

Panoptes, a Project Building Tool for Citizen Science

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Abstract

We will demonstrate the newly deployed Panoptes system for building citizen science projects which involve the public in the crowdsourced analysis of images. Panoptes supports projects built by the Zooniverse, the world's most successful collection of such projects, and allows end users - typically scientists and researchers with large data sets - to construct advanced classification workflows using simple, browser based tools. A particular strength of Panoptes is its ability to support complex retirement and aggregation tools and procedures, as well as a mechanism for sending notifications to users as they classify. It thus provides a valuable testbed for those wishing to build their own projects for the purposes of investigating the behaviour of human-computing systems outside the laboratory. It can also be used as a rapid prototyping tool to create a "proof of concept" project to test design ideas or attract investment in a citizen science project.

Crowdsourcing has become an increasingly popular means of interacting with data for researchers in fields as diverse as ecology and papyrology. Driven by the availability of datasets which include large numbers of images and the number of such projects, the consequent demand for platforms which can support them has grown substantially during the last decade. While some of the researchers turning to crowdsourcing are well-resourced and able to commission complex web development, most look to third-party solutions to provide access to the crowd. Of the platforms that have been built, the Zooniverse has been particularly successful; growing from a single project - *Galaxy Zoo* - in 2007 to its present size, with a community of more than a million registered users participating in more than forty projects. The focus of Zooniverse is on projects which will lead to scientific findings suitable for formal publication, and on offering a growing set of standardised tools for interacting with images (and, occasionally, with audio and video) that can be shared between projects.

During the last year, the Zooniverse software has been completely rebuilt with a modular and streamlined approach. The resulting software, Panoptes¹ is now deployed

and supporting projects from ecology to planetary science². An early test project, Snapshot Supernova (Campbell and et. al. 2015), showed that the system was able to cope with large spikes in traffic, receiving more than a million classifications in under twenty minutes.

Unlike previous crowdsourcing platforms, Panoptes produces more than a list of raw classifications for project scientists. Standard algorithms (e.g (Hines and et. al. 2015)) aggregate individual users' input into combined results. These algorithms can be used to implement complex retirement rules and task assignment, increasing the efficiency of classification. As an example of this kind of more advanced task assignment, we have integrated the SWAPR code³ developed by the SpaceWarps ((et. al. 2015)) team. This code integrates 'gold standard' (expert classified) data to estimate confusion matrices for each user; false negatives (images wrongly dismissed when a gravitationally lensed image of a distant galaxy was actually present) are due primarily to images being retired without being seen by an experienced user. Our system allows subjects in danger of this happening to be redirected to a pool of expert users, to ensure no image is retired without being seen by at least one expert. The system also allows for human and machine classifiers to be combined.

Panoptes allows any user to build a project directly in the browser without programming, as shown in Figure 1. This powerful functionality is expected to be of use to the HCOMP audience in carrying out experiments in efficient crowdsourcing. Projects can be launched as beta projects to the Zooniverse community, and, if approved, graduate to full Zooniverse project status. We are able to store additional metadata with each subject, and via our APIs we can support external analysis and decision-making about the data, such as retiring certain images or optimise the task flow. However, the main novel feature of Panoptes is the ability for programmatic project creation in the browser without any coding. This feature allows researchers with little or no development experience to quickly build and deploy projects. We will demonstrate this facility, and discuss the likely implications for project design. Panoptes supports rapid iteration on

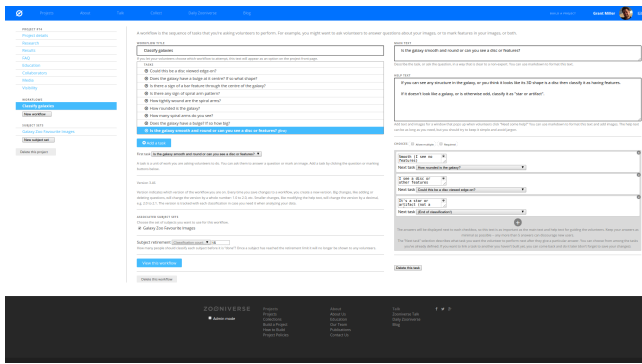


Figure 1: An example project being built in the Panoptes interface

project design, so that through a sequence of projects, very complex tasks or datasets can be tackled with a "divide-and-conquer" approach, using successive filtering tasks to iteratively weed out the most common or uninteresting entities in a dataset - for example, empty images or "normal" galaxies, allowing researchers to quickly hone in on the most interesting data. The ability to quickly build projects from nothing more than a set of images will put the power of citizen science into new areas - school classrooms, undergraduate projects, and hobbyists or interest groups and has the potential to improve public awareness of, and involvement in, real scientific research.

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