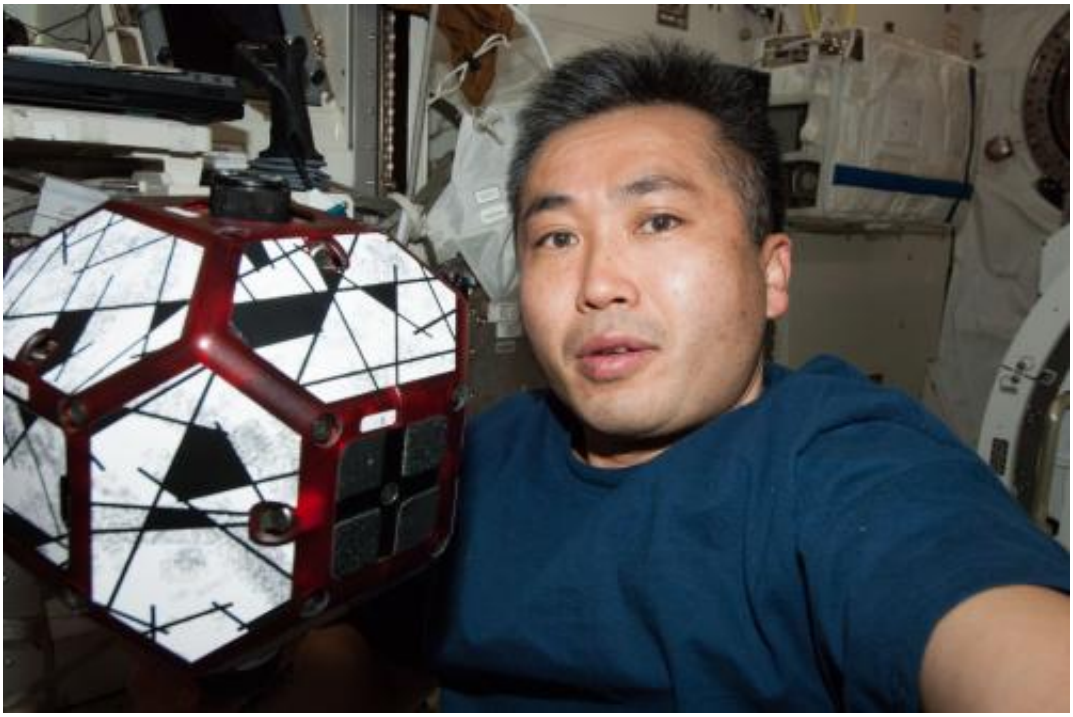
Smart SPHERES getting a software upgrade

February 21 2014, by Rachel Hoover



Japan Aerospace Exploration Agency astronaut Koichi Wakata, Expedition 38 flight engineer, conducting a session with a pair of bowling-ball-sized free-flying satellites known as Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES) aboard the International Space Station. Credit: NASA

(Phys.org) —Smart devices – such as tablets and phones – increasingly are an essential part of everyday life on Earth. The same can be said for life off-planet aboard the International Space Station. From astronaut tweets to Google+ Hangouts, our reliance on these mobile and social technologies means equipment and software upgrades are an everyday

occurrence – like buying a new pair of shoes to replace a pair of well-worn ones.

That's why the Intelligent Robotics Group at NASA's Ames Research Center in Moffett Field, Calif., with funding from the Technology Demonstration Missions Program in the Space Technology Mission Directorate, is working to upgrade the smartphones currently equipped on a trio of volleyball-sized free-flying satellites on the space station called Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES). In 2011 on the final flight of space shuttle Atlantis, NASA sent the first smartphone to the station and mounted it to SPHERES.

Each SPHERE satellite is self-contained with power, propulsion, computing and navigation equipment as well as expansion ports for additional sensors and appendages, such as cameras and wireless power transfer systems. This is where the SPHERES' smartphone upgrades are attached.

By connecting a smartphone, the SPHERES become Smart SPHERES. They now are more intelligent because they have built-in cameras to take pictures and video, sensors to help conduct inspections, powerful computing units to make calculations and Wi-Fi connections to transfer data in real time to the computers aboard the space station and at mission control.

"With this latest upgrade, we believe the Smart SPHERES will be a step closer to becoming a 'mobile assistant' for the astronauts," said DW Wheeler, lead engineer with SGT Inc. in the Intelligent Robotics Group at Ames. "This ability for Smart SPHERES to independently perform inventory and environmental surveys on the space station can free up time for astronauts and mission control to perform science experiments and other work."

NASA astronaut Mike Fossum puts one of the Smart SPHERES through its paces during Expedition 29 aboard the International Space Station. The addition of the smartphone helped turn the SPHERES into mobile data acquisition assistants. Credit: NASA

Later this year, NASA will launch a Project Tango prototype Android smartphone developed by Google's Advanced Technology and Projects division of Mountain View, Calif. The prototype phone includes an integrated custom 3-D sensor, which means the device is capable of tracking its own position and orientation in real time as well as generating a full 3-D model of the environment.

"The Project Tango prototype incorporates a particularly important feature for the Smart SPHERES – a 3-D sensor," said Terry Fong, director of the Intelligent Robotics Group at Ames. "This allows the

satellites to do a better job of flying around on the space station and understanding where exactly they are."

Later this month, Ames engineers will fly the prototype phone several times aboard an airplane that is capable of simulating microgravity by performing a parabolic flight path. The team has modified the motion-tracking and positioning code developed by Google that tells the phone where it is to work in the microgravity conditions of the space station. To verify that the phone will work, they must take the phone out of the lab at Ames and test it in a microgravity environment.

The SPHERES facility aboard the space station provides affordable opportunities to test a wide range of hardware and software. It acts as a free-flying platform that can accommodate various mounting features and mechanisms in order to test and examine the physical or mechanical properties of materials in microgravity. SPHERES also provides a test bed for space applications including physical sciences investigations, free-flying spatial analyses, multi-body formation flying and various multi-spacecraft control algorithm verifications and analyses. SPHERES also is used for the annual Zero Robotics student software programming competition. Ames operates and maintains the SPHERES facility, which is funded by the Human Exploration and Operations Mission Directorate at NASA Headquarters in Washington.

To date, astronauts have conducted 77 investigations using SPHERES to test techniques to advance automated dockings, satellite servicing, spacecraft assembly and emergency repairs. Now researchers are preparing to control the SPHERES in real time from ground control stations on Earth and from space.

In the long run, free-flying robots like SPHERES could also be used to inspect the exterior of the space station or future deep space vehicles. Robots like the smartphone-enhanced SPHERES and NASA's Robonaut

2, will provide some of the help of another crew member; SPHERES' cameras can act as another set of eyes, while Robonaut 2 literally adds another set of hands to act as an assistant with small and bulky items alike. An added bonus is that robots do not require any additional life support.

As with Robonaut 2, all tests to date have occurred in the safety of the space station's interior. However, in the future, upgraded SPHERES may venture outside the orbiting outpost.

"This is no ordinary upgrade – we've customized cutting-edge commercial technologies to help us answer questions like: How can robots help humans live and work in space? What will happen when humans explore other worlds with robots by their side? Can we make this happen sooner, rather than later?" said Fong. "Building on our experience in controlling robots on the space station, one day we'll be able to apply what we've learned and have humans and robots working together everywhere from Earth's orbit, to the moon, asteroids and Mars."

Provided by NASA