



Exploring Industry 4.0 with a VR CAVE

How the University of the West of England's Digital Engineering Gallery uses Igloo immersive technology to prepare students for the world of work





Table of contents

Highlights

The [School of Engineering](#) at the University of the West of England (UWE), Bristol uses an Igloo VR CAVE as part of a government programme to improve digital engineering skills in the Southwest of England.

The [Igloo CAVE](#) is at the centre of UWE's Digital Engineering Gallery, a state-of-the-art facility which uses the latest simulation and digital engineering technologies for teaching, outreach and research.

The three-walled CAVE is equipped with rear and floor stereoscopic 3D projection. This is combined with 3D glasses, head tracking and perspective correction to allow up to six people to view immersive content in full 3D.

The CAVE is used to:

Educate students across engineering disciplines in 3D digital design

Introduce local businesses to the latest digital engineering technologies

Explore buildings and sites that have been captured with LiDAR and photogrammetry

Support UWE's world-leading research



About The University of the West of England, Bristol

[The University of the West of England \(UWE\)](#) is a public research university based in Bristol, UK. With over 30,000 students, it is the largest university in the Southwest of England and has close links to the area's established manufacturing, engineering and technology sectors.

Bristol is home to some of the world's best-known aerospace and aeronautics companies, including Airbus, GKN Aerospace, Renishaw and Rolls Royce. It's also nearby the UK's automotive industry in the

Midlands and the green energy and construction sectors in the Southwest. With over 30 engineering courses available at undergraduate, postgraduate and professional development levels, UWE plays a key role in developing the talent and skills to support these industries.

UWE has incorporated Igloo Vision technology in the form of an [Igloo CAVE](#) into its Digital Engineering Gallery, a state-of-the-art facility used to train engineering students and industry experts in the latest

digital simulation technology and Industry 4.0 approaches to design and manufacturing.

Digital Engineering Gallery

The Digital Engineering Gallery is a new facility funded by UWE and the West of England Institute of Technology, built to train engineers using ‘technologies of tomorrow’.

Half of the Gallery is designed to replicate Industry 4.0 approaches to manufacturing and engineering. This includes the Igloo CAVE - the Gallery’s primary visualisation and design tool, where groups of staff and students can get inside their 3D models and collaborate on design and engineering projects. Once a prototype is ready, it can be manufactured using the [Festo](#) and [Siemens](#) smart factory, where 3D-printed or CNC-machined components can be assembled on an automated production line. Finally, a machine vision learning system from [Scorpion Vision](#) is available for product testing and quality control.

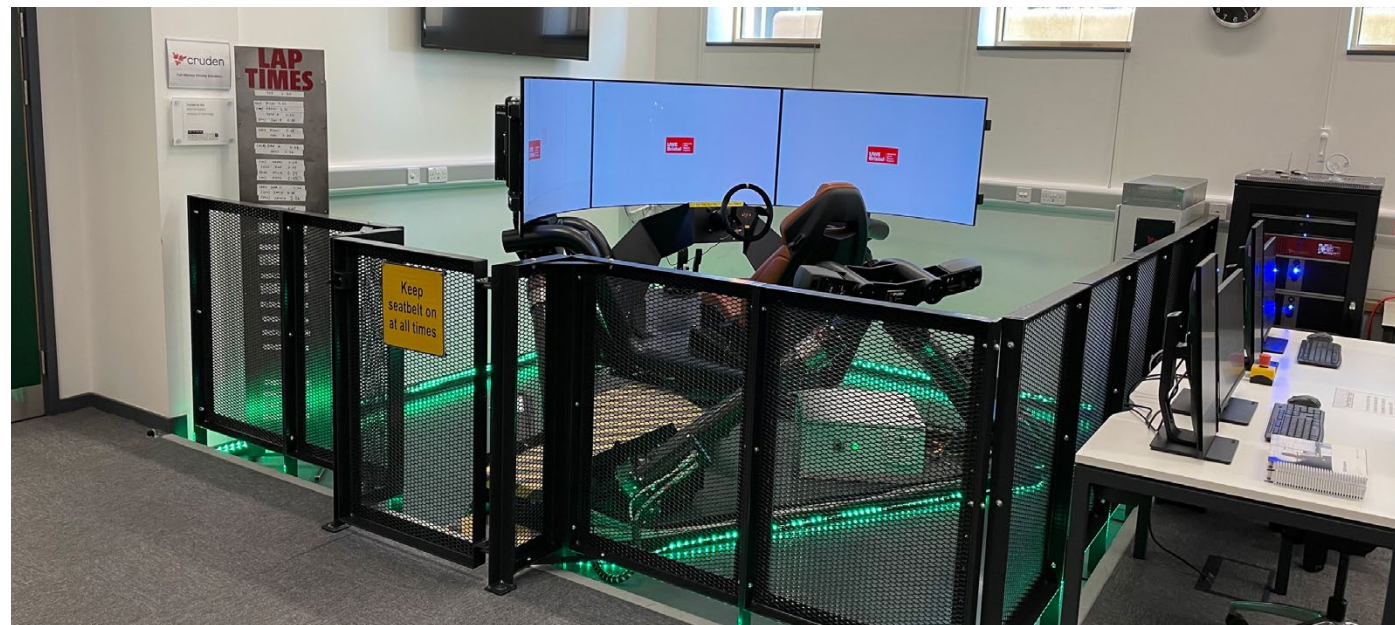


The other half of the Gallery includes a driving simulator by [Cruden B.V.](#) and a flight simulator by [Elite](#). Automotive students can design drive-chains, suspension and vehicle components using [MathWorks’ Matlab and Simulink](#) and test their performance on LiDAR-scanned tracks. Or aeronautics students can test designs for aerofoils and fuselage and test their performance across different flight scenarios and conditions in [X-Plane 11](#).

“Andy Hill, Senior Technical Instructor at UWE describes the main objective of the Digital Engineering Gallery as:

“doing as much engineering on computers as possible to save time and money before doing it physically.””

What makes the Digital Gallery so exciting is the way it incorporates so many simulation technologies side-by-side, with the Igloo CAVE at the heart of the design process.



What is Industry 4.0?

Industry 4.0 refers to the latest wave in transformative technologies used to advance design, manufacture and distribution. These technologies include things like advanced robotics, artificial intelligence, sensors, cloud computing, the Internet of Things, data capture and analytics, digital fabrication and advanced navigation tools.

“UWE’s Andy Hill described the fourth industrial revolution simply as the data revolution, with the Digital Gallery emulating modern manufacturing which is:

“fully automated, data driven and cutting edge.””



The situation

The University needed a space to educate, research and engage.

In 2021 UWE received a £1million grant from the West of England Institute of Technology to develop a facility which would improve digital engineering skills in the local area. The Digital Engineering Gallery, located in the University's new engineering building, is designed to meet three key objectives specified in the grant:

Education

To train university students with digital skills using the technology of tomorrow

Research

To incorporate the equipment into the University's world-leading research projects

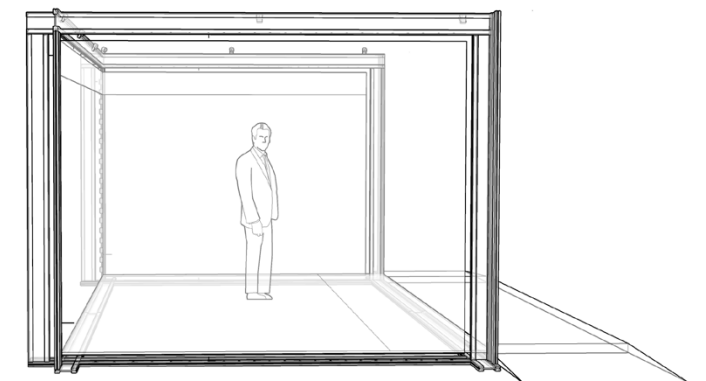
Outreach

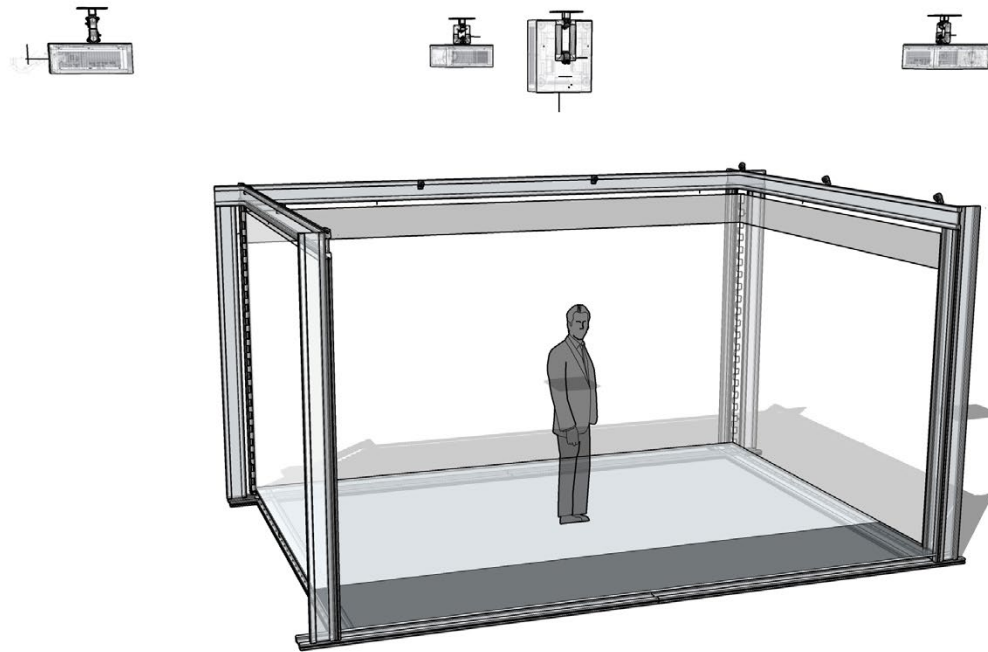
To work with local schools, communities and industry to support technology engagement and continual professional development in the Southwest

The solution

An Igloo CAVE was specified to help achieve those three key objectives.

An *Igloo CAVE* is one of the most sophisticated visualisation systems provided by Igloo Vision. CAVE is an acronym for Cave Automatic Virtual Environment and is a tool that has been used in infrastructure projects and academia for over two decades. CAVEs typically include 3D projection and perspective correction combined with motion tracking, which make it possible for users to move around virtual objects and view them from different angles.





UWE's Igloo CAVE is a 5 x 3.4m open-fronted immersive room with rear and floor projection, which can fit up to six people standing inside. The display is powered by four Digital Projection E-Vision 11,000 projectors, capable of 4K resolution and 3D projection. It also incorporates an Optitrack system which tracks head and VR controller movement.

The CAVE takes advantage of [Igloo Core Engine](#), Igloo's operating system for immersive rooms which is optimised to display industry-standard BIM and CAD tools, game engine-based content, as well as web-based data, Google Street View and Google Earth. All this is powered by an [IMPIII media player](#), our most powerful media server designed to run any GPU-hungry real-time content.

How motion tracking, perspective correction and 3D projection work together for an enhanced VR experience

In an Igloo CAVE, users wear 3D glasses with stalked markers (that look a little like antenna) can be accurately picked up by motion tracking cameras. The system tracks their movements and our perspective correction software adjusts the virtual environment accordingly.

The 3D effect means that objects appear as if floating in mid-air and motion tracking enables the user to move around and interact with these objects in a natural way, just as they would in the real world. A user looking at a car for example, could crouch down to view the underside of the vehicle or lean into the windows to check out the interior.

The result

We visited UWE twelve months after the installation to see how staff and students were using the CAVE to visualise a range of data and digital models, and how the Igloo was helping to fulfil the Gallery's commitment to teaching, outreach and research.

So far, the CAVE has been used for:

1

Virtual design review

Civil engineering students have been using the CAVE to go on virtual walkthroughs of their designs for truss bridges, built in Autodesk and imported into the Unity game engine. And the CAVE enables up to six students to carry out design review on a project, compare data and spot potential clashes. Engineering students also review CAD assets in the CAVE to check for any issues or clashes before 3D printing.

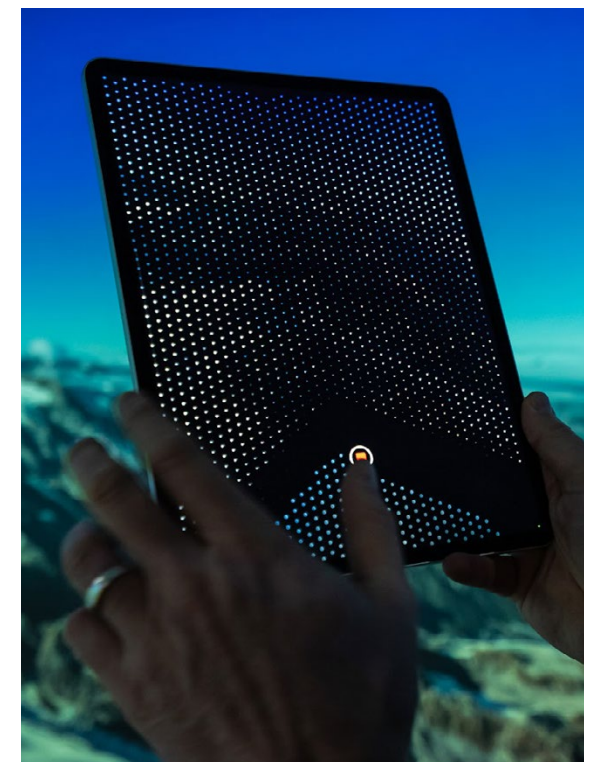
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Visualising LiDAR data

The University has invested in a point cloud scanner which uses LiDAR to create a 3D model of an interior space or outdoor environment. Students and staff in building science use the CAVE to view this data, allowing them to carry out digital surveys of built environments and preserve site data at various stages of development.

What is LiDAR?

LiDAR, short for Light Detection and Ranging, is a technology that uses lasers to measure distances and create detailed three-dimensional maps of the surrounding environment. A LiDAR device emits laser beams that bounce off objects and return to the sensor. By measuring the time it takes for the laser beams to travel to the object and back, LiDAR can calculate the distance to the object with high precision. This process is repeated multiple times from different angles to generate a 3D map.



3

Adjust designs in realtime

LiDAR scans can also be exported into Revit, from which students in architecture and Building Surveying can make changes to a building inside the Igloo in realtime.

“

Oliver Davey, UWE's Building Science instructor described how

“Something that it would take a building surveyor hours to do, we can do in about an hour-and-a-half.”

4

View historical buildings in their original form

The LiDAR scanner has also been used to scan the ruin of an old colliery. The model was then imported into Revit to remove any modern features and reconstruct the buildings in their original form and restore the old industrial equipment. The project is a test case to explore how the VR CAVE can be used in history teaching and research.

5

Analyse buildings impacted by conflict

In conjunction with the UWE's Heritage in the Crossfire research project, the CAVE has been used to visualise 3D models of historical buildings impacted by recent conflict in Libya. These models are created using photogrammetry, a technique for extracting 3D data from drone photography which can then be imported into Unity to add further texture. Students in Geography can then carry out virtual ballistics analysis of buildings in conflict zones, often too dangerous to visit in person.

“

Justin Robbins, a technical instructor at UWE described how

“it really brings it to life... seeing a bullet hole or a tank shell you can almost put your arm through.”

6

Continual professional development

As part of UWE's outreach programme, the Digital Engineering Gallery team has been running continual professional development (CPD) courses for local organisations, including the Ministry of Defence, NHS, GKN Aerospace, Airbus and Rolls Royce. These courses introduce industry experts to the latest simulation tools and how these can be used to save time and money.



Going forward

As staff and students become more familiar with the Digital Engineering Gallery, UWE Bristol is looking to rollout the use of the CAVE across engineering disciplines, ensuring that aerospace, automotive, manufacturing, design, games technology and robotics students all get maximum use of the space.

The University also has potential research projects in the funding pipeline which seek to make further use of the lab:

- The School of Applied Sciences is exploring a project which uses the CAVE to create a controlled stimulus environment for studies in the treatment of post-traumatic stress.
- In partnership with Gloucester Council, UWE is looking at ways to integrate the drive simulator and the VR CAVE so they work together in realtime. The idea is to have someone driving in the drive simulator whilst someone is interacting with a crossing in the VR CAVE to carry out research which could improve road safety in the Southwest.

Evaluating the impact

The Igloo CAVE has proven to be a valuable tool for students, staff, and external users in the Southwest. It is currently being used across various engineering disciplines to view multiple types of content, fulfilling the Digital Engineering Gallery commitment to teaching, outreach, and research.

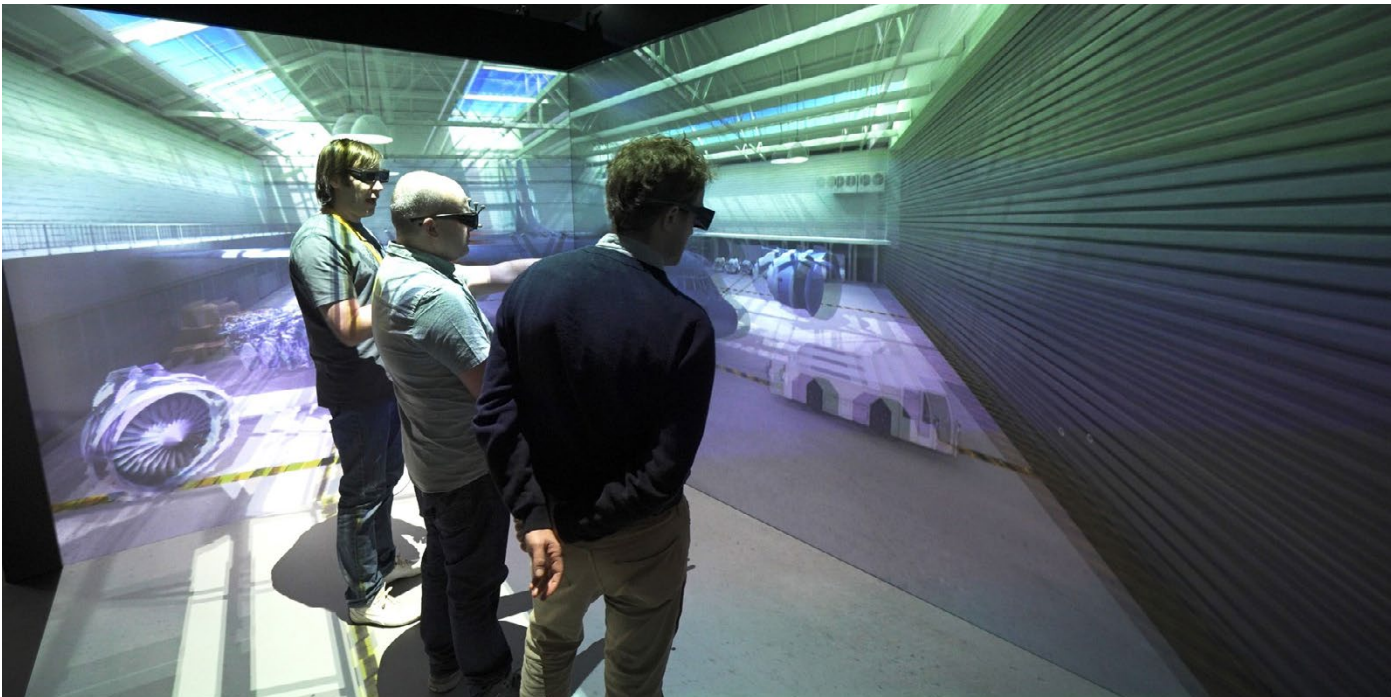


“ On preparing students for industry

The students coming through now are getting a lot more hands-on experience, because we’re working in partnership with local industries within engineering, civil engineering and aerospace, and I think their experience in here with digital tools will make them more employable in the future.”

This will be a really useful experience for the students. We’ll be able to develop lots of different ways for students to experience all different kinds of environments, depending on whatever subject they’re doing. They’ll be able to go into plant rooms, historic buildings, geographical sites, all different kinds of things. It’s just up to our imaginations and their imaginations to see where they can go.”

Architecture has adopted VR as a design tool. So not only is the VR CAVE a good teaching and learning experience, but it’s also what industry is using. So that’s one of the reasons we were really interested in looking at an Igloo system.”



“ On the value of shared VR

Viewing 3D objects in a VR headset is good, but there’s nothing like a bit of collaboration. Working collaboratively is fantastic. And this is the first time we’ve been able to view 3D models collaboratively.”

In the Igloo, they can be relaxed, they can look around, they can choose what they see and they can share the experience. So yes, it is a much better way of experiencing virtual reality.”

“ Reactions to the Igloo

On our open days we get students coming here and they see all the different pieces of equipment and they find it a great inspiration to learn about the future of technology and digital design.”

It doesn’t matter their age, whether they’re a 60-year-old professional or a six-year-old primary school kid. They are amazed.”

...every time we take students in there, they are always amazed... they’ve never experienced being in a CAVE before and they love it.”



For more information

Igloo Vision is the shared immersive workspace company

We design, develop, and deliver immersive technology and software that takes any digital or immersive content and puts it into a shared immersive space. It's a bit like stepping into a giant VR headset.

From bases in the UK, USA, Canada, and Australia, we work with clients worldwide to help them work faster, smarter, and safer.

To find out more

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