CLICKWORKERS INTERACTIVE: PROGRESS ON A JPEG2000-STREAMING ANNOTATION INTERFACE.

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Introduction: In the past, studies involving the Clickworkers Interactive crowdsourcing initiative have shown among the members of the general public both an interest in and aptitude for geologic data collection [1-5]. In the two predecessors to the Clickworkers Interactive project (Mars Clickworkers and HiRISE Clickworkers), online users were asked to identify various types of Mars landforms – craters, dunes, lava flows, and the like – depicted in HiRISE and MOC images. The result was a system, which simplified scientific data collection while uniting, educating, and entertaining the public. The most recent updates to the Clickworkers site have increased the project's potential for large-scale online data collection. Whereas previous versions of the site served static images for annotation, the new interface allows users to pan and zoom through full-resolution images. In addition, a number of new tools are at the user's disposal for more complex landform marking.

The original mission of Clickworkers Interactive was to use human intuition and reasoning skills to solve problems, which could not be solved through computation. In essence, the project extended to the scientific world the *crowdsourcing* movement, which organizes large groups of people to a cause. The result is what is now called *citizen science*. Our goal is to develop citizen-led solutions for a number of scientific problems, not just the analysis of Mars geographical data; the interface, which is currently under development will help us reach that goal. Follow our progress at www.nasaclickworkers.com.

Technical Description: The new Clickworkers Interactive interface involves 1) an image streaming service which provides users with full-sized versions of HiRISE and MRO images (in JPEG2000 format) by loading them in pieces of varied sizes and resolutions; 2) a ProcessingJS (Javascript) front-end which allows users to annotate images using a number of multipurpose tools; 3) a MySQL database which collects annotation data and manages image paths; and 4) a PHP back-end where data for a particular image can be collected, displayed (graphically and in a table), and analyzed.

Gigapixel Image Streaming: Due to the large file size of the HiRISE images, it would be unreasonable to make an online user wait to download an entire image file before annotating – for most internet users, downloading just one of the gigapixel images (around one gigabyte in size) could take several tens of minutes. Previous Clickworkers interfaces simplified this problem by serving users only portions of a single image. Unfortunately, this solution limited the user to one particular scale and would often leave pieces of landforms cut off.

We find that IIPImage software [6] provides a much more effective option to image-splitting. By loading large images in pieces and at different resolutions, one can "stream" a large image file and access parts of it only as-needed. The new Clickworkers Interactive interface involves a modification of IIPImage, which allows for integration with the ProcessingJS annotation applet. In this interface, a user can pan and zoom through different parts of an image to find and annotate landforms.

Annotation Tools: The new Clickworkers interface includes a number of different tools for marking landforms of unique shapes and sizes.

The Sidebar: Additional information, tips, image processing tools, and metadata for annotations (i.e., landform type, user-set quality, and notes) are all accessible in the sidebar next to the image viewport.

Image Processing: To facilitate annotation of low contrast or shadowed areas on images, contrast and brightness enhancement tools were developed and included in the interface. Using CSS filters, a user can modify the displayed image to his or her liking.

The Pinpoint Tool: When a landform requires a point annotation, the Pinpoint Tool makes a small dot of constant size at a particular position. The dot's size does not vary with a change in zoom.

The Circle Tool: Craters and other circular landforms often have regular shapes, which can be approximated with a scientifically calculated circle. The Circle Tool requires an input of four points, which are then fitted with a circle. The annotation changes size appropriately with zoom and has a minimum and maximum radius value.

The Polygon Tool: For shapes with freeform characteristics, the Polygon Tool allows users to create irregular n-gons to annotate that landform precisely. The resultant polygon scales accurately with zoom.

The Anomaly Tool: If something is wrong with a particular image, which cannot be resolved using image processing tools, the Anomaly Tool allows users to mark those regions with a point annotation, much like the Pinpoint Tool.

The Selection and Movement Interface: Users can utilize the Select Tool to manage a particular annotation, either by moving it (with the Move Tool) or by appending metadata to the object through the "Collect Data" tab on the sidebar. Users can also scroll through an index of annotations to select one they wish to modify.

Post-Processing: The way user input is translated into interpretable data in the back-end of the site is quite simple. User click locations within the ProcessingJS applet window are stored until the annotations are submitted, at which point the image scale (usually in centimeters per pixel at full resolution) is used to convert click coordinates to image coordinates. Those values are then stored within the database. Finally, with a number of PHP calls and the metadata inherent to all HiRISE images, that point data can be converted a second time into planetary coordinates.

References: [1] Kanefsky, B., Barlow, N.,and Gulick, V. LPSC XXXII, Abstract #1272. [2] V.C. Gulick, G. Deardorff, B. Kanefsky, and A. Davatzes. LPSC XXXVIII Abstract #2248. [3] Gulick, V. C. et al. 2010. AGU Fall Meeting Abstracts 8. [4] Gulick, G.2009. AAS/DPS Meeting Abstracts #41 41, #41.03. [5] Gulick, V. C., et al. 2007. LPSC Abstracts 38, 2248. [6] Pillay, R. 2012. IIPImage Image Server System Software.
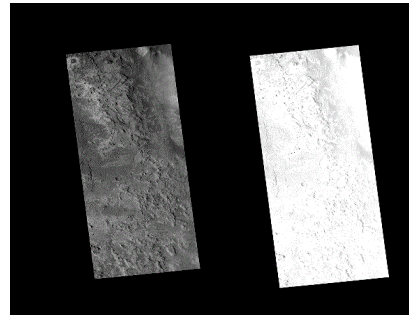

Figure 1: The washed-out image on the right has been adjusted (result on the left) using the image processing tools available through the new interface.
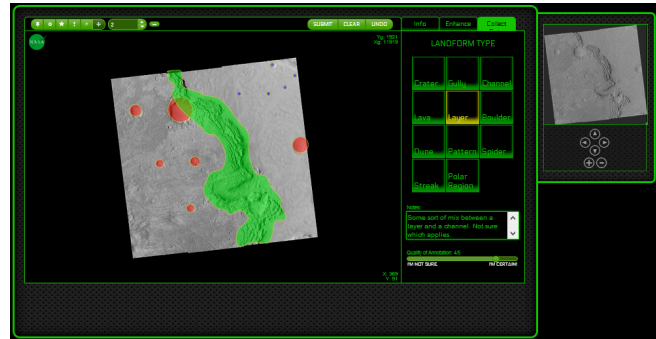

Figure 2: Clickworkers interface with example annotated image. The window on the far right is available for pan and zoom functionalities. More on pan and zoom in Figure 3.
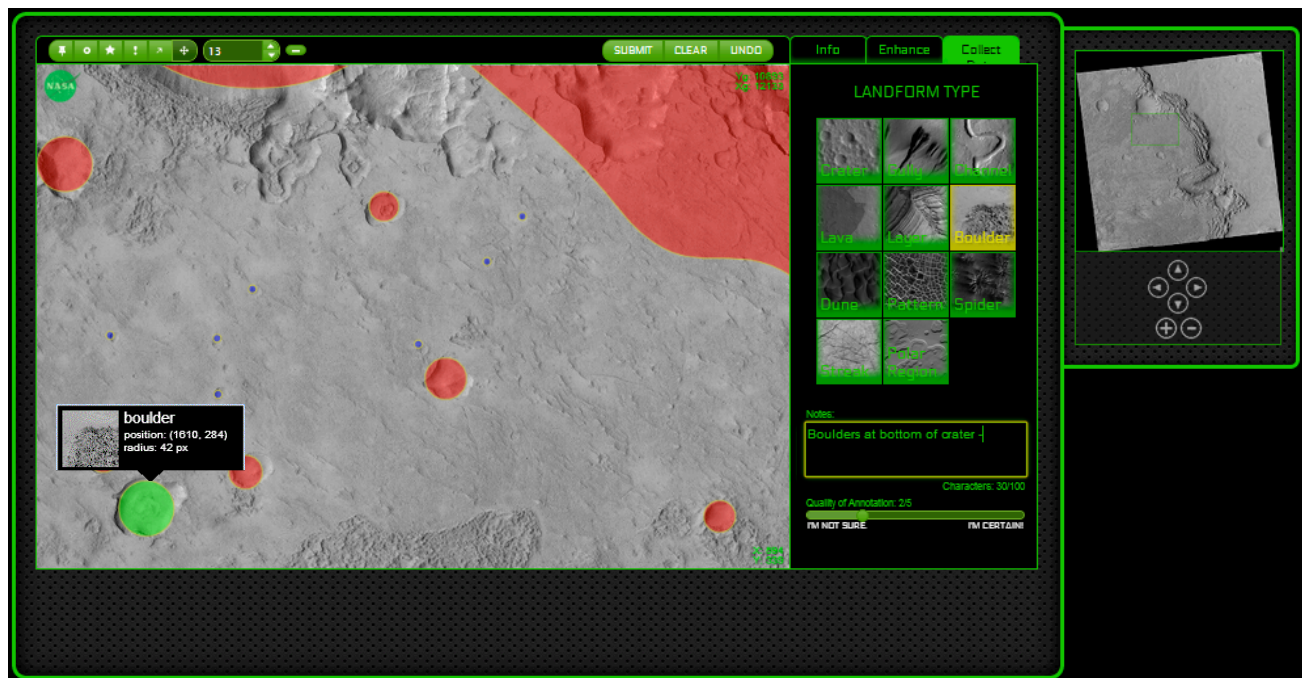

Figure 3: Users can zoom and pan in an image to get a better look at their work and find more landforms at different image resolutions. The "Collect Data" tab on the sidebar allows users to label landform types and include notes and confidence ratings for each annotation. A circular annotation has been selected using the Select Tool and is displaying metadata appended to the annotation object, including circle radius, position, and landform type. The user has added in the notes box that boulders are present on the crater floor.