Visit VR Glasgow

Welcoming multiple visitors to the Virtual City

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The development of the Virtual Reality Modelling Language (VRML) for the Internet has resulted in the emergence of a multiplicity of 3D web sites. The metaphor used by these sites varies enormously from virtual galleries to virtual cities and style varies from abstract to reality. Additionally these worlds are populated by virtual objects, some having reactive or interactive properties, including movement, audio, video, databases, artificial intelligence etc. Perhaps the most stimulating embodiment of these new environments are those that offer the participant the opportunity to meet and communicate with other visitors exploring the same virtual space/world. The Glasgow Directory is an established 3D web space, with around 10,000 visitors per year. The model represents approximately 10,000 properties in the city and is populated by contextual information on its culture and socio-economic topography. This paper describes the background to this VR space, and suggests a set of design criteria for successfully deploying multi-user software within this and similar environments. These criteria take into account lessons learned by 'observing' and analysing how participants interact with the existing system under different conditions and also what benefits they perceive on entering the environment via the multi-user interface. These recommendations will hopefully be applicable to a wide spectrum of internet virtual environment builders and users.

***Keywords**: Virtual; city; 3-D; databases; interaction*

Background

ABACUS (Architecture and Building Aids Computer Units Strathclyde) is a research group based in the Department of Architecture and Building Science at the University of Strathclyde in Glasgow.

In the 30 years since ABACUS was formed, the group has explored many research directions, the most enduring of which has been centred on the visualisation of the built environment. During the 1980's the Unit developed an interest in the feasibility of modeling and manipulating large geometrical databases of urban topography. The opportunity to test the feasibility arose in 1984 when Silicon Graphics invited ABACUS, over a 4 month period to "test-drive" their newly launched computer, at that time the most powerful but unproven geometry engine processor in Europe.

Using their own software, the team built a virtual model of the city of Glasgow representing an area of some 25 square kilometers, and attempted to produce interactive real-time 'fly-throughs' using the massive urban geometry data-set. Backed with funding from 'Glasgow Action', a team of students was employed over the summer period to help with the mammoth task of capturing the necessary data. The students, under the direction of Mike Grant, Technical Director of ABACUS, digitized the 2-dimensional plan of the city then captured the average height of each building

by viewing, stereoscopically, pairs of aerial photographs provided by the City Council. The resulting 3-D database was "draped" over a 3-D model of the topography of the city.

The expectation of ABACUS was that the Planning Department of the City of Glasgow would inherit the model and become the Archivist, but such an idea was much before its time. A few years later, the more detailed model of Edinburgh Old Town (Maver, 1987), constructed by accessing 3-D data already held electronically by the national mapping agency and architecturally "featured" by parametric variation of roof and facade detail, was commissioned by the Edinburgh Old Town Renewal Trust and put into daily use, and maintenance to evaluate interventions in Scotland capital.

The 1980's Model of Glasgow – little more than a massive 3-D map – lay fallow until:

i. the emergence of the world-wide-web and VRML.
ii. the honour bestowed on Glasgow as UK City of Architecture in 1999.

The City of Architecture award opened up funding for the establishment of The Lighthouse (http://www.thelighthouse.co.uk), the most ambitious architectural centre in Europe, housed in a wonderfully refurbished building by Charles Rennie Mackintosh, and for the development of its electronic content. ABACUS was commissioned to provide a wide range of IT applications, from digital jigsaws to interactive guides to the building itself. Most importantly the Director of The Lighthouse, Stuart Macdonald invested in the development of an interactive web-based model of the city based upon the pioneering work of ABACUS.

Fortuitously, the 3-D geometric granularity of the 1980's model of Glasgow – the topography, the road networks and the 10,000 buildings – was just right to allow downloading of some 28 neighbouring city "chunks" which could then be interactively explored on the internet.

The Concept of VR Glasgow

VR Glasgow allows visitors, individually or together, to explore the city virtually in much the same way that they would in reality.

It achieves this by linking to a number of information sources, accessible through conventional Internet techniques such as lists, tables and search engines, as well as indirectly through the VRML. Unlike many Internet systems, there is no pre-set route to follow, or list of useful links. Information is accessed through intuitive exploration of the site, and therefor varies depending on both the user, and the chosen route. In this manner, the user becomes familiar with the virtual city, in much the same way as they would become familiar with the physical city. He or she may identify particular areas of interest, which can be revisited using familiar routes, or accessed via browsing.

Current information sources include:

- Multimedia database of General Tourist Information.
- Multimedia database of Glasgow Architecture.
- Alphanumeric database of property addresses and street names.
- External Web-sites.

The uses envisaged for VRGLASGOW, and built into its functionality include:

Tourism: A prospective visitor to the city of Glasgow can explore the virtual city before arrival, resulting in greater knowledge of where to go and what to see. Browsing the city can influence choice of hotel, entertainment or shopping area, and transport networks may be examined for choice of optimum route. Places of interest worth a 'real' visit can be identified and details printed out for use during their visit. The interiors of some 40 buildings of architectural interest can be interactively "visited" using QTVR.

Education: The Glasgow Directory is being used on various levels in an educational context. From primary school pupils, given access and tasks such as, 'explore their city', 'find their school' or 'count and locate the museum', through to university or college

students who could, by exploring the model, be introduced to the concept of computer modelling application and virtual reality.

Architects: Using the Glasgow Directory, architects access parts of the city model which relate to their design proposals. City data can be downloaded in a variety of file formats and used to enhance the presentation of new building or urban interventions. By displaying design proposals within the context of the city, architects and their clients, can understand and therefor assess the scheme more explicitly.

City Planning: Proposed change to the urban fabric can first be evaluated by simulating the change within the model. Any number of proposals can be analysed in parallel, with the public being given the opportunity to vote for their favourite, a process similar to that used in the Netherlands at Ljburg (fig 1).

Implementation

To enable the Glasgow model to become a shared virtual environment a suitable software package had to be identified. For ease of implementation the VNET client/server package was chosen. This software, as well as being simple to set up, is freely available and has the support of a relatively lively user group. It is also based on the Java programming language which enables it to run on a variety of hardware platforms.

The system relies on a VNET server program running on the host machine which handles communication with each remote client as they login and explore the 3D environment. The process of joining the shared space activates a Java program on the clients machine enabling them to see avatar representations and communicate with other participants via a chat window. The VRML virtual world is downloaded onto each client machine with the result that the communication data set handled by the server is restricted to positional and text information (fig 2).

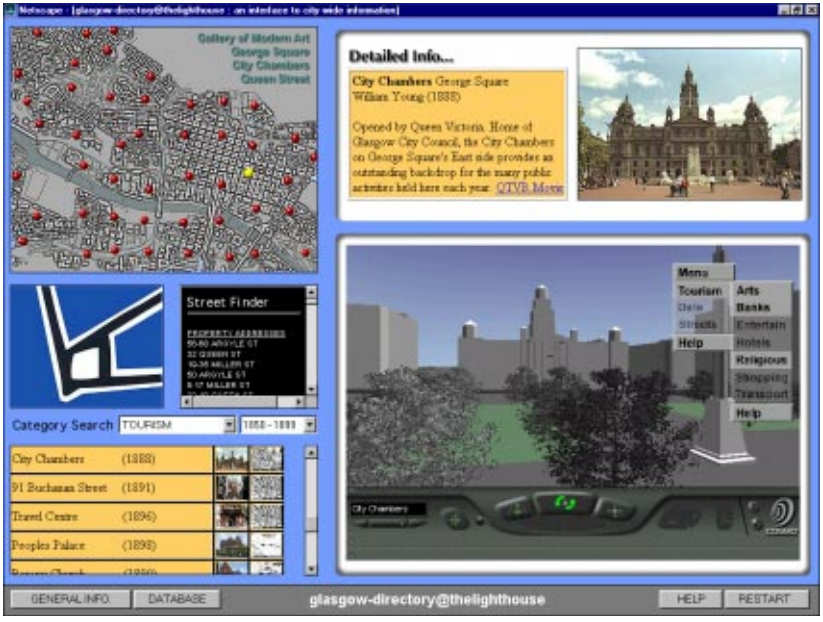


Figure 1. Typical interaction frame from VRGlasgow

Some customisation of the Glasgow model interface was necessary but once the interface was reconfigured all other aspects of the environment functioned normally.

Use of VRGlasgow

Information on how people used the Glasgow Directory has been a key feature in progressing its development. The system is capable of tracking user participation in a sophisticated manner. The resultant log files relating to 10,000 visits have been archived and have proved to be a valuable resource.

Direct user feedback has also aided the development process, and prior to the systems official launch in June 1999, 300 people registered to test the system. From that period alone 150 detailed feedback forms were received, and as a result, refinements made to the system.

In an attempt to aid deployment of multi-user functionality, profiles of visitors were studied. The aim was to understand which aspects and elements of participant experience and environment may be important in the context of this new functionality.

As a result of this new dimension, a new set of participant data is emerging. This not only documents which aspects of the environment is explored and the duration of each visit, but the number of participants sharing the environment at the time, and also a record of their communication.

The user types featured in the study were:

- a participant visiting 'alone' via the standard interface (http://iris.abacus.strath.ac.uk/glasgow)
- participant(s) visiting an interface designed and installed in a public gallery space
- participant visiting via the multi-user interface (http://www.vrglasgow.co.uk)

Visitors coming alone

Average time spent browsing the environment was 15 minutes. However two distinct groups emerged, those browsing and exploring the model, with an average time of 18 minutes, and those using the model primarily as a resource with an average time of 6 minutes.

Those 'exploring' the model were identified by their use of the 'view point' facility. This enables a tour of a city segment via pre-set observation points chosen from a menu. Those identified primarily as

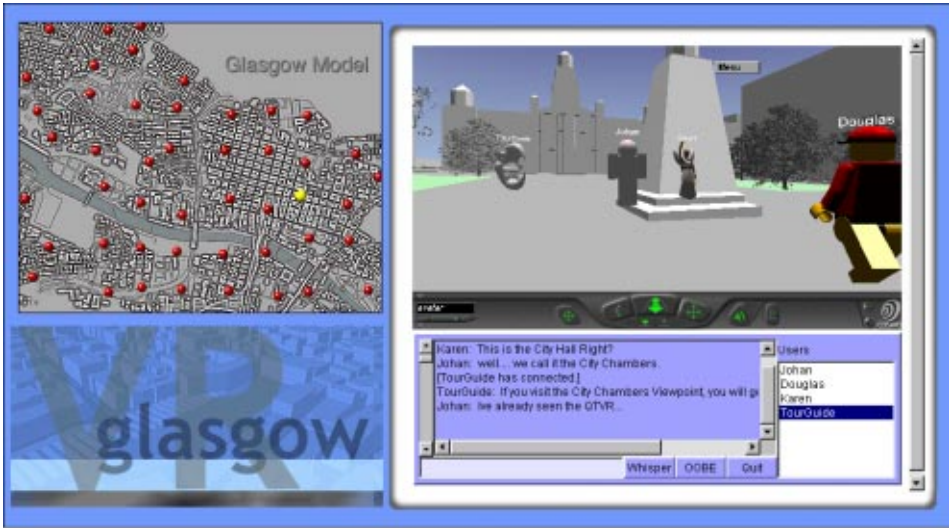


Figure 2. Multi-user Interface to VRGlasgow

using the model as a resource were accessing the 'street finder' facility which enables the model to take on the role of a 3D map and route planner.

Additionally 20% of those using the model were connected for more than 30 minutes, and 30% for less than 5 minutes. Most of those connected for less than five minutes used the street finder facility, suggesting that they connected, simply to check the location of a street or check a street name.

The most popular location to visit in virtual Glasgow proved to be the areas of George Square, Merchant City and Central Station, which are also the liveliest sections of the 'real' Glasgow, with the average participant visiting more than three distinct areas in the model. There was also a correlation between those using the street finder and those visiting only one relatively obscure zone of the model.

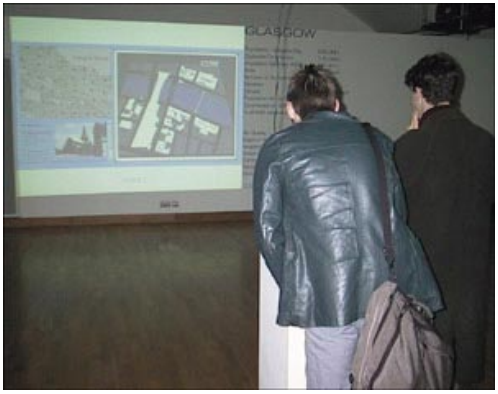
Visitors to the public gallery

Observations were made during the Meta-City Exhibition at The Lighthouse, Glasgow, during February and March 2000. A control system for the software was installed as part of the exhibition, and the results of user interaction was projected onto a wall in the gallery space, (see figure 3).

Average time spent using the system was 20 minutes, and frequently two or more people used it together. On occasion, direct help was given by the observer when participants experienced difficulty operating the hardware or software. Patterns of use were similar to those using the standard interface, except that the system was used less as a resource, and perhaps as a result, the average time spent was longer.

Also those using the software were already in the 'real' Glasgow while exploring the virtual city. Two related observation were of interest i.e. on occasion 'obscure' zones of the city were visited for relatively longer periods, and also when two or more people were present one would sometimes act as a tour guide. The former is suspected to be as a result of people familiar with Glasgow visiting areas of personal interest in the virtual environment (e.g. the street where they lived or worked), and the latter was an interesting chance to observe people acting as tour guides in a virtual world. For example one participant used three areas of the model to describe and discuss with another the difference between the 'old' and 'new' architecture of these areas, using the street layout as a guide to where the architecture from the past was located. Another group had a very lively discussion relating to new architectural developments in the city centre with one of the group acting as navigator or 'driver' (fig 3).

Figure 3. Gallery Users



Visitors coming together

Since this is the area under development, the number of observations gathered are limited at present.

The VNET software enables several people to share the city centre zone of the Glasgow model, to see avatars of each other moving through the zone, and to communicate via a text window.

Average time spent using the system was 50 minutes, longer than the previous user types with the nature of the visit of course containing a social element.

Three aspects were of particular interest.

- The fact that a tour guide was either present in the virtual world (via one of the ABACUS staff) or emerged naturally as a more experienced user guiding a less experienced visitor.
- It was noted that when the 'official' tour guide was present participants would have no hesitation asking for technical help or advice about the city.
- The environment was explored to a greater level by a higher number of participants, most likely as a result of tour guides explaining how to get the most out of the system.

The discussions recorded were also of interest with participants often relating to each other their experience of the 'real' Glasgow, as well as discussing the virtual world both from a technical and environmental perspective. Other virtual and real cities and environments were also discussed.

One problem encountered by visitors was that they often 'lost' one another within the environment because they broke visual contact or used the view point option to jump to another location. Time was then 'wasted' trying to meet up again often with one user describing to the other where they had gone and the other then trying to find them.

Further Development

The web-based feedback has been instrumental in formulating the strategy for future development, viz:

- More effort should be place on developing the central zone of the virtual city, since visitors tend to gravitate towards this area. Even those with no experience of the 'real' Glasgow were found to visit the city centre more than the surrounding areas. Regular developments of these zones will also encourage users to return.
- The valuable contribution made by a virtual tour guide should be recognised in future development and use. Regular times for virtual tours should be offered, and also the ability to contact a guide even if not present. The development of further automated tours should be considered, (there are currently two helicopter tours of the city).
- The system would benefit from the addition of a facility that helps identify the location of other participants. For example a map of the area with moving markers, one for each avatar.
- Avatars should be distinct from other elements in the environment. (regularly participants were found trying to hold a conversation with the helicopter and city statues).

The development and evolution of the Glasgow Directory as a shared cyberspace will continue, with the challenge being to integrate this new functionality in a way which adds value to the existing data set.

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