The Asteroid Data Hunter challenge was part of NASA’s Asteroid Grand Challenge.

The data hunter contest series, which was conducted in partnership with Planetary Resources under a Space Act Agreement, was announced at the 2014 South by Southwest Festival and concluded in December.

The series offered a total of $55,000 in awards for participants to develop significantly improved algorithms to identify asteroids in images captured by ground-based telescopes. The winning solutions of each piece of the contest combined to create an application using the best algorithm that increased the detection sensitivity, minimized the number of false positives, ignored imperfections in the data, and ran effectively on all computer systems. (www.nasa.gov)

Please see the following video for an overview of the Contest.
https://youtu.be/72bKusFX0Tg
A Grand Challenge: Find and Plan for All Asteroid Threats

NASA anticipated the close flyby of asteroid 2012 DA14 on February 15, 2013, but the asteroid explosion above Chelyabinsk, Russia that same day was unexpected. With over 1,000 injuries and millions of dollars in damages, it was a powerful reminder of potential hazards to Earth. The safe flyby of 1998 QE2 in May further emphasized that asteroid encounters happen more often than most people realize.

Since 1998, NASA’s Near Earth Object Observation (NEOO) Program has led the global effort to find potentially hazardous asteroids, and has successfully found 95 percent of the potentially devastating 1 km wide near-Earth asteroids. More needs to be done; asteroid impacts and explosions from objects much smaller than 1 km, like the one over Russia, have the capability of rendering massive devastation. It will take a global effort with innovative solutions to find all of these potentially hazardous asteroids. NASA understands the importance of addressing this challenge in collaboration with the numerous entities around the world that have been actively working on these issues for some time. Recognizing the global importance of completing a catalog of asteroid threats, NASA is seeking to engage the world in a coordinated effort to: Find All Asteroid Threats to Human Populations and Know What to Do About Them.

Observatories and organizations around the world already coordinate extensively with each other and NASA to find and characterize asteroid threats. Now is the time to expand the conversation regarding how we work together to meet this challenge. With the President’s FY 2014 budget request, NASA intends to enhance current ground-based detection facilities and is considering further improvements to existing ones to contribute to the global effort to find all of these threats. To know what to do about the potentially hazardous asteroids.

NASA will expand its conversations about ways to work more collaboratively on technology development and threat mitigation. Recognizing the power of traditional and innovative collaboration – including the use of public-private partnerships, citizen science, crowdsourcing, and incentive prizes, in addition to international and other cooperative partnerships – NASA will lead a dialogue addressing how to best use these methods to aid in solving this global problem together.
Background

In April 2010, President Obama announced a mission to send humans to an asteroid by 2025 and to Mars by the 2030s. NASA’s FY 2014 budget supports an amplified focus on asteroids: a mission that combines robotic and human activities already underway to capture and redirect an asteroid and eventually send crews to it in a more cost-effective manner than other proposals, along with using innovative partnerships and approaches to help us identify and track asteroids and protect the planet from potential threats.

Global efforts to detect, track and characterize hazardous asteroids are important to understanding how to deal with any potential threat. Finding these objects and having a plan for dealing with them is one of the Obama Administration’s 21st century “Grand Challenges” – ambitious but achievable goals on a national or global scale that capture the imagination and demand advances in innovation and breakthroughs in science and technology. Grand Challenges are an important element of President Obama’s Strategy for American Innovation.

Traditional and Innovative Methods

NASA has a rich history of utilizing traditional and open innovation methods to engage a large audience of stakeholders in the pursuit of its endeavors. This effort to find all asteroid threats and have a plan for dealing with them will build upon that history.

- **Public-Private Partnerships:** Under its Space Act authority, NASA works with diverse organizations in the private and public sector in order to meet wide-ranging NASA mission and program requirements and objectives. It is NASA’s policy to utilize the authority granted to the Agency in the Space Act to further the Agency’s missions.

- **Prizes:** NASA’s successful prize program has contributed innovative solutions to NASA problems by reaching out to nontraditional audiences. The Centennial Challenges Program directly engages the public in the process of advanced technology development, and has led to new spacesuit components, robotic technology, all-electric airplanes and a new class of sub-orbital reusable launch vehicles. The NASA Center of Excellence for Collaborative Innovation has found innovative solutions to NASA needs from a variety of unexpected sources through the NASA Tournament Lab and the NASA Innovation Pavilion.

- **Citizen Science:** Amateur astronomers have historically contributed to the discovery of the near-Earth objects (NEO). Because we have discovered the vast majority of the larger NEOs, the challenge of amateur astronomers directly assisting with new asteroid discovery will increase with time. However, amateur astronomers can still provide critical pieces of information for the characterization of known and newly discovered NEOs through light curve analysis. We hope to increase the number of these citizen scientists, to compliment a large increase in new NEO discoveries.

- **Crowdsourcing:** NASA is embracing the practice of enabling contributions from large groups of people, and especially from the online community. An example of a successful space-focused crowdsourcing effort is Galaxy Zoo, which already has hundreds of thousands of contributors from around the world classifying hundreds of thousands of galaxies using NASA’s Hubble Space Telescope archive to help us understand how these galaxies, including our own, were formed.

- **International Cooperation:** Since its inception, NASA has enjoyed significant benefits to almost all of its programs through some level of international cooperation. Given the inherently global nature of this Grand Challenge, NASA plans to continue this tradition of significant international cooperation.
Be an Asteroid Hunter in NASA's First Asteroid Grand Challenge Contest Series

March 10, 2014

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Be an Asteroid Hunter in NASA's First Asteroid Grand Challenge Contest Series

NASA's Asteroid Data Hunter contest series will offer $35,000 in awards over the next six months to citizen scientists who develop improved algorithms that can be used to identify asteroids.

This contest series is being conducted in partnership with Planetary Resources Inc. of Bellevue, Wash. The first contest in the series will kick off on March 17. Prior to the kick off, competitors can create an account on the contest series website and learn more about the rules and different phases of the contest series by going to:


Managed by the NASA Tournament Lab, the entire contest series runs through August and is the first contest series contributing to the agency's Asteroid Grand Challenge.

"For the past three years, NASA has been learning and advancing the ability to leverage distributed algorithm and coding skills through the NASA Tournament Lab to solve tough problems," said Jason Crusan, NASA Tournament Lab director. "We are now applying our experience with algorithm contests to helping protect the planet from asteroid threats through image analysis."

The Asteroid Data Hunter contest series challenges participants to develop significantly improved algorithms to identify asteroids in images captured by ground-based telescopes. The winning solution must increase the detection sensitivity, minimize the number of false positives, ignore imperfections in the data, and run effectively on all computer systems.

"Protecting the planet from the threat of asteroid impact means first knowing where they are," said Jenn Gustetic, Prizes and Challenges Program executive. "By opening up the search for asteroids, we are harnessing the potential of innovators and makers and citizen scientists everywhere to help solve this global challenge."

Gustetic and Jason Kessler, Grand Challenges Program executive, will host a panel March 10 at the South by Southwest Festival in Austin, Texas titled "Are We Smarter than the Dinosaurs?" to talk about how open innovation can meaningfully engage people in discussions on and research into space exploration and help us solve problems of global importance. They will provide an outline of the Asteroid Data Hunter contest series and other efforts to detect asteroid threats, as well as ideas for mitigating these threats.

"Current asteroid detection initiatives are only tracking one percent of the estimated objects that orbit the Sun. We are excited to partner with NASA in this contest to help increase the quantity and knowledge about asteroids that are potential threats, human destinations, or resource rich." said Chris Lewicki, President and Chief Engineer of the asteroid mining company Planetary Resources, Inc. "Applying distributed algorithm and coding skills to the extensive NASA-funded Catalina Sky Survey data set will yield important insights into the state of the art in detecting asteroids."

Through NASA's asteroid initiative, the agency seeks to enhance its ongoing work in the identification and characterization of near-Earth objects for further scientific investigation. This work includes locating potentially hazardous asteroids and identifying those viable for redirection to a stable lunar orbit for future exploration by astronauts. The Asteroid Grand Challenge, one part of the asteroid initiative, expands the agency's efforts beyond traditional boundaries and encourages partnerships and collaboration with a
variety of organizations.

The algorithm contests are managed and executed by NASA's Center of Excellence for Collaborative Innovation (CoECI). CoECI was established at the request of the White House Office of Science and Technology Policy to advance NASA open innovation efforts and extend that expertise to other federal agencies. CoECI uses the NASA Tournament Lab (NTL) for its advanced algorithmic and software development contests. Through its contract with Harvard Business School in association with Harvard's Institute of Quantitative Social Science, NTL uses the topcoder platform to enable a community of more than 600,000 designers, developers and data scientists to create the most innovative, efficient and optimized solutions for specific, real-world challenges faced by NASA.

For more information on NASA's Center of Excellence for Collaborative Innovation, visit:

http://www.nasa.gov/coeci

For more information on Planetary Resources, Inc., visit:

http://www.planetaryresources.com

For more information on NASA's asteroid initiative, visit:

http://www.nasa.gov/asteroidinitiative

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A software application based on an algorithm created by a NASA challenge has the potential to increase the number of new asteroid discoveries by amateur astronomers.

Analysis of images taken of our solar system’s main belt asteroids between Mars and Jupiter using the algorithm showed a 15 percent increase in positive identification of new asteroids.

During a panel Sunday at the South by Southwest Festival in Austin, Texas, NASA representatives discussed how citizen scientists have made a difference in asteroid hunting. They also announced the release of a desktop software application developed by NASA in partnership with Planetary Resources, Inc., of Redmond, Washington. The application is based on an Asteroid Data Hunter-derived algorithm that analyzes images for potential asteroids. It’s a tool that can be used by amateur astronomers and citizen scientists.

The Asteroid Data Hunter challenge was part of NASA’s Asteroid Grand Challenge, which is focused on finding all asteroid threats to human populations and knowing what to do about them.

Image Credit: NASA

NASA's Asteroid Data Hunter contest series was part of NASA's Asteroid Grand Challenge, which is focused on finding all asteroid threats to human populations and knowing what to do about them.
significantly improved algorithms to identify asteroids in images captured by ground-based telescopes. The winning solutions of each piece of the contest combined to create an application using the best algorithm that increased the detection sensitivity, minimized the number of false positives, ignored imperfections in the data, and ran effectively on all computer systems.

“The Asteroid Grand Challenge is seeking non-traditional partnerships to bring the citizen science and space enthusiast community into NASA’s work,” said Jason Kessler, program executive for NASA’s Asteroid Grand Challenge. “The Asteroid Data Hunter challenge has been successful beyond our hopes, creating something that makes a tangible difference to asteroid hunting astronomers and highlights the possibility for more people to play a role in protecting our planet.”

The data hunter challenge incorporated data provided by the Minor Planet Center (MPC), at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, and images provided by the Catalina Sky Survey, an astronomical survey project run by the University of Arizona, Tucson, and focused on the discovery and study of near-Earth asteroids and comets.

“We applaud all the participants in the Asteroid Data Hunter challenge. We are extremely encouraged by the algorithm created and it’s already making a difference. This increase in knowledge will help assess more quickly which asteroids are potential threats, human destinations or resource rich,” said Chris Lewicki, president and chief engineer at Planetary Resources. “It has been exciting for our team to work with NASA on this project, and we also look forward to future space-based systems leveraging these results.”

Astronomers find asteroids by taking images of the same place in the sky and looking for star-like objects that move between frames, an approach that has been used since before Pluto was discovered in 1930. With more telescopes scanning the sky, the ever-increasing volume of data makes it impossible for astronomers to verify each detection by hand. This new algorithm gives astronomers the ability to use computers to autonomously and rapidly check the images and determine which objects are suitable for follow up, which leads to finding more asteroids than previously possible.

“The beauty of such archives is that the data doesn't grow stale, and with novel approaches, techniques and algorithms, they can be harvested for new information. The participants of the Asteroid Data Hunter challenge did just that, probing observations of the night sky for new asteroids that might have slipped through the software cracks the first time the images were analyzed,” said Jose Luis Galache of the MPC. “Moreover, this software can now be used to analyze new images and is available to any observer who wants to use it. The Minor Planet Center applauds these efforts to provide superior tools to all, and looks forward to receiving new asteroid observations generated with them.”

The desktop software application is free and can be used on any basic desktop or laptop computer. Amateur astronomers may take images from their telescopes and analyze them with the application. The application will tell the user whether a matching asteroid record exists and offer a way to report new findings to the Minor Planet Center, which then confirms and archives new discoveries.

Through NASA's asteroid initiative, the agency seeks to enhance its ongoing work in the identification and characterization of near-Earth objects for further scientific investigation. This work includes locating potentially hazardous asteroids and identifying those viable for redirection to a stable lunar orbit for future exploration by astronauts using NASA’s Space Launch System rocket and Orion spacecraft. The Asteroid Grand Challenge, one part of the asteroid initiative, expands the agency's efforts beyond traditional boundaries and encourages partnerships and collaboration with a variety of organizations.

The algorithm contests were managed and executed by NASA's Center of Excellence for Collaborative Innovation (CoECI). CoECI was established at the request of the White House Office of Science and Technology Policy to advance NASA's open innovation efforts and extend that expertise to other federal agencies. CoECI uses the NASA Tournament Lab (NTL) for its advanced algorithmic and software development contests. Through its contract with the Crowd Innovation Lab at Harvard University, NTL uses Appirio’s Crowdsourcing platform powered by Topcoder to enable a community of more than 750,000 designers, developers and data scientists to create the most innovative, efficient and optimized solutions for specific, real-world challenges faced by NASA. Data storage of the Catalina Sky Survey data was provided by Amazon Web Services.
The new asteroid hunting application can be downloaded at:

http://topcoder.com/asteroids

For information about NASA's Asteroid Grand Challenge, visit:

http://www.nasa.gov/asteroidinitiative

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