Serious gaming

Professor Bob Stone, Research Director, Human Factors Integration Defence Technology Centre, discusses the revolution of defence prototyping and training applications…

A change, we are told, is in the wind. Those involved in the mainstream exploitation of simulation technologies for defence training, design, rapid prototyping and so on cannot help but have noticed a recent and massive rise in interest in a technology that claims to be responsible for delivering that which the virtual reality (VR) and early real-time simulation communities failed to deliver in the closing decade of the last century. This technology is popularly known as 'serious gaming'.

What is serious gaming? In very broad terms, serious gaming focuses on the exploitation of high quality computer games software tools such as those underpinning the 'first person shooter' (FPS) or 'role-playing' (RP) games currently being enjoyed by youngsters and adults alike all around the world. These tools take the form of software development kits (SDKs), regularly released by leading games developers shortly after the publication of a new product, together with a growing number of content generation packages becoming available – many free of charge – from the web. These tools enable avid games players to develop their own virtual humans (or 'avatars'), environments, weapons and adversaries, thereby prolonging the longevity of the game they have purchased. However, the availability and affordability of these tools have also very rapidly generated interest from another group, the serious applications community, including those responsible for designing training and real-time visualisation systems for defence, surgery and education to mention but three examples.

The use of computer or video games to provide solutions to serious applications – notably those involving personnel training – is not new. For example, 'Battlezone' – a successful 3D wire frame tank game first published in 1980 for the Atari – was developed a year later into a serious game for the US Army to support training for the Bradley military vehicle (The Bradley Trainer). Indeed, long before today's serious gaming 'revolution' – and at a time when other, more over hyped technologies such as VR were just about to break out of their NASA and DoD 'homes' – the future potential of computer games to solve the accessibility and affordability problems of modelling and rendering tools for interactive 3D applications had already been recognised. Of course, for the decade following the events of the late 1980s (and this continues even to this day), the VR community was faced with just the opposite: very expensive graphics 'supercomputers', unreliable wearable devices and limited software products – not to mention the crippling year on year maintenance costs that these products demanded.

Less well remembered than 'Battlezone', but representing a major step forward in the history of serious gaming, was 'The Colony' – an excellent first person space survival game created in 1988 for the Apple Macintosh by David Smith. Smith's game development software, which was in 1990 commercialised as a 3D toolkit ('Virtus WalkThrough'), was subsequently modified for use as a virtual scene planning tool for the science fiction film 'The Abyss', and later formed the basis of a relationship with Tom Clancy that was to spawn such memorable titles as 'SSN' and 'Rainbow Six'.

Then there was the revolutionary 'Wolfenstein' (the sequel relaunched in 2002 as 'Return to Castle Wolfenstein'), 'Doom', 'Quake', 'Hexen', 'Heretic', 'Unreal' and 'Half Life'… the list goes on. The graphics of some of the early versions of these games may appear crude and simple today. But as long as the user's attention is captured and he or she is required to maintain a spatial and temporal awareness of the 3D situation in order to survive within the scenario, and as long as the simulation responds meaningfully in real-time, the underlying engine can be used to develop a training simulator capable of delivering valid, reliable and believable content to highly motivated students of all ages and skills. Indeed, a version of 'Doom II' was used to train US Marines at the Marine Corps Modeling and Simulation Management Office ('McMismo'), Quantico Base, Virginia. Tom Clancy's 'Rainbow Six', mentioned above – despite being put on temporary hold following the events of 11th September 2001 – was actually modified using maps and scenarios requested by the US Army to train troops to fight terrorists in urban terrain.

Other DoD sponsored titles included 'C-Force', a collective training game targeting latest generation computer games systems, such as Xbox and PlayStation 2; 'CS-12', hosted on the PC; and VBS1, a first person or collective training simulator for battlefield or homeland security applications, itself based on a commercial games engine known as 'Real Virtuality' developed by Bohemia Interactive Studios. Many of these recent games go much further than their predecessors by moving away from the FPS scenario to introduce role-playing and command responsibilities for virtual Forces endowed with Artificial Intelligence (AI).

Based on Epic's 'Unreal' engine, 'America's Army' was originally produced to allow young Americans to investigate military career opportunities (whilst reducing the cost of preparing and distributing printed information). 'America's Army', a distributable 3D game developed by the Moves Institute specifically for the US Army, had, by early 2005, developed into one of the most successful online games ever. Directed and managed by the US Military Academy's Office of Economic & Manpower Analysis at West Point, 'America's Army' was, in December 2003, the focus of intense cross-discipline interest at a Serious Games Day held at the Wilson International Center in Washington DC, the precursor event to a Serious Games Summit now staged annually.

Early evidence?

One of the early barriers facing the VR community was the absence of evidence supporting the efficacy and cost benefits of the technologies, together with case studies describing their adoption into mainstream commercial and educational practices. The serious gaming arena is in a slightly better position, although research papers on the subject of skills development and transfer are only now becoming evident. Certainly, from recruitment and teaming perspectives, early indications from such projects as 'America's Army' and, from a UK perspective, 'DIVE' (described below) are encouraging.

Another concern relates to the management of expectation. Take, for example, recruits into the Armed Forces. Increasingly, there is a desire to avoid potentially costly mismatches between the skills that many of the incoming recruits will already possess, courtesy of their previous 'extra-mural' experiences with computer games. Exposure of these recruits to current generation technology-based training systems developed in support of their early defence careers may actually foster frustration. Worse still, negative transfer of training could occur, by virtue of the primitive status of legacy simulation systems in many branches of the Armed Forces (when compared to the quality and performance of the readily available and pervasive FPS computer game counterparts).

From the perspective of individual perceptual and cognitive skills, an article in the May 2003 edition of 'Nature' by Shawn Green and Daphne Bavelier of the University of Rochester presented results suggesting that students and young adults between the ages of 18 and 23 – all accomplished, regular FPS gamers – exhibit better performance scores in tests of visual attention, monitoring complex environments and multi-tasking than non-FPS games players. Related articles addressing the positive impact of computer games exposure on the manual dexterity skills of specialists in other domains, notably laparoscopic ('keyhole') surgery, have been published in medical journals such as 'Surgical Endoscopy' and 'Gynaecological Endoscopy', and at the annual conference series Medicine Meets Virtual Reality and the newly launched Games for Health conference.

Serious gaming for defence applications in the UK

One long running and well publicised project in the UK serious games arena has been 'DIVE' – the Dismounted Infantry Virtual Environment, recently ported from its early 'Half Life' host to take advantage of the latest visual and functional qualities of the 'Half Life 2' engine. Developed by QinetiQ and Maverick Developments via funding from the MOD's Directorate of Analysis, Experimentation & Simulation (DAES), 'DIVE' is a networked PC training system that has not only been shown to be highly immersive for the military participants but also provides valuable post-session feedback, or after action review. A typical 'DIVE' scenario involves a virtual representation of the urban combat training 'village' at Copehill Down and focuses on house search and clearance. Each PC is networked so that soldiers go through the game as a section against an 'Opposing Forces' threat using real tactics and techniques. Enemy Forces are controlled by team mates and some computer generated Forces are also included. 'DIVE' has recently been elevated to 'front line' status and was part of the equipment line-up for the Royal Gloucestershire, Berkshire and Wiltshire Light Infantry, deployed to Afghanistan. QinetiQ is now home to another MOD initiative in the serious games arena – the Commercial Off-the-Shelf Evaluation Unit (COTSEU), a group tasked to support the development of early games-based demonstrators and to maintain a technology watch on hardware and software developments emerging from the global gaming community.

The Human Interface Technologies (HIT) Team at the University of Birmingham, a member of the COTSEU and one of the academic partners in the Human Factors Integration Defence Technology Centre consortium, is co-ordinating a wide variety of serious gaming projects. One study being conducted for the Royal Navy seeks to develop a desktop games engine-based demonstrator, supporting the training of Dillon Minigun aimers. Another study is producing a gaming solution to test navigational and spatial orientation skills on the part of junior warfare officers, prior to their exposure to the bridge simulators at HMS Collingwood in Fareham. Using proprietary games engines – particularly the Crytek 'CryEngine' (the power behind the popular game 'FarCry'), together with the Crytek 'SandBox' software development kit and free 3D content generation tools such as 'Gmax' – it has been possible to develop experimental test beds in incredibly short periods of time. The rapid development of urban and Middle Eastern scenarios for testing new defence systems, such as small UAVs and robotic land vehicles, and for evaluating new forms of human interface devices to control those systems, are key areas of research interest. The HIT Team is also working with Midlands-based Kestrel Aerospace to develop concept visualisation, ergonomic solutions and training programmes for radically new manned and unmanned air vehicles.

Another defence related project was designed to assess the role of vibration in the tasks undertaken by Helicopter Voice Marshals – aircrew located in the rear cabin of helicopters whose job it is to guide the pilot using verbal instructions during an approach toward a target (on land or sea) for the purposes of rescue or load deposit. The first phase of the proj-

ect resulted in the development of a vibration sensing device, which was flown on an EC-203 helicopter whilst performing typical marshalling manoeuvres. The data collected were then used to drive a three axis modified entertainment simulator motion base, linking the simulator motion and vibration to interactive 3D graphics developed using Microsoft's 'Flight Simulator 2004'. A more permanent control system supporting the integration of gaming technologies with the motion base platform is now being developed.

The most advanced example of a serious games project, however, has been developed in conjunction with UK games company Blitz – specifically, the company's serious gaming division TruSim. The 'Interactive Trauma Trainer' (ITT) is a proof of concept demonstrator project, part-funded by the HFI Defence Technology Centre, in conjunction with subject matter expert input from the Royal Centre for Defence Medicine (RCDM). The ITT is the result of an intensive human factors project, based on task analyses conducted with RCDM and Army Field Hospital specialists. The task facing the trainee trauma surgeon is to make appropriate decisions relating to the urgent treatment of an incoming casualty with a 'Zone 1' neck fragmentation wound. Appropriate interventions – oxygen provision, blood sampling, 'hands-on' body checks, patient visual and physiological observation, and endotracheal intubation – must be applied within five to six minutes in order to save the virtual casualty's life. Together with TruSim and Welwyn Garden City-based VEGA Group, the University has recently launched the UK Serious Games Alliance – a partnership formed to deliver affordable interactive 3D training solutions to users in defence, medical and government sectors (to mention but three) through the application of computer gaming technology to lifelong learning and technology-based training programmes in defence.

A cautionary tale

In his book entitled 'Digital Game-Based Learning', published in 2001, the author, Mark Prensky, describes 'Digital Natives' born after 1974 as the 'Twitchspeed Generation', with members of this community having, amongst other activities, spent 10,000 hours on video or computer games (with a similar amount of time using mobile phones), exchanged a quarter of a million emails and spent only 2,000-3,000 hours reading. Perhaps those responsible for planning defence manpower selection, training and continuing education programmes should take some comfort in the fact that, despite the shortcomings in the more traditional recruitment parameters (numeracy and literacy amongst them), it is highly likely that the members of this 'Twitchspeed Generation' may well be already endowed with many of the perceptual and motor skills necessary to take full advantage of the new Network Enabled Capabilities that will (it is claimed in numerous defence publications) make the UK's leaner Forces more agile than ever before.

However, be warned. Already the serious gaming community is experiencing a 'period of elevated hype', in exactly the same manner as that witnessed at the beginning of the 1990s, when VR first emerged onto a worldwide stage and then gradually deteriorated into a technology-push fiasco as the closing decade of the last century progressed. The serious gaming bandwagon is rolling. At national and regional levels, government bodies are starting to launch a number of hastily funded 'us too', or 'catch-up' programmes, partly to combat the inevitable challenge from the media that the UK is, once again, being left behind on the world's technological stage. Seedcorn grants and contracts are being offered to these consortia with almost impossible to achieve local wealth and job creation caveats. In parallel, unheard of venture capitalists are suddenly appearing, lining up senior captains of industry, exposing them to presentations from a range of so-called 'experts' in serious gaming – some actually flown in from the US at considerable cost. Universities are vying to establish the biggest and best centres of research excellence, equipped with the latest (and soon to be obsolete) technologies. And, no doubt, government funding bodies will soon be bombarded with all manner of university led proposals, many top-heavy with bids for 'essential' items of hardware and software.

There is little doubt that the widespread availability of gaming related software tools will enable many more individuals than was the case in the VR era to become involved in the creation and delivery of high quality, distributable virtual environments. There is also little doubt that, given time, a good number of organisations will adopt serious gaming for a range of applications (particularly training related). But forcing an early step change will meet with failure as it did in the VR 'era'. Technology of this nature has to be designed in conjunction with the end-user, packaged in a form that the end-user can understand and taken out to the end-user for immediate use; this is where the VR centre of yesteryear failed. It is vital that the proponents of serious games technologies learn from the harsh lessons of the recent past. Otherwise, history will repeat itself and large sums of money will be wasted.

Professor Robert J Stone
BSc (Hons), MSc, C.Psychol, AFBPsS, FErgS, Eur.Erg, FIoN, FVRS
Chair in Interactive Multimedia Systems
Director, Human Interface Technologies Team
University of Birmingham
Department of Electronic Electrical and Computer Engineering
Edgbaston
Birmingham B15 2TT
Tel: 0121 414 7395
Mobile: 07740 858901
r.j.stone@bham.ac.uk
www.bham.ac.uk
www.hfidtc.com