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Walk on Hands: Experiencing Vibrations in the Hands to represent Virtual Walking

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This demonstration is linked to the 1072 regular paper submitted to IEEE World Haptics 2025 conference and conditionally accepted. It aims to showcase that when observing a virtual walk, foot steps of the avatar can be augmented with vibrations displayed in hands and enhance the walking experience compared to no vibrations. While vibrations feedback is generally displayed under the user feet and necessitate specific hardware [1], [2], the technique proposed here can be displayed by VR controllers an so constitutes a cost effective alternative. To allow the attendees to test the different haptic feedback, they will have the possibility to switch between vibrations in the hands, under the feet and no vibrations.

I. Scenario and setup

During this demo, the attendees can experiment a simulation where they embody a first-person avatar and see themselves walking in VR. They remain static, sit on a chair while wearing a VR headset (see Fig.1). Vibrations either displayed in their hands and under their feet augment their virtual walk. In both cases, the vibrations represent the contact between the virtual heel of the avatar and the virtual ground. These vibrations are displayed through haptic interfaces presented below.

The demo setup (see Fig.1) is composed of a chair the attendees will sit on, a table in front of them, a laptop to run the simulation, the VR headset (Meta Quest 3), the haptic interfaces under the feet and in hands and an Arduino Mega to connect the haptic interfaces to the simulation through serial communication. A button embedded inside the right handle enables the attendees to switch between vibrations under the feet, in the hands and no haptic feedback and so to compare them. Only two plugs are needed: one to connect the laptop and one for the Arduino. The haptic interfaces are powered through the Arduino and the headset through the laptop.

II. Vibrations in the hands

Handheld interfaces are designed to display vibrations in the participants' hands. Handles take the form of $110mm$ long cylinders of diameter $40mm$. They have a hollow structure, with a wall thickness of $6mm$. All the pieces are 3D printed in PLA, with a grid inside pattern that fills them at 15%. The vibrations are displayed using tactors *VPM2* of diameter $12mm$, thickness $3mm$, powered at $3V$ by the Arduino Mega,

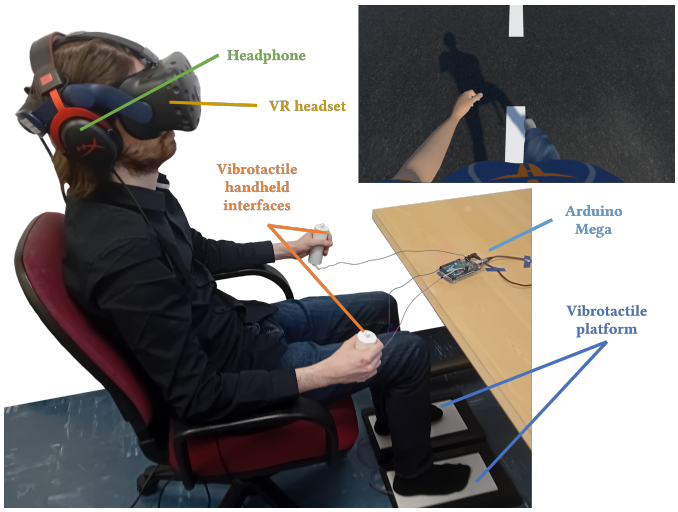

Fig. 1. Overview of the demo set-up. A user is sitting on a chair with handheld vibrotactile interfaces in his hands and feet on vibrotactile platforms. He wears a VR headset and headphones to receive visual and audio stimuli from the simulation. An Arduino Mega commands the vibrations. (Left) Self-view of the user's avatar. (Top-Right)

and generating 1G vibrations at $70Hz$. For each handle, a tactor is included at the center of the flat surface to ease contact with the skin.

III. Vibrations under the feet

The foot interfaces are designed to closely resemble the handheld ones to minimize bias from vibration propagation. Each interface consists of two plates measuring $300mm$ by $130mm$ and is 6 mm thick. Each plate includes a tactor, similar to those used in the handheld interfaces. The tactors are positioned 30 mm from the back edge of the plates, allowing attendees to place them under their heels, which is where the feet make initial contact with the ground while walking.

References

[1] E. Kruijff, A. Marquardt, C. Trepkowski, R. W. Lindeman, A. Hinkenjann, J. Maiero, and B. E. Riecke, "On your feet! enhancing vection in leaning-based interfaces through multisensory stimuli," in *Proceedings of the 2016 Symposium on Spatial User Interaction*, 2016, pp. 149–158.

[2] L. Turchet, P. Burelli, and S. Serafin, "Haptic feedback for enhancing realism of walking simulations," *IEEE transactions on haptics*, vol. 6, no. 1, pp. 35–45, 2012.