National Aeronautics and Space Administration

NASA**facts**

Space Technology
Game Changing Development
Mixed Reality Crew Assistance

Work on the International Space Station (ISS) includes implementing complex, difficult-to-interpret procedures that could be significantly improved for crew performance with some procedural assistance. The Mixed Reality Crew Assistance (MRCA) project is developing technologies that can provide a "holographic instruction manual" to enable crew member efficiency when performing tasks.

Mixed reality technologies will increase utilization of the ISS and expand crew autonomy for missions beyond Earth orbit, a necessity to broadening human presence in the solar system. MRCA's goal is to create mixed reality tools that enhance operational procedures by augmenting what the crew sees and hears while performing a task. The key concept is a first-of-its-kind wearable crew assistant capability providing efficient access to complex procedures, looking to gain a 20-percent improvement in task execution.

Pilot studies in 2015 showed that crew often struggled to understand context and dependencies within procedures, which cause a slowdown in work performance. At NASA's Jet Propulsion Laboratory, early tests of mixed reality technologies demonstrated engineers performing assembly tasks with a dramatic reduction in errors. Mission director for NASA's Extreme Environment Missions Operations (NEEMO) and the ISS's Capsule Communicator (CAPCOM) reported tasks scheduled for multiple hours at NEEMO were completed in less than one hour.

The goal of this project is to create mixed reality tools that enhance operational procedures by augmenting what the crew sees and hears while performing a task.

For MRCA to accomplish its goal, three enabling areas of technology are under research and development: model alignment, procedure authoring, and object recognition.

Model alignment seeks to provide more accurate registration of holographic annotations in large and small volumes. This will allow users to align virtual models right on top of their real-world counterparts.

Procedure authoring will increase efficiency of crew-to-crew and crew-to-ground interactions by allowing activities to be authored and played back with immersive technologies. With minimal training, domain experts can assemble a procedure that can be experienced by crew on the station.

Object recognition involves identifying and tracking relevant equipment for procedures. The ability to recognize objects from a repository of space station components will assist crew in stowage and inventory activities and for locating the necessary tools for executing a procedure.

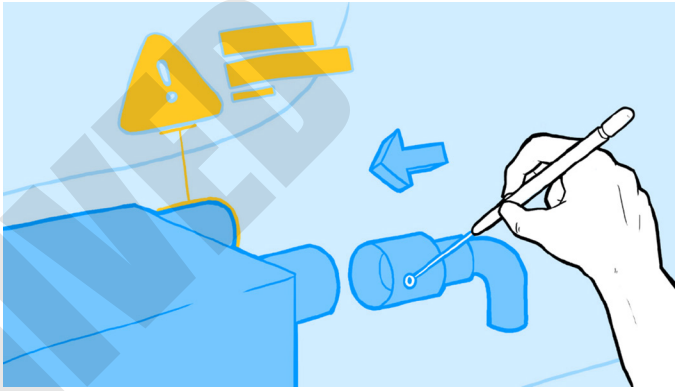
Overall, the use of virtual and augmented reality technologies will empower our astronauts with expert knowledge and training when and where they need it.

Microsoft is providing extensive support for this effort by making modifications to device firmware and operating systems in response to NASA's requests. NASA's Science Mission Directorate is funding mixed reality application development for Mars rover operations. NASA's planned Europa Clipper Mission, Surface Water Ocean Topography, Jason-3, and Mars 2020 are funding mixed reality application development for spacecraft design. The technology also has potential industry uses, such as Chevron's interest in using mixed reality applications for drill site equipment maintenance.

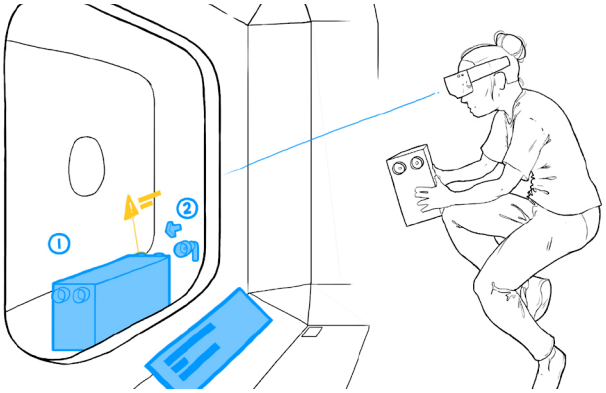
The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit http://gameon.nasa.gov/

ISS crew members, including Commander Scott Kelly, identified mixed reality as a technology with immediate applicability. Here, Kelly tests the Microsoft HoloLens.



Domain expert authors procedure on the ground using augmented reality technologies.



Astronaut follows instructions overlaid on top of real world scenario to help execute tasks onboard the ISS.

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