/video conferences with clinicians every other week. During our first visits we collected user requirements from healthy older adults as well as those with light to medium Alzheimer’s disease. Our focus was finding motivational aspects in the Kinect-games previously played at the senior hospital and issues that have resulted through continuous exposure of the same gameplay. The therapy games were mainly played in a group setting in which each player only played around 3 minutes in a one hour session. The clinicians suggested our exergames should strive to increase the time each patient is focused on, since some players might otherwise not get any meaningful exercise or be bored.

Figure 1: Recommended exercises for seniors to improve balance. Top images show rotating of the torso. Bottom images show stretching the arms and rotating the head.

2.1 User Study

In general the user study consisted of the previously mentioned visitations at the hospital, and postprocessing of the gathered data thereafter. The visitations can be separated into three main sections: 1. The time before midday was used to meet with individual older adults with dementia, since their state of mind is usually better early in the day and declines in the afternoon. We devoted one hour to each patient which we used to have a conversation to collect user requirements. Afterwards they got to play a current version of our exergame while we took notes of our observations. Finally they were able to give feedback and ask questions after removing the VR headset. 2. At noon most inhabitants of the hospital ate lunch, so we were able to have interview sessions with different experts every time we visited. We spoke with clinicians, shareholders of the hospital, technicians, physicians (which we explain in more detail in the next section) and others. 3. Late noon to afternoon we had focus group interviews (in groups of 4-7) with older adults without neurological diseases where we let them play our exergame prototype while the others spectated. Both player and spectators where interviewed at the same time and their remarks noted by one of our researchers.

1 https://developer.microsoft.com/de-de/windows/kinect

* e-mail: sebastian.rings@uni-hamburg.de
† e-mail: frank.steinicke@uni-hamburg.de
‡ e-mail: tobias_picker@hs-duesseldorf.de
§ e-mail: caspar.prasuhn@uni-hamburg.de
2.2 Interviews with Physicians

We had multiple interviews with different physicians at the senior hospital to create a catalogue of relevant exercises for older adults in general. We summarize the main aspects of exercises for fall prevention:

- Shifting the center of mass. The body has to react to the movement, which trains muscle stability and coordination while also increasing sense of balance.
- Exercises should move away from the patients normal viewing axis to increase safety in areas where the patients movements are weaker. Otherwise tasks would not be demanding enough to achieve a positive training effect.
- Dynamic exercises are always better than static ones. E.g. slow, large steps are better than standing on one leg and holding that position. Also, the chosen posture should always be steady and tasks should use this security to increase muscle activity.
- Exercises should increase the day to day live of the patients. When creating exercises you should always ask the question, where would this be useful in their normal lives.
- Degree of difficulty should always start easy but have the ability to increase as the patient gets better at solving a task. Improving through multiple difficulties is a very motivating aspect for players of these therapy games.

Using these guidelines we designed multiple exercises and use cases for our target audience (Figure: 1).

3 Exergame

When creating the game design for our first exergame we initially focused on how we could induce the required movement of an exercise into gameplay, without having the patient perform a monotone tasks with constant guidance. The result of our brainstorming is a 3D printed camera, which the player has to use to focus on different points of interest (Figure: 2). In order to include the camera in an understandable context we created a game, where the patient has to photograph landmarks in a 3D 360 degree Video at famous spots in the city where the senior home is located. This design also addresses motivational requirements of the patients, since few have the chance to explore the city on a regular basis due to cognitive or movement impairments.

Using strategic 360 degree 3D camera placement we were able to produce the previously designed exercises in the patients movements as seen in figure 3. In a zooming interaction we could also control the distance the patients stretch out their arms, off centering their center of mass and improving their ability to reach for distant objects e.g. on a kitchen shelf. At the same time the players have to find famous landmarks, which resembles a cognitive orientation task, which is comparable to the tasks completed in the kinect games previously played at the senior home. In preliminary evaluations, participants required around 30 minutes to complete all tasks, which was our goal through the requirement analysis.

4 Conclusion

The prototyping phase of our first exergame is complete and the results show great potential promise. Exercises could be reproduced through game design and without teaching new mechanics. Even patients with medium dementia were able to use the 3D printed camera to take pictures, since this task is similar to what they used to do previously in their lives.

The conducted user study yields important information for creating VR Exergames for older adults with neurological diseases. We created a catalog of exercises and requirements, and used the results to create a final prototype of an exergame with motor-cognitive tasks for our target group.

In an immediate next step we plan to evaluate the exergame in a 2 month study to report on the improvements in balance and cognitive fitness using tests such as MMSE [2] and MOCA [3].

Acknowledgments

This work was funded by the German Federal Ministry of Education and Research (BMBF) as well as the German Research Foundation (DFG), the European Union’s Horizon 2020 research and innovation program and the Federal Ministry for Economic Affairs and Energy (BMWi).

References