Virtual ACS 2021 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Promoting Technology and Collaboration

A Rapid Development Platform for Modular, Mixed and Augmented Reality Simulators

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Background: Simulators for learning various procedures often share common elements (e.g., tracked ultrasound probes for TEE, TTE, FAST, venous access) resulting in similar, redundant development effort. Simulation technology may become more affordable with modular design. We describe the SMMARTS (System of Modular, Mixed & Augmented Reality Tracking Simulators) open architecture, rapid simulator development platform.

Technology Overview: A modular stand provides mechanical indexing (registration) of a discrete block representing the anatomy relevant to the simulated procedure. A software development kit (SDK) integrated with the modular stand and a set of hand-held tracked tools such as a needle and ultrasound probe facilitates software development. The SMMARTS SDK (URL: https://github.com/UF-CSSALT/SMARTS-SDK) developed in Unity Technologies' Unity game engine consists of features to facilitate the development of medical simulators. SMMARTS includes an Arduino microcontroller and Ascension Technology Corporation's 6DOF tracking connectivity along with software tools like a replayer feature, user interface templates, 3D model visualization, scoring monitors, cognitive aids, common error messages, and Experience API LMS compatibility.

Potential Application in Surgical Simulation and Education: The SMMARTS platform has been used to develop simulators in our lab (ventriculostomy-EVD, epidural loss-of-resistance, instructor-less central venous access, TRUS prostate biopsy, pterygopalatine fossa block, lumbar/chronic pain blocks, intravenous access, and chest tube insertion) and externally (hardware front-end to practice psychomotor skills for a third-party screen-based simulator). A potential application is US-guided hip effusion biopsy for orthopedic surgery and other fluid and tissue biopsies. SMMARTS can currently track a Kelly clamp and can be extended to track other surgical instruments.

Potential Opportunities to Collaborate: As an open architecture platform that has been used to develop multiple compact, deployable, turnkey simulators including one currently deployed in Iraq, SMMARTS is available for use by third parties to rapidly develop simulators for new procedures including surgical ones and also extend SMMARTS platform capabilities.