The Gamification of Business Productivity and Scientific Education

Dr William Hurst

Scientia

THE GAMIFICATION OF BUSINESS PRODUCTIVITY AND SCIENTIFIC EDUCATION

It is undoubtable that virtual reality and augmented reality will soon be an integral part of our daily lives at home, in education, and at work. Here, we look at some of the exciting projects that **Dr William Hurst** of the Department of Computer Science at Liverpool John Moores University is driving forward and read how he is embracing virtual reality and augmented reality to enhance teaching and education, providing insight into how such technology may be utilised in the not too distant future.

The VR panda teddy bear avatar used during proton therapy

Virtual Reality and Augmented Reality

Virtual reality (VR) and augmented reality (AR) have increased in prominence and public interest in recent years, leaping from the pages of science fiction into our homes and workplaces. Although still perhaps seen more as a novelty or a 'must-have gadget' at present, with ever-faster computing speeds and capacity, the future of VR and AR has the potential to become routinely embedded as an enhancement to all aspects of our domestic, educational, and working lives.

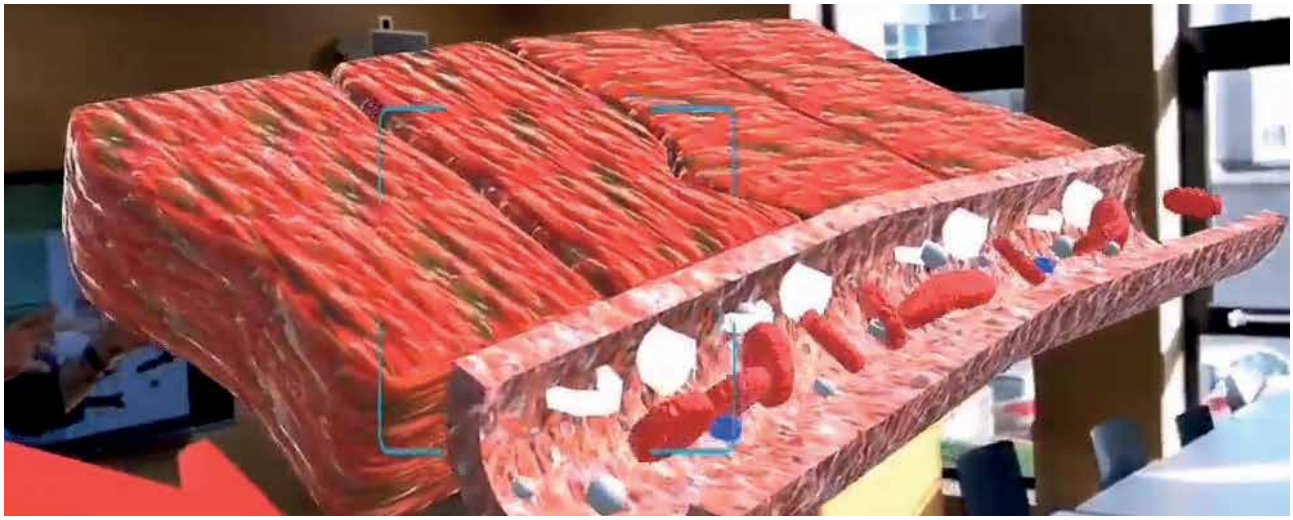
VR and AR differ in several ways. VR is a computer-simulated 3D-environment in which the user wears a bulky headset over their eyes, to become fully immersed (at least visually) in a different virtual environment. The user can interact with and navigate through the often stunningly realistic virtual world, but as a downside, they are effectively cut-off from the real world until they remove their headset or switch off their VR app again.

In comparison to VR, augmented reality allows the user to remain in the real world, aware of their surroundings and those around them but superimposes 2D or 3D computer simulations in real-time onto their field of vision, perhaps through transparent visors or spectacles, to add animations or layers of useful or contextual information.

Preparing for Industry 4.0

Dr William Hurst is dedicated to the development of new technologies to support the transition of the UK's industry into the new manufacturing paradigm – industry 4.0. The fourth industrial revolution is the next stage of manufacturing; taking us into a new phase of autonomous systems driven by access to vast quantities of data and machine learning. The UK has a lower productivity record in comparison with its worldwide competitors, and so productivity-enhancing systems are critical to the nation's future success.

In light of this, InnovateUK funded a project in this area, called Productivity Accelerator (ProAccel). The £102,000 ProAccel project, led by Dr Hurst, was a business and community-centric



AR Molecular Interaction.

Dr John Barrow, Aberdeen University, UK

modular cloud-based multimedia platform. It utilised advanced data analytics and gamification techniques, like AR and VR, to dramatically improve the way productivity information is utilised so that it can support businesses in the new digitally oriented world.

Amongst the prototype's early test applications, the team tested a prototype tower crane cockpit simulator to improve the productivity of training of crane operators, enabling them to learn in a safe but highly realistic 3D virtual environment.

The VR Proton Beam Therapy Unit

Dr Hurst's current research includes several collaborative projects exploring the use of creative VR and AR technologies to augment or revamp current ways of working, with a particular focus on medical and educational settings. An exciting example of this creative approach is Dr Hurst's joint work with Kieran Latham, and Imagin3D of Daresbury Laboratories in Warrington, to create a virtual reality proton beam hospital therapy unit. This work originated through an innovation award to explore the use of AR and VR to increase the productivity of UK businesses. The technology the team has produced has both productivity-enhancing and humanitarian benefits.

Two new hospital-based proton therapy centres have been built in the UK to aid the treatment of different types of cancers and are particularly useful for childhood cancers. The proton beam treatment process, however, can be an intimidating and frightening experience for children as it involves lying inside a large spherical machine for a prolonged period while radiation is directed towards their tumour cells to destroy them.

Children are typically allocated a two-hour time slot to receive their proton therapy treatment; but often this may be insufficient, as significant time may be required to reassure the understandably apprehensive child to enter the machine for treatment, and to remain still throughout the process. Clinical schedules may overrun, or treatment may not be completed if the child is uncooperative. The team have addressed this challenge by developing a VR application that allows children between the age of 3 to 11 to experience the proton beam unit's processes and preparation for treatment, initially through a VR experience. A VR panda teddy bear avatar is used to engage with the child and reassures their anxieties as they are guided through the proton beam therapy process.

While the idea is simple, the VR development process, working with a building information model (BIM), is highly complex. In brief, BIM is the

The team at Imagin3D

process to recreate a detailed 3D model of a real-world object or environment, using 3D scanners to create point cloud data. In fact, such scans are often too detailed for VR use, comprising close to a five million polygon resolution, and so much of the app's development is to manually simplify the scanned models, removing superfluous details by hand. The optimisation process results in a much lower polygon count model that is suitable for deployment into a VR game engine. The proton beam therapy unit VR application is being developed with Unreal Engine software that places the digitised model into a physically dynamic and realistically textured environment. It allows the application of industry-standard gaming models to achieve game-play levels of responsiveness for users.

Augmented Reality for Undergraduate Teaching

Dr Hurst has also recently worked on the development of an award-winning idea (awarded best paper at VISUAL2019), to use augmented reality to enhance life-science education. Led by Dr John Barrow at Aberdeen University, the project aims to develop experiential learning methods using AR cutting edge gaming technology to improve undergraduate teaching.

Dr Barrow's interest is directed towards modernising the way life-sciences are taught at university. Dr Barrow's experience of teaching bioscience and medical students over many years has led him to the conclusion that students often struggle to grasp the complex and abstract nature of molecular interactions and structures within biochemistry and cellular biology. Traditional teaching methods and textbooks have relied on rote learning and static two-dimensional cartoons or symbolic line representations of what are in reality, highly dynamic processes that are hard to then visualise in three dimensions.

Working with Dr Hurst and Imagin3D, Dr Barrow was keen to apply gamification techniques to create more suitable teaching material for the digitally literate generation of students. Gamification is where aspects of gaming technology and approaches are used in a non-game context. In addition, AR could be used to visually bring to life molecules and cellular activities as part of the classroom experience, and to offer new and engaging learning experiences that move away from purely didactic teaching.
Dr Barrow initially developed his software with Imagin3D and Dr Hurst to explain the complex metabolic processes in insulin signalling and will follow this up with a programme to visualise the glycolytic pathway, the biochemical process in the body to breakdown glucose for the production of energy. Both are fundamental to the teaching of cellular metabolism but are often taught in a linear fashion following the breakdown of one molecule to another in the pathways, a slightly dry and didactic process ripe for a modern make-over.

Student interns were involved to develop gaming aspects of the software with built-in challenges and problems to solve. For example, the students used game animations to build proteins through multiple pathways. The software development was focussed on utilising existing 3D molecular visualisations that are freely available online. These can be integrated into virtual environments, where the user can then interact and 'play' with them in a live situation to help them more intuitively understand their functions.

While this technology is still in its infancy, the potential for its wider use is enormous. The developed learning apps can be deployed digitally through VR, AR, platform-free videos and apps, as well as online. Medical applications could be used, for example, for health professional and patient education, to convey complex ideas or explain treatment procedures.

The Future of VR and AR

The integration of VR and AR integration into our daily lives will ultimately become a seamless part of our perception of the world around us within just a few decades. Dr Hurst's work demonstrating the wider uses of the technology provides insight into the many potential benefits to humankind in the fields of medicine, education and beyond.

Meet the researcher

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Dr Hurst is a Reader (Associate Professor) in Creative Technologies in the Department of Computer Science at Liverpool John Moores University (LJMU). He has over 60 international publications in the areas of Data Visualisation, Artificial Intelligence, Machine Learning, Computer Graphics and Data Science. Dr Hurst has also had successful grants from the EPSRC, Innovate UK, SBRI and UKAIS for multiple projects within these areas.

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KEY COLLABORATORS

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The team at Imagin3D have over 12 years' experience in 3D and immersive technologies, including Augmented/Virtual Reality and Serious Gaming. Imagin3D have produced 2 award winning immersive training environments and delivered the first Virtual Factory on the £20m pilot for the governments 'manufacturing made smarter' scheme. In2019, Imagin3D were shortlisted for the Halton Chamber New Business of the Year and won two academic best papers for their work in AR and VR field.
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FURTHER READING

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