ADN - Asteroid Detection Network

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Abstract

This project is the result of the Santiago, Chile-based event of the SpaceAppsChallenge, called out by in April 2014. It proposes a multilateral network between official institutions, citizens, amateur astronomers to facilitate efficient, and above all fast, communications between the stakeholders. We aim to bring together governmental and research institutions with private individuals for achieving more rapid and efficient follow-up observations of newly detected asteroids, focusing on NEOs that may pose a threat to us. Following a 4-pronged approach: 1) connect people and institutions to follow a common goal, 2) provide guidelines/tutorials for robotic observing, 3) make usage of IR detectors on robotic telescope more popular, and 4) allow people w/o access to a telescope to engage in observations via remote utilization of telescopes around the world.

1. Introduction

In June 2013 NASA announced a grand challenge to “find all asteroid threats to human populations and know what to do about them.” A large part of this Grand Challenge is to expand the role of individual inventors, tinkerers, citizen scientists, developers and technologists in participating meaningfully in addressing the work of this challenge with their individual skill sets. Asteroids are both a threat and an opportunity to the planet and humankind; the threat of their impact is one of the few natural phenomenon that we could expand our knowledge base enough to prevent devastation from.

The Chelyabinsk meteor that exploded in the atmosphere over Russia was an example of a small Near Earth Object (about 17m wide) that was undetected before it collided with Earth. Chelyabinsk caught the world by surprise. Location of these small, fast-moving Near Earth Objects (NEOs) requires space-based hardware or large professional telescopes. Once their position is identified, rapid follow-up from smaller, amateur AROs might help to quickly assess the threat they pose and characterize their composition, rotation and other attributes.

2. Current state of the art

Today there are numerous projects and initiatives in operation to tackle this challenge, especially the detection and tracking, represented by both official research organizations and governments, as well as citizen-based and amateur societies. Among the governments institutions, there are the joint efforts between, the large national space agencies, but the seem not to intend to tap into the power of the crowd of amateur and citizen scientists.

3. Description of the project

Primarily we aim to achieve a better awareness and involvement of citizens in the topic of NEO threat detection. Since the Chelyabinsk event in early 2013 the awareness about the threat of asteroids on critical orbits (i.e. orbits that cross earth's orbit, or those of NEOs) has increased in the population. With our three-pronged approach to achieving this, we intend to tap into the enormous knowledge already established at many scientific and governmental institutions, and connect this infrastructure to citizens and amateur astronomers who are willing to contribute to this human effort.
Our four main areas of interest are:

1. Connect people and institutions to follow a common goal. Earlier in 2012, the NASA budget on asteroid detection and tracking was reduced significantly, so that the priorities dropped accordingly. After the Chelyabinsk event the development changed when the *NASA Innovation Incubator Program* took this topic up again and included it in the *2013 NASA SpaceAppsChallenge* in order to involve the public. We intend to develop smart interfaces between the existing institutions, i.e. governments, agencies and research organizations, with the public in order to put the existing assets into better use for this goal. These are:

Asset 1) telescopes around the world with robotic capability (e.g the so-called GOTO capability),

Asset 2) citizens willing to participate in this endeavor, and

Asset 3) large, well-maintained databases like the one at the Minor Planet Center (MPC), where all information, ephemeres, light curves etc. of asteroids are centralized, verified and scrutinized.

2. Tutorials for robotic observing. Many telescopes, amateur class and professional ones, already count with features for remote operation. Most if not all of these are of proprietary, commercial origin, and there is only little visible effort spent on standardization. Also, there are a multitude of software interfaces, APIs and protocols available, so that the novice, amateur user is stuck with the choice, hardly any information on how to decide well, and especially no information about future support and upgrade capability. We see therefore a great potential for standardization on software level, but we also see the necessity for backward compatibility of existing systems. We will pursue the following approach to this:

a) Study exhaustively the market on robotic telescope systems, contact the developers, manufacturers, and create awareness with them for the need of standardization. Many already count with a serial protocol, some on RS232, RS485, USB and Bluetooth, or communicate via Ethernet or Wifi, and it may be of value to develop an Open Source _protocol abstraction layer_ library that can be shipped with any commercial product to provide a standard accessible interface (API).

b) For the large DIY telescope builder community it will be great to provide references to simple, economic automation components like stepper motors, worm gears, control and driver boards, and Open Source code for addressing these, so the existing manually operated telescopes can be upgraded to be commandable from the internet.

c) Develop a crowd-funded campaign on www.experiment.com which facilitates upfront resources for an independent, open-source development of a complete Az/El mount with standardized interfaces to ground (i.e. to a tripod or any other "pole") and to popular telescope types (tube sizes).

It is very encouraging to see that there are a number of simultaneous efforts at this very same 2014 NASA SpaceAppsChallenge at other locations that are tackling some of these topics. They will be contacted and invited to join this standardization effort.

3. Make usage of IR detectors on robotic telescope more popular. In the thermal infrared, the contrast of the thermal emission of asteroids to the cold background of space is much larger as in the visible. The disadvantage of visible light observations is due to the dark grey surface of the asteroids (low "albedo", only 3-6% of the sun's light will be reflected), therefore it is only possible to detect and track the larger asteroids, that provide enough surface to reflect an absolute minimum for making themselves detectable. One other aspect of this theme is to explore operational models for sites at high altitude mountain ranges, e.g. in the high and dry Andes of northern Chile, where the transparency of the atmosphere is close to 90% in the thermal infrared. Such a site, combined with state-of-the-art technology and remote, robotic operations, will put a tool in the hands of the public which otherwise is only possible to be done from space-based platforms.

4. Allow people without access to a telescope to engage in, and support, observations via remote utilization of telescopes around the world. Or first-order approach to facilitating this is via the development of an *Astronomical Observing Time Brokerage Platform* (working title). We imagine a market for observing time with a pricing of the order of current cell phone connection fees (approx. fraction of US Dollar per minute on source) for observing time, so that telescope time becomes affordable for the one that don't have a telescope or are at locations that don't allow observations (e.g. due to light pollution in large cities), and compensate somewhat for the effort that others make for investing in and maintaining remotely accessible telescopes.

With these goals achieved we think that mankind will be able to, for the first time, predict and hopefully avoid one of the previously unpredictable natural catastrophes.

4. Roadmap

After the “hackathon” event of 2014’s SpaceAppsChallenge in Santiago, we plan to execute these as next steps, in order not to lose momentum:

1. Get in contact with the mentioned stakeholders, representatives of institutions and amateur/citizen societies, and present and explain this project description, jointly with the

request for exploring whether they would be able and willing to provide some fraction of required funding. Deadline: **End of April 2014**

2. Form a study group with interested students that can tackle the hard- and software related works, interfaces, and devise the most adequate, state-of-the-art technologies for standardization. Deadline: **End of June 2014**, close to the end of the semester in Chile.
3. Create a pilot project for a robotic, thermal IR asteroid watcher that is located in the high Andes in northern Chile, in order to demonstrate the capability of such an imaging system. Deadline: **End of June 2014**, close to the end of the semester in Chile, to obtain agreements of potential consortium members.
4. Create a web platform for observing time brokerage with help of the the new crowd-content-creation in the World Wide Web. Additionally, crowd-fund the effort, and award donations with observing time contingents. Deadline: **September 2014**.

Work as it proceeds will be added subsequently to the link to this repository.

Please feel, free to comment, amend etc. to drabanus@gmail.com .