Bailey Anderson

LA 558 Web Mapping

Tech Report

April 10, 2017

VR and GIS Technology

Virtual Reality (VR) is undoubtedly a word that we have all heard time and time again in varying contexts with mixed sentiments of excitement, uncertainty, and curiosity. By definition, VR is a computer simulated environment that prompts sensations of being physically present in another environment through either wearing goggles and being tethered to a computer (allowing for higher graphic quality) or being untethered by placing a smart phone into a mask (something as simple as Google Cardboard).

VR is an experience that makes you feel like you're really part of a different environment. According to Forrester, this technology will "transform the way individuals interact with one another and with software systems… integration across multiple mobile, wearable, Internet of Things and sensor-rich environments will extend immersive applications beyond isolated and single-person experiences." Many leading research companies have echoed similar thoughts – VR is expected to eventually hit or leak into all industries and sectors, which includes GIS technology. This tech report will cover how technological advancements and a resurgence of consumer expectations will lead to opportunity for VR and GIS solutions, and discuss a few current VR GIS technologies that exist in today's marketplace.

Since the early 90s, VR has been anticipated for mainstream adoption as a result of the release of Howard Rheingold's *Virtual Reality* in 1991 and Nintendo's "Virtual Boy" console. This technology was advanced for its time because it was able to display stereoscopic 3D graphics. However, with Star trek and other depictions from Hollywood occurring around the same time, these technologies failed. Consumer expectations did not match reality, and the costs were extremely high.

Now, we're in the midst of resurgence because the technology is getting there. Vendors have overcome key technical challenges, including greater resolution, computing power, and overcoming VR sickness. Furthermore, computing power per dollar has skyrocketed. In 1993, Virtuality's hardware cost $70,000. In 2016, you'd just need $1,500 for an Oculus Rift and a Nvidia-970-equipped PC, or $879 for a Samsung Galaxy S7 phone and a Samsung Gear VR headset. That's 35,000 times the computing power at just one-eightieth the cost of yesterday's VR. On top of this, developer tools have advanced and become democratized – it's relatively easy to develop for VR and deploy to key hardware platforms. Finally, social media has paved the road and created demand for shareable, immersive technologies.

IDC forecasts, "AR/VR expected to reach mass adoption levels by 2021, when more than a billion people worldwide will regularly access apps, content, and data through an AR/VR platform." This will affect many industries, and has already begun disrupting marketing, healthcare, and real estate. With technology and massive investments continuing to pour into this industry, it's not so much as a question of if this will happen, it's a question of when this will happen and affect most industry and current technology - including GIS and Web Mapping.

GIS has grown extensively since the mass adoption of the internet and the rise of mobile usage for some of the same reasons as VR. There is a huge opportunity to incorporate VR into web mapping systems to become even more immersive, as today's web GIS are somewhat limited to map display and graphic manipulations. However, the mix of VR and GIS is nothing new; it has actually coined its own term: VRGIS. The first successful documented example of GIS and VR was in the early 90s with the creation of a new system that depicted the Georgia Tech campus area. The amount of research and application projects has since grown drastically.

One example of a company who is taking strides in VRGIS is Esri with their developments through CityEngine, the company's 3D modeling software. CityEngine alone facilitates the creation of detailed to-scale 3D city models by working with architectural object placement and arrangement. It is used largely for urban planning, architecture, visualization, entertainment, and naturally, for GIS professionals. For example, creating a mapping environment within CityEngine can start out with making a street network using a drawing tool or with imported data from sources like openstreetmap.org or data formats like Shapefiles, then enhanced to meet the needs for the purpose in which it's being used for.

Recently, Esri unveiled a VR solution with their new ArcGIS 360 VR app for CityEngine, available for the Samsung Gear VR headset. After downloading from ArcGIS Online, one can immerse into 3D scenery by teleporting to static viewpoints with pop-up contextual information overlaid. By simply having a smartphone paired with a wireless headset, this is leaps and bounds away from relying on high-performance graphics computers and cumbersome wired accessories, paired with 3D modeling software. "We greatly simplified the creation and sharing of the mobile VR experience," said Dominik Tarolli, head of 3D geodesign at Esri. "In a matter of minutes, a CityEngine user can now create a VR experience out of a 3D scene and share it in ArcGIS Online, Esri's cloud solution." This solution comes with an abundance of capabilities, including an OpenStreetMap-ready integration and rule set.

Another example of current GIS technology implementing VR solutions is the Glob3 Mobile (G3m) SDK project, which is a platform for mobile mapping development. This company has included VR features, and one of those features incorporates stereoscopic rendering. In VR, stereoscopic rendering is essentially using 2 photos of the same object taken at slightly different angles, to simulate how your eyes, which are set slightly apart, experience the natural world. Through these features, they have designed a process that creates a separate image for each eye that shows the same image from a slightly different view. Then, the two images are shown next to one another, which make them compatible with the various VR headsets. This enhancement allows the Glob3 Mobile project to create, on top of their existing mobile SDKs, virtual reality applications. With just a phone and a headset, these apps built on this platform enable the user to explore a 3D virtual earth that previously just used web mapping limited to mobile applications and websites.

Based on these two examples and the fact that they have been released within the year shows that VRGIS is still in its infancy compared to where other industries are with VR and enterprise/consumer products. As overall technology for VRGIS improves, further investments are made by more companies, and examples like Glob3 Mobile and Esri pave the way and iterate from learnings, this space will only grow. As it’s lagging slightly behind other industries, it won’t likely be a change that comes overnight, and it won’t necessarily replace existing technology – just as the mobile phone has not

completely replaced desktop. It will be exciting to see more enhancements and capabilities that will allow the user interact even further with GIS.

Sources Cited

"Gartner Identifies the Top 10 Strategic Technology Trends for 2017." Newsroom. Ed. Gartner. Gartner, 18 Oct. 2016. Web. 9 Apr. 2017.

"GIS on virtual reality glasses with mobile map tools." GIS on virtual reality glasses with mobile map tools. Ed. Foss4G North Amercia. FOSS4G North America, 2 May 2016. Web. 10 Apr. 2017. <https://2016.foss4g-na.org/session/gis-virtual-reality-glasses-mobile-map-tools>.

Gownder, J. P. "The Coming Wave of Virtual Reality." The Coming Wave of Virtual Reality. Forrester, 31 May 2016. Web. 9 April 2017.

Haklay, Muki. Virtual Reality and GIS: applications, trends and directions. Ch. 5 Virtual Reality and GIS. Centre for Advanced Spatial Analysis . Web. 9 Apr. 2017. <http://www.academia.edu/2656550/5_Virtual_reality_and_GIS>.

"IDC Sees the Dawn of the DX Economy and the Rise of the Digital-Native Enterprise ." Press Release . Ed. IDC. IDC, 1 Nov. 2016. Web. 7 Apr. 2017.

Miller, Matt. "CityEngine unveils mobile Virtual Reality solution." CityEngine unveils mobile Virtual Reality solution. Esri, 19 Dec. 2016. Web. 6 Apr. 2017.