



Virtual^{site} – visualizing the construction process

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Abstract

Virtual^{site} is a learning resource funded by the National Teaching Fellowship Scheme (NTFS) that offers a range of on-line construction-related educational materials for use in schools and Higher Education Institutions (HEIs). Using the latest media technologies, photorealistic virtual tours of building projects are being created. Not only can users navigate each site, viewing projects at different stages of construction, but they can also access more detailed information via hot spots superimposed on the panoramic scenes. On completion Virtual^{site} will also comprise quizzes for school-children, a gallery of site photographs and careers information. Numerous local contractors and suppliers in West Yorkshire have contributed to the project and the media database currently holds over 800 images, panoramic scenes and object movies.

Keywords: QuickTime VR, panoramas, object movies, digital photographs

Good practice points

- Promoting a culture of shared ownership of multi-media resources has a two-fold benefit. Not only is greater use made of existing learning materials but also a willingness to develop and pool new resources is apparent.
- Creating a central digital catalogue of slides, transparencies and videos is a simple, yet effective, means of improving access to valuable visual resources.
- Having the right tools for the job is a pre-requisite for the efficient production of high quality panoramas and object movies.
- Investment in interactive multi-media is only justified when it provides learners with new tools to aid the comprehension of complex problems.

Introduction

Concerns that academics, when urged to transfer existing educational materials into digital format suitable for CD-ROM or the Internet, simply add sound and images without sufficient consideration are often aired (Stemler, 1997; Stoney and Wild, 1999; Fowler and Mayes, 1999; Riley and Gallo, 2000). Poorly designed materials, they argue, neither intrinsically motivate students to make use of these resources nor do they learn from them. Hence the challenge for multimedia designers is to create learning environments that enable students to examine, perceive, interpret and experience information so that they might convert this information into knowledge (Chaloupka and Koppi, 1998).

Virtual^{site} is a learning resource funded by the NTFS that offers a range of on-line construction-related educational materials for use in schools and HEIs. As such, Virtual^{site} does not explicitly seek to provide the immersive educational experience envisaged by these authors, but is more closely aligned with the concept of learning objects – providing academics and developers with a variety of media e.g. digital photographs, panoramic and

multi-row object movies and case studies, that can be used to enhance conventional PowerPoint presentations, provide scenarios for assessment tasks or complement student assignments. Indeed emphasis is placed throughout on flexibility, as the resources are equally suited to staff and students.

Whilst Virtual^{site} provides a repository for existing learning materials within the School of the Built Environment at Leeds Metropolitan University, new resources are also being developed. Using the latest media technologies, photorealistic virtual tours of building projects are created by linking QuickTime VR (QTVR) panoramic movies. Users are able to navigate around building sites, viewing projects at different stages of construction, and access more detailed information via icons superimposed on individual panoramic scenes. This paper outlines the process used to create seamless panoramic images and multi-row object movies; the techniques employed to embed QTVR objects within panoramic scenes; and early attempts to integrate these resources in the undergraduate curriculum.

Virtual^{site}

In recent years there have been several successful attempts to bring the construction site into the classroom – in particular, CALVisual and SiteCam. The former established a database of images relating to construction whilst the latter, using a variety of media, focused on the construction process. Virtual^{site} seeks to build on these valuable resources, and explore new ways to offer students greater control of their learning. Since the site was launched last year a collection of over 800 images of construction activity has been placed in the Virtual^{site} gallery (see Figure 1) together with a smaller number of panoramic, single-row and multi-row object movies. Efforts to integrate these resources have begun and the website now contains a major case study (i.e. the A1-M1 Link Road) and a virtual tour of a housing development. Work on the latter continues as learning objects are embedded on panoramic scenes and a recently commenced refurbishment project provides further opportunities to broaden the nature and scope of the learning materials on offer.



Figure 1: Virtual^{site} gallery

Virtual^{site} will shortly comprise a series of school-based activities, which seek to encourage children of all ages to think about careers in construction. Based on the work of Keel *et al* (2004), and using some of the resources described in this paper, these exercises will be aligned with the National Curriculum. Children and teachers will be able to download presentations, follow links to FE and HE courses and use short video clips, which feature typical weeks in the working lives of project team members. Recognising the strides that have already been made by many professional bodies and organisations, notably CITB-ConstructionSkills (www.bconstructive.co.uk), to promote careers, the resources being developed are consistent with the philosophy of Virtual^{site} i.e. to complement existing initiatives and make available a wide-range of flexible resources.

Learning Objectives

Specific learning objectives that Virtual^{site} seeks to achieve include:

- To provide staff/student access to a database of construction-related images, panoramas and multi-row object movies;

- To devise quizzes and school activities for Year 3/4 and Year 9/10 school children, which complement the National Curriculum;
- To produce a careers diary and provide links to related FE and HE courses;
- To evaluate the effectiveness of photo-realistic QTVR scenes in built environment education.

Web-based photo-realistic QTVR movies

The principles used for the creation of digital panoramas are similar to those used by photographers for many years (Dickinson *et al*, 2004). With the aid of a camera and tripod, a series of overlapping images are stitched together with an appropriate software package e.g. Adobe Elements or Realviz Stitcher. However, Kaidan's 360 One VR optic (see Figure 2a) offers a simpler, if initially more expensive, solution. The doughnut image produced by the optic's inverted convex mirror (see Figure 2b) is transformed using PhotoWarp software to produce a seamless panoramic image (see Figure 2c).

VR Worx software creates a virtual panoramic movie, linking the left and right edges of the image to form a cylindrical shape, which the viewer can pan, tilt and zoom about (Proni and Weisman, 1999). The scale and window size of the finished movie are defined, as are compression settings, to achieve the necessary balance between file size and image quality – a consideration which is particularly important when planning web-based delivery. High quality results can be achieved in minutes rather than the hours or perhaps days needed when using more conventional techniques. Moreover, VR Worx enables multiple QTVR movies to be linked together, allowing users to move between individual scenes and view the whole site.



Figure 2a: Kaidan 360 One VR optic



Figure 2b: Doughnut-shaped image



Figure 2c: 360 degree view of the construction site

Creating and embedding QTVR objects movies within panoramic scenes

A QTVR object movie allows a viewer to interact with an object and reveal different views by clicking and dragging an object with a mouse or by using keyboard commands (Proni and Weisman, 1999). Objects can be created as single-row movies i.e. objects can be spun through 360 degrees in a horizontal plane, or as multi-row movies i.e. objects can be tilted in all directions. As such, this form of media offers a powerful tool which can help students visualize construction components and equipment.

Figure 3 shows an automatic optical level placed on a Megellan M-2000 object rig half-way through the shooting of an object movie. Photographs are taken at 10 degrees intervals as the level is rotated on the turntable and, for multi-row object movies, additional rows of photographs are taken at various angles through the vertical plane. VR Worx assembles these images and creates a QTVR object movie.

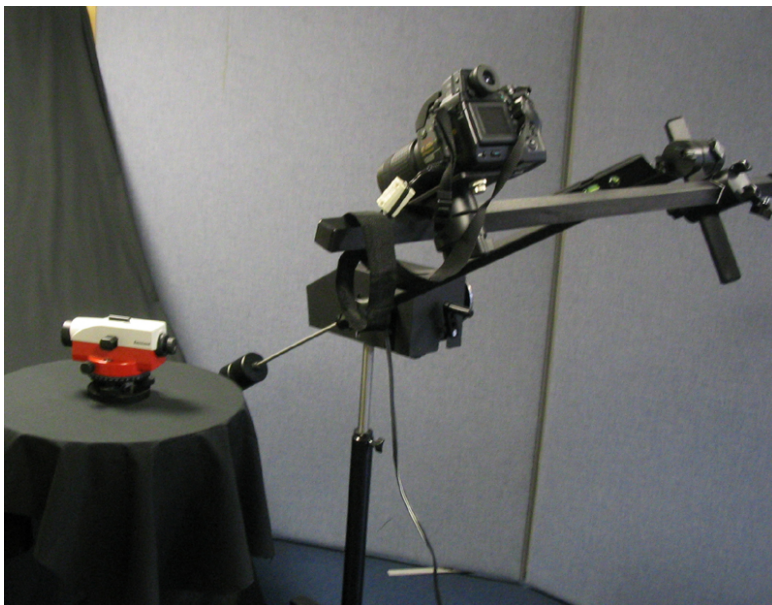


Figure 3: Kaidan Megellan M-2000 object rig

VR Worx also allows panoramas to be linked, via hot spots drawn over each scene, to traditional linear movies, static images, sound and object movies (Proni and Weisman, 1999). Hence, there is the potential to create an immersive construction environment, which goes some way to achieving the goals set by Chaloupka and Koppi (1998).

Virtual^{site} in the curriculum

The housing project, which forms the basis of a virtual construction tour on the web-site, was used in 2004 to provide first year students with a realistic context for their studies. Using the scheme layout and various house types on a semester one 15 credit undergraduate module, *CAD and IT Applications*, approximately 150 students were required to measure the area of the building site, forecast income and expenditure throughout the project lifecycle and create a presentation on future trends in the housing market. Virtual^{site} enabled students to navigate around the site and to use relevant images from the gallery to tailor their presentations.

Early student reaction to the module has been encouraging:

Lively teaching style and interactive atmosphere; good variety of exercises; interesting topics; as a group we have learnt a lot of new IT skills and are pleased; The IT lessons have gone well and ... presentations were of high quality.

However, the configuration of student and staff platforms to facilitate the smooth operation of QTVR multi-row objects and panoramic movies has led to difficulties. Conflicts in MIME settings between applications and excessive load times were the source of initial access problems. Further compromises in image quality were necessary and the parallel development of web-based and DVD resources are currently being considered.

Many built environment students will use an automatic optical level early in their studies (see Figures 3 and 4). Perhaps they will crowd around the tripod whilst the tutor demonstrates how to operate the level before being given their

chance – whilst some students, of course, will be some way off holding the staff! The object movie is no substitute for hands-on practice, but it does offer everyone the opportunity to gain familiarity with the equipment. Although it is a time-consuming task to annotate to object movies, superimposing labels on individual photographs, the benefits gained can be significant. Figure 4 shows a six-row, fully annotated QTVR movie which is to be used by tutors in the next academic year on introductory surveying modules.



Figure 4: Multi-row object movie

Resources available on Virtual^{site} have also been used at Open Days and, in conjunction with other activities, during school science and careers weeks. The potential to use and re-use the materials is proven but the extent to which Virtual^{site} can make a difference is very much dependent upon uptake. Clearly, the web-site must be populated with relevant content, and it is unquestionably teaching and lecturing staff who are best placed to make these decisions.

Further Developments

Visualisation of construction operations and the processes that occur on a building project is an important area which should have wide appeal in the built environment. A collection of images and movies are available for use (www.leedsmet.ac.uk/teaching/vsite) in project work and careers pages (under development) will add a further dimension to the web-site. Hopefully, these resources will be of assistance in enhancing educational delivery and graduate performance.

The creation of media-rich teaching resources is extremely time-consuming. It is essential, therefore, that such materials are closely aligned with educational need. However, the team is currently exploring ways to embed sound within panoramic scenes to enhance the construction site experience. Compromises in image quality, file size and platform build remain a concern and pilot testing will seek to establish the added-value gained by inserting directional sound into QTVR construction site movies.

Virtual^{site} has been running for 18 months and has received £50k funding from the National Teaching Fellowship Scheme, but the continued support of academics, contractors and consultants are crucial to the success of the project. The team would be delighted to work with HEIs/industry partners wishing to produce similar resources. Please contact i.dickinson@leedsmet.ac.uk to arrange a visit to the School – we can provide first-hand experience and instruction in the use of a range of digital media technologies.

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www.cebe.heacademy.ac.uk/learning/acbee/index.php

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