


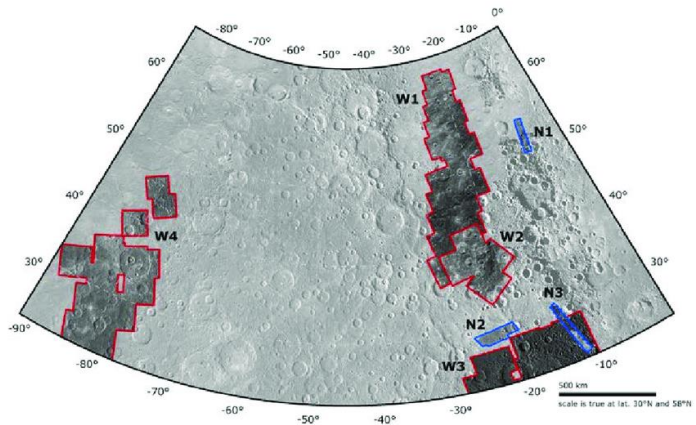
CS486C – Senior Capstone Design in Computer Science

Project Description

Project Title: Planetary Image Caption Writer	
Sponsor Information:	Laszlo Kestay, Research Geologist Astrogeology Science Center United States Geological Survey laz@usgs.gov 928-556-7002
	

Project Overview:

Planetary Science is laying the foundation for humanity to become a space-faring species by discovering what our future homes are like. In many cases, the reality of alien worlds has been more amazing and bizarre than any science fiction author could have imagined, which emphasizes the value of careful scientific exploration and methodical analysis shared across an international community of scientists and engineers. In Astrogeology, we focus on the aspects of planetary science that you can hit with a rock hammer. From the cratered plains of Mercury to the frozen cocktails of comets we are interested in the make-up of the surface: the details of the terrain, what it's composed of, and the sequence of processes that formed it. Our precision topographic maps have been used for every successful landing on the Moon, Mars, and asteroids. The production of accurate foundational geospatial products is an essential skill that USGS brings to space exploration; without you are, quite literally, lost in space.



As it currently stands, unfortunately, our group does a very mediocre job of providing easy access to the geospatial information we produce. As the saying goes, a picture is worth a 1000 words, and thus figures in publications are central in conveying information about geologic features across our solar system. Most of the images of planetary surfaces in NASA's archives have been processed through the USGS's Integrated Software for Imagers and Spectrometers version 3 (ISIS3). The image labels of ISIS3 files are chock full of all kinds of essential geospatial information about the image – latitude and longitude, the elevation of the sun, the size of the pixels, which way is north, etc. – but there is no convenient way to extract this meta-information. Of course, the metadata can be extracted manually (e.g., using a binary editor on the ISIS3 file) and then typed into a document. Annotations on images are manually constructed custom additions created in other software packages such as Adobe Photoshop after the data has been exported from ISIS3. This process is so tedious that it is never done in a systematic and complete way by scientists. As a result, the rich metadata contained in ISIS3 image headers remains essentially inaccessible

and under-utilized ...meaning that scientists often lack key pieces of information to make sense of what they are looking at.

What is needed is a user-friendly “viewer tool” for interactively exploring ISIS3 images and converting subscenes into publication-ready figures and figure captions. Specifically, the tool would allow users to load up one or more ISIS3 images, extract and calculate the geospatial metadata for those images, allow the user to view and interact with the data, and export both the image and metadata in easily usable standardized formats. This will greatly facilitate clear and complete communication with technical and non-technical audiences.

Specific functionalities can be separated into priority groups as follows:

- Phase 0: minimum viable product: a software tool that open and displays an ISIS3 image, while extracting geospatial information out of ISIS3 binary headers and:
 - Adds standardized graphical symbols for certain geospatial information (e.g., a north arrow and scale bar) to the image.
 - Calculates additional geospatial information for user defined subsection(s) of the file.
 - Shows extracted metadata in nicely-formatted fashion. Should also be able to export extracted metadata into a plain text file in human-readable format.
 - Adds geospatial annotations to the output image file, as specified by user.
 - Provides a way to save off the resulting image for sharing/publication.
 - Tool may rely on the user having ISIS3 installed, i.e., can use ISIS3 tools for some functions.
- Phase 1: A nice tool that is truly usable to end-users. Wraps the core capabilities outlined in the last bullet in an interactive WYSIWYG graphical interface, allowing users to view the image, interactively make modifications to image parameters, and view the resulting modifications in real-time.
- Phase 2: Stretch goals. ISIS3 can only be installed on linux and MacOS machines, excluding users of Windows and mobile operating systems. The team will be asked to consider what it would take to make the tool run without having a full ISIS3 install on the users’ computer. There are complex trade-offs in picking the most viable path to making this tool be able to stand alone, and the team will explore how this could be accomplished most easily.

If this tool is easy enough to use, it will be one of those hidden heroes of planetary science, used by scientists and engineers across the globe in dispelling confusion about where important things are on the different objects in our Solar System.

Knowledge, skills, and expertise required for this project:

- Sufficient familiarity with C++ to access/understand/leverage packages in the ISIS3 software suite
- Experience with modern web2.0 design and deployment, including one or more web application frameworks.
- Familiarity with binary image file manipulation, image editing software packages and tools, and exporting images in a variety of formats.
- Skill in GUI design and evaluation, including testing on actual end-user populations.

Equipment Requirements:

- Linux/MacOS hardware with ISIS3 installed

- All development environments and tools needed for this project to be available in open-source.

Software and other Deliverables:

- The software application as described above, deployed and tested on actual hardware designated by client. Must include a complete and clear User Manual for installing, configuring and operating the software.
- An as-built report detailing the design and implementation of the product in a complete, clear and professional manner, providing the basis for future development of the product.
- Complete professionally-documented codebase, delivered both as a repository in GitHub, Bitbucket, or some other version control repository; and as a physical archive on a USB drive.