VIRTUAL BURRATOR

Birmingham University's Professor Bob Stone reports on how work in the field of Virtual Healthcare has lead to important discoveries about the past at Burrator Reservoir

In 2010 two postgraduate students from the University of Birmingham, Cheng Qian and Vish Shingari, visited Devon for the first time to begin research projects that are today having a major impact in the field of *Virtual Healthcare* – in this case the use of 3D computer simulations to help rehabilitate hospitalised patients. With their supervisor (the author) being a born and bred Plymothian, it may come as no surprise that the two Devonshire locations chosen as the focus for the students' studies were Wembury Bay and Burrator Reservoir, both areas of outstanding natural beauty.

The original aim of what became the *REVERE* (Restorative Virtual Environments for Rehabilitation) project was based on experimental findings by environmental psychologist Roger Ulrich in the USA in the 1980s. He discovered that patients who had undergone gall bladder surgery and who had been placed in a ward with window views onto a group of trees recovered faster, required fewer painkillers and rated their stay in hospital more positively than those who had no such view. Since that time, the importance of nature to our mental and physical well-being has been the subject of extensive research, with groups across the world demonstrating the significant healthcare impact of exposure to a wide range of environments, from coastal paths to forests, and from gardens to inner-city parks.

However, there are still many locations throughout the UK and further abroad where access to scenes of nature are just not available. Urban hospitals and care homes are but two good examples where, in many cases, examples of faded pictures and murals – some not having been changed for years – may be the only rural or coastal scene some patients or residents will ever see. In collaboration with clinical colleagues at the Queen Elizabeth Hospital Birmingham (QEHB), the *REVERE* project set out to investigate whether or not simulated, or *Virtual Reality* (VR), recreations of scenes of natural beauty could achieve similar effects to those discovered by Ulrich. (At the time of writing, two VR 'windows on a natural world' are undergoing experimental evaluation within the Intensive Care Unit of the QEHB: some interesting results are beginning to emerge, especially with regard to the effect of these virtual views on patient sleep quality. A similar system has been constructed and is awaiting installation into a Gloucester-based dementia care home.)

The 2009 *Oxford Handbook of Critical*
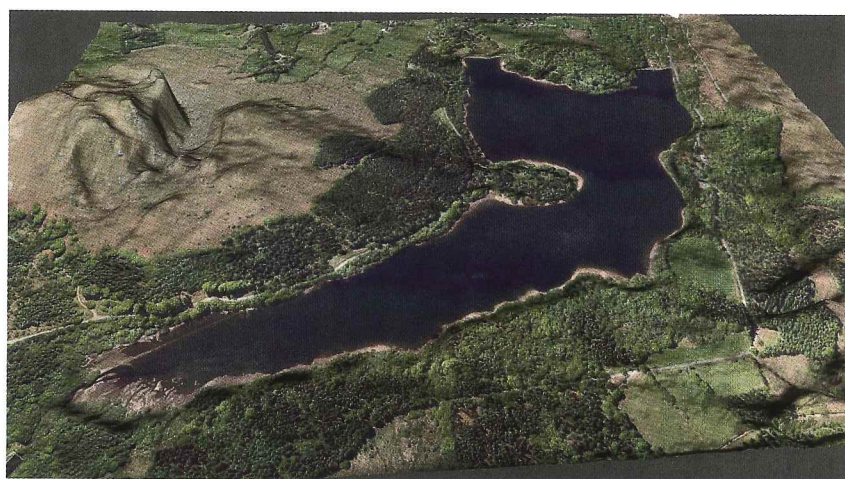
Virtual Burrator template model

PHOTOGRAPHS COURTESY OF **BOB STONE**

Care Nursing includes the statement that 'All bed areas should have … access to natural daylight and, ideally, an outside view from the windows'. The *REVERE* Project, and Virtual Burrator in particular, cannot hope to compete with the natural beauty of Dartmoor, but it can, in its own small way, help to bring just some of that beauty to those critical patients or dementia care home residents who might just benefit from a window providing a living view of one of Devon's regional gems.

The 'construction' of these two VR

locations, and Burrator in particular (a huge area and still ongoing), has been very much a labour of love on the part of the two students, both of whom (together with others in the research team) have been giving freely of their time, with no external sponsorship or support (although their supervisor's predilection for pasties and cider is often too great for them to even consider refusing a trip to Devon!). Every visit to Burrator uncovers something new and huge numbers of measurements, photographs, sound samples, even aerial

video sequences from small quadcopters or 'drones' are collected to generate virtual resources that are used to provide rich content for the VR scenes.

To build Virtual Burrator, it was first necessary to purchase a 'digital terrain map' of the area, basically a collection of points corresponding to real-world 3D coordinates that can then be converted into a surface model and 'pasted over' with a very high-quality aerial photograph. The resulting 3D scene can then be used as a 'template' onto which the development team can place 3D models of natural and man-made objects – trees, bushes, rocks, roads, bridges, fences, and so on – some constructed from scratch, others acquired from 3D model repositories on the Web. Finally, using a powerful software toolkit, often referred to as a 'rendering engine', it is possible to exploit gaming techniques to bring the scene alive. This includes animating the plants so that they move with the simulated wind, adding virtual creatures, creating a 24-hour day-night cycle and integrating sounds of wildlife, wind and water effects.

That same rendering engine allows users to explore Virtual Burrator freely using a wide variety of computer technologies. It is even possible to add scents and smells of the countryside to the VR creation, although this technology is still in its infancy and not yet ready for widespread use. Nevertheless, the known positive health effects of, for example, essential oils in wood such as pine, many of which inhibit the growth of bacteria and support the body's immune system in combating cancer, mean that investigations of how best to introduce scents into virtual scenes of nature are well worth pursuing.

As well as the healthcare focus for the team's research, another important and related pursuit is that of *Virtual Heritage* – using VR technologies to make the invisible visible by developing educational recreations of long-vanished sites of historical interest. One of the most exciting aspects of the Virtual Burrator project, as with its Wembury counterpart, has been meeting with local inhabitants and historians who have taken the time to find out what we are doing in the area and also talked to us about the rich history of both locations. The temptation to extend Virtual Burrator to include snapshots of times gone by has always been great, especially when it has been possible to use the results to introduce local people to sites they were previously unaware of.

Burrator Lodge

The suspension bridge, erected to enable access to and from Sheepstor while the reservoir was being enlarged (1923–8)

Burrator & Sheepstor Halt at night

One good example of this is Yelverton Reservoir, an old structure about the size of a large swimming pool with sloping white-bricked or tiled sides that is concealed from the main reservoir's perimeter road between the Devonport Leat outflow waterfall and Burrator Lodge by dense undergrowth. Another relates to the 1920s suspension bridge anchor points, clearly exposed on the east side of the reservoir, but concealed by plant growth on the west side. The Virtual Burrator software makes it possible, at the press of a button, for the suspension bridge to appear and for users of the software to cross the reservoir as the construction worker would have done all those years ago.

But by far the research team's favourite locations are the foundation stones and kissing gates of the old Burrator & Sheepstor Halt, followed closely by Wembley Walk and Longstone Manor. Using a range of historical resources, from postcards and old videos sourced from eBa to books and photographs, many provided by locals, it has been possible to develop quite a detailed virtual reconstruction of the old railway halt and its once-inspiring views over the reservoir to Sheepstor. Modifying this scene to include other local historical features has also attracted the team's attention, and has resulted not only in the fly-past of Spitfires from the long-abandoned airfield of RAF Harrowbeer at nearby Yelverton, but also a very eerie night-time scene, where it is possible to 'si on the platform and watch the mist drift past the platform lamps and onto the sing

Spitfires at dusk over Burrator & Sheepstor Halt

Longstone Manor house: Pix4D recreation

track, accompanied by the background sounds of owls and the distant whistle of a steam engine.

Virtual Wembley Walk is still a work in progress, but the romantic nature of what was originally part of the road to Sheepstor via the bridge of the same name, especially with the foxgloves in full bloom – not to mention the granite artefacts taken from nearby buildings that make up the archways – meant that it was one area not to leave out. Building each artefact can take considerable time, especially given the detail required to produce a convincing 3D representation. More recently, however, it has been possible to accelerate the collection of survey data from sites around Burrator, courtesy of a new software package (Pix4D). We can now fly one of our quadcopters over a location such as Wembley Walk or Longstone Manor and then, using the aerial video footage, generate fully textured 3D models of the site automatically. This is an exciting and time-saving development, especially given the short periods we have available to conduct surveys in the area. However, the team is still highly reliant on information and assets owned by locals or sourced from elsewhere in the quest to make these historic virtual sites accurate and, thus, educational. Longstone Manor is an excellent point in case. Apart from one recently discovered
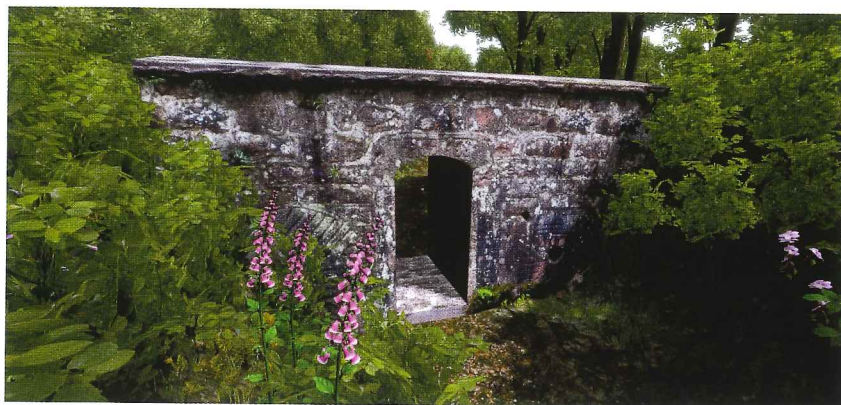
Wembley Walk

and rather grainy 1920s picture of the intact house and the immediately adjoining barns and buildings, no other images have been yet been discovered.

Nevertheless, the team is regularly invited to provide demonstrations and talks and we live in hope that, one day, a member of the audience may just provide us with that missing image, or that missing page of information, which will enable us to deliver the historical accuracy we strive for. Indeed, public engagement is becoming an increasingly important feature of all UK University research, and events such as the official opening of South West Lakes Trust's Burrator Discovery Centre in 2014, and our evening presentation in St Leonard's Church in Sheepstor in early 2015, have encouraged

many to look again in their shoeboxes or old suitcases under the bed or in the attic.

Even despite the lack of resources and support, it is hoped that the Virtual Burrator project will continue for the foreseeable future as, at the very least, it provides students at all levels with exciting opportunities for both historical and technology-based projects, and members of the public the chance to become involved with a fascinating heritage project. There is still much to do – Lowery Cottage and its railway level crossing and Park Cottage Inn, for example. The team also hopes to be able to conduct an underwater survey, using a surface-based vessel equipped with multibeam sonar, with the aim of exposing any of the remaining man-made features that may one day help to extend the VR model to include a comprehensive scene of the Meavy Valley as it may have looked in the 1800s, before the coming of the flood that changed the area for ever. ■

Bob Stone describes himself as a proud Devonian who takes every opportunity to visit the county of his birth and upbringing. He is Professor of Interactive Multimedia at the University of Birmingham and directs the Human Interface Technologies Team – a small group of researchers who develop unique computer-based solutions for training and visualisation applications in defence, healthcare and heritage. www.birmingham.ac.uk/stone.

Quadcopter flying over Longstone Manor