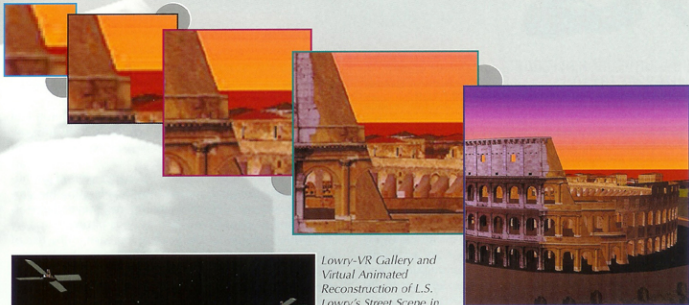# VIRTUAL
REALITY

Tomb of Nefertari.
Courtesy of Infobyte S.p.A.

Sony Glasstron head-mounted display.
Courtesy Virtual Presence Ltd.

VR

Lowry-VR Gallery and
Virtual Animated
Reconstruction of L.S.
Lowry's *Street Scene* in
Coming From The Mill
(circa. 1930).
Courtesy Virtual Presence Ltd.
& Salford City Council.

Coliseum.
Courtesy of Infobyte S.p.A.

VIRTUAL REALITY

*'The willing suspension of disbelief
for the moment…'*
(Coleridge, 1817)

After an incubation period of six to seven years, the field of endeavour popularly referred to as virtual reality (VR) has recently experienced something of a massive revival. Important developments have helped VR become an accessible, usable and justifiable technology for many industrial, commercial, educational and public sectors. This revival, with some evangelical help from its proponents, will help accelerate its much-awaited appearance on the World Heritage stage.

But what exactly has changed? Generally speaking, VR, promoting intuitive, real-time interaction with three-dimensional databases (eg. Stone, 1996(b)), has matured into a toolkit for which there are real applications and evidence of real financial, design, training and communication benefits. Preoccupation with the once ubiquitous head-mounted display (HMD) and immersive VR has diminished. Desktop implementations (using standard computer screens), together with conventional or stereoscopic image projection systems, have become popular of recent years. 'Higher-end' visualisation techniques, such as the CAVE (small rooms with large video projection walls) and dome-based or 'wrap-around' imaging systems, have their uses and are highly impressive. However, they are generally too expensive for widespread application.

Enter low-cost multimedia computers and high-performance graphics hardware, with many recent workstations outperforming their ageing 'supercomputer' cousins. Coupled with this, the spread of VR modelling and run-time software (such as DirectX, OpenGL, VRML, panoramic digital imaging tools, even some PC games engines), together with low-cost and free resources from the Web, is beginning to make VR much more accessible to the non-specialist user or developer than was the case just two years ago.

WHY VR FOR HERITAGE?
INTERPRETATION,
ACCESSIBILITY AND PRESERVATION

THE TERM IS USED HERE to designate the use of computer-based interactive technologies to record, preserve, or recreate artefacts, sites and actors of historic, artistic, religious and cultural significance and to deliver the results openly to a global audience in such a way as to provide formative educational experiences through electronic manipulations of time and space.

There has been growing international interest in using VR to recreate historic sites and events for such purposes as education, special project commissions and showcase features at national and World Heritage visitor centres. As two researchers of the NYNEX Worldwide Communications & Media Group – Rory Stuart and John Thomas – said in the early 1990s, VR can give the general public access to places and things not normally accessible, to explore objects and experience events that could not normally be explored without 'alterations of scale or time', to interact with remote communities and to interact with virtual (historical) actors (sometimes referred to as 'artificial virtual life').

With heritage however, VR goes much further in that it offers a means of protecting the fragile state of some sites and can help teach visitors to explore, interpret and respect them.

VR can show the potential damage caused by human intervention and pollution by accelerating the simulated destructive effects to monuments or even large areas of land and sea, over short periods of time.

While 1995 and 1996 saw an increase in the use of VR for heritage and cultural applications, the impetus for such interest reaches back even further to an impressive demonstration, staged at the Imagina Conference in Monte Carlo in February, 1993. A member of the French clergy, wearing an HMD and grasping a tracked hand controller, was joined in his virtual world by a cartoon-like character. This character was actually a graphical representation, or avatar, of another real human, not located in Monaco, but in Paris. She was

Virtual Everglades. Courtesy Victor J. DeLeon, Florida Atlantic University.

'there' to provide a real-time guided tour of a virtual reconstruction of the Cluny Abbey, a building destroyed in the early nineteenth century. This pioneering demonstration proved conclusively that a formative experience could be delivered over a standard communications infrastructure (in this case the French Numeris ISDN system network).

But the first conference was held only in 1995, at the Assembly Rooms in Bath, UK. It featured such projects as Virtual Pompeii (Carnegie Mellon University), Virtual Lowry (Virtual Presence; Stone, 1996(a)) the Caves of Lascaux (University of Cincinnati) and the Fortress at Buhen, Egypt (ERG Engineering).

At the same time, a project instigated by English Heritage was announced, to develop both large-scale and Web-friendly VR models of Stonehenge. The large-scale model, complete with a mathematically accurate model of the night sky and a virtual sunrise, was presented in June of the following year at the London Planetarium by the famous astronomer Patrick Moore and Sir Jocelyn Stevens, former Chairman of English Heritage.

Virtual Stonehenge was also demonstrated live at the second conference, held in London in December 1996. This conference was one of contrasts. At one end of the spectrum were such projects as Virtual Stonehenge (Virtual Presence), the Battle of Gettysburg (TACS Inc) and the Tomb of Menna in Thebes (Manchester Metropolitan University), all targeting low-to medium-range computers. At the other end was the visually stunning (and ongoing) 'supercomputer'-based work of Infobyte, notably the widely-referenced Coliseum project and an early prototype of the IBX 'infinite resolution' Engine, used in a number of important fresco projects to generate higher and higher resolution digital images of the virtual artwork as the viewer moves closer (eg. Mahoney, 1996). Another advanced project was announced by Miralab (University of Geneva) which later resulted in a stunning virtual re-creation and animation of the terracotta warriors of Xian.

The latest event in the series is long overdue, as a result (says the January/February 1999 edition of *VR News*) of a distinct lack of worthy conference candidates. This
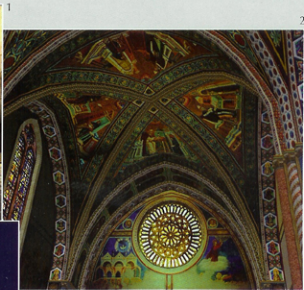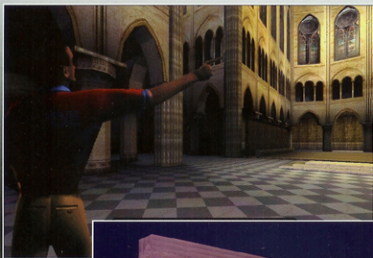
1. Notre-Dame.
Courtesy Victor J. DeLeon, Florida Atlantic University.

2. The Basilica of St. Francis in Assisi.
Courtesy of Infobyte S.p.A.

3. Shirakawa-go. Gassho-zukuri farmhouse.
Courtesy Virtual Systems Lab, Gifu University.

is a great pity, as there have, in fact, been a number of potentially important world-wide developments in VR and heritage. The author's personal favourites (in addition to projects mentioned above and such ongoing and exemplary efforts of Infobyte's as the Tomb of Nefertari and the Basilica of Saint Francis in Assisi) include the following.

THE VIRTUAL AMIENS CATHEDRAL PROJECT

DIRECTED BY Professor Stephen Murray, a result of collaboration between the Media Center for Art History in New York and the Digital Design Laboratory of Columbia University. This is an excellent example of how one should exploit multiple forms of media to make visually rich images, plus the wealth of background and historical information readily accessible and navigable over the Web. For video production, the main model of the cathedral has been rendered to very high levels (using Softimage), with some stunning stained glass, light streaming and architectural effects. However the model can also be produced for real-time interaction, or can be used to generate Web-friendly QuickTime VR panoramas backed up by animations and well-structured images.

SHIRAKAWA-GO

THIS JAPANESE mountain village (located within the valley of the River Sho-gawa, in the north west corner of Japan's Gifu Prefecture) became part of the UNESCO World Heritage List in December 1995, as an outstanding example of a particular style of architecture, providing a similarly outstanding cultural example of traditional human settlement. The village farmhouses are constructed in a unique style known as *Kiritsuma-Gassho-zukuri* and can boast up to five floors in the A-frame roof space. Not only are these floors used for accommodation, they also support the silkworm industry, worms being raised in the space between the gables of the steep, snow-repelling thatched roofs. One only has to see the photographs of the respected Japanese photographer Hiromi Morita (see reference listing) to appreciate the beauty of Shirakawa-go, especially during the winter season.

But the Gifu Prefecture also hosts the well-known Softopia Information Society Initiative and the recently opened VR Techno Centre. Indeed, many of the Prefecture's developments in IT and VR, including the virtual reconstruction of the village of Shirakawa-go, complete with a detailed example of a *Gassho-zukuri* farmhouse, can be traced to Gifu University's Virtual Systems Laboratory (VSL) and the visionary work of Professor Takeo Ojika, his growing research team and the Virtual Systems and Multi-Media (VSMM) organisation, whose annual conference features projects in some detail.

THE GREAT BARRIER REEF

SCOTT THRANE, Executive Officer of the VSMM Society, is leading a team of researchers in one of the world's more ambitious heritage projects. The Great Barrier Reef, off Australia's Tropical North Queensland, a UNESCO World Heritage site since 1981, is famous throughout the world for its coral seascapes and aquatic life. Tourism (boat excursions, diving, etc.) is the site's main commercial use; it is also its main problem, especially with the anticipated influx of visitors during the 2000 Olympic Games. In an attempt to use VR as a major weapon against pollution and destruction caused by tourists, and to educate visitors about the reef itself, Thrane and his colleagues have been working on a large VR installation, boasting large-scale DOME and CAVE displays, networked interactive zones and examples of artificial life, which interact with the user depending on the role he or she initially selects (eg. marine biologist, schoolchild, etc.).

The Everglades

THE GOALS OF THE Virtual Everglades project (DeLeon & Berry, 1998) and those of Thrane's Barrier Reef have much in common. Both attempt to include a form of public education to promote ecological awareness of endangered environments. The Everglades project is also of note in that it employs a games graphics engine (Epic's Unreal 3D Engine) which will undoubtedly improve the demonstration's accessibility by PC owners in due course. The current plan is to deliver the Virtual Everglades via a free-standing mini-projection theatre, exposing users to an impressive quality 3D simulation of an actual area of the Florida Everglades National Park in the United States of America as if they were travelling on a high-speed airboat. DeLeon is on schedule to complete a project during the summer of 1999, recreating Notre Dame Cathedral using the Unreal Engine – some of the early results are quite stunning.

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Stonehenge

WHILE THE CURRENT VR model of Stonehenge has not been modified since its first appearance in 1996, it has been presented throughout the
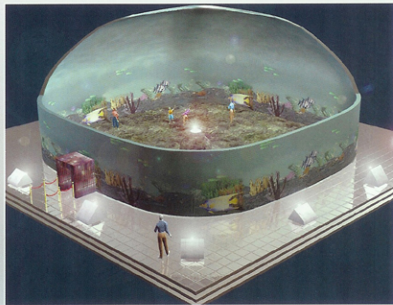
1. *The Church of St. Pantheleimon, Ohrid, FYR Macedonia (6th century VR reconstruction).*
Courtesy Disoski Darko.

2. *Barrier Reef (DOME VR and Immersive 'Role-Play' Facility).*
Courtesy Scot Thrane.

3. *Virtual Amiens Cathedral.*
Courtesy: the Trustees of Columbia University, New York

world (eg. at the VSMM '98 conference and European specialist archaeological and museum events). An earlier British heritage project, Virtual Lowry (mentioned above), also receives regular requests for demonstration. In essence, this project involved the transformation of L.S. Lowry's 1930s painting *Coming From The Mill* into a 3D simple animated reconstruction of a northern town – not dissimilar to Ancoats, one of the future proposals for World Heritage status (Smith, 1998).

Returning to Virtual Stonehenge, the project has been instrumental in the planning process for the removal, via an underground tunnel, of the controversial A303 road. Given this frequent – and highly encouraging – re-use of what are now quite old models, more attention will presumably be paid to some of the project's original educa-

tional and accessibility aims. With Stonehenge in particular, emphasis should be placed on enhancing the model by endowing the stone circles, local topography (The Avenue, Cursus, etc.) and more remote barrows with informative historical and geographical records, or by exposing some of the more 'publicly appealing' features such as Sir Christopher Wren's graffiti – something visitors simply do not get to see.

A comment by Maurice Luker, the University of Columbia's (New York) executive producer of the Amiens Cathedral project, concerns anyone involved in these and similar projects: 'We're not just trying to do old things like showing slides' he said. 'Artists and educators have long manipulated new imaging technology to change fundamentally how we envision and understand

References

- **Britton, B.J.** (1996), *'Making History: The Art of Science'*, Presentation given at the Union of Prehistoric and Protohistoric Scientists; Forli, Italy; September, 1996. Available from
  http://www.daap.uc.edu/soa/benh/forli2.html
- **Coleridge, Samuel Taylor** (1817), *Biographia Literaria*; Chapter 12.
- **DeLeon, V.J. and Berry, H. R.** (1998), 'Virtual Florida Everglades'; Proceedings of VSMM '98: *FutureFusion – Application Realities for the Virtual Age*; Volume 2; pps. 458-463.
- **Mahoney, D.P.** (1996), 'Breathing Virtual Life Into Art'; *Computer Graphics World*; October, 1996; pp. 19-20.
- **Smith, C.** (1998), *'UNESCO World Heritage Sites: A Consultation Paper on a New United Kingdom Tentative List of Future Nominations'*. Issued by the UK Secretary of State for Culture, Media and Sport; August, 1998. See also: http://www.culture.gov.uk/WHS1.HTM
- **Stone, R.J.** (1996(a)), *Virtual Lowry: A World Within a World* EVA'96 – Proceedings of the Electronic Imaging & Visual Arts Conference; Sainsbury Wing, The National Gallery; 25 July, 1996.
- **Stone, R.J.** (1996(b)), *A Study of the Virtual Reality Market*; prepared for the UK Department of Trade & Industry (Communications & Information Industries Directorate).

Some reference Web Sites

- **Miralab, University of Geneva**
  http://miralabwww.unige.ch
- **Infobyte**
  http://www.infobyte.it
- **Armchair Travel**
  http://www.armchair-travel.com
  An excellent repository of panoramic VR examples, with a number of useful downloads (including Westminster Abbey and Saint Paul's Cathedral) and tutorial links, developed using Apple's QuickTime VR tools.
- **Virtex Limited**
  http://www.virtex.co.uk/site-Architecture.htm
  Another excellent site showing a number of demonstrations (including south west England's Cleeve Abbey and Roman Baths) built to a high quality using the Superscape VR package.

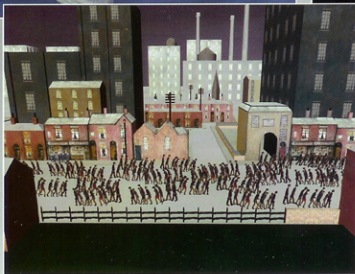*Stonehenge.* Courtesy Virtual Presence Ltd.

our world. New technology makes possible a new way of seeing'.

WHERE NEXT?

WHAT OF MORE recent heritage? Will virtual industrial archaeology become a serious pursuit, with graphical recreations of petrochemical plants, or long-abandoned tramways and railroads? In the UK, a small movement is already supporting the next logical step in archiving today's site and plant models to become tomorrow's archives in a library of virtual industrial archaeology. Such an idea is not as outrageous as one might first think. After all, the World Heritage List already contains such industrial sites as the

Semmering Railway in Austria, Ironbridge Gorge in the UK, various canals and even iron and salt works (see also Smith, 1998).

However, defining the future applications of VR in World Heritage is no great problem. Neither is defining the near- to mid-term technologies that will underpin those applications. The biggest problem facing proponents of VR in the very near future is the pressure applied by the more commercially minded (and, it must be said, not well-informed) trustees of some of the national and international 'heritage' centres throughout Europe and elsewhere. There have already been instances where respected professional archaeologists have had their normally impeccable academic logic compromised by the need to show their financially-driven committee colleagues that they too are concerned with

1 Tower Bridge, London.
Courtesy Virtual Presence Ltd.

2. Terracotta Warriors of Xian.
Courtesy Miralab, University of Geneva.

3. Lowry VR Gallery and Virtual Animated Reconstruction of L.S. Lowry's, Street Scene in Coming From The Mill (circa. 1930).
Courtesy Virtual Presence Ltd. & Salford City Council.

the monetary payback of VR in such centres. In one excellent recent example, the value of VR over and above costumed re-enactments of battles was questioned. In another it was suggested the conversion of what would have been a classic VR rebuild of a large Roman fort (which offered the promise of considerable research and educational spin-offs) into a 'death-by-ballista' 'shoot-'em-up' experience, with centre visitors beating off a virtual insurrection.

Ever since the proliferation of VR games systems in the early 1990s, the application of the technology to more 'serious' pursuits, including heritage, has demanded extraordinary commitment and stamina on the part of those evangelists attempting to raise awareness of VR as one of the more credible tools of information technology. To many in the VR community, sooner or later, the ever-increasing range of software packages for domestic PCs and dedicated gaming consoles, not to mention the proliferation of information-rich communities across the World-Wide Web, would inevitably commit arcade-based VR entertainment ('the dirty, thirteen-letter word' as Lascaux's creator Britton (1996)) labelled entertainment in the context of virtual heritage) to stagnation and obscurity.

Yet today, unless care is taken very early on in the development of some of the stunning applications, those who would use them to attract individuals from all walks of life run the risk of a similar and more rapid slide into obscurity. The risk is that desperation and commercialism will dominate the near-term application (or its rejection) of VR to heritage as a widely accessible means of recording, preserving, interpreting and educating.

Ultimately, one can only pray that VR will prevail in virtual World Heritage as it has done in the sceptical domains

Other panoramic VR sites to visit include

http://www.bdiamond.com (Black Diamond's Surround Video)
http://www.livepicture.com (Live Picture's RealityStudio)
http://smoothmove.com (Infinite Pictures' Smooth Move panoramic system)
de pinxi (http://ibase041.eunet.be/pages/Agency.html)
– Belgian company offering virtual galleries, museums and heritage examples, as well as its own turn-key software package, ARGO.
UK VR Forum (http://www.ukvrforum.org.uk)
– As well as general information, this site also contains an extensive Web VR modelling and run-time resource listing, as generated by Virtual Presence for the Forum (alternatively, this list can be obtained by contacting the author).
Dataview Solutions Ltd (UK)
– Features the Pavan VRML development tool for combining virtual landscapes and buildings with multimedia, photographic, and GIS data. On the page referenced here they cite the virtual reconstruction of a Roman Fort
http://www.pavan.co.uk/docs/class/romans.html
Active Links
http://www.geocities.com/Athens/Acropolis/5014/vh-6.html

Other relevant Web Sites

World Heritage List
http://www.unesco.org/whc/heritage.htm
VSMM
http://www.vsmm.vsl.gifu-u.ac.jp
Hiromi Morita's photographic images of Shirakawa-go
http://shirakawa-go.com.l/e_photo.html
Virtual Presence
http://www.vrweb.com
– for **Virtual Stonehenge** and **Virtual Lowry.**
The *CSA Newsletter* subject index
http://csaws.brynmawr.edu:443/web1/
Human Interface Technology Laboratory some cross-references under the Lab's 'art' directory;
http://www.hitl.washington.edu/kb/old-artapps.html
The Amiens Project
http://www.mcah.columbia.edu/Amiens.html
The Ancient City of Ayutthaya
http://www.sli.unimelb.edu.au/~cliff/virtual.html
Real Time Graphics publication
http://www.realtimegraphics.com
VR News publication
http://www.vrnews.com

of industry and commerce. Although Britton, as quoted above, was quite scathing of the use of the word 'entertainment', his musings on history, art and science do contain an important message: 'We shape the destiny of the future with our stories about the past by the effects of our imperfect presentations on the enthusiastic minds of the public'.

As with industrial and commercial applications, the time when Hollywood-style 3D graphics and VR component technologies *per se* could overawe us has passed. So has the time for being impressed by fixed-location facilities housing demonstrations, or the so-called 'reality centres' or 'centres of VR excellence', set up by universities and government bodies.

The key issue now is accessibility. This means paying attention to what some might consider more mundane issues – usability, the human-computer interface, database interchange formats and so on. Accessibility also demands that a global communication infrastructure be put in place to provide formative experiences and, of course, entertainment (in a form that does not detract from the real heritage content). Access must not just be restricted to those who work in the expensive laboratories where the developments occur. Neither should it be a privileged experience for those who are invited to take part in the infrequent conferences and exhibitions on the subject.

Accessibility means opening up this valuable form of communication to all citizens of the planet, regardless of ability and social status. A major challenge for VR, yes; but the rewards will persist for decades.

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Scientific Director, Virtual Presence Limited

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1. Amiens Virtual Amiens Cathedral.
Courtesy Trustees of Columbia University, N.Y.

2. Stonehenge Virtual Summer Solstice Sunrise.
Courtesy Virtual Presence Ltd.

3. Terracotta Warriors of Xian.
Courtesy Miralab, University of Geneva.

2

3