INSIDE OUT

Immersive Technologies

by Paul Chapman

My first experience of "good" virtual reality (VR) was in 1998. As a PhD student and graphics programmer working in the offshore industry, I was lucky enough to visit the University of North Carolina at Chapel Hill. Professor Henry Fuchs and his team had been developing some incredible VR systems and I was blown away with what I experienced – picking up (and feeling) a virtual apple in my hand, and dropping it into a deep cavern with my heart racing as I walked over a rickety old bridge. I was already interested in VR but now I was completely smitten.

In the 1990s, the majority of graphics systems at universities were based on Silicon Graphics computers that were enormously expensive. Anything to do with VR required a huge investment. Then, in the early 1990s, a film called *The Lawnmower Man* got everyone excited about VR. The heavily pre-processed and embellished technology resulted in the press and media descending in droves on university campuses demanding to see the latest tech. They were thoroughly underwhelmed; is this it? The low-res displays, delayed tracking, and VR induced nausea meant it was going to be many years before they came knocking again.

As the 1990s progressed, one area of computing that started to make real progress was the computer graphics processor industry. As an offshore engineer, one of my biggest challenges was that the technology at the time could not handle the real-time display of high-resolution seabed terrain (generated from multibeam sonar). Then NVIDIA Corporation arrived on the scene with its new revolutionary graphics processor units (GPUs), developed for computer games, and almost overnight I was able to render significantly more complex seabed terrains with photorealistic lighting. The labs full of Silicon Graphics computers were replaced with significantly cheaper PC computers running the latest GPUs. So many industries should take a moment to thank gamers for demanding low cost, powerful GPUs, enabling other industries and researchers to benefit from the new technology.

But immersive technologies were still failing. After a plethora of unsuccessful products (such as Nintendo's Virtual Boy), VR was all but forgotten as a commercial technology until 2012 when Palmer Luckey launched a crowdfunding campaign for a new headset, the Oculus Rift. This new device leveraged advances in mobile phone displays to create a significantly better visual experience. Oculus was later sold to Facebook for an impressive CDN$4.8 billion. Palmer Luckey had kickstarted VR again with a truly functional, credible, and affordable VR system. Since then, VR has not looked back.

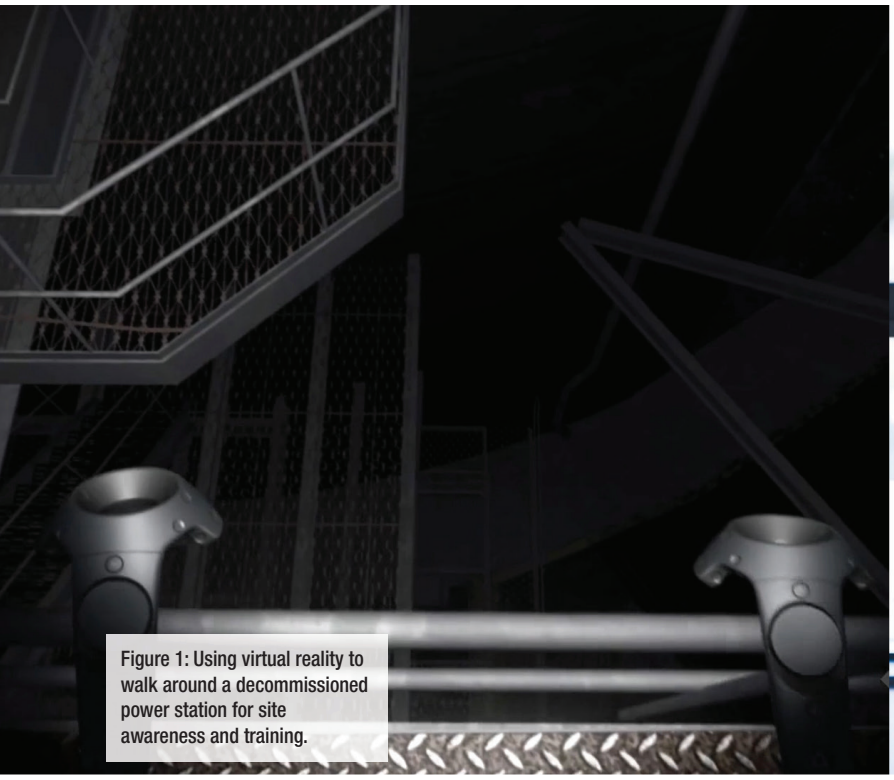

Figure 1: Using virtual reality to walk around a decommissioned power station for site awareness and training.

ARCADIS, MAGNOX, GSA

Figure 2: Using HoloLens 2 to interact and study a large shipwreck from the comfort of home.

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In the last eight years, the significant increase in funding and rapid maturity of technologies around VR is evidenced by a greater understanding by society in its potential application. A recent example of this in Scotland is the adoption of VR technology by local government through the installation of headsets in primary and secondary schools leading to a greatly enhanced student learning experience including trips to the ocean floor, moon, and Great Wall of China. The possibilities with VR are endless. For example, VR enables us to train staff about the safe operation of complex machinery. Or perhaps finding your way around a large ship and learning location awareness such as escape routes before even stepping on board. In a similar vein, at Glasgow School of Art, we developed VR training simulators to prepare engineers for what they were going to expect when they walked into a pitch-black nuclear power station that was being decommissioned (Figure 1).

Augmented reality or AR (where we enhance our physical world with computer-generated graphics) has always lagged behind VR, primarily because the necessary technology is a lot more complicated. In recent years, there has been significant advances by companies such as Microsoft with its second iteration of the HoloLens (Figure 2) and we are still waiting to see what Apple will bring to the party. One fascinating extension of AR is mixed reality (MR) that allows real and virtual elements to interact within the same environment. For example, a virtual ball bouncing on a real physical table. These technologies have the ability to make the most substantial change to our society in the way we work, rest, and play.

When this immersive technology matures, it will change everything for us. No more mobile phones, just a discrete, inconspicuous "wearable" displaying computer imagery correlated with our surroundings. Professional and social networks will share data. For example, when someone enters your office, people will be identified either by handshaking protocols between devices or, if they are not wearing a system, facial recognition that will automatically cross-reference your social media accounts such as LinkedIn and Facebook (Meta). Your wearable will display your visitor's name conveniently above their head so no more embarrassing scenarios where you try to look discretely at your diary to remember. Moreover, their tag will be augmented with other user-selected metadata, perhaps their partner's name and what you discussed at your last meeting so no doubt substantially diluting our ability to remember and raising a number of social, privacy, and ethical questions.

After so many false starts, these technologies have finally become affordable, useable, and practical for real-world problems. More importantly, they are just going to get better.

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