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Promoting Technology and Collaboration

Exploring Interaction Paradigms in VR Surgical Training: Hands Alone or Hand-Held Devices?

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Background: Virtual reality (VR) is increasingly used for medical and surgical training, yet many trainees arrive with little or no prior VR experience. Traditional head mounted displays (HMDs) paired with dual hand controllers require users to master up to 16 discrete inputs (buttons/ thumbsticks) before engaging with learning objectives. In short, cognitive load from the control scheme can consume limited practice windows and drive early abandonment.

Technology Overview: To reduce this entry barrier, we redesigned several existing VR training modules to use optical hand tracking on recent HMDs (e.g. Meta Quest 3). Interactions were rebuilt around the tracked pose and articulation of the hands, prioritizing gesture-based actions (pinch, grab, poke) over controller buttons. Early use shows higher task engagement, reduced navigation errors through content and fewer instructor interventions compared with controller based versions. Known constraints include loss of tracking with out of camera poses, self occlusion, and variable fidelity under difficult lighting.

Potential Application in Surgical Simulation and Education: Controller free interaction is well suited for onboarding, orientation, anatomy exploration, instrument identification, sterile field workflows, and low force psychomotor tasks (e.g., knot tying sequencing, port placement planning). By reducing interface navigation and learning time, short ad hoc sessions about 30 minutes each can focus more on educational content, potentially improving skill acquisition and transfer for novices.

Potential Opportunities to Collaborate: We invite partners to: (1) co develop validated hand gesture taxonomies mapped to surgical tasks; (2) benchmark learning outcomes versus controller and desktop modalities; (3) co design low profile, high fidelity tracking add ons to mitigate occlusion and extend to precision tasks; and (4) share datasets and interfaces that enable multi institution reproducibility. Advancing stable, high fidelity hand tracking could unlock next generation modules for fine motor training and procedure rehearsal.