Crime Scene Robot and Sensor Simulation

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Abstract
Crime scenes contaminated with chemical, biological, radiological, nuclear or explosive (CBRNE) contamination present significant hazards to responders. Teleoperated systems provide an attractive approach to placing humans in harms way. Yet training operators in the use of telerobotics and complex sensor systems is difficult. Here we describe the C2SM crime scene robot and sensor simulator system -- a virtual reality-based training system. The training system provides a simulation of both the underlying robot platform as well as the onboard sensors. This allows training to take place without physically deploying the robot or the simulation of chemical or radiological elements that might be present.

Introduction
• Crime scene investigation is traditionally performed as a manual, labour intensive task.
• This approach has proven to be highly effective for 'normal' crime scenes, but is less effective for contaminated scenes where on-site risks require protective clothing.
• For CBRNE scenes teleoperated investigation and remediation provide increased responder safety but introduce problems related to effective operator training.

Basic System Design
• System must run on commercial off the shelf hardware.
• Must extend to multiple robot platforms and multiple sensor packages.
• Leverages standard software toolkits (Blender, Ogre, Newton, Python).

System is built around a server and physics engine that provides a common physical reality and sensor simulation for all active agents in the environment.
Graphical displays mirror the user interface experienced with the real hardware and sensor suites.
Scripted scenario simulator/manager enables the rapid development of training scenarios.

User Displays

Mimicking the real hardware, each robot is actually controlled from two separate displays. One associated with the robot base (here a Vanguard platform) and the second associated with the sensor suite mounted onboard the robot.
Synchronization issues between the robot platform and the onboard sensor suite are properly mirrored in the simulated system.
Multiple agents can operate in the common physical simulation.
In addition to viewpoints associated with the simulated vehicles supervisor consoles exist to provide novel views of the scenario underway.

Scenario Simulator

• Python-based scenario simulator.
• Scripted nature of the scenario simulator provides for rapid prototyping by trainers unfamiliar with the details of graphical simulation.
• Has complete access to environment state information.
• Objects manipulated by the scenario simulator can be either physical objects (controlled by physics engine) or virtual.

The scenario shown above presents a sequence of targets that the operator must acquire with the robot. Time course runs left to right and from top to bottom. As each target is acquired it is extinguished and the next target appears. After all targets have been acquired the set of targets is shown.

Current Status and Future Work
• System is being readied for first field trials with regional police forces for late 2009/early 2010.
• System is being integrated with real data from the robot and its sensors so that the tool can be used for task rehearsal as well as training.
• Validation against real hardware is ongoing.

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