# ProCibo: A Virtual Reality Environment for Functional Reach Training

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## Introduction

From the moment we set our first steps we practise walking until it eventually becomes second nature. However, due to injury, illness, or disease, someone might lose control over this automated task. In these cases, physical therapy is often used to help restore a patient's use of muscles and train a new automatic walking pattern. An important element in physiotherapy is to reduce postural sway and increase functional reach which can include using a body weight support system to let patients experience walking at an early stage of their rehabilitation. However, this also restricts them to a predefined area, away from everyday situations. As continuing their rehabilitation throughout everyday life can be challenging, being able to bring these everyday situations into the rehabilitation therapy might therefore aid their transition. In our project 'Virtual Reality for Rehabilitation' we try to achieve this by transferring everyday situation into a virtual reality environment. In addition, this also allows for usage data to be collected, analyzed, and presented to provide meaningful insights. For this we are developing a system that supports patients as well as therapists.

## Methods

Throughout the project we applied a user-centered approach and started with a physiotherapist to gain insights into physical therapy. We then designed two game concepts aimed at functional reach exercises based on the Berg Balance Scale [1]. Next, these game concepts were implemented (in Unity) as virtual reality games. We used an Oculus Quest 2 to present the virtual reality environments but also to determine a baseline for functional reach measurements by detecting hand movements. These measurements take place in the baseline game were users are challenged to remove tree branches in front of them while standing still. In the following game a shopping list is determined based on the measurements from the baseline game. This shopping list will be used by the users to fill their shopping chart in the virtual supermarket ProCibo. Finally, we tested the setup with users in terms of functionality and usability. Here we used a think-aloud method to examine how they would interact with the virtual reality environment while performing simple tasks.

## Results and discussion

Although our system is still in development responses from users are positive in terms of usability and functionality. However, as users can walk around in the second game, aligning the body weight support system with the virtual supermarket aisle is crucial but difficult to achieve (and maintain). Future work includes improving alignment of virtual and real world, adding more games for additional items of the Berg Balance Scale, and adding sensors to quantify balance and gait.

## Conclusions

By applying a user-centered approach we were able to develop a virtual reality environment which allows patients to practise within their limit and in an interactive way.

## References

[1] Berg K et al. (1989). Physiotherapy Canada 41 (6): 304-311