Collaborative Walking in VR

Master's Research Internship - Can be Continued as a PhD Thesis
PACCE - LS2N - Nantes Université
February - August 2024

Context: walking in virtual reality (VR) is a common daily activity that is often done in groups and in a variety of contexts. This physical and social activity is essential to consider in the metaverse, but the solutions proposed to walking in VR are often focused on teleportation or translation rather than on a real-world activity that could be reproduced. One reason for this is the focus on the efficiency of movement, but also the fact that implementing this type of task in VR is not trivial.

According to Nilsson et al. (2018), designing natural walking experiences in VR involves two major challenges: 1) enabling unconstrained walking in virtual worlds that are larger than the tracked physical space and (2) providing users with appropriate multisensory stimuli in response to their interaction with the virtual environment. To overcome these challenges, many ways of simulating walking have been proposed in the literature, including the use of a joystick, dedicated machines (e.g., treadmills), or gesture-based movement (e.g., "walk-in-place", "arm-swinging", "tapping in place", etc.) (Nilsson et al. 2018).

The results of a study by Nilsson et al. (2018) suggest that the "arm-swinging" technique - which consists of moving by swinging the arms back and forth - seems as natural as the "walk-in-place" technique, and less tiring. Based on the work of Zehr and Haridas, 2003, the authors describe that one possible reason why this gesture was perceived as relatively natural is that it involves a rhythmic arm swing similar to that which sometimes occurs during real-world walking. This technique was used in the creation of the first VR walking prototype we developed, others are possible, like redirected walking (Banakou et Slater, 2023), or seated walking (Kokkinara et al, 2016).

The second important dimension of walking is its social and collaborative aspects. According to Joseph (2020), walking is also "producing indices of one's activity at the very moment of its execution, framing and marking one's movement with and for those who observe it." Walking together involves adopting a common pace, going in the same direction, and staying relatively close, while adjusting one's position relative to the group.Today, the research community has not yet produced a system that reproduces natural and unconstrained walking, with multiple users, in virtual environments. A first system has recently been proposed at LS2N Nantes Université, which needs to be improved and evaluated.

Work: The student will:
- carry out a scientific literature survey on the state of the art on various topics: walking in virtual reality, social presence, etc.
- define a set of requirements for a collaborative VR walking tool.
- implement a collaborative VR walking tool offering appropriate multisensory interactions and stimuli. The student will be able to build on the existing tool.
- define a protocol for evaluating the tool.
- conduct experimentation and analyze data.
- write a report, which will serve as the basis for a scientific article.

Candidate:
- M2 in computer science, specializing in Virtual Reality / HCI
- Autonomous
- Research enthusiast
- Good written and spoken English

Project team:
- Jean-Philippe Rivière, lecturer in Human-Computer Interaction (riviere-jp@univ-nantes.fr)
- Yannick Prié, Professor in Human-Computer Interaction (yannick.prie@univ-nantes.fr)
- Jean-Marie Normand, Professor in Computer science (jean-marie.normand@ec-nantes.fr)
- Rebecca Fribourg, associate professor in Computer science (specialized in VR & AR) (rebecca.fribourg@ec-nantes.fr)

Main supervisors:
- Jean-Philippe Rivière & Yannick Prié

Miscellaneous:
- Location: Halle 6 Ouest, Nantes University and Ecole Centrale de Nantes
- Salary: around 600€ / month + 50% of transportation costs covered

How to apply?
- Send a cover letter, CV and portfolio to Yannick Prié (yannick.prie@univ-nantes.fr) and Jean-Philippe Rivière (riviere-jp@univ-nantes.fr)

Bibliographie :

Banakou, D. & Slater, M. (2023) A comparison of two methods for moving through a virtual environment: walking in place and interactive redirected walking. Frontiers Virtual Reality. Volume 4. | https://doi.org/10.3389/frvir.2023.1294539

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Haridas, C., & Zehr, E. P. (2003). Coordinated interlimb compensatory responses to electrical stimulation of cutaneous nerves in the hand and foot during walking. Journal of neurophysiology, 90(5), 2850-2861.

Kokkinara, E., Kilteni, K., Blom, K. *et al.* First Person Perspective of Seated Participants Over a Walking Virtual Body Leads to Illusory Agency Over the Walking. *Sci Rep* **6**, 28879 (2016). https://doi.org/10.1038/srep28879

Lévy, J., & Lussault, M. (2000). Logiques de l'espace, esprit des lieux: géographies à Cerisy. (No Title).

Nilsson, N. C., Serafin, S., Steinicke, F., & Nordahl, R. (2018). Natural walking in virtual reality: A review. Computers in Entertainment (CIE), 16(2), 1-22.

Prithul, A., Adhanom, I. B., & Folmer, E. (2021). Teleportation in virtual reality; A mini-review. Frontiers in Virtual Reality, 2, 730792.

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Yannick Prié - Professor of Computer Science
Head of Master "Cultures Numériques" / "Digital cultures" Master's program
LS2N UMR 6004 CNRS - Polytech - Nantes University
yannick.prie@univ-nantes.fr - https://yannickprie.net/ - @yprie - (+33)240683248