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Idaho Project Draws From Technology Used in Smartphone, Gaming Industries

IDAHO FALLS, Idaho – An Environmental Management project at the Idaho National Laboratory Site is using robotic technology and taking cues from the smartphone and gaming industries to increase the dexterity of equipment operators.

The calcine retrieval project recently purchased and began testing a robotic arm and digital control system that uses haptic feedback to allow operators to "feel" the metal walls and other intrusions of high-level waste tanks.

Smartphone users feel haptic feedback when they receive text messages. Gamers feel haptic feedback when they use controllers that vibrate to create a sense of realism in first-person games. The feedback can come in the form of force, vibrations, movement, or a combination of the three transmitted to the operator.

Last summer, engineers began testing a robotic arm in a mock-up of one of the project's high-level radioactive waste storage tanks known as bin sets. The robotic arm was used to direct simulated dry calcine waste toward a retrieval system, but the operators of the arm had no depth perception and limited visibility in the 20-foot-long tank. As a result, they often slammed the robotic arm into the tank walls.

"In many respects, our operators were flying blind," Fluor Idaho Calcine Retrieval Project Manager Howard Forsythe said. "Once the simulated calcine was airborne in the tank, it was virtually impossible to see even with an array of cameras."

The haptic feedback technology allows the operators to feel the forces the robot is experiencing, making the controls feel more natural and letting the operators feel their way through the environment.

Another component of the technology is a digital twin, which is a computer-generated version of the arm displayed on a screen. The digital twin will mimic in real-time the movements of the physical arm so the operator can see how the arm is positioned within the calcine storage bin, even when the bin becomes too cloudy for the camera system.

The project is also using a six-axis robotic arm that allows the operator to control the position of the end of the arm while it determines the required joint angles to achieve the desired position. The internal motors of the arm allow it to resist movements from the operator if the arm is colliding with a wall or has reached a physical joint limitation.

The control system is also capable of running in simulation mode, in which the operator is directly controlling the digital twin and not the physical arm, allowing the operator to practice prior to controlling the physical arm. The testing so far has taken place in simulation mode, while integration and testing with the physical arm is anticipated for early this summer.

The calcine retrieval project will retrieve 220 cubic meters of calcine from one bin set and transfer it to another bin set. The first bin set would then be closed under federal regulations.

Fluor Idaho, LLC is a wholly owned subsidiary of Fluor Corporation with subcontractor partners CH2M, North Wind Inc., Portage, and Waste Control Specialists. Fluor Idaho manages the

Idaho Cleanup Project Core contract at the Department of Energy's Idaho National Laboratory Site located 45 miles west of Idaho Falls. The 5-year, $1.4 billion project, funded through the U.S. Department of Energy's Office of Environmental Management, focuses on safely remediating the Idaho National Laboratory site including dispositioning transuranic waste, managing spent nuclear fuel, and treating high-level radioactive waste.

For more information visit the Idaho Cleanup Project on the Web at https://fluor-idaho.com

Suggested Caption

Idaho National Laboratory Site Calcine Retrieval Project Design Engineer Derek Allen tests a robotic arm and related software that uses haptic feedback in advance of full-scale testing.