

Neurorehabilitation in shared virtual reality

Ing. Peter Nehila, Ing. Štefan Korečko PhD.

Technical university of Košice



Faculty of Electrical Engineering
and Informatics

Motivation

In the field of therapy, new methods are constantly being tried that could simplify the work for both therapists and patients. One of our main goals is to improve the results and make treatment of patients more effective. We aim to achieve this by creating an immersive collaborative virtual environment, in which patients and therapists can interact with each other. Therapist can lead patients over different training scenarios, which are visualized in virtual space.

Proposed System

We designed and implemented system using virtual reality, that can be used for neurorehabilitation of patients that suffer from loss of movement in their arms. System includes a collaborative environment, which is an environment allowing multiple users to interact with each other in real time. The system can communicate with an external device (EEG) used to sense brain activity of the patient and to detect whether they are attempting to perform the movement required of him. Subsequently, an animation of the hand movement is displayed in virtual reality.

One of the core features of our system is providing immersive experience for patients. For this reason, we've implemented full body avatars. Another important aspect of our system is configurability of trainings. Therapists can choose among multiple types of movements, which are represented by different objects and animations. Each movement can have defined multiple points, to which objects are moved.

Therapists can also change durations of movements and periods between each move.

System uses client-server architecture for providing network capabilities. System supports most of the commonly used VR headsets used nowadays, as well as desktop computers. Mainly therapists can use our system without the need for VR headset.



Figure 1, Patient during training

Results

- the system we've created offers new ways of interacting with patients using virtual reality. Some patients have shown higher interest in more complex training,
- we've tested the system performance on different devices (Table 1). Good performance is one of the key requirements for systems, in which immersiveness is one of the key features. Stable performance of system also helps lowering the effect of simulation sickness,

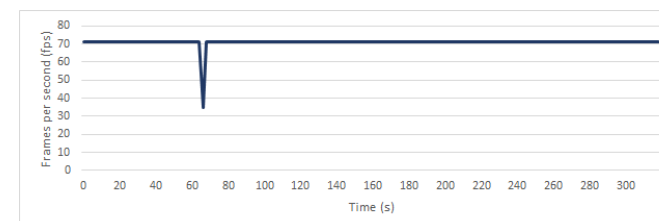


Figure 2, Performance when using Oculus Quest 2

Table 1, performance tests on different devices

Platform	Average FPS
Oculus Quest 2	70,7764
Desktop	59,7202
Laptop (Dedicated GPU)	59,6428
Laptop (Integrated GPU)	43,5789

Conclusion

System was built using Unity game engine, to allow for easier expansion of systems functionalities, as well as possibility of gamification in the future. The problem when using virtual reality is simulation sickness and overall dissatisfaction, caused by using it. This is one of the main issues, when dealing with patients, who can be even more sensitive to these aspects. When designing and implementing the system we've put focus on optimizing the system so that it can be extended in the future for more immersive experience. By creating this collaborative system, we hope to make rehabilitation easier, more enjoyable and we hope it brings better results, which can improve the lives of many people.