

Edinburgh: 200 years of heritage through image-based virtual environments

Mark W. Wright, Gordon Watson, Gair Dunlop and Roy Middleton

Edinburgh Virtual Environment Centre

University of Edinburgh, Scotland UK

Mark.Wright@ed.ac.uk



Figure 1: Panorama of Edinburgh from St Giles Cathedral. Robert Barker 1790. © Edinburgh City Art Centre

Introduction

Heritage is an important application of virtual environments. The key role of virtual environments in this sector is to provide a spatial context for historical records, artifacts and places. This spatial context makes the material more readily understandable by the public and provides a useful framework for teaching and research. Furthermore, the delivery of such material over the Internet turns heritage itself into a virtual commodity with all the associated economic advantages. Freed from physical and geographical constraints the material can be made available to a much wider audience at remote locations.

Recent advances in computer graphics have lead to the creation of highly photo-realistic “imaged-based” virtual environments. In addition, convergence of the disciplines of computer graphics and computer vision has given rise to techniques for capturing the 3D structure of objects and scenes and displaying them within virtual environments. This short paper reports on work in progress concerning the application of these new techniques to heritage. These applications are within the context of the “Edinburgh Royal Mile Project”. This project, sponsored by SCRAN [1]

(Scottish Cultural Resource Access Network), aims to create a virtual tour of Edinburgh’s Royal Mile by creating image-based virtual environments from a range of source material. It is convenient to divide the activities of the project into three areas as follows:

- Identification of suitable source material.
- Creation of image-based virtual environments from this source material.
- Delivery of the virtual environments to the end user.

In the rest of this paper we will report on each of these aspects of the project. Firstly, we will discuss issues concerning the identification of source material. Secondly, we will cover the creation of image-based virtual environments using a range of techniques including panoramas, image warping and hybrid model/image-based techniques. Finally, we will show that the concept of imaged-based virtual environments has a much longer history than is commonly accepted and describe how such environments can be delivered in different forms.

Identification of source material

Archive image gathering and selections were guided by both practical questions of access and by some aesthetic considerations. A wider range of institutions was initially approached, then the search narrowed down to four: The Royal Commission for Ancient and Historical Monuments of Scotland (RCAHMS), the Edinburgh Room at Edinburgh Central Library, the City Art Centre, and Edinburgh University Map Library. We were very lucky at this stage to be introduced to a private collector, Professor David Simpson, whose wide knowledge of early maps, drawings and panoramas contributed greatly to a wider social picture of Edinburgh's changes. Questions of copyright and negotiation for permissions took longer than expected, but co-operation and chances for future collaborations are emerging from this process.

We selected the pre-photographic era of around 1800 as the first zone of our project, then worked with photographs from the late Victorian period. The medium being the message, images available via calotypes (using paper negatives) seemed to convey an impression of much greater age than those of more crisp techniques such as collodion negatives, despite being made only 20 years or so earlier. Much of the surface differentiation of the prints is retained through digitisation, and this will perhaps convey the (correct) impression that these reconstructions are provisional documents, with both congruences and disagreements in different artists' views of the city and its changes. Occasionally there has been great difficulty in finding any images at all of a few places in our scenes. This is due partly to the search for the picturesque rather than the complete by artists, and also due to the social perception of the Royal Mile as a dismal slum with some attractive features which carried over into both the market for their images and the way they "pre-edited" their image selection. This perception has fluctuated but never quite receded from the 1800s until recent times. For instance, there are very few images of the south side of the High Street between the Tron Kirk and Parliament Square East.

Creation of image-based virtual environments

Image-based approaches to scene modeling have recently become increasingly popular in the computer graphics community. Imaged-based scene descriptions represent both texture and geometry discretely. In particular, there are no explicit models of surfaces or boundaries. There are two main advantages to this approach. Firstly, it is possible to create photo-realistic descriptions of

scenes. Secondly, the computational resources required for representation and rendering are effectively independent of scene complexity. This means that photo-realistic representations can be displayed and manipulated interactively. This is in contrast to model-based approaches using polygons for example. Polygon models can look unrealistic even with hundreds of thousands of polygons present. Also, as the polygon count increases more time is required to render the model.

In this project we are exploring the use of a number of image-based approaches to virtual environment creation. We have created contemporary panoramas using Live Picture, which is a technique similar to QuickTime VR [2]. We have also taken 2D historical documents such as paintings and warped them using a technique developed at Hitachi called "Tour into the Picture" or TIP [3]. Currently we are experimenting with a hybrid model/image-based technique called FAÇADE from Berkley [4], although it is too early for results.

Contemporary panorama making is in comparison straightforward. All that is needed is a wide angle lens, a panoramic tripod, a few specific site permissions, and some very early starts to beat the traffic and sun glare. A mixture of external and internal panoramas is being made and links between them are being created. We have been working in collaboration with Edinburgh City Council and the National Trust for Scotland who have given us access to Gladstone's Land (a 17th century merchants house, imaginatively restored). See Figure (2).

If we only have a single photograph or painting then it is not possible to create panoramas or extract depth information. However it is possible to create an impression of 3D structure by imposing a model on the subject by hand. This is the principle behind Hitachi's "Tour into the Picture"(TIP)[3]. Figure (3) shows an example of this technique applied to a painting of White Horse Yard in the CanonGate. The first frame on the left is the original. The next frame shows a morph to a new view point. The two frames on the right show the distortions that occur if the motion is extended due to inaccuracies in the user defined model.

The Barker Panoramas

It is generally assumed that the use of panoramic images for the creation of virtual environments is a modern invention dating perhaps from Chen's paper at Siggraph [2], in 1995. Further more, the use of panoramic images within large screen multi-user virtual environments such as the Visionarium is even more recent. Edvec has displayed a virtual

tour of remote Scottish Isles on the Trimension Visionarium at Siggraph 1998. It may come as some what of a surprise therefore, to discover that a patent for a large screen immersive image-based virtual environment was granted to Robert Barker in Edinburgh in 1787.

Barker was an itinerant portrait painter born in Ireland. He moved to Edinburgh in the early 1780's. The story goes that he was out walking on Carlton Hill with the whole vista of the City of Edinburgh laid out before him. He then had the notion that he would like to capture the entire view on canvas. What is certain is that a patent was granted in 1787 [5]. The patent mainly concerns the viewing of the panorama rather than its production. The panorama was hung in a large circular building called a rotunda with the painting wrapped around the wall like the label on a soup tin. Viewers were admitted to via a spiral staircase to a central gallery. Special note was made that the viewer should not see the top or bottom of the painting to improve the illusion "of being on the very spot". This is perhaps the first reference to the concept of immersion within a virtual environment.

Unfortunately, none of the large scale Barker panoramas have survived. However, there are a number of small scale panoramas which are about 30 centimeters high and 2.5 meters long. We have used modern imaged-based techniques to create virtual environments of this panorama and deliver it to viewers in different ways. The panorama we used was of a view from the top of St Giles Cathedral on the Royal Mile. This panorama belongs to the Edinburgh City Arts Center. The panorama was first photographed using a medium format film camera. The photographic slides were then scanned in using a high quality flatbed scanner. Successive images were merged in Photoshop to form a continuous panorama which is shown in figure (1).

We then created imaged-based virtual environments from the panorama in two ways. Firstly, we used Reality Studio to create a computer based panorama similar to those in QTVR. Just like a QTVR system, a small window displays a small portion of the panorama within a window. Dragging the mouse allows the user to see other portions of the panorama.

Although this system allows the user to view the panorama interactively, it does not produce the sense of immersion and presence that the original panoramas must have had. We therefore decided to deliver the panorama using a different mechanism; namely a head mounted display hosted by a Silicon Graphics Reality Engine.

The panorama was mapped onto a cylinder and viewed from the center using the graphics utility libraries of OpenGL. Rather than use a mouse for viewer interaction, a gyroscopic head tracker was used to determine the angle of the viewer's head. The system then rendered the corresponding view of the panorama for that viewing direction and delivered the image to a head mounted display, a Sony Glasstron.

As the viewer turns their head they see different parts of the panorama in a way which is much more like the original panoramas. This is the first time a Barker panorama has been viewed as an immersive image-based virtual environment for 200 years.

Conclusions

Work in progress has been presented on a project to create a virtual environment of Edinburgh's Royal Mile. A key focus has been the use of image-based modeling and rendering techniques. We have demonstrated the use of panoramas and image warping to created 3D environments from historical records. We have also shown that the concept of image-based virtual environments is an old one with its roots beginning in Edinburgh over two hundred years ago.

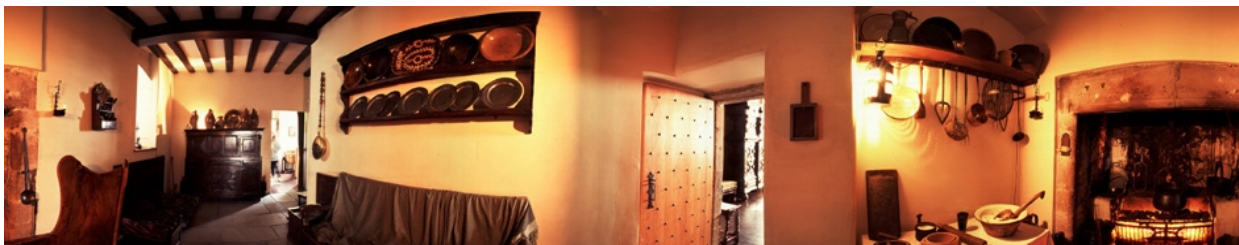


Figure 2: Contemporary panorama of a 17th Century Kitchen at Gladstone's Land, Gair Dunlop, © EdVEC

Bibliography

1. Scottish Cultural Access Network (SCRAN)
<http://www.scran.ac.uk>
2. S. E. Chen, Quicktime VR – An Image-based approach to virtual environment navigation. Siggraph95, pp29-38, 1995.
3. Y. Horry, K. Anjyo, K. Arai. Tour into the Picture: Using a spidery mesh interface to make animation from a single image. Siggraph97, pp225-232, 1997.
4. P. E. Debevec, C. A. Taylor, J. Malik. Modeling and rendering architecture from photographs: A hybrid geometry and image-based approach. Siggraph97, pp11-20, 1997.
5. R. Barker. Repertory of arts and manufactures 4, pp 165-167, [London,1796].



Figure 3: Morph of 2D image to change viewpoint by using a user defined perspective model . Created using Hitachi's "Tour into the Picture (TIP). White Horse Yard 1819, © Edinburgh Central Libraries