NASAfacts

Space Technology
Game Changing Development
Robonaut 2

Overview

Robonaut 2 (R2) has been onboard the International Space Station since launching aboard space shuttle Discovery on the STS-133 mission in February 2011. It is the first humanoid robot in space, and although R2's primary job for now is demonstrating to engineers how dexterous robots behave in space, the hope is that, through upgrades and advancements, it could one day venture outside the space station to help astronauts make repairs or additions to the station or perform scientific work.

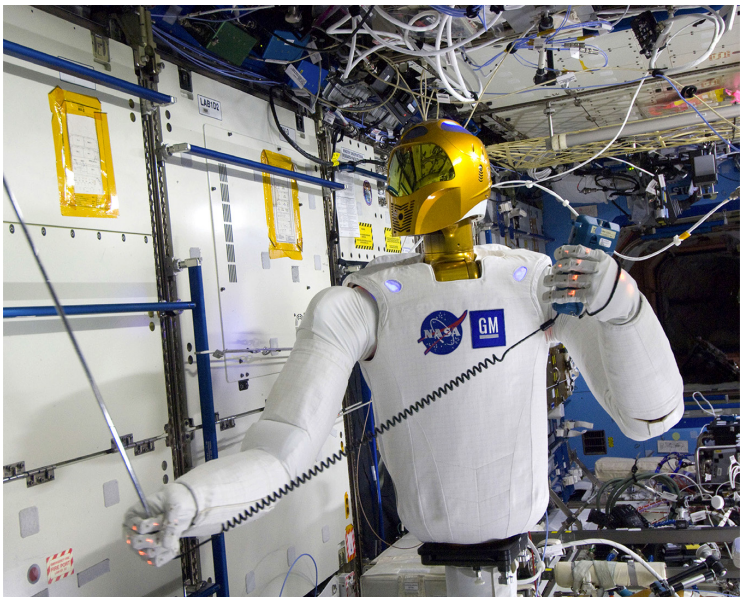
R2 powered up for the first time in August of 2011. Since then, robotics engineers have tested R2 inside the Destiny Laboratory, completing tasks ranging from taking air measurements to handrail cleaning, simple but necessary tasks that require a great deal of crew time. R2 also has a task board on which to practice flipping switches and pushing buttons; and he has been controlled by station astronauts on multiple occasions through the use of virtual reality gear. There are no plans to return R2 to Earth.

History

Work on the first Robonaut began in 1997. The idea was to build a humanoid robot that could assist astronauts on tasks in which another pair of hands would be helpful or to venture forth to perform jobs either too dangerous for crew members to risk or too mundane for them to spend time on. The result was R1, a humanlike prototype of a robot that could perform maintenance tasks or be mounted on a set of wheels to explore distant destinations.

Through 2006, R1 performed in numerous experiments in a variety of laboratory and field test environments, proving that the concept of a robotic assistant was valid. The same year, General Motors (GM) expressed an interest in hearing about the project. GM had been developing its own dexterous robots and, after seeing what NASA had already accomplished, proposed teaming up. A Space Act Agreement was signed in 2007 to allow GM and NASA to pool resources and work together on the next-generation Robonaut.

In February 2010, R2 was unveiled—a faster, more dexterous, more technologically advanced humanoid robot than had ever before been seen. Its potential was quickly



R2 takes airflow measurements onboard the ISS.

recognized, and space was made on Discovery's final mission to provide R2 a ride to the space station. There it is making history as the first humanoid robot in space: and as a first "test bed" for engineers to study how a humanoid robot actually performs in microgravity.

Current

R2 was recently upgraded with robotic legs, more powerful computing capabilities, and a vastly improved software control and safety system. These improvements will allow R2 to move around the International Space Station (ISS), allowing engineers to develop technologies needed for robotic maintenance and servicing of space station structures and systems. Some tasks envisioned for R2 include inspection, inventory, vacuuming air filters, and cleaning handrails. These are all essential tasks currently completed by human crew.

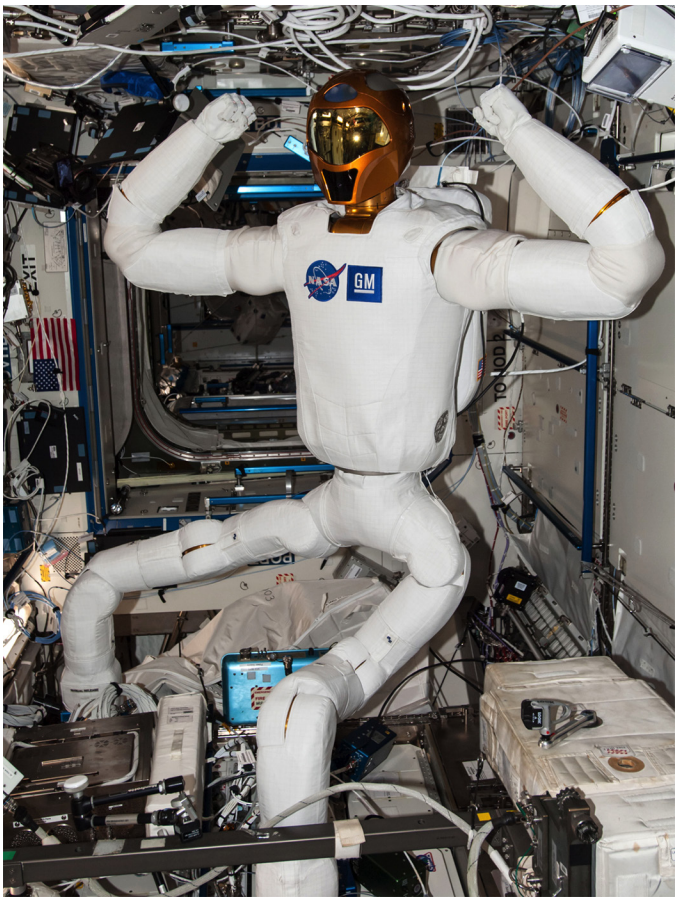
Future

The ISS is only the first of R2's possible missions. Conditions aboard the space station provide an ideal proving ground for robots to work shoulder to shoulder with people in microgravity. The new mobility package will allow R2 to move around and, after further upgrades and testing, eventually work outside in the vacuum of space. This will help NASA understand robotic capabilities for future deep space missions.

As R2 technology matures, similar robots could be sent deeper into space to test the system in more extreme thermal and radiation conditions. Someday, R2 could service communications, weather, and reconnaissance satellites, which have direct benefits on Earth.

The next step for robotic capabilities such as R2 would be to explore near-Earth objects, including asteroids and comets, and eventually Mars and its moons. The robot will serve as a scout, providing advanced maps and soil samples, and begin work on the infrastructure that astronauts would need. The crew that follows would then be much more prepared for the exploration ahead.

This evolution of capabilities for both robotic and human exploration will make a Mars surface mission possible. This human-robotic partnership will allow Mars surface missions to be conducted safely by a smaller crew—without sacrificing mission plans and results.



R2 with robotic legs inside the ISS.

There is a logical progression for the next generation of space exploration. The first look at a new destination is through a telescope, then through the eyes of a robotic precursor such as R2, followed by arrival of human explorers. Humans and robots exploring the solar system together will provide greater results than either could achieve alone, enabling an exciting future of exploration.

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/

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