Sky Viewer Investigations for LSST EPO

J. Matt Peterson,[1] Amanda E. Bauer,[1] Ben Emmons,[1] Ryan Bruner,[2]
Jimmy Watkins,[2] Tom Gonzalez,[2] and Paula Wellings[2]

[1]*Large Synoptic Survey Telescope, Tucson, AZ, USA*

[2]*Theresa Neil: Strategy + Design, Austin, TX, USA*

Abstract. The Large Synoptic Survey Telescope (LSST) is an 8-m optical ground-based telescope being constructed on Cerro Pachon in Chile. LSST will survey half the sky every few nights in six optical bands. LSST Education and Public Outreach (EPO) is investigating requirements and technologies to create a next generation sky viewer. We discuss and survey current sky viewer technologies and identify new features required for an LSST EPO sky viewer.

1. Introduction

LSST Education and Public Outreach (EPO) reports on the early investigations of using and implementing a skyviewer across its software systems. We researched available open-source skyviewer software and identify requirements and possible features for our implementation (Jacoby et al. 2017; Emmons et al. 2017). Over the summer we prototyped an implementation of this using Aladin and Aladin-lite (Boch & Fernique 2014). Independent of the prototyping we contracted design work and user experience testing from Theresa Neil: Strategy + Design (TNSD)[1] which resulted in user interface features.

2. Requirements

The skyviewer has three software engineering requirements.

1. Build on an existing sustainable open-source project.
2. Simple to extend and integrate with existing tools and libraries.
3. Usable in multiple contexts.

3. Implementation

Aladin v10.009 and Aladin Lite were used to create a prototype survey with HSC Public Data Release 1 UDEEP COSMOS data (2 sq. deg.) (Aihara et al. 2017). This was

[1]`http://www.theresaneil.com/`

reprocessed by the LSST DM team using the LSST DM pipeline (Jurić et al. 2015). It took 16 hours on a single node using 8 vCPUs and 16 GB of RAM to process 127 GB of calibrated exposure FITS images across three bands (*i*, *r*, *g*) into 16.7 GB HiPS (Fernique et al. 2015) color PNG image survey (HiPS Norder=3-12). Aladin and Aladin Lite use HEALPix (Calabretta & Roukema 2007). It is supported in multiple libraries in Python 3, which has seen extensive use at LSST (Jenness, T. 2018) and is used in our Jupyter (Pérez & Granger 2007) science notebook investigations. HiPS and MOC (Fernique et al. 2015), which use HEALPix, are IVOA standards we plan to support. Finally, HEALPix is acceptable for use with the LSST science platform and our formal education teams.

4. Comparison

	Aladin & Aladin-lite	Leaflet based skyviewers	World Wide Telescope (WWT)
Projection	HEALPix	Mercator	TOAST
Tile Manager	HiPS	Leaflet	WWT
Tile Creation	Aladin	ImageMagick, custom	Montage
Examples	ESA, CDS,[2] DES,[3] LIGO[4]	DECaLS,[5] CFHTLS,[6] HSC-SSP,[7] NASA, SDSS[8]	WWT web client

Table 1. Types of skyviewers

We compare three types of skyviewers in table 1. Aladin and Aladin Lite, World Wide Telescope (WWT) (Gray & Szalay 2002) and Leaflet based skyviewers.

5. User Interface

EPO contracted design work and user experience testing from TNSD. Through this user experience testing TNSD identified weaknesses with existing Skyviewer design and iteratively improved the design. The figure 1 is the result. Some specific features are a gallery, object and detail slider, search, filters and the ability to create collections.

[2]Centre de DonnÃes astronomiques de Strasbourg

[3]Dark Energy Survey

[4]Laser Interferometer Gravitational-Wave Observatory

[5]DECam Legacy Survey

[6]Canada-France-Hawaii Telescope Legacy Survey

[7]Hyper Suprime-Cam Subaru Strategic Program

[8]Sloan Digital Sky Survey

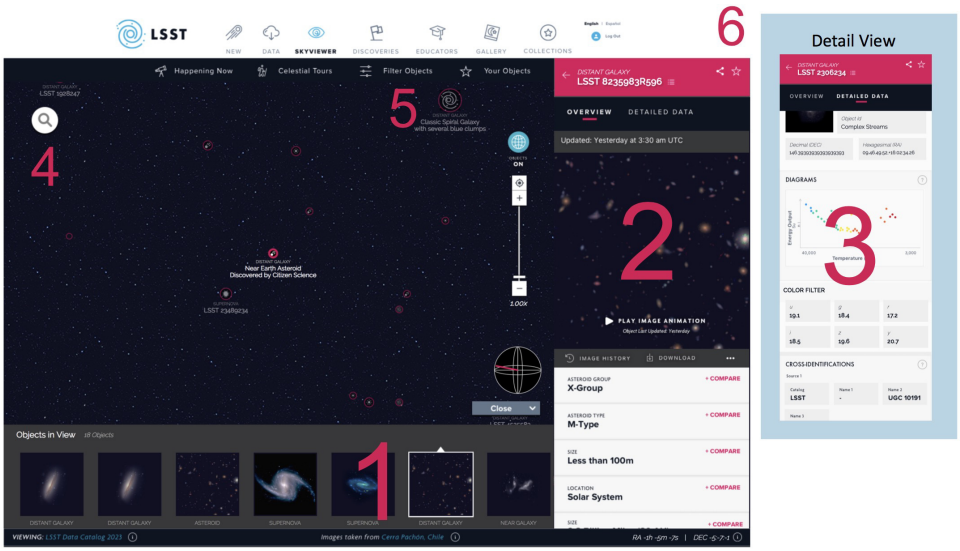

Figure 1. Planned design mockup features for the LSST EPO Skyviewer. Features are labeled as Gallery(1), Object slider(2), Detail slider(3), Search(4), Filter(5) and Collections(6).

6. Conclusion

EPO plans to implement this as modular open-source software components. Components should be reusable for different audiences through configuration and extension. Components will be used by our portal and science notebook systems. Since our science notebook system will extend the LSST DM science platform(Dubois-Felsmann et al. 2017), our components will be available to LSST scientists.

Though we plan to use Aladin and Aladin Lite, some improvements are required. Aladin Lite and HiPS do not support dynamic image creation using individual bands.

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