Virtual and Augmented Reality Solutions for Minimally Invasive Surgery

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Abstract

In Medicine and Surgery, Augmented and Virtual Reality (AR/VR) are being implemented as tools for improving quality by decreasing errors and complications, reducing costs by shortening operating times and training residents on AR/VR environments prior to patients and developing new and better work processes using systems integration and preoperative planning simulators. There are clinical, research and educational benefits to utilizing 3D visualization. These applications mesh with other simulation, networking and wireless technologies as well.

The future of medical imaging involves volumetric imaging, the combining (registering) of serial or multimodal scans and image guided surgery. More intuitive and flexible visualizations of medical imaging are needed for the planning of minimally invasive intervention and educating medical students and physicians. Physicians have traditionally visualized computed tomography (CT) scan anatomy by taking a series of two-dimensional axial, coronal or sagittal images from CTs and mentally stacking them to recreate a 3-dimensional (3-D) or volumetric understanding of the represented anatomy. Computerized 3-D rendering of the area scanned and immersive 3-D AR overcome this conceptual limitation and are useful in teaching anatomical relationships to medical students and for physicians planning procedures. Users crop, manipulate and navigate through 3-D environments created from actual patients’ CT scans, allowing them to explore a patient’s anatomy in a much more intuitive and flexible way. This allows them to perform virtual dissections and to navigate the anatomy to view it from any perspective, including perspectives not possible in cadaveric dissection, surgery or traditional atlases.

Implementation of these technologies is growing exponentially. The latest CT and MRI scanners have software and attached workstations that allow for useful viewing 3-D volumes and even surface views for virtual bronchoscopy, colonoscopy and vascular studies. These newer scanners also produce better and higher resolution datasets that support useful 3D visualizations. These visualizations play a central role in the advancement of surgical simulation, image-guided surgery and automated surgical procedures.

Proponents offer that 3D is more intuitive and allows for the visualization of data in ways not possible in 2D. Use of stereo projection, cine modes, and overlay (registration) of multiple studies add additional utility to visualizations of medical imaging. Thus allowing clinicians to assess more of the information available in an imaging dataset or to more accurately compare serial studies. Additionally, networking and wireless allow for collaboration and consultation in ways that are just beginning to be explored. Opponents suggest that it is expensive and not needed in most cases. Also, the technology is still developing and is very limited in most areas. The implementation of these technologies is redefining traditional clinical specialties and setting new standards for patient care.

These technologies will provide intuitive and valuable tools for training the next generation of physicians and guide future minimally invasive procedures.