Mixed Simulation for Medical Training

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Technology description

Facilitates the Training of Clinicians in Procedural and Cognitive Skills Using 3D Color Visualization

This mixed simulator technology is especially suited for training in blind and guided medical procedures. This teaching tool uses augmented reality principles similar to the yellow first-down line on TV football games and has the potential to improve patient safety. The technology seamlessly integrates numerous exponential technologies, such as medical imaging, miniature 6 degrees of freedom (DOF) sensors smaller than a grain of rice and 3D printers to collocate (superpose, overlay or underlay) physical and virtual systems that are anatomically correct replicas of individual humans.The Institute of Medicine has estimated that medical errors kill more people than motor vehicle accidents, breast cancer and AIDS combined. Many of these adverse events were attributed to substandard care and could have been prevented if healthcare professionals had been properly trained. Verbal and written instruction, while necessary and worthwhile, cannot take the place of hands-on training. Alternatively, practicing on human patients is unconscionable. This simulator allows instructors to visualize and consistently score trainee performance, while students can rehearse and self-debrief without endangering human lives.

Technology

Many medical procedures require placing an instrument like a needle inside a target such as a vein while avoiding accidental contact or puncture of surrounding organs or tissues. The mixed simulation technology developed by UF researchers collocates anatomically authentic virtual and physical 3D objects that represent the part of the human body that is of interest. The technology has already been successfully applied to three procedures: central venous access (upper torso and neck), regional anesthesia (spine) and ventriculostomy (brain). In all three applications, a 6 DOF sensor smaller than a grain of rice is fixed inside the needle bore near the needle tip such that, as the trainee directly manipulates and steers the needle, the needle tip position can be tracked respective to both the physical and virtual components representing the human body. Real-time 3D visualization can be turned on to allow trainees and instructors to observe and critique technique and strategy. Because of the needle tip tracking, metrics heretofore unavailable are provided that facilitate implementation of automated and consistent scoring algorithms. These scoring algorithms open the possibility to self-

debriefing when experts are not available to provide feedback. Individual humans were scanned using CT and MRI and 3D files consisting of discrete objects representing different organs and tissues were created. The physical parts of the mixed simulation are created by feeding the 3D files to a 3D printer. The technology integrates readily available commercial off-the-shelf components into turnkey (set up time of about seven minutes) simulation systems that are compact and lightweight (meeting airline checked luggage requirements).

Application area

Mixed simulators with anatomically correct physical and virtual components that combine real-time 3D visualization with tracked instruments, recording and playback, and automated and consistent scoring algorithms to facilitate training of clinicians in procedural skills

Advantages

Allows trainees to practice psychomotor and cognitive skills and learn from mistakes in a controlled environment, sparing actual patients the discomfort and risk from having novices practice on them
Physical and virtual anatomy is completely authentic, an exact replica of any individual human used as the model
Can replicate any kind of anatomy, ensuring students are prepared for even the most uncommon situations
Allows trainees and instructors to view in real-time a 3D color visualization of the procedure
Can decrease errors and potentially ensuing malpractice lawsuits
Trainees directly manipulate and steer actual (tracked) instruments instead of using a mediated interface like pointers and haptic pens
Tactile feedback from palpation and/or contact of medical instruments with physical structures like bones, provide learners a realistic experience
Unlike current commercial offerings, reduces/eliminates the need for expensive disposables

Institution

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