

Making Visible the invisible: An Augmented Reality Interface for Human-Robot Radiation Inspection

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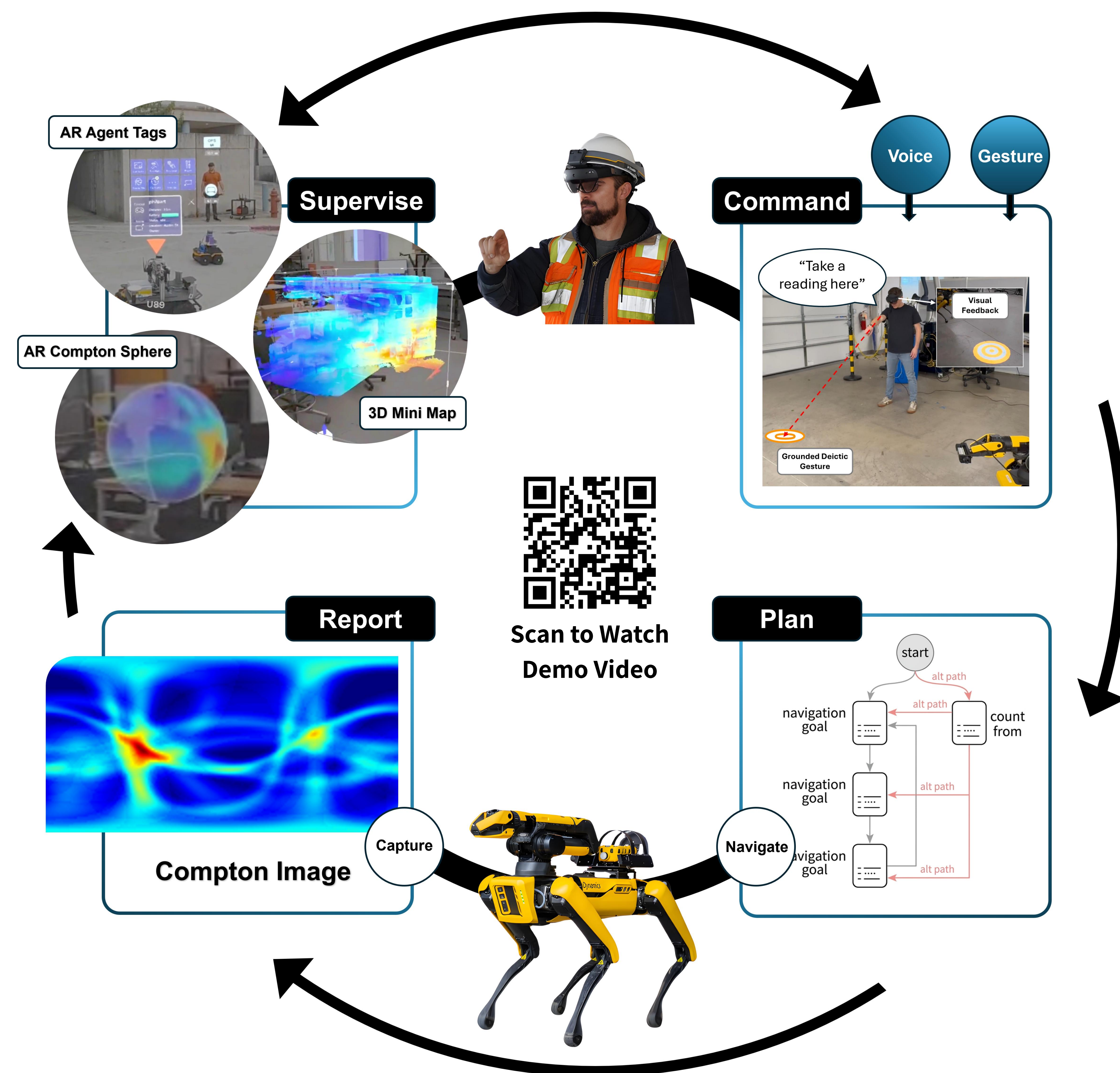
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Introduction

Ionizing radiation by nature is invisible to the human eye and can be challenging to detect, localize, and interpret in complex environments such as nuclear facilities or contaminated areas. Traditional radiation surveys often rely on manual measurements, which can expose personnel to hazards, or on robots following preprogrammed paths that limit flexibility.

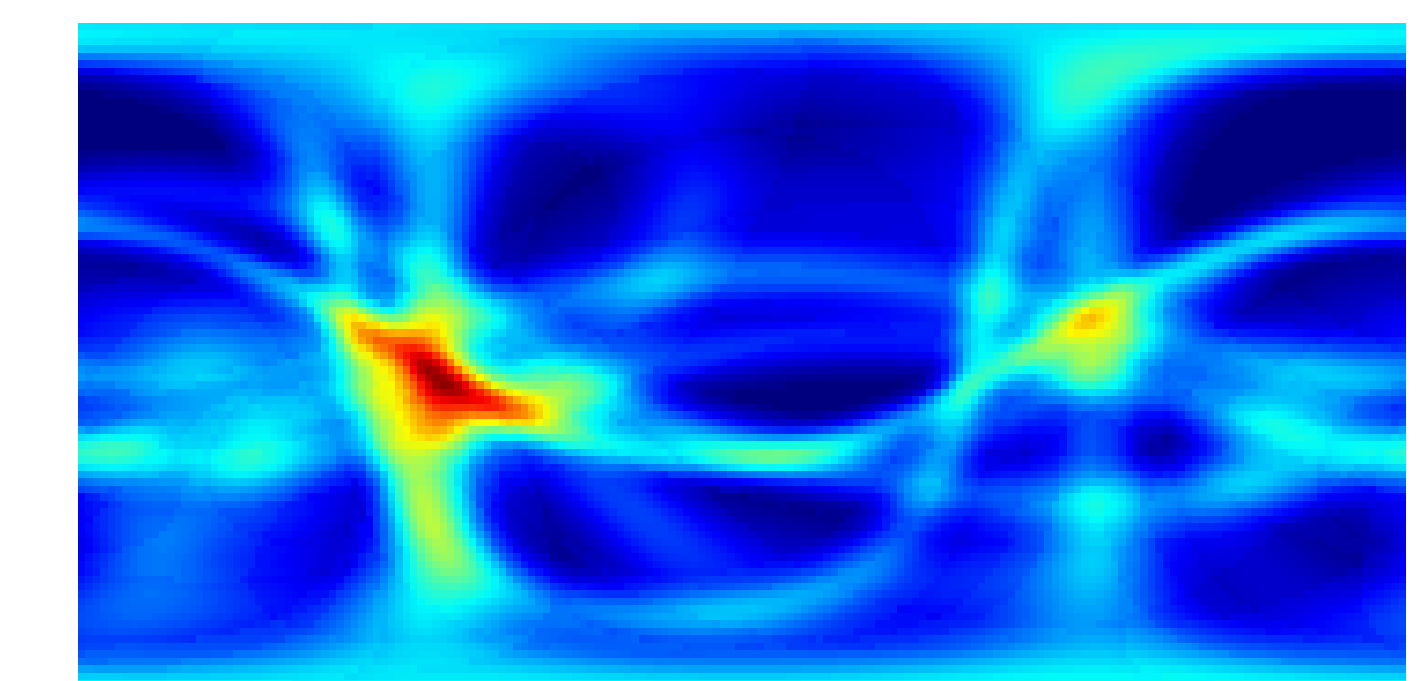
In this work, we present an augmented reality (AR) interface for intuitive visualization of radiation data collected by a mobile robot. Using **Cacti**, a human-robot interaction layer, we allow users wearing an AR headset to guide the robot through hand gestures and voice commands to take measurements at desired locations and to visualize radiation sources directly within the physical environment enabling rapid identification of hazardous areas.

Human-Robot Teaming System Overview



Application

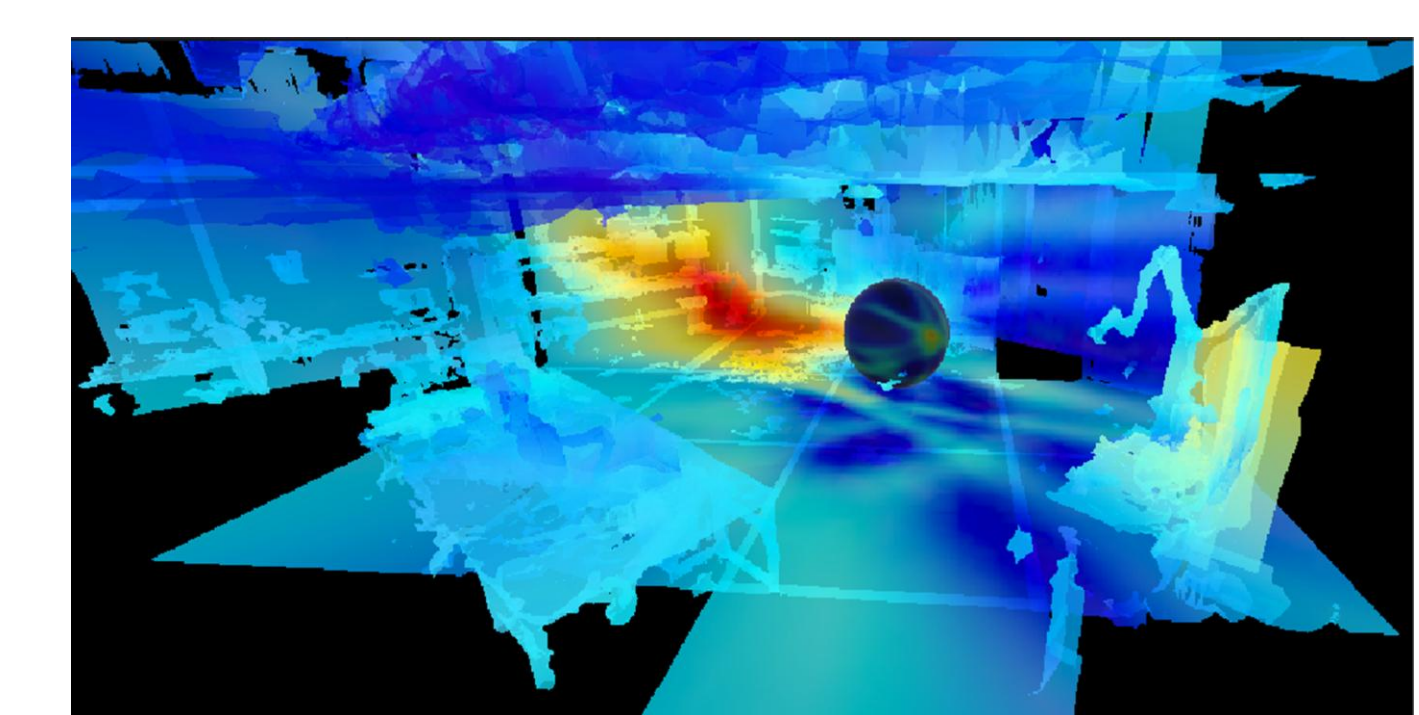
- AR interface for radiation visualization
- Human-robot interaction via hand gestures + voice commands
- Real-time Compton imaging projection



Compton Image



3D Representation



Projection over Mini-mesh

Cacti Integrations

- Custom egocentric model
- Hand segmentation
- Dynamic gesture classification
- Voice input commands

System Hardware

- Compton Camera: M400
- Radiation Source: Cs-137 gamma source
- Spot Robot
- Headset

Conclusion

- Enable real-time radiation visualization
- Reduce human exposure risk
- Improve situational awareness