Case study

NUCLEAR AMRC
ADVANCED MANUFACTURING RESEARCH CENTRE

Virtual glovebox offers a helping hand for **Sellafield**

Visualisation engineers at the Nuclear AMRC have demonstrated an interactive model which can simulate any kind of glovebox used to handle hazardous material for the nuclear decommissioning programme.

The collaboration with Sellafield Ltd and the National Nuclear Laboratory (NNL) will support the design of new kinds of glovebox, the planning of experiments and waste handling programmes, and training of operatives.

The technology demonstrator, developed with funding support from the High Value Manufacturing Catapult and NNL, combines an adaptable physical mock-up with a detailed virtual model viewed with a headset.

Gloveboxes designed for different applications for different sites can vary widely in size, shape and configuration. The physical rig developed by NNL and the Nuclear AMRC can be adjusted to simulate almost any configuration, and provides an extra level of realism by restricting the user's movements in the same way as the real box.

The combination of physical and virtual models will supplement the use of bespoke physical models during development and allow operators to start training at an earlier stage.

"Often VR technology is bracketed as just being a training tool, but this opens up new opportunities in areas such as helping designers right at the outset or in digital design reviews," says Aaron Tizick, project lead at the Sellafield Innovation Centre. **"It also offers prompts during operation and can even calculate likely dose readings."**

The system tracks the operator's head and hands, instantly mapping their movements into the virtual environment. The data can also be used to calculate the radiation dose that the user would receive from handling real materials, allowing operations to be planned efficiently without risking safety.

"Determining the duration an operator is able to work in an glovebox environment is currently done by experienced operators estimating a time," notes Qasim Kapasi, technical lead for virtual and augmented reality at NNL. **"Pessimistic assumptions are usually applied to ensure the safety of the operator, which can reduce productivity."**

The Nuclear AMRC led development of the software and tracking system. The team initially investigated motion-capture technology used in the film industry, but found that available systems were expensive and fiddly to set up. Instead, they tried the consumer HTC Vive.

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"Commercial tracking systems have been around for years and cost tens of thousands of pounds," says Nuclear AMRC research engineer Craig Hamer. **"The Vive system gives you tracking and a VR headset for less than £1,000. That made it affordable and, because it's set up for the gaming market, it's really easy to use. It can easily track your movements in space, but we still had to do a lot of development to take that into the virtual glovebox environment."**

The system can track physical items and mate them with virtual equivalents, so users can feel the heft of a real object while seeing and manipulating a virtual tool. One handheld control can be converted into a range of virtual tools such as spanners and brushes to open and clean simulated waste canisters.

Obstructions such as shielded side walls with narrow viewing windows or semi-transparent lead-lined windows can also be virtually recreated.

Technology specialists and operators from the partners, and representatives from Sellafield's current glovebox manufacturers, visited the Nuclear AMRC at the end of the pilot project for a hands-on demonstration of the system.

"General feedback from the attendees was very positive, with many commending the reality and flexibility of the design," says Kapasi. The team will now use recommendations from the users to provide higher fidelity and accuracy.

The demonstration highlighted the system's potential for streamlining the design and development process for new gloveboxes. **"When you're developing a prototype cell, the virtual model can remove a significant number of iterations,"** Hamer notes. **"You'll only have to build it once rather than six times."**

The virtual system also showed promise for training, although additional development will be needed to create realistic training scenarios.

"It's still early days and there's more development work needed on the software, but this has the potential to offer valuable experience with gloveboxes for those who don't use them on a day-to-day basis," says Tizick. **"It could help identify apprentices, trainees and operators with a natural aptitude for the work and help get them up to speed."**

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