ACS 2022 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Research In-Progress

Customizing Virtual Reality Cardiac Auscultation Training Employing Upper Limb Ergonomics

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Introduction: Virtual reality (VR) applications enable the development of replicable, immersive, interactive, and engaging simulations for the training of cognitive and/or psychomotor aspects of medical practice. Current consumer-level VR allows for seated and standing interactions that are mapped to virtual spaces (e.g. operating room, or a bench). However, in general, VR lacks relevant customizations that acknowledge the user variability with respect to ergonomics. For example, upper limb interactions are critical to improving the realism and effectiveness of reach and grasp in training. Here, we present a VR cardiac auscultation simulation for auscultating a virtual patient. The trainee placement varies based on their upper limb reach to ensure a comfortable distance from the virtual patient.

Methods: The auscultation training simulator was developed using the Unity game engine, SteamVR, VR controllers to calibrate the upper limb length, and the HTC Vive trackers to manipulate the virtual stethoscope. The trainees examine the patient by placing the virtual stethoscope over the aortic, pulmonic, tricuspid, and mitral areas on the virtual patient's chest as presented in Figure 1. Preliminary Results: Participants new to cardiac auscultation (n=10) performed three examinations. Results show that with the current arrangement, tracker occlusion can occur between the trainee and the HTC Vive base stations when holding the HTC Vive tracker. While participants were within comfortable reach, the tracking issue produced 25 faulty interactions between the stethoscope and the auscultated area, thus affecting completing the examination.

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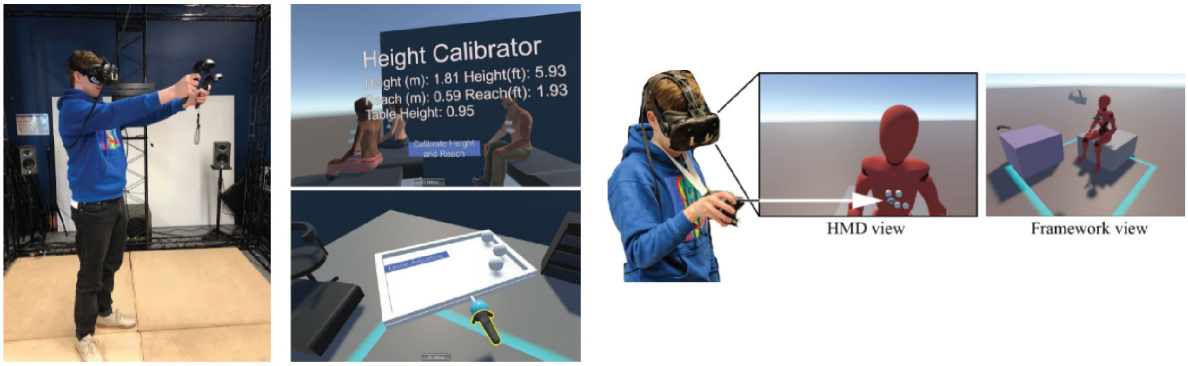
Next Steps: We have demonstrated shortcomings of our current solution with respect to tracking occlusion. Additionally, our approach allowed placing trainees within comfortable range by using their upper limb ergonomics.Future work will explore alternative solutions to SteamVR in addition to hand tracking and custom-made user interfaces and the effects on usability, presence and performance within the virtual auscultation.



a) Upper limb calibration b) Virtual cardiac auscultation

Figure 1 Calibration and cardiac auscultation examination