

RAPID: A Virtual Reality simulator to train first responders involved in health care efforts related to the COVID-19 virus outbreak

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Outline

- Need and Motivation
- Objectives
- Scope of Simulation Modules
- Findings
- Conclusion



Motivation: The Covid Pandemic

- As Covid continues to impact society globally, there is a need
 - to train the healthcare personnel (nurses, first responders)
 - using approaches that don't expose them to physical environments.
- to perform the screening/testing activities in a methodical, safe and efficient manner.
- There is a need to explore the design of Virtual/Mixed Reality based training approaches which will
 - Support a low-risk, more effective training medium
 - Enable a Low cost repeatable process



Objectives

- The overall objective is the design and creation of a Virtual Reality based simulation environment to support training of first responders including nurses in hospitals, communities, and cities in the US in order to respond more effectively to the recent COVID-19 outbreak.
- This project will accomplish two objectives: (i) increase the pool of first responders involved in COVID-19 testing; and (ii) develop a more effective process to train and prepare experienced and new nurses for testing and patient treatment.



Overall approach

- Explore a **Human-Computer Interaction (HCI)** based approach to design the VR/MR based training environment
- Adopt a **participatory approach**:
 - ER and other nurses/triage coordinators
 - Medical doctors and specialists
- Build an **information centric process model (ICPM)** that maps the target processes
 - Testing process
 - Hooking up patients to ventilator
- ICPM
 - information/physical inputs,
 - controlling elements influencing that step,
 - the tools/personnel involved in completing that task
 - the outcomes after completing that step



Overall Approach

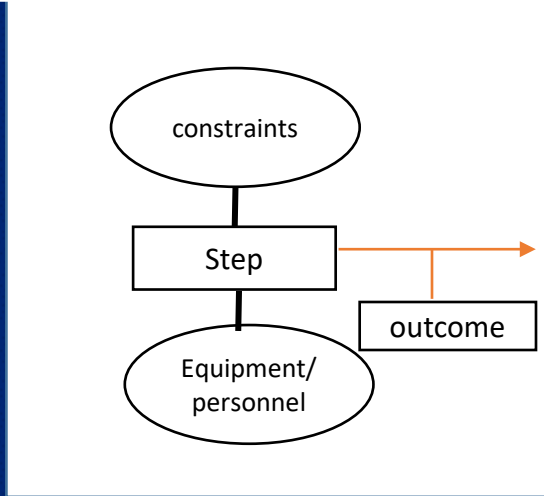
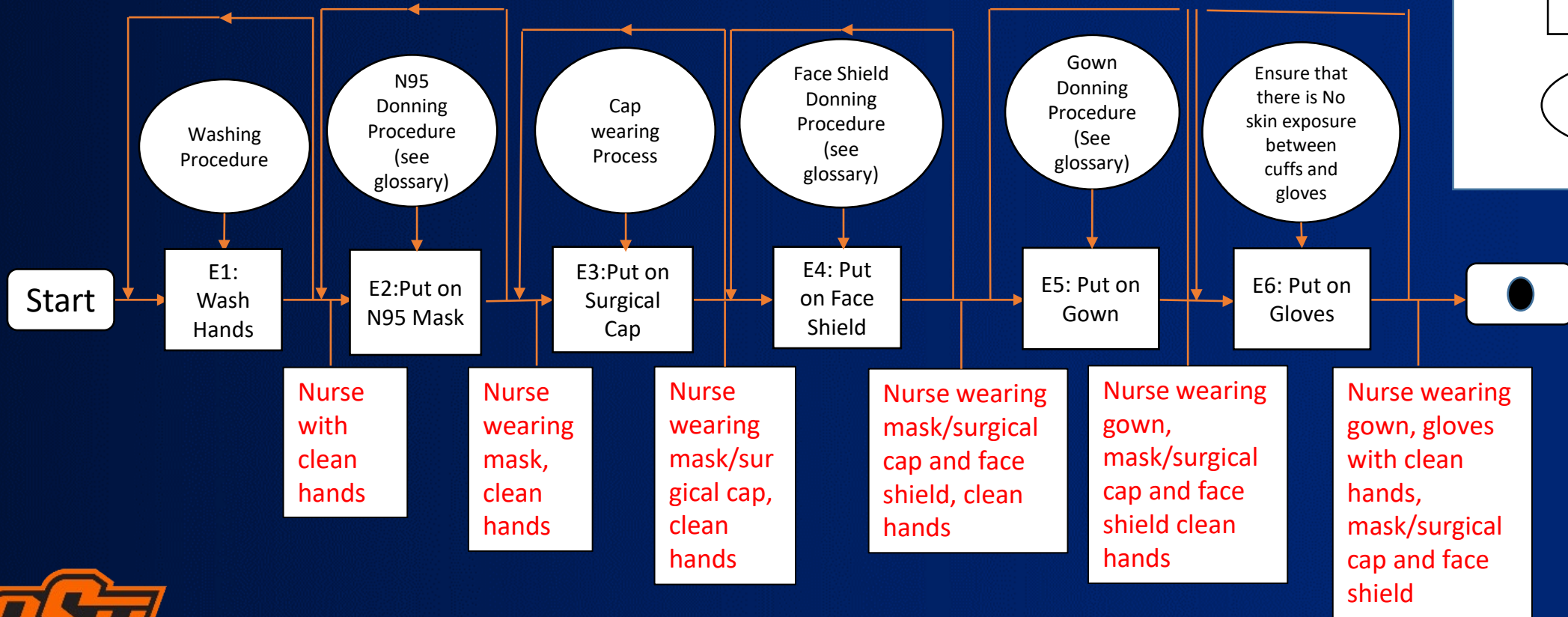
- Create the **Info Centric Process Model (ICPM)** – verify / validate (**participatory approach**)
- Using ICPM as basis, design the 3D training environments
- Investigate the impact of HCI attributes on users' skills and knowledge acquisition after interaction with the VR environments
- Build Simulation modules using HTC Vive (and HoloLens 2)
- Validate/Modify content and details
- Interact with Nurses/Doctors/Nursing students to collect assessment data
- Distribute these simulators free of charge to hospitals, clinics and nursing programs



Elided ICPM

Pre-Swab procedure

Washing procedure = wash hands thoroughly using soap for 20 seconds



Background: Human-Computer Interaction (HCI) or Human Centered Computing (HCC)

Cognition: mental process in gaining knowledge and comprehension. **Cognitive load** : The working memory load utilized by a user when performing a particular task

- Plays a key role when learning to perform complex tasks
- flying airplanes and performing surgery

Cognitive Load Theory

- Instructional Design can be used to reduce the cognitive load on the learners

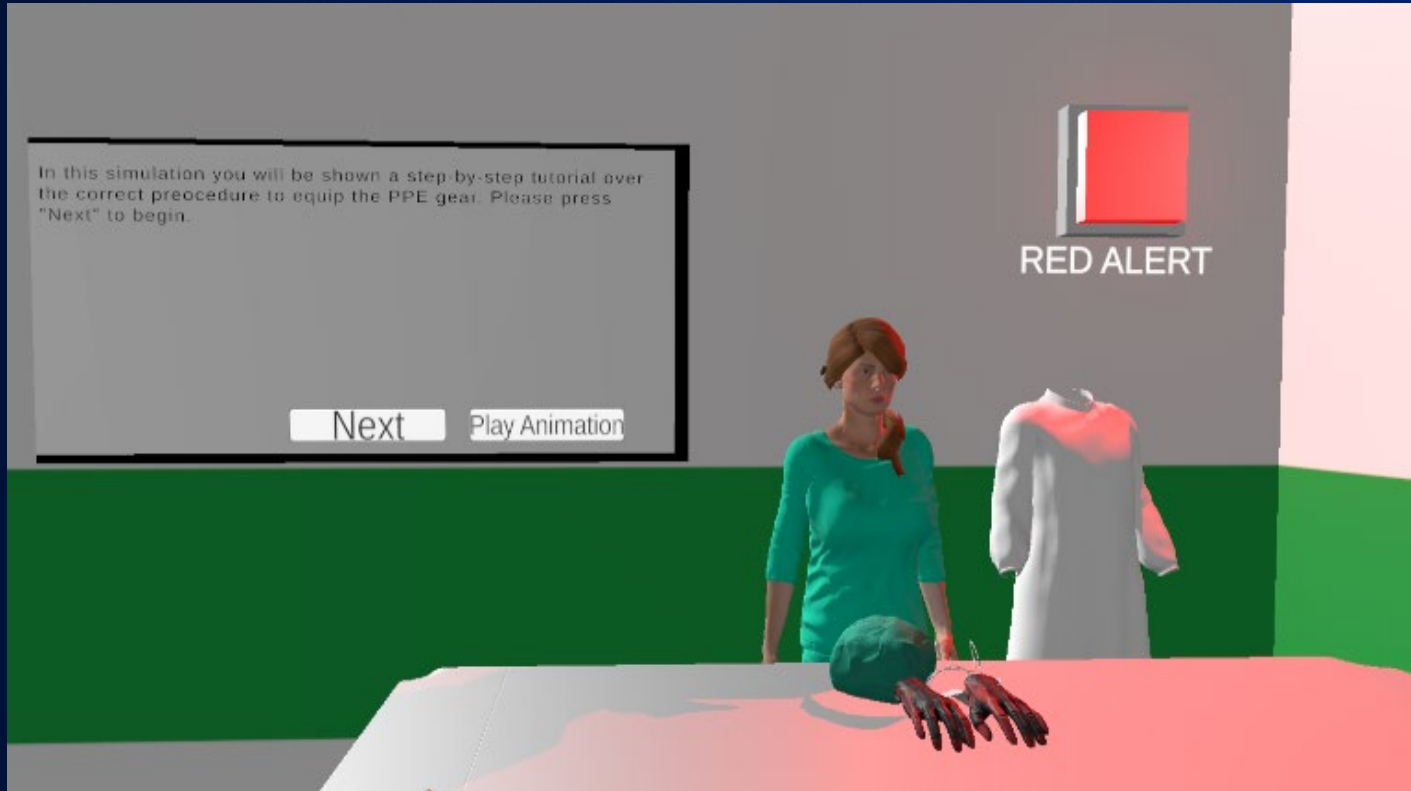


Creation of VR based Training Environments

- Three training environments developed for the first responders training focused on the COVID-19 pandemic to train first responders in
 - pre-swab activities
 - swab activities
 - post-swab activities



Pre-Swab Training Module



Inside view of the 3D VR Pre-Swab Training Environment

All modules:

- Have avatars, oral and text cues to guide during training
- After training, users have to complete challenge tasks (for skills acquisition) and knowledge assessment questions
- HCI tests also conducted

Swab Training Module



Above: Inside view of the swabbing process (the nurse being trained can first see all the details and then wear the VR headset and Practice the procedure – see right)



A nurse being trained using the Vive VR platform

Post-Swab Training Module



Creation of VR based Training Environments for First Responders

Assessment Activities

- Training scenario had additional cognitive load --audio, visual or audio-visual distractions.
 - Distractions included:
 - Flashing overhead lights, Shadows over windows
 - Red alert/blue alert lights and sirens, tornado warning sirens
- **Finding:** The group without cognitive load (Group A) received higher scores in the knowledge assessment compared to the group with additional cognitive load (Group B)
- **Distractions/interrupters increase individual's Cognitive load, which in turn negatively affects comprehension and knowledge acquisition**



HCI Findings

- Experiments: if audio and visual distractions and interruptions affect the affordance of a scene experienced by nurse participants.
- **Affordance was measured through tests of scene comprehension**, where users would observe a unique scene and answer questions about objects in the scene
- **Cognitive load** was measured through heart rate monitoring using a **pulse oximeter**.
- participants with audio/visual distractions and interruptions experienced a 4% higher heart rate.
- **Findings:Hypothesis accepted:**
 - That interruptions and distractions affect scene comprehension and understanding
 - Such interruptions and distractions do increase the cognitive load of users



Ventilator Hookup Training



- WIP
- HCI based design of 3D Environment for VR based ventilator hookup training
- Help train and refine skills of nurses and nursing students
- Vive platform

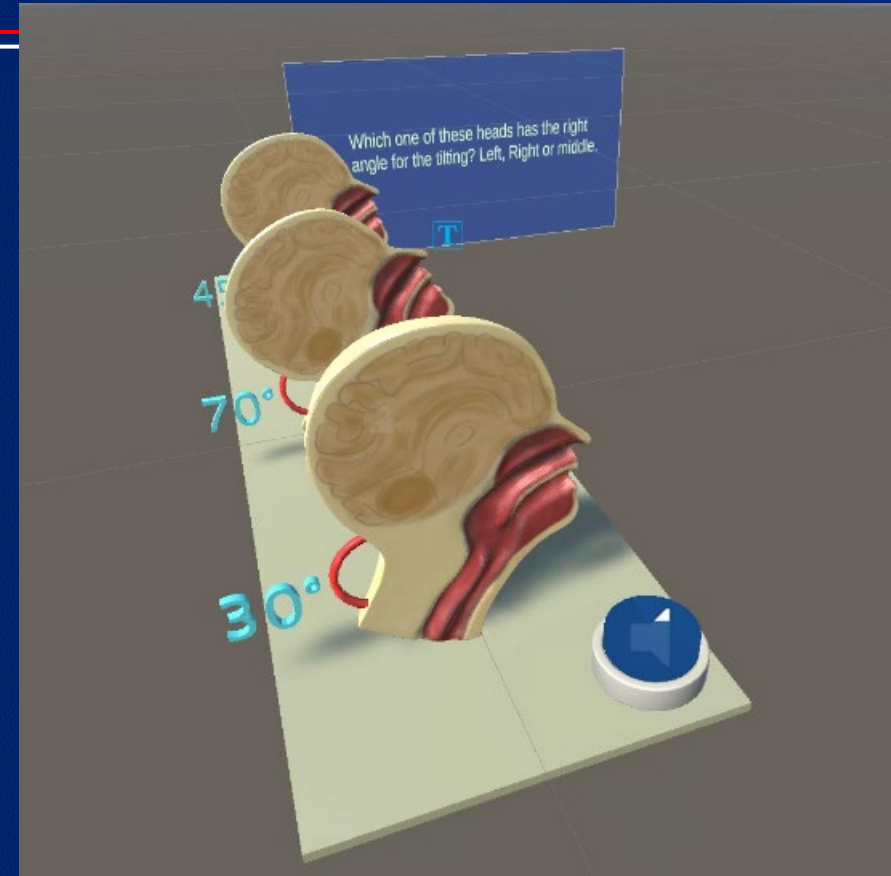
WIP: MR based vs VR based Training

- Comparison of effectiveness of VR and MR based training environments is in progress
 - on first responders' knowledge and skills acquisition.
- questionnaire-based pre and post-test method -- a total of 22 participants
- Initial results: **nursing students performed slightly better in knowledge tests** when using **MR simulators**.
- Skills tests : WIP
- More research needed



WIP: MR based vs VR based Training

- Knowledge tests:
- Questions regarding proper angle for tilting head, swab duration and angle.



Conclusion

- Research is continuing
- Interacting with hospitals in Arizona
(Yavapai Regional Medical Center, Prescott, AZ)
- Interacting with 2 nursing colleges in Oklahoma (nursing students)
- Obtained feedback from ER nurses in Dallas, Houston, Prescott (AZ), Stillwater (OK), Enid (OK).



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