

## Partnership with Google Makes Exploration of Earth, Moon, and Mars a Click Away

NASA's partnership with Google Inc. has spawned dynamic and interactive projects that connect and benefit citizens of Earth. Through projects such as Global Connection and Planetary Content, technologies that enhance the power and accessibility of images and data are making it possible for people to explore Earth and space in bold new ways.

"The partnership with Google has been extremely fruitful for NASA and the scientific community in general," said Dr. Terry Fong, director of the Intelligent Robotics Group at Ames Research Center, which supports these projects. "The ability to create and share detailed images of our planet and space has benefited scientists immensely. And, perhaps, even more importantly, because everyone has access to this information, it has encouraged people across the globe to be more interested and involved in their world and beyond."

### Global Connection Project

Inspired by the technology that enabled NASA's Mars Exploration Rovers (MERs) to create panoramas of Mars and provide virtual tours of the Red Planet via the Internet, Randy Sargent of Ames and Dr. Illah Nourbakhsh of Carnegie Mellon University (CMU) looked at ways consumers could access similar technology for more "down-to-Earth" applications. In 2005, Sargent and Nourbakhsh created the Global Connection project, a collaboration of scientists from NASA, Google, CMU, and the National Geographic Society who are dedicated to connecting, informing, and inspiring global communities through the power of spatial images.

Global Connection initially focused on geo-locating and embedding high-resolution aerial imagery of Africa photos taken by conservationist Mike Fay, National Geographic stories, and other images of Africa into the Google Earth™ mapping service (<http://earth.google.com>). The Google Earth tool lets users zoom in and get a closer look at Fay's detailed images overlaid on the terrain and better experience this distant continent.

Sargent and Nourbakhsh were inspired by panoramas returned by the Mars rovers to create a system that consumers could use on

Earth. They worked with Charmed Labs, LLC of Austin, Texas to design and manufacture the GigaPan™ robotic camera mount, a low-cost device that allows anyone with a digital camera to capture and share detailed shots and create ultra high-resolution panoramas with ease. The GigaPan platform has been spun off from Charmed Labs into its own company, GigaPan Systems, located in Portland, Oregon.

Two other related products, a Web site (<http://gigapan.org>) and panorama stitching software based on the NASA Vision Workbench (an open-source computer vision library developed by the Intelligent Robotics Group) have helped to enable panoramic images to be shared across the globe. Thanks to this technology, users can display and view a bird's-eye panorama of stitched photos on the Web site and then zoom in for an impressive bug's-eye view of high-quality detail, much like taking in the actual scene with high-powered binoculars.

Google has supported the development of the GigaPan<sup>SM</sup> system in numerous ways, including outreach to new users and applications, as well as hosting several hundred geo-referenced panoramas in the Google Earth mapping service. Most recently, the Global Connection project has been working in cooperation with the United Nations Education Scientific and Cultural Organization (UNESCO) to provide students in different countries with GigaPan system, allowing them to share panoramic images and cultural experiences via the Web site.

Global Connection also fostered disaster response efforts following Hurricane Katrina

by processing approximately 8,000 high-resolution images that the National Oceanic and Atmospheric Administration (NOAA) captured of flood-damaged New Orleans. At the request of NOAA, the Global Connection team created new software tools to present the images, taken over 10 days, in a searchable, stitched-together format. The GigaPan system made the preparation of image overlays faster than was previously possible and provided real-time information and updates for rescue and aid workers.

In addition to assisting government officials, disaster relief imaging technology helps volunteers, displaced individuals and their loved ones, and the general public access information that is relevant to them. Nourbakhsh estimated that the Global Connection server supported some 2.5 million viewings of the high-resolution overlays of post-Katrina images by users of the Google Earth site during September 2005.

### Planetary Content Project

Through the Planetary Content project, data and images collected by NASA and the science community at large can be easily published, shared, and explored via various Google mapping services, enabling virtual exploration of Earth, the moon, and Mars. The Planetary Content team at Ames manages the NASA layers for these services.

The Google Earth mapping service includes astronaut photography of Earth, satellite imagery of Earth courtesy of the NASA Earth Observatory, and Earth's City Lights, a feature that shows light pollution across the globe.

Mars can be explored in three dimensions using the Google Earth 5.0 site (<http://earth.google.com/mars>).

Users have two options for exploring the moon: either the Google Moon™ mapping service (<http://www.google.com/moon>) or the newly launched Moon in Google Earth feature (<http://earth.google.com/moon>). This newest addition to the Google Earth 5.0 mapping service is an interactive, 3D atlas of the moon, including images, maps, and stories from the Apollo missions and other images and information. With the Moon in Google Earth feature, users can explore a virtual moonscape, follow guided tours from astronauts Buzz Aldrin and Harrison (Jack) Schmidt, view high-resolution street view-style panoramic images, and see previously unreleased footage of the lunar surface.

Similarly, Mars can be explored in 3D using the Mars in Google Earth feature (<http://earth.google.com/mars>). Released in February 2009, this feature contains information from many missions to the Red Planet, including NASA orbiters, landers, and rovers. With this feature, users can view global 3D terrain images, images with captions describing the science behind the breathtaking scenes, detailed maps of the MER traverses, and browsable satellite images taken by the five major orbital cameras.

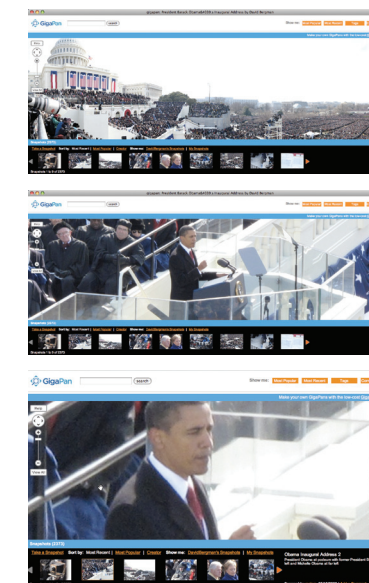
The Mars in Google Earth feature has attracted at least as much attention as the mapping service's ocean features, which was the primary purpose for the Google Earth 5.0 release. Dr. Fong is pleased by this, but he is even prouder of how the content is being used.

"At the 40th Lunar and Planetary Science Conference in March 2009, we received hundreds of inquiries from planetary scientists about how they could use the 3D mapping of Mars as part of their research," Dr. Fong said. "For us, it is truly exciting how we can use a platform like the Google Earth mapping service to reach students, educators, engineers, and scientists all at the same time. Partnerships help make it all possible." ■

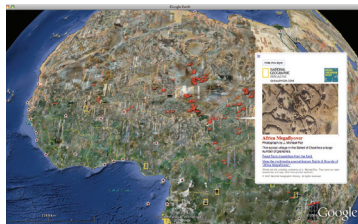
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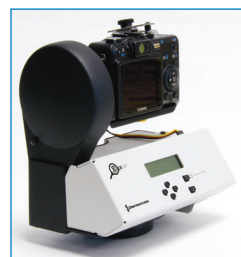
The GigaPan<sup>SM</sup> system was developed by Carnegie Mellon University in collaboration with Ames's Intelligent Robotics Group, with support from Google Inc.



Photographer David Bergman used the technology originally developed by Ames's Randy Sargent and CMU's Illah Nourbakhsh to create a 1,474-megapixel panoramic photo of President Obama's inauguration (top)—that is more than a hundred times sharper than ordinary digital photos. Viewers on the GigaPan Web site (<http://gigapan.org>) can click on the panorama to see close up in unprecedented detail (center and bottom).



The Global Connection project is helping people explore Africa and other regions of the world via the Google Earth mapping service (<http://earth.google.com>).



The GigaPan robotic platform enables photographers on Earth to create super-sized digital panoramas.