The SpacePortal Visualization System

This document describes a platform for visualizing, presenting, and collaborating with astronomical data. Through a combination of intelligent design decisions and the utilization of free, open source software and commodity hardware, a large, powerful, and performant visualization system is now possible at very modest cost. The SpacePortal visualization system will enable new modes of collaboration between informal science centers and research institutes through the synchronization of content across display walls at various locations.

Modular Design

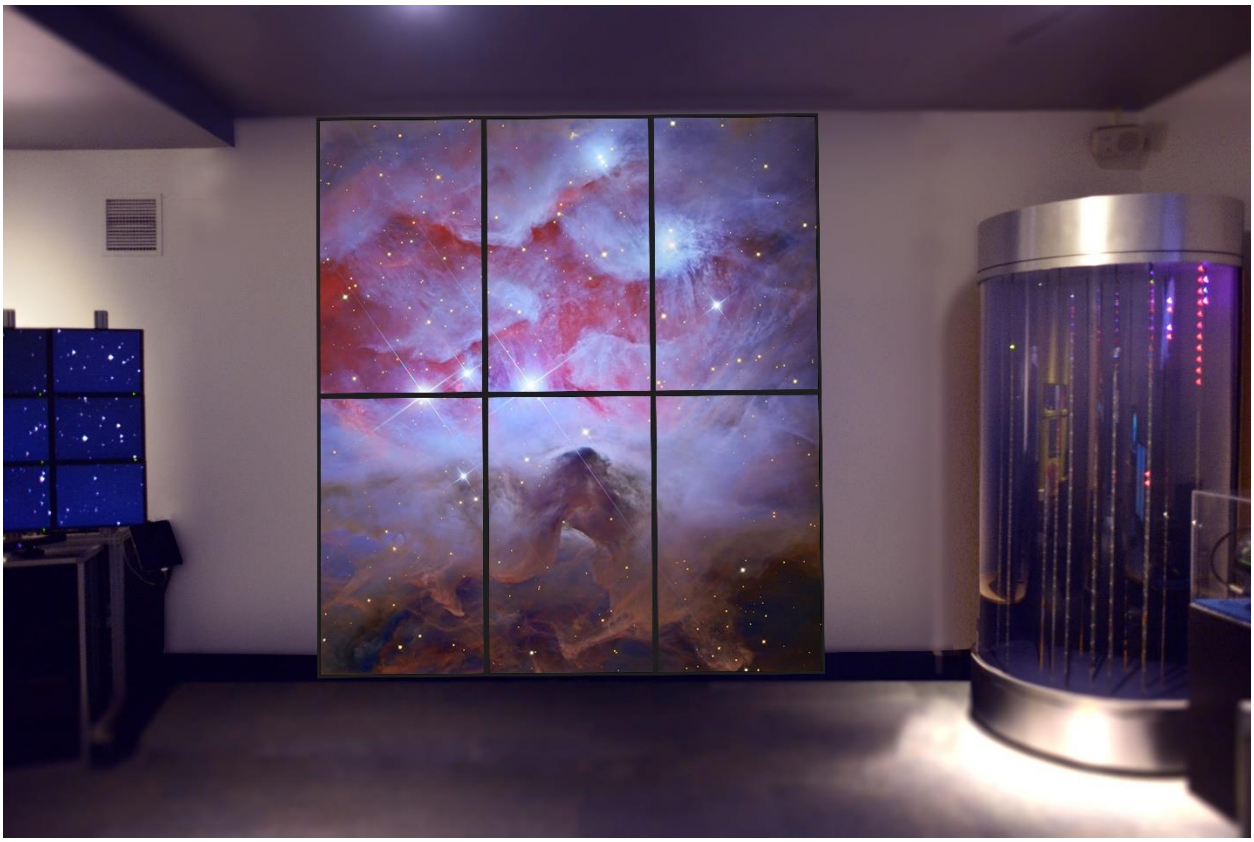

Figure 1: A mockup up of a single SpacePortal module in the Space Visualization Laboratory at the Adler Planetarium

A single SpacePortal display module consists of a 3x2 array of HD displays driven by a single computer. A single display module creates a 20 MegaPixel display and when using 70in panels is quite large (9ftx10ft). These modules can be joined together to creates even larger displays. A display consisting of multiple modules can run in several different configurations, with applications either running on separate modules or being stretched across multiple modules. The ‘Software’ section below describes the various applications that run on the SpacePortal and the ‘Design Decisions’ section describes the rationale behind the module size and configuration.

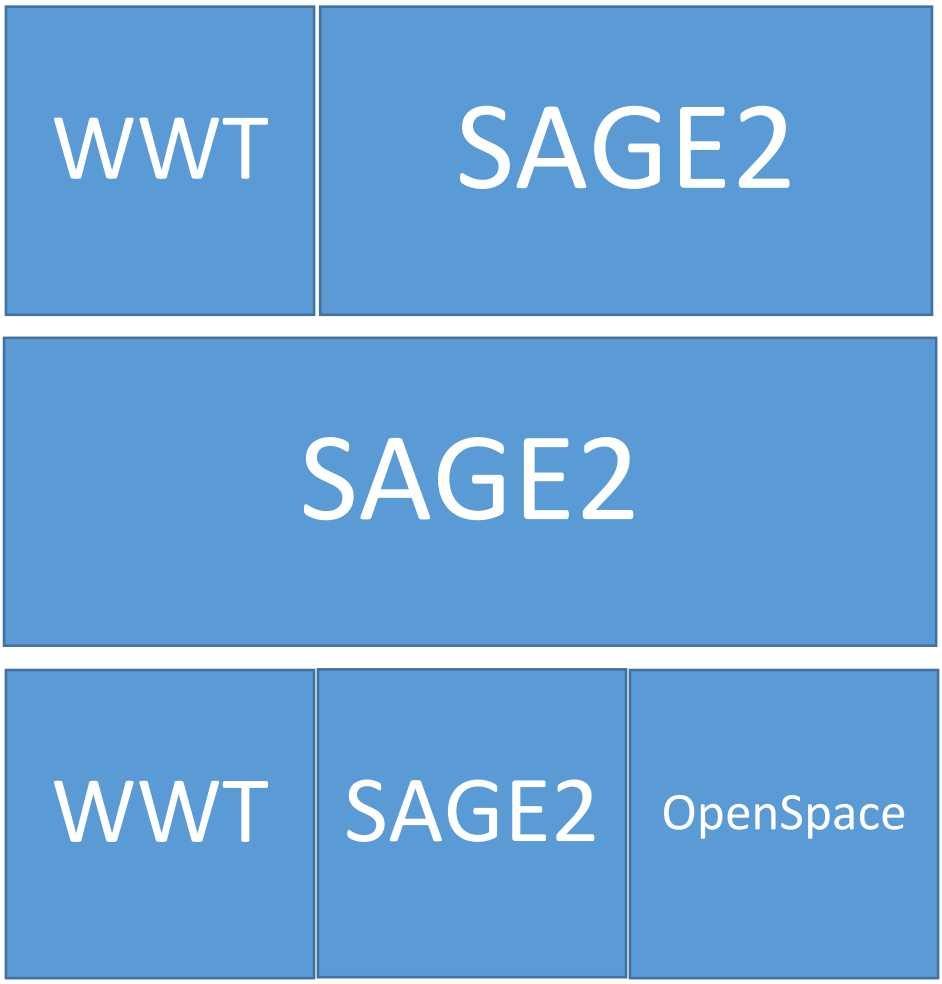

Figure 2: A SpacePortal display consisting of multiple modules can run in various configurations. This diagram shows three potential configurations for a three module SpacePortal display.

Software

SAGE2

SAGE2 (http://sage2.sagecommons.org/) utilizes cloud-based and web-browser technologies in order to enhance data intensive co-located and remote collaboration. Users can drag and drop images and videos, share their laptop screens and launch applications. Content can be synchronized across walls at remote locations.

The SpacePortal team will develop astronomy SAGE2 applications such as:

- Custom Worldwide Telescope based applications
- Live Streams of astronomical datasets, such as the Solar Dynamics Observatory: http://sdo.gsfc.nasa.gov/data/kiosk.php
- Live scrolls of astronomy RSS feeds such as: https://www.nasa.gov/content/nasa-rss-feeds

- D3 visualizations of key astronomical concepts: http://www.epantaleo.com/wp-content/uploads/2015/10/HR_diagram_d3.html
- Applications and visualization involving Zooniverse projects: http://zooniverse.org

Worldwide Telescope

WorldWide Telescope (WWT), a "Universe Information System" that allows users to retrieve and share data using an interface that resembles either the sky or a 3-D view of our universe. Originally developed by Microsoft Research, WWT is now an open source project spearheaded by the American Astronomical Society. WWT can run on the SpacePortal either as a stand alone Windows application or the web version of WWT could run inside the SAGE2 environment.

OpenSpace

OpenSpace, is a new astronomy visualization package being developed by the American Museum of Natural History and Linköping University. The software excels at tracking spacecraft missions, and future versions will expand its capability. It also has the capability to link displays for networked events, such as the “Breakfast at Pluto” held during the New Horizon’s flyby. OpenSpace’s NASA grant will fund the creation of a WebGL version which could run inside SAGE2.

The SpacePortal Network

The power of this platform comes from having a network of displays so that content and expertise can be shared between sites. Here we roughly outline a plan for building an initial SpacePortal display network.

1. We build a SpacePortal at the Adler’s Space Visualization.
2. Remote presenters start contributing to Astronomy Conversations program through the web.
3. Space Portals are built at the KICP at the University of Chicago and CIERA at Northwestern University.
4. The St. Louis Science Center builds a Space Portal and the Astronomy Conversations program is simulcast there.
5. The Museum Gallery at the LSST base camp in La Serena Chile adds a SpacePortal display wall.

Design Decisions

Display area over Pixels

Tiled display walls often are overkill with a pixel density frequently exceeding what can be resolved by eye. For this reason we choose large (70in class) displays at HD resolution (1920x1080).

Single computer over cluster

Utilizing large displays allows us to build a large display wall with just six panels. Six HD panels can be effectively driven by a single gaming class computer with just a single graphics card (such as the AMD FirePro W600). A single computer simplifies operation and software development and reduces cost when compared to a cluster (by a factor 1/n, where n is the size of the cluster). This solution also enables simple bezel correction by the graphics card, simplifying the software cost.

Small Bezel Displays

While bezelless displays are nice we have decided against them. These displays are significantly more expensive (compare $8000K for a 55in bezelless display to $1,200 for a 70in display with a 0.5cm bezel). The smaller panels would also require a cluster solution. Working with small bezel commodity TVs enables a simpler system at 1/10th the cost for the same display size. Solutions like the Christie Microtiles, while having many attractive features, are even more expensive.

Cost

Approximate cost of a single display module:

- 6 70in displays: 6 x $1250 = $7,500
- Powerful gaming PC = $3,000
- Graphics Card = AMD FirePro W600 GPUs = $500
- Wall Mounts: 6 x $250 = $1,500
- Graphics dongles 6 x $20 = $120
- Videoconferencing, cameras mics = $200
- Gaming, Gesture controllers = $160

Total $12,980

Possible upgrades:

- Active stereoscopic display (system is 3D capable need IR emitters and active glasses).
- Touchscreen overlay