Real-time Radiation Detection in Virtual Environments

Nathan Burgess, Yoann Altmann
School of Engineering and Physical Sciences, Heriot-Watt University
(ncb1, Y.Altmann)@hw.ac.uk

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Project Overview

Background

- Thorough assessment of the distribution of radioactive substances needed for many applications
- Manipulation and analysis of physical radiation sources in real environments is challenging
- Virtual Reality (VR) models represent a very promising alternative for rapid simulation of scenes and detectors.
- VR systems can also be used to train workers, but realistic simulation models are required

Objectives

Main Objective:

- Implementation of fast radiation transport algorithm to render the radiation flux at the detector

Milestones:

- Milestone 1: simulate simple scenes (i.e., 3D meshes) composed of a single radiation source
- Milestone 2: Use the Unity platform to create a virtual environment and allow the user to progress in it.
- Milestone 3: Adapt the convolutional forced detection (CFD) algorithm from (Fang 2021, Scientific Report) to perform real-time spectroscopy

Radiation Simulation

- Traditional ray tracing via Monte Carlo simulation is generally slow.
- Researchers at the University of Illinois, Urbana-Champaign have recently developed much faster method based on CFD, enabling real-time simulation
- Code has been implemented on standard laptops, but not yet on embedded platforms. (a couple of seconds to simulate one measurement)

Development Steps

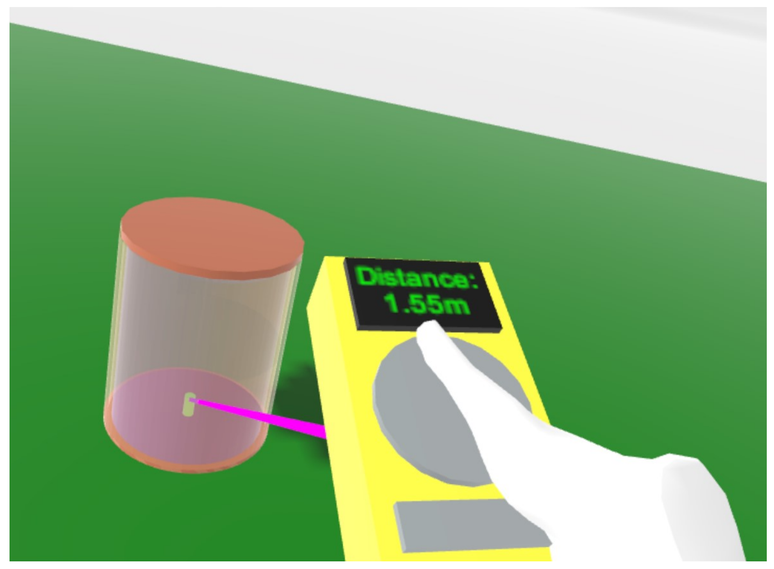
Build interaction and locomotion systems using Unity's XR Interaction Toolkit

Recreate the nuclear test environment within the VR environment

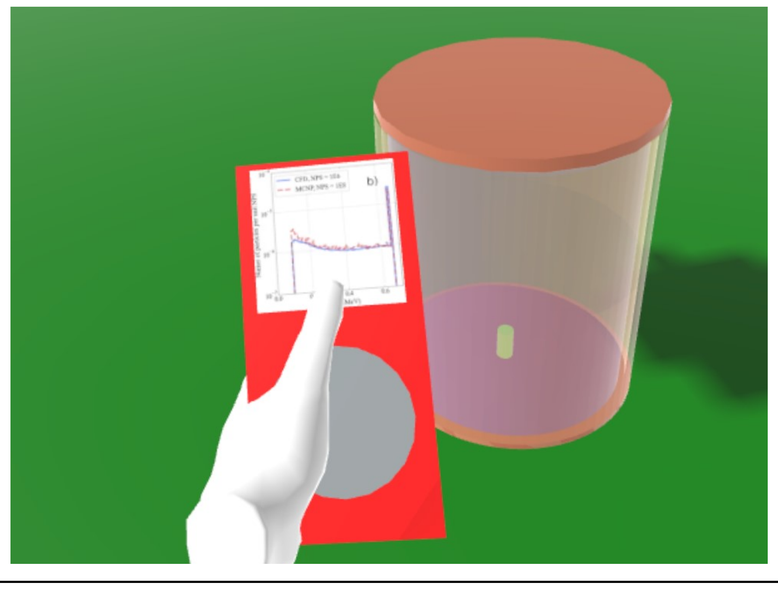
Create measuring tools to measure the effects of radioactive sources

Integrate the radiation simulation into Unity as a native plug-in library

Results



Example of early stage test demonstrating the virtual test environment, interaction system, and a mock-up detector (distance measurement)



A mock-up of the final integrated system using the CFD simulator to display source spectrum (ongoing work)