

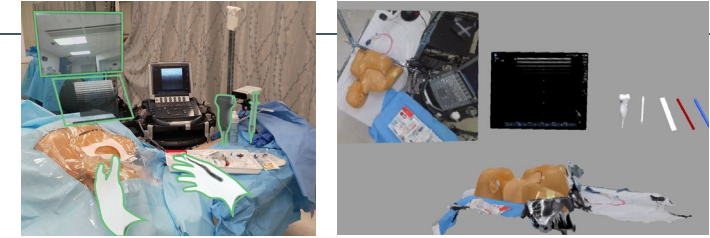
Augmenting Remote Medical Procedure Training and Assistance with Spatial Computing and Volumetric Capture

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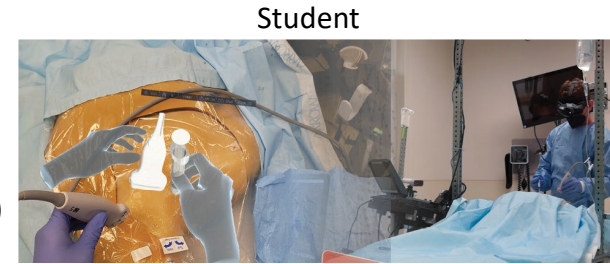
Student and Instructor Workspace

Introduction

- **Mixed reality (MR)** can be used to support procedural skills supervision in resource limited or remote environments
- To evaluate the effectiveness of MR in procedural skills training, and its effect on cognitive load (CL), we used both 2D video and MR to train a cohort of novice practitioners in **Ultrasound-Guided Central Venous Catheter (US-CVC)** placement and evaluated **post training skills and cognitive workload**

Study

- 20 trainees with limited US-CVC experience were assigned to training via **2D video conferencing or MR**
 - 2D: instructors demonstrated procedures via webcam feed, while observing the student's over-the-shoulder camera and US video feed
 - MR: instructors and students both donned a **Hololens 2 HMD**, which allowed instructors to use gestures and virtual objects to demonstrate correct positioning in the student's field of view while observing a **volumetric view** of the student's workspace
- After training, students performed the procedure independently, and were scored via procedure checklist and global rating scale. Instructors and students completed **NASA TLX, SIM TLX, our CL instrument, open questions**



Results

- Quantitative: A two-sample two-tailed Welch's T-test shows significantly **lower frustration** ($p=0.02$) and **higher distraction** ($p=0.03$) on the SIM TLX for learners when using MR
- Qualitative: Complex parts (instrument handling) of the procedure can be taught **more intuitively and effectively** using MR in combination with an aligned volumetric view

Discussion

- Cognitive load does neither increase nor decrease significantly when using MR for CVC training
- Lower frustration compared to video may be caused by **more intuitive volumetric communication**
- Higher distraction may be due to the **novelty of the technology**

Ongoing Analysis

- Indepth analysis of cognitive load including intrinsic, extraneous, and germane load
- **Analyzing performance** after training
- Identifying **strengths and weaknesses of MR** for medical procedures



Local Server Camera mount Over-head RGBD camera Side-view RGBD camera Head-mounted display Remote Computer

SIM TLX: Prop. of Total Workload

