Application of Virtual Reality in Built Environment Education: a student-orientated framework

Abstract

The application of Virtual Reality in Built Environment learning and teaching has the potential to make a positive impact on student experience and outcomes. This report documents the stages involved in developing a student-orientated framework for integrating Virtual Reality into Built Environment education. The overall aim was to create a virtual reality simulation of Anglia Ruskin University’s Chelmsford campus, and to design tools which students across Built Environment disciplines can use as a platform to evaluate new developments, which can be adapted to simulate the wide range of situations and contexts experienced in the real world, and which may be utilised by part-time, full-time and distance learning students. The work was funded by a Learning and Teaching Project Award in 2010.

Keywords

virtual reality, 3D modelling, technical skills, built environment

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Introduction

The significant expansion in the use of 3D visualisation techniques which has taken place over the last 20 years has offered new opportunities to engage users in active, collaborative participation in ‘realistic’ virtual environments, or ‘Virtual Realities’, interactive computer simulations that echo the participant’s actions and give the feeling of being immersed or present in the simulation (Sherman and Craig, 2003). A form of virtual reality has long been used by Built Environment practitioners, teachers and students, in the form of 3-dimensional models which transform 2-dimensional drawings and plans into ‘virtual’ representations of projects in a 3D form. Such models, either in physical or computer-generated, may depict the current state of land or buildings, the proposed end-result following development, or interim stages. They aid appreciation of the impact which development projects have on the environment, of the design challenges and processes involved, and of the benefits to people, but do not offer the added features of immersion in the virtual environment and the ability to interact with it which are available in Virtual Reality models.

This project, which was awarded a Learning and Teaching Project Award in 2010, is underpinned by the principle that the learning experience is enhanced if students create the models themselves. The overall aim was to create a virtual reality simulation of Anglia Ruskin University’s Chelmsford campus, and through doing so to design a student-orientated teaching and learning environment which students across Built Environment disciplines can use as a platform to evaluate new developments, which can be adapted to simulate the wide range of situations and contexts experienced in the real world, and which may be utilised by part-time, full-time and distance learning students. The project complements earlier research undertaken by the authors to stimulate students’ learning using Virtual Worlds, and in particular Second Life, as a delivery mechanism (Hockey et al., 2010; Jimenez-Bescos et al., 2011).

Methodology

The decision to build a virtual model of the Chelmsford campus - a ‘Virtual Campus’ - allowed the authors to manage and implement the entire process, from collection of data to dissemination of the model, and provided a familiar environment to which students could relate.

The first phase of the project involved a design-build-test-review cycle implemented by the researchers. Testing allowed assessment of both the modelling process and the end-product, the Virtual Campus model, from a user perspective. The process utilised software and data sources already available to or easily accessible by the Department of the Built Environment, as shown in Figure 1. Options for presentation of the virtual model included desktop applications and the Department’s Virtual Reality laboratory. The facilities here include a fixed 3D stereographic projector and large screen, providing the user with an immersive experience similar to watching a 3D film in a theatre.

Using the Chelmsford campus masterplan and additional data collected on site, a first stage model was created for dissemination to Built Environment students during Fresher’s week. This permitted an evaluation of users’ receptiveness to a 3-dimensional representation of the campus as an orientation tool. A second stage, enhanced Virtual Campus model was built and demonstrated to a group of students with varying levels of technical skills in the Department’s Virtual Reality laboratory. Feedback from the attendees was collected by means of a questionnaire pre- and post-viewing to capture their impression and expectations of 3D models.

In the second phase of the project, the potential for integrating Virtual Reality models into the Built Environment curriculum was evaluated and a framework was developed to maximise integration into the curriculum. This minimises the technical, computing load on students whilst maximising the benefits in terms of visualising and investigating the virtual environments created.

The Modelling Process

The 3D Virtual Campus model was built following the process displayed in Figure 1. It comprised three main elements: 3D model creation data and software; Worldviz Vizard which provides the platform for integrating 3D models, multimedia and user interaction; and the virtual delivery option (the virtual model can be used on a desktop computer or displayed using stereographic projection facilities). Autodesk 3D Max was selected to create the Virtual Campus model as it allowed for more detail to be inserted into the model than would Google’s popular SketchUp. The incorporation of terrain data, elevation data, and
topographic data from the Ordnance Survey and LandMap added complexity to the process, requiring pre-processing and transfer of data between interim software packages before assembling a final model in Autodesk 3D Max.

Findings
Figure 2 shows the first stage Virtual Campus model, which was featured in the Built Environment Department Newsletter to Fresher students in September 2010. To reach the large number of students involved, the model was presented in traditional paper medium, allowing an evaluation of the impact of the additional information portrayed by the model, such as building heights and mass.

The model proved successful amongst students and staff as it transmitted useful information regarding the environment in which the students were studying in an attractive and informative way. The model offered a step forward from a 2D map as it allowed the user to relate to the shape and orientation of the various buildings, roads and paths, river, open spaces and car parking areas, together with an added sense of the mass of the buildings, both as free-standing elements and in relation to one another.

Following further development, an enhanced Virtual Campus model was demonstrated using stereographic 3D facilities in the Department of the Built Environment, as shown in figure 3. The demonstration took place during an Anglia Ruskin University ‘Uni4U’ event, and allowed attendees to experience the immersive and interactive features of a Virtual Reality application.
Feedback collected via a questionnaire during the event revealed that attendees welcomed the opportunity to experience the use of Virtual Reality, and were able to recognise the real world of the campus in the Virtual Campus and situate themselves in it. This was facilitated by inclusion in the model of enhanced data relating to building and infrastructure layout, landscaping and topography. The majority of respondents stated that they would use the technology to visit virtual buildings or virtual cities. A small number of comments suggested that the increased availability of 3D movies raised expectations of the facilities available in teaching and learning contexts.

**Developing a Student-Orientated Framework**

The concerns outlined above were addressed via the design of the simplified student-orientated framework presented in figure 4. The framework comprises a modelling guide which students follow, and uses Google SketchUp to minimise the compatibility and integration issues of the initial modelling framework. It then incorporates a virtual reality checklist, where students select the different features and delivery options they wish to include in their model. As Python, the programming language used by the Worldviz Vizard to generate a virtual model, is standardised, the checklist functions as an end-user programming tool structuring the Python programming ready for submission to Worldviz Wizard.

![Figure 4: Student-orientated framework](image)

It is envisaged that, by following this student-orientated framework, any student in the Department of the Built Environment could make use of a virtual environment to display and present their own 3D models. Use of this framework will be a first step in the integration of Virtual Reality into learning and teaching in the Built Environment.
Conclusions

The complexities of developing and deploying virtual reality technology in a learning and teaching setting are real, as demonstrated in this report. However, adoption of a staged student-orientated approach will bring the integration of Virtual Reality into the Built Environment curriculum a step closer. The researchers believe that the use of Virtual Reality will make an impact on the quality of students' work and assist curriculum delivery to match the abilities of future cohorts of students who are increasingly familiar with technology. Students progress through their University career developing a knowledge of and skills in Virtual Reality technologies, leaving with a heightened awareness of the applications and potential of Virtual Reality for their professional life.

References

