ACS 2025 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

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Challenges in Surgical Education

Transforming Neurosurgical Education and Planning with AI-Powered Augmented Reality

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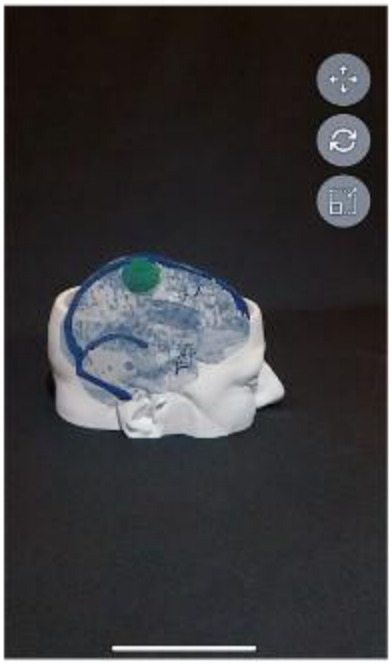
Background: Advanced tools like navigation systems and simulators are crucial for neurosurgical education and planning, but their high costs limit accessibility in Latin America, creating barriers to equitable treatments. This lack restricts medical students and surgeons from practicing with the latest techniques, essential for mastering complex procedures. Meanwhile, in developed countries where such tools are more accessible, simpler and more affordable alternatives for less complex procedures could help reduce costs and make high-quality training more sustainable.

Current Challenges: In modern operating rooms, where precision and expertise are crucial, relying on two-dimensional imaging for surgical planning and navigation presents significant limitations, especially for less experienced professionals. Augmented Reality (AR) emerges as an innovative solution, offering interactive experiences with human anatomy. When combined with artificial intelligence (AI) in medical imaging, AR's potential is substantially amplified, enabling automated, time-efficient processing and precise visualizations of complex structures. Together, these technologies provide a comprehensive, three-dimensional view of the human body, allowing surgeons, trainees, and medical students to move beyond the constraints of flat images, deepen their anatomical understanding, and make more precise and informed decisions during surgery.

Need of Innovation: We propose a solution that leverages AI-powered augmented reality to visualize brain tumors and other anatomical structures directly on patients' heads using a smartphone. This approach offers an automated workflow with convolutional neural networks (CNNs) for accurate MRI segmentation and an AR alignment algorithm, enabling professional users to gain immediate, intuitive access via a mobile app. By providing a portable, low-cost solution, this innovation facilitates interactive and dynamic learning experiences that are crucial for surgical education, allowing surgeons and medical students worldwide to train effectively and confidently in complex neuroanatomy and surgical planning, while also supporting cost-effective approaches for simpler procedures.

AR model visualization



AR model aligned with
3D printed case