Evaluating Differences in Smart Walker-assisted Locomotion in Augmented and Virtual Reality Environment

Matheus Loureiro, Weslley Oliveira, Fabiana Machado, Igor Vieira Ricardo Mello & **Anselmo Frizera**
Human-Centered Systems Laboratory, Federal University of Espirito Santo

1 INTRODUCTION

The global trend of population aging has increased demand for healthcare professionals, particularly those assisting individuals with mobility impairments [1,2]. To aid these people, rehabilitation robotics, such as smart walkers (SW), can be used to enhance motor capabilities [3].

However, repetitive and painful tasks in rehabilitation can reduce patient engagement and motivation. To help enhance motivation during rehabilitation, tools such as augmented reality (AR) and virtual reality (VR) can be used [4,5].

In this context, this paper presents a study aimed at evaluating the differences between the use of AR and VR in smart walker-assisted locomotion. The objective is to compare user performance and experience when performing the same task in different reality-based environments.

2 METHODOLOGY

Fourteen healthy volunteers (20.8 ± 2.6 years) were recruited to participate in an experiment using the UFES WalkerXR (Fig. 1), divided into two groups: AR-VR and VR-AR. The participants performed tasks in both AR and VR environments (see Fig. 2), walking along a lemniscate path while collecting as many yellow items as possible in a 3-minute period.

The Virtual Reality Sickness Questionnaire (VRSQ) was administered before and after each session to assess motion sickness symptoms. Additionally, after each task, participants completed the 18-item Physical Activity Enjoyment Scale (PACES) to measure enjoyment.

A statistical analysis was conducted to compare PACES scores, and the number of items collected across AR and VR conditions (AR vs. VR), as well as task order (T1 vs T2), to evaluate significant differences in performance and experience.

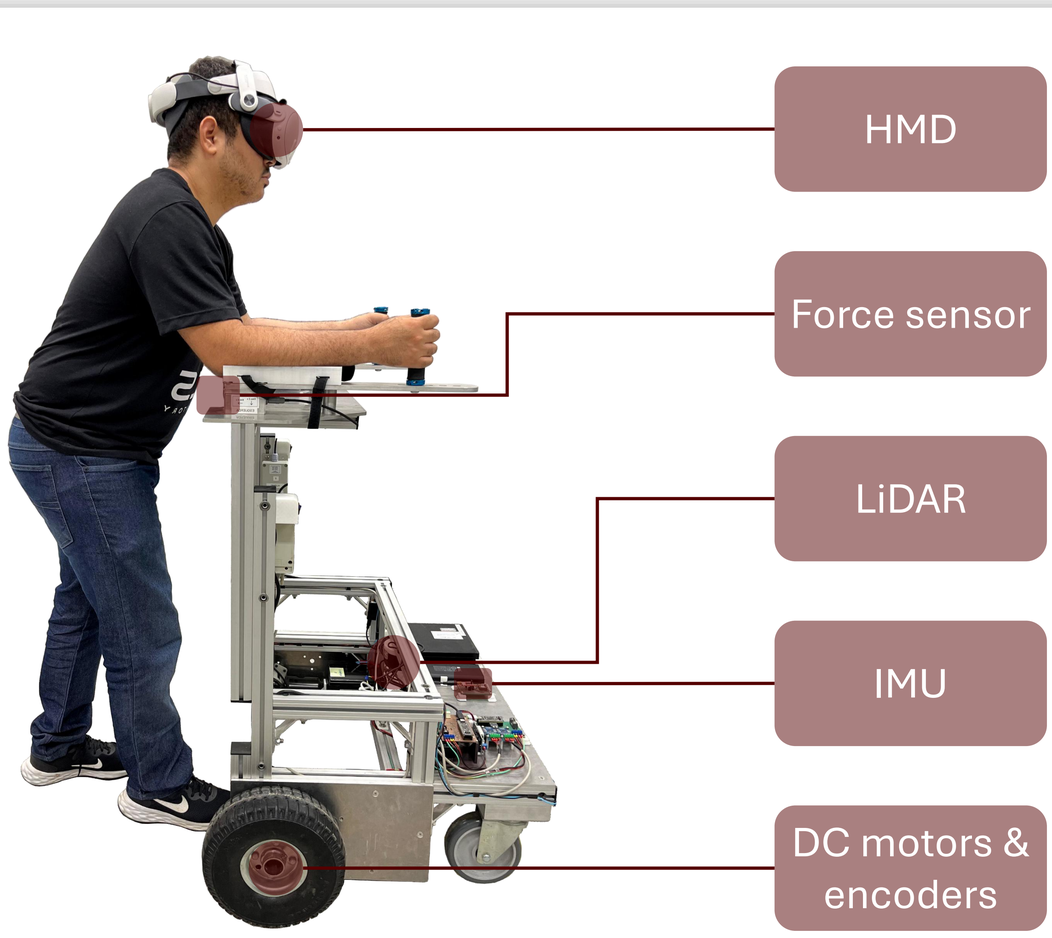


Fig. 1. UFES WalkerXR and its sensors.

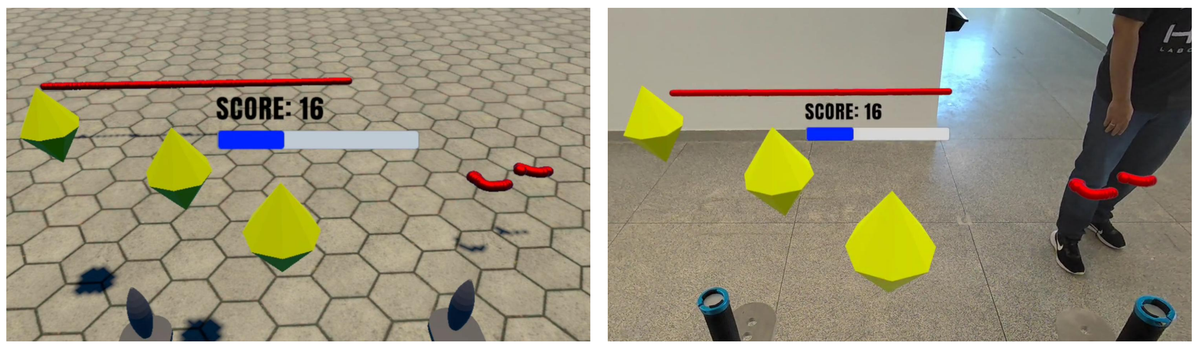


Fig. 2. Point of View of the User in the VR and AR enviroments.

3 RESULTS AND DISCUSSION

The VRSQ results showed no motion sickness symptoms in either AR or VR. In the AR-VR group, participants collected an average of 69.14 items in AR, decreasing by 1.7 in VR, while the VR-AR group saw an increase of 6 items when switching to AR (Fig. 3). Overall, 3.9 more items were collected in AR than VR (not statistically significant). The restricted speed likely limited faster walking, reducing a potential learning effect, as only 2.1 more items were collected in the second trial (T2).

The PACES scores showed a statistically significant increase in enjoyment when transitioning from VR to AR (Fig. 3), with the AR environment scoring 99.14 compared to 93.85 in VR ($p = 0.03$). 10 Volunteers reported higher enjoyment in AR, citing increased confidence and safety due to real-world visibility. Those who preferred VR emphasized the immersive experience.

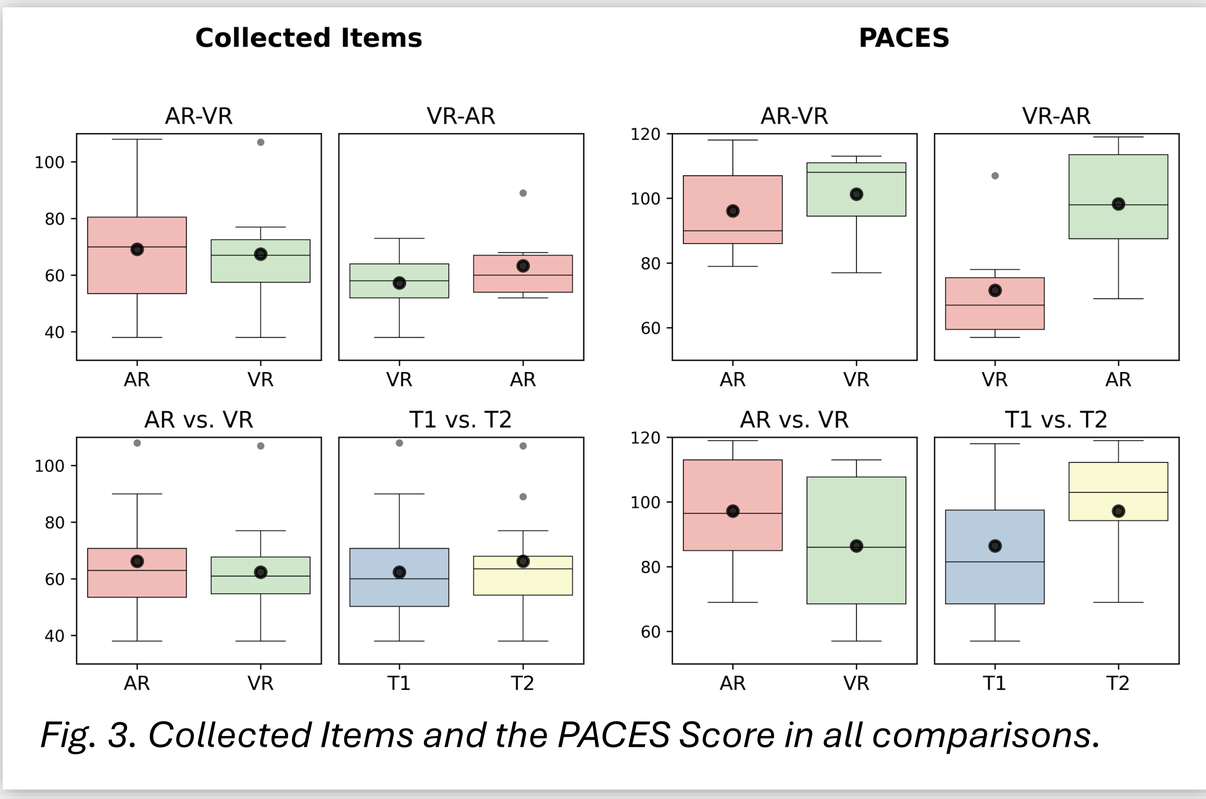


Fig. 3. Collected Items and the PACES Score in all comparisons.

4 FUTURE WORKS

Future research will apply AR and VR to individuals with cognitive and gait impairments, particularly older adults, to explore their long-term benefits in improving function, quality of life, and motivation in rehabilitation.

REFERENCES

[1] World Health Organization, “Ageing and Health”.
[2] A. A. Ravankar et al., ”CARE: Cooperation of ai Robot Enablers to Create a Vibrant Society”.
[3] G. Verdezoto et al., "Smart Rollators Aid Devices: Current Trends and Challenges".
[4] D. Vancampfort et al., “Dropout from exercise interventions in adults with knee or hip osteoarthritis: a systematic review and meta-analysis”.
[5] V. Patil et al., “Integration of virtual reality and augmented reality in physical rehabilitation: a state-ofthe-art review?".

@HCS.UFES
Funding