

**Bring Your Jacket; It's Going to Be Cold: Explore the Solar System in VR & AR.** A. J. Shaner<sup>1</sup>, J. Blackwell<sup>2</sup>, C. Shupla<sup>1</sup>, A. Hackler<sup>1</sup>, <sup>1</sup>USRA – Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058, shaner@lpi.usra.edu, <sup>2</sup>Diamond Age Technology, Houston, TX, DiamondAgeTechnology@gmail.com.

**Introduction:** Viewing 2D visualizations of planetary data on a flat screen has been an inspirational, if not simply an efficient, means of engaging and communicating planetary science and exploration to the public. However, immersive, 3D experiences with planetary data is better, if for no other reason than it has one more “D.” The past few years has seen the emergence of both virtual reality (VR) and augmented reality (AR) immersive experiences, with both continuing to grow and showing great promise for the future.

The Lunar and Planetary Institute (LPI) has harnessed the power of VR and AR to engage both the public and scientific community with planetary data. Working alongside the scientific community, LPI has integrated digital spacecraft models, spacecraft instrument data and data-supported artistic license to bring planets and moons into the hands of users and to immerse users in planetary missions and set them on alien landscapes in our own solar system.

**Pluto Virtual Reality Experience:** Images and other data returned from the July 2015 flyby of the Pluto system by the New Horizons spacecraft brought the dwarf planet closer to us than ever before. Developed as an immersive, interactive proof-of-concept, the Pluto virtual reality experience puts users face-to-face with the dwarf planet and its largest moon, Charon. Users can “touch” Pluto and Charon, spinning them with out-stretched hands, experiencing the geology of the two objects as seen by New Horizons cameras. Then, users can “step” onto the surface of Pluto and be immersed in one of two 360° landscapes, visually ex-



periencing it as if they were there.

New Horizons science team members Dr. Paul Schenk (LPI) was consulted on the acquisition of data to create the VR experience as well as the hypothetical

appearance of small-scale surface textures in the Pluto landscapes.

**Augmented Reality App:** Following up the Pluto VR experience, LPI developed an application for both tablets and smart phones (Android and iOS devices) named “lunar and planetARy.” This free educational app transports students, teachers, scientists, and anyone who wants to journey through space on an interactive tour of the asteroid belt, the Moon, Mars, Saturn, Pluto, and Europa. Using the app requires 1) downloading the app to your device and 2) with the app open pointing your device at one of six different posters, one of each of the bodies listed above.



Users pointing their device with the open app at the Moon poster will bring up a rotating image of the Moon, created using data from the LROC instrument onboard the Lunar Reconnaissance Orbiter. Users may either use their finger to rotate the Moon, or move their device around the poster to see different faces of the Moon. Tapping a thumbnail image of an Apollo command module in the lower-left corner places the user inside the Apollo 11 command module. Similar to the Pluto landscapes in the VR experience, users become immersed in a 360° view of the capsule’s interior, looking through the screen of their device. Back away from the Moon poster far enough and a user will find themselves outside of the capsule where they can walk around the poster to view its various sides. The Pluto landscapes in the VR experience are also integrated into the Pluto AR experience.

LPI scientists Dr. Paul Schenk and Dr. Steve Clifford assisted with development of the Europa and Mars pieces of the AR app, respectively. Dr. Schenk provided insight on various models of crack formation on the surface of Europa. Dr. Clifford provided feed-

back on the veracity of possible ancient shorelines shown in a “wet Mars” model.



**Planetarium Visualizations:** Though in its early stages, LPI has also been creating imagery for display in planetariums. This imagery is not only accessible to planetarium professionals, but is being created for LPI’s scientist engagement program. Using planetarium-ready visualizations, scientists can engage audiences in an immersive planetarium environment, sharing their planetary research through compelling stories and images. This aspect of LPI’s scientist engagement program is in early stages of development. To date, LPI has produced images of an early and current Mars for full-dome visuals on behalf of the MAVEN mission, including the “wet Mars” visual above. LPI’s landscape imagery from the Pluto VR/AR experiences can be projected into planetarium domes, as well as a possible 360° view from the shore of Ligeia Mare on Titan. This image is also found in the Titan chapter of the LPI/NASA PSD/JPL-produced e-book “The Saturn system through the eyes of Cassini” available at [www.lpi.usra.edu/features/091317/E-book](http://www.lpi.usra.edu/features/091317/E-book).

#### **Lessons Learned:**

*Public Engagement.* While exciting and entertaining, the use of Pluto VR experience in large public settings has shown to be problematic. Depending on a number of factors including age and experience with VR, the amount of time it takes for many users to become familiar with using their hands in the environment is problematic. This can lead to frustration and even a significant drop in enthusiasm for engaging with the VR experience.

While less immersive, the AR experiences tend to attract more people and hold their attention for a longer period of time. This is likely due to already knowing how to use their own devices making it easy to manipulate the imagery on their screen.

*Scientist Engagement.* When creating the alien landscapes the available data will only allow us to vis-

ualize the surface to a limited extent. It is critical to have a working relationship with a relevant scientist to iterate on the artistic design beyond the detail of the data to create a final product that aligns with a best guess of the scientific community.



**Additional Information:** The “lunar and planetARY” app is available through both the Apple App Store and Google Play. Simply search for “lunar and planetary institute.” Posters for use with the AR app may be viewed and downloaded at [www.lpi.usra.edu/AR](http://www.lpi.usra.edu/AR) in both poster (24” x 36”) and letter size (8.5” x 11”).

Questions or requests for additional information regarding the development of either the Pluto / New Horizons VR experience or the AR app, please contact John Blackwell at [DiamondAgeTechnology@gmail.com](mailto:DiamondAgeTechnology@gmail.com). For questions, or more information regarding the scientist engagement in planetariums program, please contact Andy Shaner at [shaner@lpi.usra.edu](mailto:shaner@lpi.usra.edu).