High-tech over Burrator: a report by Professor Bob Stone

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You may recall recent news items and tweets on our "Virtual Burrator" project. Briefly, this is a project being undertaken by my HIT Team researchers and students and is one of two areas in Devon (the other being Wembury Bay **www.virtual-wembury.net (http://www.virtual-wembury.net)**) that has been selected to test the hypothesis that Virtual Reality recreations of peaceful, attractive rural areas – forests, coastlines, lakes, and so on – can help patients who have undergone serious surgery to recover, or can help improve the health and well-being of those in rehabilitative or residential care. In addition, the team is further exploiting the extensive 3D model of Burrator (**www.virtual-burrator.net (http://www.virtual-burrator.net)**) developed by MPhil student Vish Shingari to pinpoint important heritage sites, with the aim of bringing those sites "back to life" over the coming years. With the periods of excellent weather evident in the southwest this summer, it seemed like an ideal time to return to the area to continue some of the ongoing survey work and to test out one or two new technologies.

One of those technologies is Augmented Reality (AR) – we've been evaluating a couple of software packages recently (AR Toolkit and Vuforia). Most of the demonstrations of AR technology you see on the Web are conducted in well-controlled laboratory environments, or in built-up urban areas where there are strong geometric features that can be recognised by the computer to register its real-world position and, thus, the position of the 3D object it wishes to superimpose onto that real-world scene. Other AR systems use GPS to register the position of the tablet computer and scene. However, once you take these technologies into rural settings, such as the woodland around Burrator, then scene registration becomes a big problem. Just consider Longstone Manor (**http://www.derelictplaces.co.uk/main/showthread.php?t=20473 (http://www.derelictplaces.co.uk/main/showthread.php?t=20473)**), a 16th Century Manor House finally abandoned in the late 1800s, when Burrator Reservoir was completed. Sure, the remains of this once-grand house present some strong geometric features, even today. However, the sheer amount of plants and trees growing in and around the location, not to mention the ivy trailing over the high walls, provide us with significant challenges in trying to restore the property to its original (virtual) splendour using AR techniques. Nevertheless, one of our PhD students, Yuqing Gao, has taken on this challenge, despite the serious lack of images or artistic representation of what the manor house and outbuildings actually looked like in both their original 1500s state and after the main building's "modernisation" in Georgian times.

Gao's work on this occasion was to take physical measurements, detailed images, video and GPS readings of the remains on the site, with the aim of building a rich database from which she can start to develop new AR techniques for complicated rural locations. In addition, given the low Reservoir water levels evident during the visit, we were able to build up more of a picture as to the extent of the original grounds. Also on this visit, we made use of a new technology brought in to help with our Virtual Heritage efforts – a small hexacopter, built by another of our students and equipped with a range of onboard sensors (GPS, magnetometer, barometer, sonar, and so on) and, uniquely, a 3D or stereoscopic pair of small cameras. These cameras are mounted on a small pan-and-tilt unit such that the direction of view can be controlled independently of the motion of the hexacopter, by the "pilot" – in this case our new BAE Systems-sponsored PhD student Chris Bibb – on the ground wearing a Virtual Reality head-mounted display. By putting the aircraft into "loiter" mode, the pilot is, thus, free to look around and obtain aerial views in 3D. We were also able to test-fly the hexacopter around another of our sites of interest, the long-abandoned Burrator & Sheepstor Halt on the track of the old Yelverton-to-Princetown railway line. Being able to view (and record) these locations in 3D is providing us with much more overhead detail than can be obtained from Google Earth (for example).

Finally, and as something of a "light relief" exercise, we decided to test our AR technology even further, using the backdrop of Burrator Reservoir and Sheepstor as the real-world focus. On our last visit to the region, we successfully used AR to bring a Spitfire back to life in one of the dispersal pens at the old RAF Harrowbeer site (**http://www.rafharrowbeer.co.uk/) (http://www.rafharrowbeer.co.uk)** . However, this time we wanted to go a step further and see if we could use AR techniques to "fly" a virtual RAF Lancaster over the actual Reservoir and main dam. The exercise was challenging, but successful, thanks to efforts by another PhD student Cheng Qian. Using a marker to help the iPad tablet recognise its location (again, the image, or natural feature recognition performance of the software we're evaluating is quite poor), we managed to obtain two flight sequences – one at low level over the surface of the Reservoir, the other higher up, from the old railway line close to the remains of the Halt.

Each visit to the Burrator Reservoir provides us with new information and new challenges, and we look forward to our next "challenge", which involves visualising the area prior to flooding, with the roads, buildings, bridges, rivers and leats all in place. We are also receiving considerable encouragement, support and even heritage assets, like old maps and photographs from local residents, historians and pub owners.

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