The ICSPACE Platform: A Virtual Reality Setup for Experiments in Motor Learning

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Virtual Reality platforms offer versatile means for the analysis and the improvement of motor learning, e.g., by providing appropriate multimodal feedback. We designed a VR platform that enables full-body motor learning of complex actions: Our intelligent coaching space (ICSPACE) combines a two-sided CAVE (front, floor), an optical motion capture system (MoCap), and a custom-tailored virtual reality motion pipeline. A self-developed low latency rendering engine visualizes a virtual fitness center, as well as the user's own motion mapped on a virtual character inside a virtual mirror. This character can be visualized in multiple abstractions, ranging from a stick figure to a high-fidelity human avatar. We generate the high-fidelity avatar based on our research on 3D scanning combined with template fitting to provide users with dynamic 3D clones. Additional to the direct feedback on one's own motion inside the virtual mirror, the intelligent coaching space enables us to apply augmented feedback strategies, such as dynamic error highlighting and supporting visualizations such as helping geometries. To this end a motion analysis component segments and classifies the performed movements and detects typical error patterns in real time. We identified these error patterns in advance during a collaboration with sports scientists and coaches.

The whole system is designed to provide very low end-to-end latency of only 42ms from MoCap of the user to the corresponding visualization inside the CAVE. The poster provides an overview of the individual components of ICSPACE. A special focus is on measuring latency, best practices for setting up VR environments for motor learning, and a presentation of ongoing research in online motion analysis and virtual cloning.