Development of a Virtual Reality Simulator for Training Radiology Residents on Fluoroscopy

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Introduction

Objective: to develop a virtual reality (VR) fluoroscopy machine simulation to train radiology residents

Background:

- VR is becoming more prevalent in the field of medical education as it is more engaging and effective than learning mediums like screen-based learning and 360-video [1]
- VR is easily repeatable and safe for both students and "patients", allowing them to make mistakes in a risk-free environment [2]
- Fluoroscopy is decreasing in usage but is an important skill. However, it uses radiation and cannot simply be practiced on standard patients

Methods

Tools:

- The application was developed in Unity 3D using the Meta Interaction SDK
- 3D assets, including the fluoroscopy machine and monitor, were modeled in Blender
- The application was designed for the Meta Quest 2 virtual reality headset

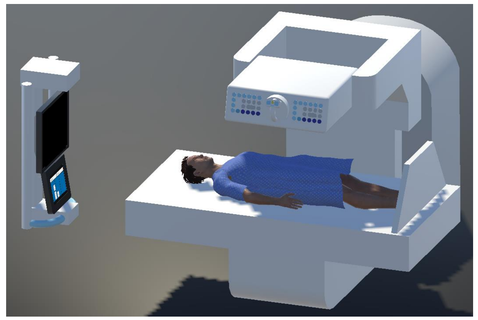
Design Constraints:

- The application needed to run entirely on the headset, untethered to an external computer
  - Maximum polygon count of approximately 1 million per scene
  - Minimum of 72 FPS
- Load DICOM files for pseudo x-ray imaging
- Incorporate mixed modality interaction (controller and hand tracking)

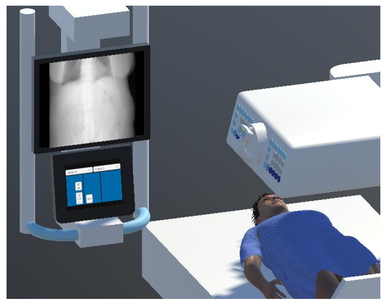
Results

Development:

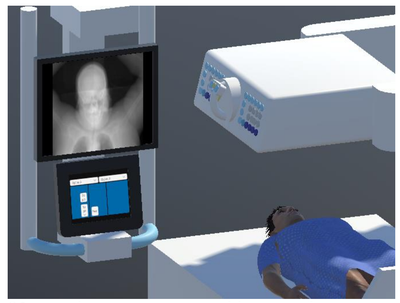
- Successfully deployed as standalone application for the Meta Quest 2 headset
- Achieved an average of 72 FPS (measured with OVR Metrics Tool)



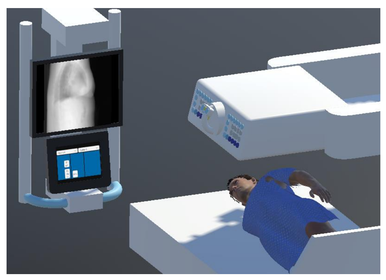
general view of the application



0° rotation, centered image detector



0° rotation, uncentered image detector



70° counterclockwise rotation

30° clockwise rotation

The displayed x-ray image changes depending on the location of the image detector, the rotation (every 5°) of the patient, and the image type (still image, rapid sequence image, or fluoroscopic image)

Discussion

Summary: We demonstrate that VR simulations of medical scenarios can be rapidly prototyped with current software development tools

Future Development:

- Need to fully implement all features available on a fluoroscope including:
  - Tower lock and image exposure weighting
  - Real time model deformation to simulate a swallow study
  - Foot pedal for imaging
- Develop the VR tutorial and fluoroscopy tutorial
- Design a study to investigate whether VR experience is noninferior to in-person experience for fluoroscopy training

Overall, VR simulation in medicine can be helpful to supplement in-person/traditional medical training, but more research and studies must be done on this topic

Acknowledgements

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References

1 Mistry D, Brock CA, Lindsey T. The Present and Future of Virtual Reality in Medical Education: A Narrative Review. Cureus 2023; 15. [PMID: 38274907 DOI: 10.7759/cureus.51124]

2 Pottle J. Virtual reality and the transformation of medical education. Future Healthc J 2019; 6: 181–185. [PMID: 31660522 DOI: 10.7861/fhj.2019-0036]

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