



Exploring the Solar System: Ice Hunters, Mercury Zoo, and Planet Investigators

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Abstract

A new suite of citizen science software, “Community Science Builder” (CSB) has been created to facilitate exploration and annotation of space images. First launched as the backbone of “Ice Hunters,” this software is designed to facilitate planetary science that requires images to be annotated by users. Initial features include: marking objects with a set of pre-defined markers and an administration dashboard for expert review of incoming annotations. Beginning with the release of “Planet Investigators” and “Mercury Zoo” in late 2011, CSB will also allow moving objects to be matched between frames, linear features to be traced, and interesting features to be annotated with flags and comments. In this paper we discuss upcoming projects, and the software’s features and flexibility for generating science.

1. Introduction

While great strides are regularly being made in the development of automated image-analysis algorithms, the human eye remains a more trusted source for certain image analysis. From marking KBOs in subtracted image pairs, to outlining craters on rocky surfaces, humans can effectively, with modest training, identify features against varied backgrounds. While historically this type of image annotation has been done by trained scientists and their students, the Stardust@Home [1] and Galaxy Zoo [2] projects demonstrated that it is possible to train members of the public – citizen scientists – to accurately identify basic features in images. Building on the success of these projects, the CSB software was designed to allow the rapid launch of new citizen science projects. Inspired by the easy to install and easy to use Wordpress.org blogging software, CSB is designed for use by non-programmers. Its design and implementation fulfill three basic goals: CSB allows any user with access to a basic webserver and

database to set up a citizen science project, it allows real-time monitoring and moderating of user classifications, and it allows new features and tools to be added easily through a standardized plugin system.

2. Projects

2.1 Ice Hunters

IceHunters.org facilitates members of the public searching for the KBO (or KBOs) the New Horizons spacecraft will visit after its 2015 Pluto flyby. Secondary outcomes include the creation of catalogues of KBOs, variable stars, and asteroids found in project images. Among the types of problems computers continue to struggle with is the identification of real sources, such as KBOs, in the residuals of subtracted images. While computers can successfully find many supernovae, variable stars, and KBOs in difference images, they don’t find all of them, and their results depend heavily on consistent image quality. Humans can adjust their “Search Parameters” in real time to changing conditions. CSB debuted in May 2011 as the backbone to the IceHunters.org citizen science project. The initial interface, using a “Mark and Annotate” science tool, allowed users to mark two predefined image features, blobs (e.g. variable stars and KBOs) and streaks (e.g. asteroids), in 424 x 424 pixel cutouts from difference images. Users could also select check boxes to annotate the images with a quality rating. While statistics are not available at the time of this writing, sampling of the data indicates that objects marked by 5 or more people (out of 15) are typically real.

2.2 Planet Investigators

The Hubble Archive Project “Planet Investigators” (PlanetInvestigators.org) [3], debuts in private-beta in summer 2011 and launches in fall 2011. Users are asked to verify the rejection of artifacts, catalogue

known and unknown objects (e.g. moons, asteroids, KBOs) in images, and also annotate features on objects (e.g. clouds, transits). As a result of this project, HST Archive users will have access to better-annotated images. Initial WFPC2 image sets focus on Jupiter and Saturn and their surroundings.

2.3 Mercury Zoo and Surface Science

The Mercury Zoo project, slated to launch in fall of 2011, will be the first surface science project to utilize the CSB software. Built as a sister site to Moon Zoo, Mercury Zoo asks members of the public to view MESSENGER images of the Mercury's surface to mark the locations of different geomorphological features. While the final feature set is still being designed at the time of this writing, initial designs include tools to mark craters, trace along linear features, and flag and annotate other interesting features. The design goal of the project interface is to allow a user to use simple drawing tools to mark features on an image such that when the image is removed, a cartoon tracing remains for easy analysis. This site also adds backend features not seen in Moon Zoo that allow team scientists to view thumbnails of the most recent (and not so recent) image annotations to spot check the data and provide users feedback through an announcements system that can be triggered based on specific user (mis-)behaviors. The creation of these tasks for Mercury Zoo opens the door for the easy creation of projects related to additional solid-body surfaces.

3. Technological Underpinnings

The CSB software is designed to work on most standard webservers. Built on a php foundation with javascript tools, CBS stores its data in a MySQL database and uses Redis to generate image queues and to store frequently accessed data. While the software was initially designed to integrate with the Zooniverse software suite (under the ZooBuilder code branch), it can also support, with modification of a single file, use of other login systems (e.g. OpenID).

3.1 User Features

Beyond access to a suite of science tasks to participate in and related educational and training content, basic user features include: the ability to view all personal classifications, the ability to see project specific image galleries (e.g. linear features on Mercury, asteroids in Ice Hunters), and the ability

to comment on and discuss project discoveries.

3.2 Administrative Features

The software's backend interface has three basic user levels: admin, scientist, and contributor. Site contributors have the lowest access and can only access basic content areas, such as adding content pages through a what-you-see-is-what-you-get interface, posting announcements, moderating user comments, and seeing site statistics. This is designed to allow EPO professionals to maintain content, communicate with users, and maintain usage numbers for reporting. Project scientists have access to all these features, and can also view (and flag as needed) incoming annotations, export catalogues, and upload setup tables for new image sets. (Scientists can also receive nightly dumps of the data via an automated system.) Admins, as the name implies, fully administer the site and have the ability to, among other things, change site themes, push live new data, put the site into maintenance mode, and turn on and off new plugins.

3.3 Plugins

In addition to the core features discussed above, CSB supports the addition of new features through a well-defined plugin system. Plugins underdevelopment include: an integrated Facebook badges app, site-wide polls / quizzes, and site badges that users can download for display on their own site. Additional social media tie-ins and statistic suites are possible.

References

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