Sense of Embodiment Inducement for People with Reduced Lower-body Mobility and Sensations with Partial-Visuomotor Stimulation

科技藝術書報討論

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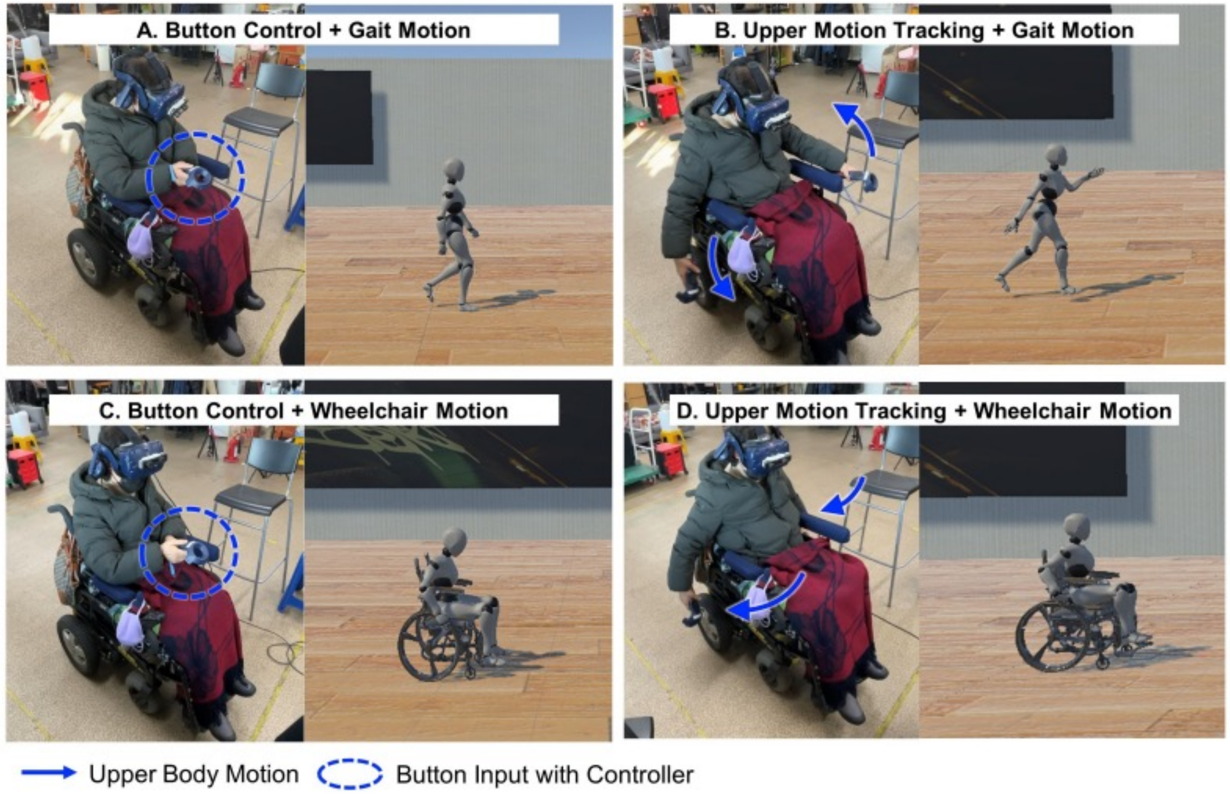

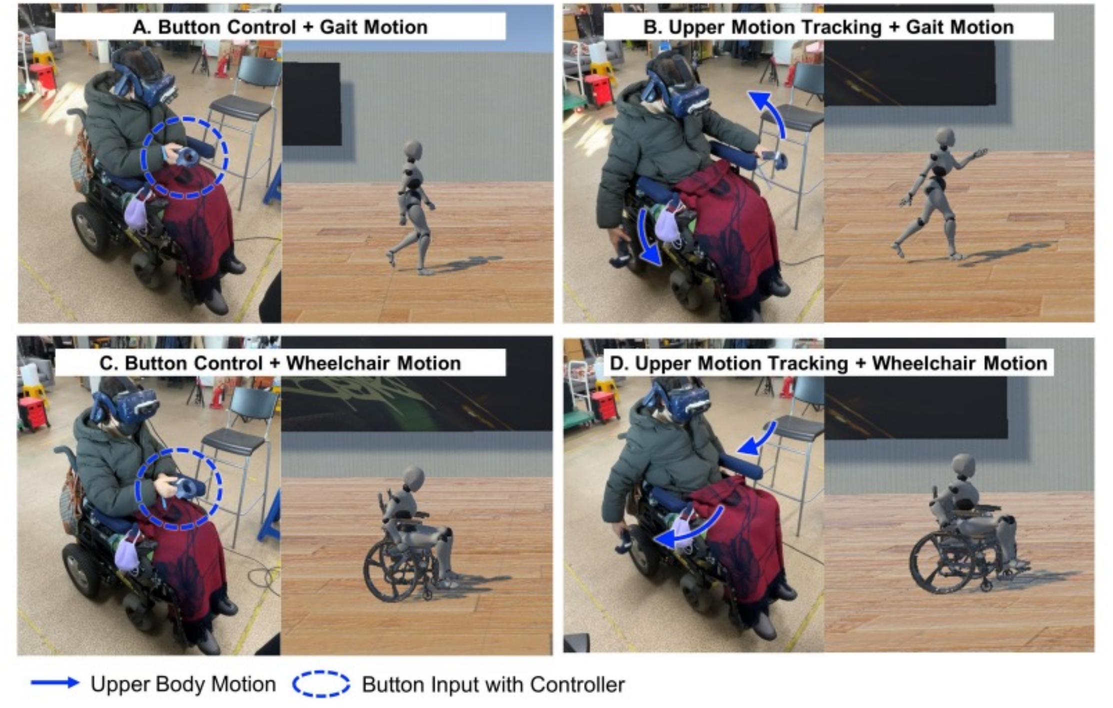

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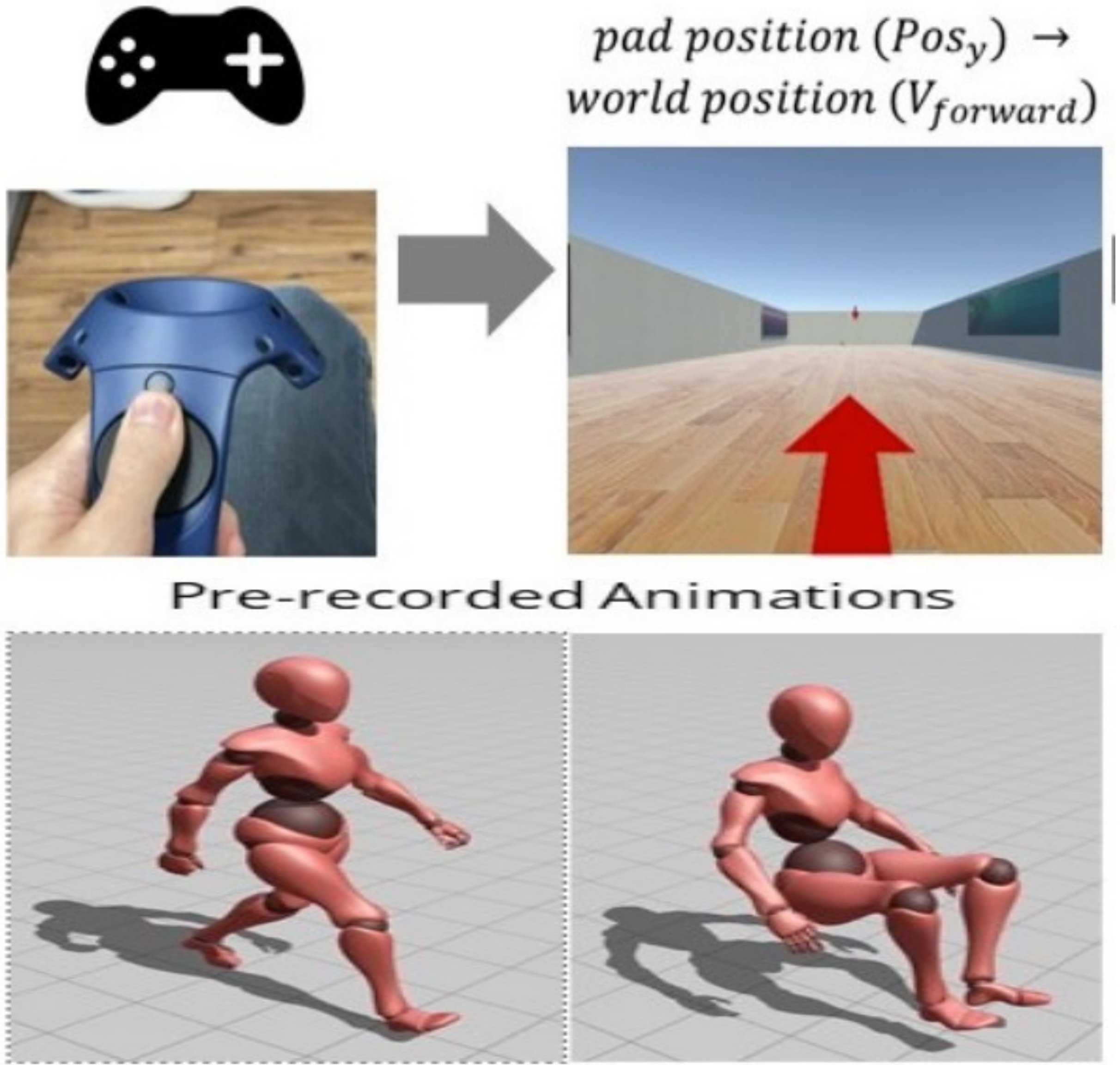

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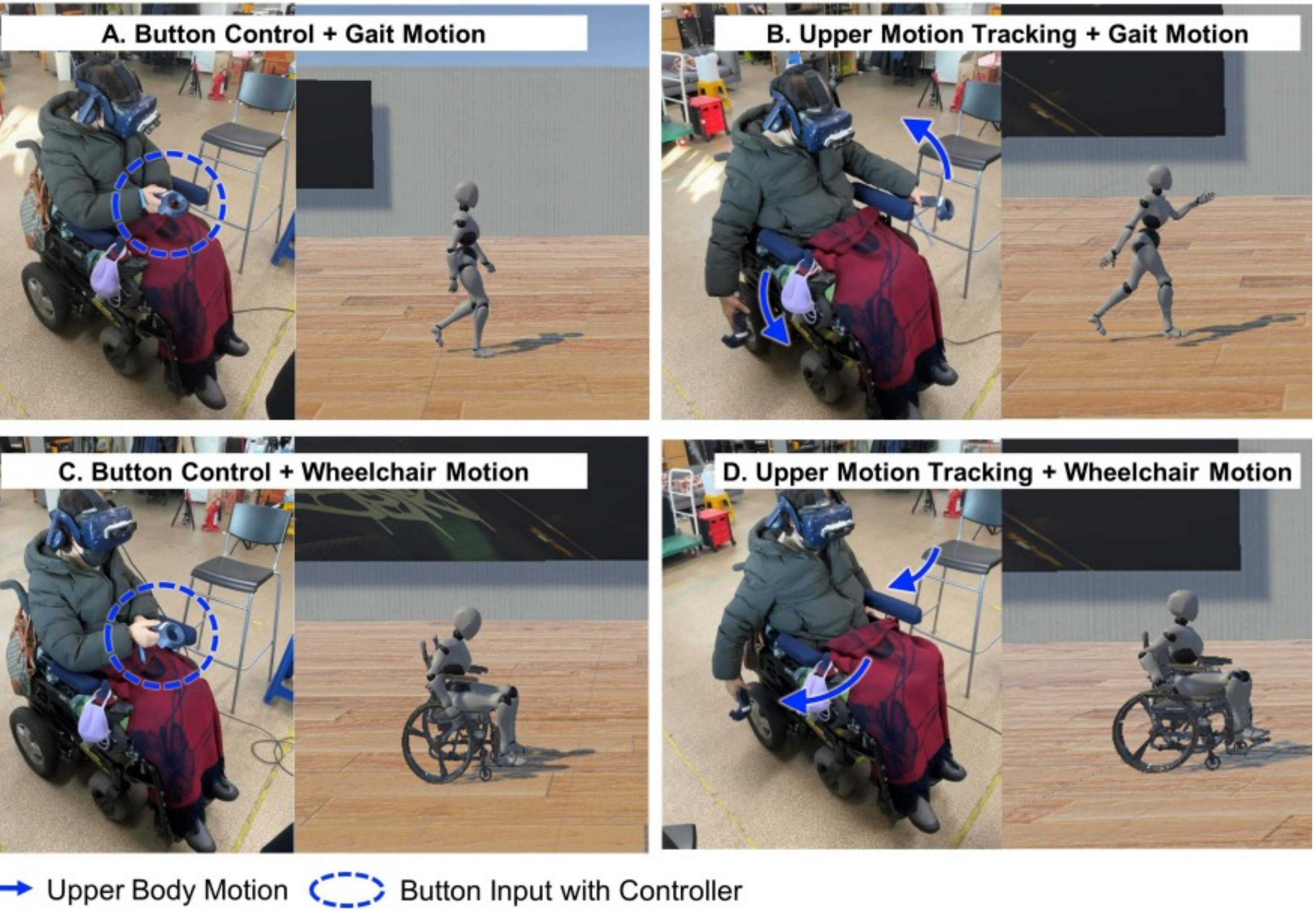
ABSTRACT

“To induce the **Sense of Embodiment (SoE)** on the virtual 3D avatar during a Virtual Reality (VR) walking scenario, VR interfaces have employed the visuotactile or visuomotor approaches. However, peo- ple with reduced **lower-body mobility and sensation (PRLMS)** who are incapable of feeling or moving their legs would find this task extremely challenging. “

Upper-body motion tracking-based partial-visuomotor technology

Consideration for SoE and PRLMS participants to provide Virtual Reality(VR) capabilities environment. The friendly usage of the VR related to the reality activities connected to the real world.

INTRODUCTION



"With the advancement of virtual reality (VR) and full-body motion tracking, a full-body avatar has been deployed in recent re-search and industrial VR interfaces."

Provided the subjective feeling Experience to SoE and PRLMS.

The VR was based on multi-modal synchronous input or arm swing in a stand-up position.

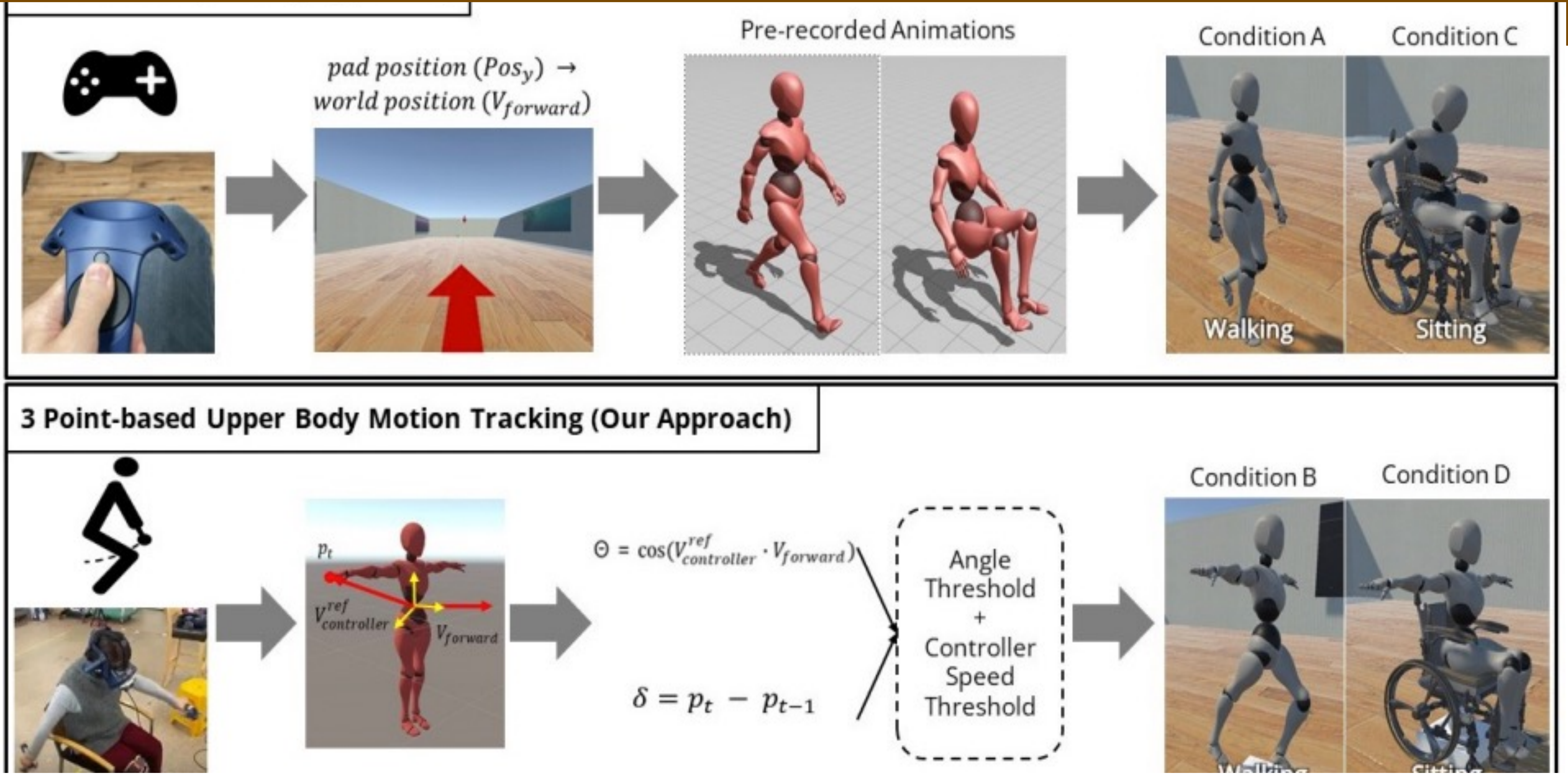
The advance of this study provides four modes of more effective and economical methods.

INTRODUCTION

“Partial-visuomotor stimulation which automatically generates lower body motion animation from upper motion tracking. “

The focus groups with SoE or PRLMS have difficulty representing the body activities compared with normal body activities. Based on this consideration to find suitable activities to represent the body sensors usage in VR.

IMPLEMENTATION AND APPARATUS



IMPLEMENTATION AND APPARATUS

Various input: controller manipulation & upper body motion tracking with controllers.
Output methods: lower body motion generation on a wheelchair & lower body motion generation for gait.

Propose a 3-point-based upper body motion tracking for SoE inducement for People with Reduced Lower-body Mobility and Sensations.

IMPLEMENTATION AND APPARATUS

Condition A: Button Control + Gait Motion

HTC Vive controller pad was used for avatar manipulation, where the avatar movement was limited to forward/backward directions. We adopted the automated animation from Mixamo for the gait motion.

Condition B: Upper Motion Tracking + Gait motion

For upper body motion tracking, we used SteamVR Plugin to track the movement of the headset and two controllers along with VR Final IK Unity asset.

Compute the angle (θ) between the hand controller location relative to the reference coordinate and controller a forward vector along with the x-axis (right vector).

$$\theta = \cos^{-1}(V^{ref}_{controller} \cdot V_{forward}) \qquad (1)$$

Both legs change angle when the hand controller angle falls within a pre-defined range (-130°~-90°). If the user stops moving their hands, the character also stops moving.

IMPLEMENTATION AND APPARATUS

Condition C: Button Control + Wheelchair Motion

Condition C has the same input method as Condition A. For the wheelchair motion, we embedded the "Wheelchair" animation. Added "wheel pulling hand gestures" and "wheel rotation" animations when moving forward.

Condition D: Upper Motion Tracking + Wheelchair Motion

The position of the hand controller is used as input. The user swings his hands back and forward simultaneously as if he is pushing the wheelchair. To calculate the location of the hand controller, a fixed reference similar to Condition C. If the angle between the location of the hand controller to the fixed reference along the x-axis (right vector) is between -130°~-100°, the moving forward command is triggered.

The local rotation of leg joints on the lower body animation as a general sit pose.

RESULT AND CONCLUSION

A total of 8 participants (6 female, 2 male) ranging from 36 to 64 (M=57, SD=9.20) who possess paralysis on a lower limb and are wheelchair users (paraplegia due to spinal cord injury=3, lower body paralysis caused by polio=3, left hemiplegia due to cerebral infarction=1, leg amputee =1). All participants experience all experiment settings in a within-subject design.

Condition B: “I think the motion of standing up is much better (P6)",
"Button pressing felt convenient, but it didn’t feel like I was moving my body (P2)"

"The upper body+walking was felt like real walking which makes me swinging my arms more enthusiastically in the subsequent trial (P7)", and
“I felt like I was walking while moving my feet in the upper motion tracking+gait motion (P8)"

RESULT AND CONCLUSION

“It is usually physically/mentally exhausting to ride a wheelchair. For example, I tend to be out of breath even if I ride an electric wheelchair".

As the VR application considers the SoE and PRLMS, the user experience between the reality and virtual world had some familiar user experience in which the participant could fulfill the VR experience as accurate.

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Multi-scale Mixed Reality Collaboration for Digital Twin

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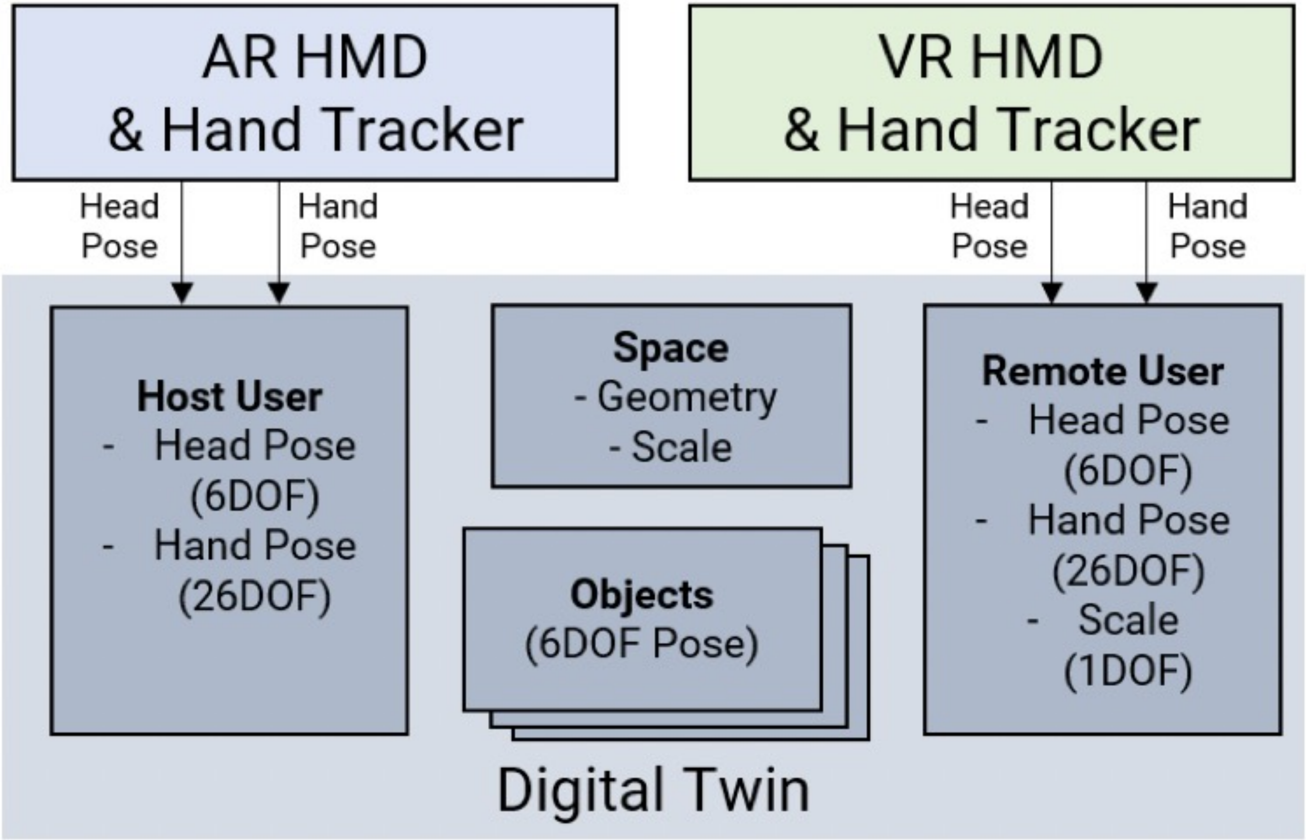

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Connection

The VR and AR usage based on the humanity usage to enable the VR environment. The sight seeing did not cover the participant which did not have same behavior or experience which may confuse the participant when they join the VR or AR environment.

These kinds of study provide some effective models to consider the people with SoE and PRLMS and provide some connection or friendly input and output in VR which let the participant have acceptable or connection when used the VR and AR.

With the Digital Twins for industry to simulate the world in reality, this part of the participants did not take notice during design mindset. This kind of scope define or behavior define as baseline during the research provide a good model in Metaverse.

Comments

I thought the models defined for SoE and PRLMS simplified its complex activities and provided an effective and referenced technology as expected for industry purposes. Models that could be accepted by various participants also provide another idea about the initial process for specific usage of AR/VR, which is capable for the people who use VR/AR in mismatched input and output interfaces.