Development of a Virtual ADL Training Prototype by Using VRfree Gloves

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Introduction

Parkinson disease (PD) is a progressive neurodegenerative disease, while most patients with PD experience loss and impairment of upper limb function, especially finger movements.This may, affects activities of daily living, such as cooking, and thus quality of life. A promising way to improve finger movements in rehabilitation programs, is virtual reality (VR) training. Therefore, the aim of the project was to develop and evaluate in healthy and PD patients an new VR gloves based rehabilitation training program (i.e., exergame) to train finger movements.

Materials and Methods

In a first step, two different exergames were developed, a kitchen game where the participants had to cook a fried egg and a space game where participants had to catch planets (fig. 1). Second, the exergame was tested in 6 healthy (age 25 to 59) and 5 PD (age 60 to 65) patients, whereas a training session lasted 10 to 15 min. In addition, to assess the performance, usability and stress level during the training, heart rate and electrodermal activity were monitored by a smart watch, hand movement of the controllers and gloves were tracked and in game statistics were calculated. At the end of the experiment each participants had to answer fill out different questionnaires about game experience, sickness, flow state and immersion and presence.
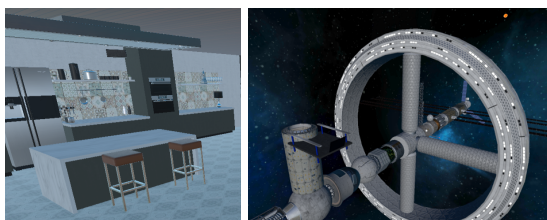

Fig. 1 Left: Kitchen-Exergame, Right: Space-Exergame

Results

The score of the game experience and challenge questionnaire had a significant difference between healthy and PD patients ($p<0.05$). The simulator sickness questionnaire score was almost close to the minumum score scale (M=8.7, SD =7.8 Score range [0 100]). Furthermore, the mean of the electrodermal activity (i.e., Stress level) measured by the wrist band was 1 microsiemens (SD=1) and heart rate was around 80 beats per minute (SD=5.6). The total summed up distance moved by the hand during playing the exergame kitchen, as shown in fig 2, was not significantly different between healthy subjects (Range 17 and 30 m) and PD patients (Range 19.3 and 19.9 m). In case of the space exergame the moved distance was as well not significant different (PD, 56.8 meters, healthy subjects, 78.6 m) see fig 2.
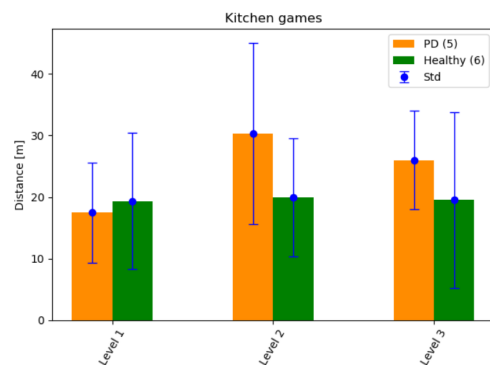

Fig. 2 Travelled distance in the 3 kitchen levels

Discussion

This pilot study has shown the usability of VR technology in the rehabilitation program for patients with PD. After a very short introduction and with no previous VR knowledge, every participant was able to use the developed system in order to train finger movements. The scores in the different questionnaires were in line with literature and thus indicate a high usability and acceptance. In addition, cybersickness was close to zero during the intervention and can therefore be neglected. The data from the wrist band and the questionnaires showed a low stress level. Therefore, the developed exergame has a great potential in rehabilitation programs of finger movements for patients suffering from PD.

References

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