Creating an Augmented Reality Training Simulation for the National Bureau of Standards Reactor using Unity and the Microsoft Hololens

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Introduction

- The NCNR hosts the National Bureau of Standards Reactor
- A 20 MW Nuclear Reactor used for research
- Operators must be vigorously trained
- Current training in classroom with occasional exercises
Project Goals

- Create an effective and interactive NSBR training simulator
  - Accurate to the reactor
  - Perform well technically
- Be able to test hypothetical scenarios such as emergency situations
- Be able to update the virtual console
- Portable and easy to access
Technology Used*

- Unity Game Engine with scripting in C#
  - Interface to create and interact with virtual objects on many platforms
- Microsoft HoloLens 2.0
  - AR/Holograms give interactive interface
  - All interactions done with voice, hand and eye gestures

*NIST does not condone or sponsor the use of these brands/products
Virtual Reactor Components

- System uses 84 switches, 10 recorders, and 8 screens/displays
- Modelled in various 3D softwares
- Annunciators shown on panel
Component Programming

- GameObjects handled by Unity
- Displays simulated by Chart/Graph Software for Unity
- Interaction of each button/switch updates a value in CSV database to manage states
Programming the Simulation

- Used Microsoft Mixed Reality Toolkit API
- CSV Files and C# Dictionaries are used to map switches/buttons to functions & display
- Mapping matrix controls interaction results
  - Each switch mapped to a perturbation

<table>
<thead>
<tr>
<th>Name</th>
<th>States</th>
<th>Description</th>
<th>Unity Name</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>Storage Pool Pump #1</td>
<td>on/off</td>
<td>Provides power to storage pool pumps, SwitchSPP1,5</td>
<td>SwitchSPP1,5</td>
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<td>Storage Pool Pump #2</td>
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<td>Provides power to storage pool pumps, SwitchSPP2,5</td>
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</tbody>
</table>
Educational Use

- Switch Instructions/Info
- Procedure Steps Listed/Timed
- Generates Report
  - Total Time
  - Total Mistakes
  - Switch/Annunciator Error Percentages
Operator Interaction

- Scenarios consist of:
  - Startup procedure
  - Fire on Console
  - SCRAM Procedure
  - Free Access

- Realtime reactor values are taken from a server to feed into simulation

- 1:1 Scale with Physical Movement
Personal Work

- Legacy Project Starting from 2017/18
- Contributing work on:
  - New Models
  - Better UI
  - Bug Fixes
  - Code Organization
Future Work

- Bug Fixing
- More user friendly interface
- Higher Efficiency
- Ports to other platforms (VR or PC)
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Thank you.
Questions?