Virtual Reality or Mixed Reality? A pilot study on the impact of immersiveness during balance training in healthy adults.

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Summary

Immersive training for functional mobility and balance, is increasingly implemented as a rehabilitation tool due to its known benefits. This study investigates if the level of immersion (virtual versus mixed reality) impacts balance (training) and reports the user experience in different (patient) populations. By using an instrumented body weight support system, balance disturbances are documented using center of mass displacements and forces exerted on the harness, while playing a virtual game using a head-mounted display.

Introduction

Immersive training for functional mobility and balance is increasingly used as a rehabilitation tool due to its demonstrated benefits.[1] The fast technological evolution offers a huge growth and variability in applications with different levels of immersion. This immersive character, together with the gaming aspect, affects the engagement in therapeutic activities and therapy adherence. Currently, there is not enough substantial evidence to recommend a specific level of immersiveness in rehabilitation. Available studies suggest varying effects based on the degree of immersion (e.g. head-mounted displays versus screen projections). [2] However, within the use of head-mounted displays no clear preference has emerged between Mixed Reality (MR) and Virtual Reality (VR) for rehabilitation purposes.

Therefore, this project aims to investigate if the level of immersion (VR versus MR) impacts balance (training) and user experience in different (patient) populations.

Methods

This pilot study will be performed on healthy adults (18-65 years) who complete a virtual balloon popping task while installed in the safety harness of Rysen (Motek) and wearing a head-mounted display. Rysen is a 3-dimensional body weight support system that enables individuals to move freely within their environment while safely practicing at the limits of their balance capabilities. In the "Popping Balloons" application (Holomoves), participants pop balloons by virtually touching them with their hands using hand tracking instead of controllers. The same application will be used in a fully immersive virtual environment (VR) and a mixed reality (MR) condition with the real environment visible. Both conditions will be offered in a randomized order to avoid learning effects or fatigue. Primary outcome measures are center of mass (COM) displacements and forces exerted on the harness measured by the research module of Rysen. Secondary outcome measures are the user experience (System Usability Scale, iGRoup Presence Questionnaire) and cybersickness (Simulator Sickness Questionnaire). Additionally, patient preference for VR or MR will be questioned.

Results and Discussion

As data collection has just started, this abstract presents example data. The output of the Rysen provides spatial coordinates during the period of the exercise measured by an accelerometer mounted in the harness. These coordinates can be used as a proxy for COM displacements of the subject. The Rysen also provides information about the forces exerted on the harness. In the example data (figure 1) the red peaks represent a greater force applied by the harness to correct for balance loss of the participant in the frontal (top right), sagittal (top left) and transverse (bottom left) plane.
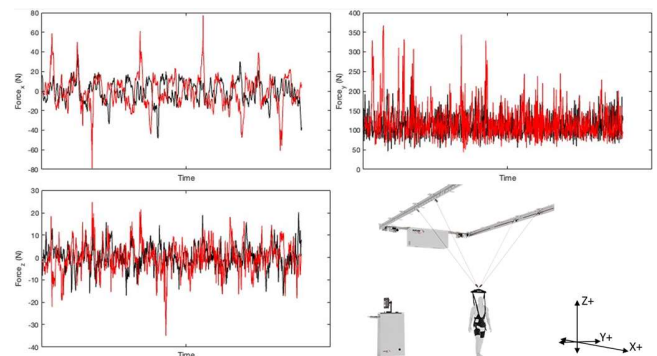

Figure 1: Force data example (black: stable condition, red: condition with balance loss) and study set-up in the Rysen

This data will allow us to detect which condition (VR of MR) causes the most balance disturbances. This will help to identify the most challenging condition. Together with the questionnaires this will help us determine which degree of immersion is best suited for the different patient groups and to be implemented into their rehabilitation program

Conclusions

Since MR is increasingly being used in gait and balance rehabilitation, guidelines concerning the level of immersion will help to determine individualized treatment plans for different patient groups.

References

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