ONE CITY TO GO

A multi-modal approach to delivering city data

PHILIP BERRIDGE AND ANDRE BROWN
CAADRU: Simulation and Modelling Research Group
School of Architecture and Building Engineering
The University of Liverpool
LIVERPOOL L69 3BX
UK
p.berridge@liverpool.ac.uk
andygpb@liverpool.ac.uk

AND

MICHAEL KNIGHT
mknight@liverpool.ac.uk

Abstract. The work described here is aimed at developing city models, with underlying data, in such a way that the model and data can be accessed quickly and efficiently. A particular outcome of our approach to the work is that the model and associated data can be accessed through a palmtop device. This degree of portability opens up a range of opportunities to access this important information; the kind of information related to city models and associated data that is expanding daily.

1. Context

In the past mobile city information systems, without 3D graphic capability have been developed such as CitiKey [1] and Citysync [2]. Equally some - very effective net-accessible city information systems with 3D representation have been developed such as Virtual Glasgow (Maver, 1996; Maver *et al*, 2000) [3] and Virtual Cheltenham [4]. Over the past few years there has been experimentation and development of mobile city guides with 3D capability such as those described by Raposo *et al* (1997) and Belz *et al* (1998). One project of interest in particular is the Deep Map project (Coors and Wiedmann, 1998) that will embody 3D worlds in a mobile environment

[5]. Also of interest is the CyPhone project that aims to create visions of the future UMTS devices [6]. More recently Rakkolainen *et al* (2001) have developed their system to visualize real-time Global Positioning System (GPS) data through VRML worlds. Our work parallels and augments such recent developments, and does this by integration of associated digital technologies.

2. Accessibility

Many of the current web implementations of three-dimensional models require specialised browser plug-ins and are slow to access. Although VRML and other more specialised plug-ins provide a high level of functionality they have a small installed user base outside the CAAD and product design fields. We believe that at present this limits their usefulness, as functionality does not exist for the user if that functionality is not usable.

Much of our recent research has focused on using readily available, low-cost and generic technology to provide access to virtual worlds and 3D models at a city wide and building specific level (Knight and Brown, 1999). This new strand of the research applies the same strategy to providing access to three-dimensional city models and underlying information about cities and buildings over the Internet. We believe that this approach will make the data accessible to a greater number of users thus helping to support the urban planning process and facilitating end user consultation.

One initial programme of the research has focused on presenting information on significant buildings in Liverpool over the Internet using a number of different technologies [7]. At the core of this work is a three-dimensional city model and a web-based database that provides the content for the site. At present the database contains thirty-five buildings the data for which is split into 24 fields.

The database content is interfaced over the web in four ways; server generated web pages, interactive multimedia city architecture tours, PDA based tours and a ‘city navigator’.

3. The database methodology

A recent report by researchers at the University of California at Berkeley estimated that at the end of the year 2000 there were 2.1 billion static web pages accessible over the Internet with an additional 7.3 million pages being added every day (Lyman and Varian, 2000). Although Odlyzko (2000) advises us to be cautious of the huge growth statistics quoted in this field it is undoubtable that Internet growth rates are substantial.

Whilst it is clear that the Internet offers a huge mass of data it is widely accepted that many pages are of a reduced value as they are seldom or never updated. In order to improve the efficiency of the update process many sites store much of their content in a centralised database often allowing updates to be administered without knowledge of HTML. This database methodology has the added advantage of allowing data to be used multiple times throughout a site without the need for dual keying. This provides developers with the possibility of allowing wide-ranging access to up to date information in a variety of contexts. The multi-modal approach of this project benefits from this.

4. Server generated pages

When a user accesses a database driven web page the content is extracted from the database and added to the page by a server based script before it is sent to the user's browser. This approach forms the most basic method of accessing the Liverpool Architecture database. When a building is selected via a web-based form the HTML page that is displayed shows building data taken from the database.

The present HTML form uses a simple pull-down menu that lists each of the buildings in the database. The menu is generated from the database so when additional buildings are added they are automatically included in the pull-down menu. As the database expands the form will be modified to allow a more complex search of the data.

5. Interactive Multimedia tours

The second application of the data is in the form of two animated architectural tours of the city. While the web-based form allows individual building data to be accessed the tours provide a useful structure for accessing a group of buildings. At present the two available tours are based on the geographic proximity of buildings and cover the east and west business districts of the city. These routes are based on initial research carried out by the Liverpool Architecture Society.

The animated tours use a pseudo 3D model of parts of the city to show buildings in their context, making them easier to locate. The model provides users with an overall plan of the city with landmark and featured buildings modelled using simple primitives. The highly refined nature of the model drastically reduces end user download times but still provides enough data to show how each building sits within the overall cityscape. In addition to the model the tours use images and text based information from the underlying

database. This combination of a simple virtual model with supplementary photographic images provides users with a good level of contextual information whilst minimising access times.

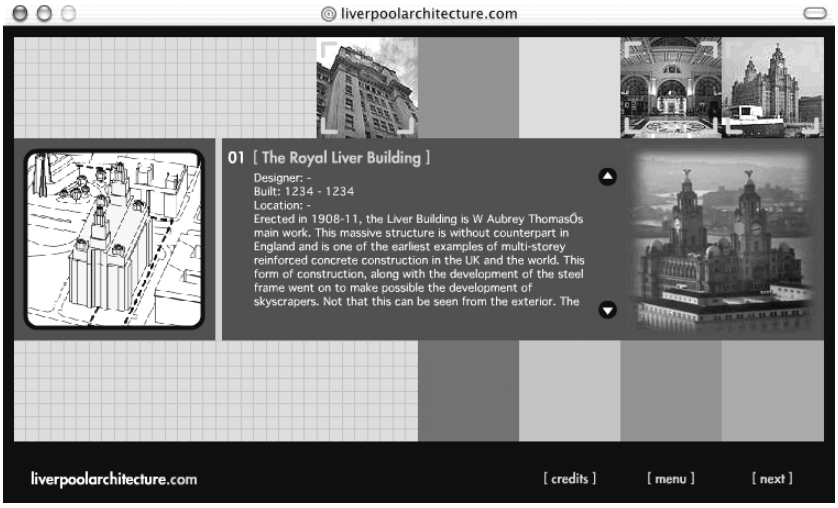

Figure 1. The tour interface showing the Royal Liver Building.

Many online tours use either linked HTML pages or VRML models whereas the two prototype Liverpool tours use Macromedia Flash technology (figure 1). This approach was chosen as it enabled simple animation of the 3D model using cross-platform technology that has a high installed user base outside design disciplines. The animation is limited to a predefined route that progresses from building to building as users navigate the tour.

6. Palm based tours

The third strand of the project is the customisation of the tours for mobile users. The work aims to exploit existing handheld computing technology and has focused on allowing access via a Palmtop device so that users can view the information as they do the physical tour.

Our Palmtop prototype (figure 2) allows access to the building database remotely (on site) via a web enabled PDA and this is being implemented currently. However, our work to date has concentrated on pre-installing the data for later off-line viewing (whilst on site). This results in a stand-alone portable system that has performance benefits, as it does not rely on wireless networking. It is, however, limited as it does not allow dynamic interaction with the database on location (Davies *et al*, 1998).

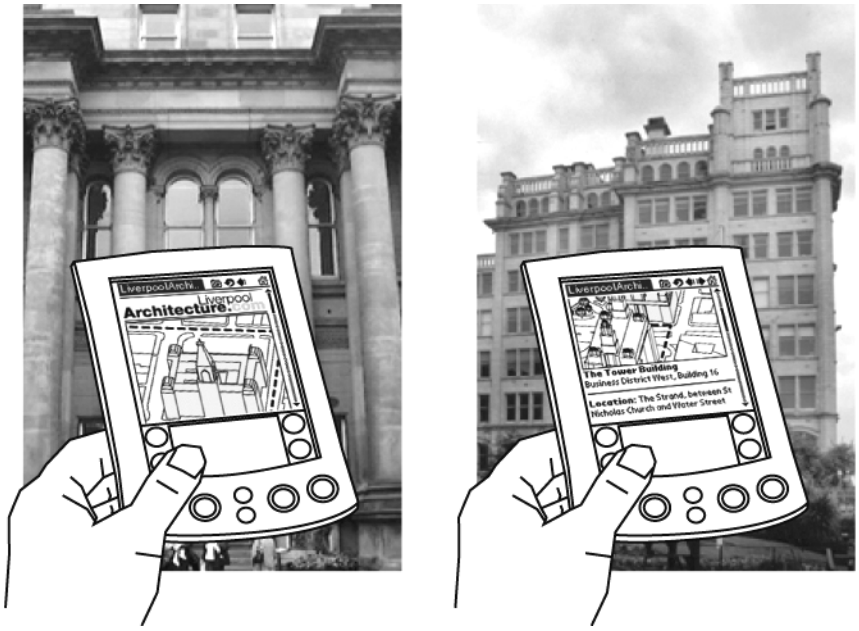

Figure 2. The PDA-based mobile tours

In order to allow a large number of users to easily access the data on a Palmtop the building data is viewed using AvantGo [8]. This software is now installed as standard on many PDAs and was selected for prototype development because of the project's emphasis on using low-cost/generic technology. AvantGo runs on the Palmtop and acts as a protocol gateway between the PDA and the HTML output from the web server hosting the database (Herstad, Van Thanh and Kristoffersen, 1998).

On the prototype when the database content is downloaded to a PDA it follows the specification stored by a default user profile on the web server. The default profile allows users to access both the east and west business district tours, with each building represented by a simple 3D model image, text description and directions. The enhanced prototype will allow users to define their own custom profile, enabling them to select the building data they wish to download thus creating customised Architectural tours of the city. These custom tours may, like the present ones, be based on the geographic proximity of buildings but users will also be able to search the database and build tours around other criteria such as building types, architects and periods of time.

7. The City Navigator

The fourth component of the project is the city navigator, which is concerned with applying a three-dimensional model to improve the usability of data. The objectives of this aspect of the work are to enable users to find out both *what* a building is and *where* a building is.

The system uses a small window to display an easily understood pseudo 3D model of the city. Only a portion of the model can be viewed on screen at any one time but users can freely navigate around, selecting buildings to access their database entry. When a user moves the cursor over a building basic data relating to that building is displayed, when a user clicks on a building the full database entry is displayed.

Landmarks provide key visual cues when wayfinding and it has been shown that 3D models help users to recognise landmarks and find a route in cities easier than symbolic 2D maps (Rakkolainen et al, 2001). The second objective of this strand of our work is to enable users to locate a known building within the city using the 3D computer visualisation for navigation support. To achieve this the city navigator combines the use of both the model and a HTML form to interface with the underlying database.

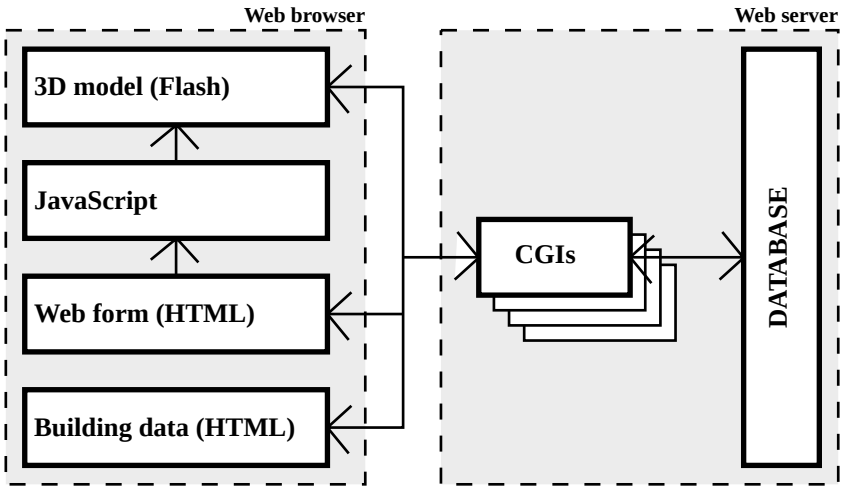

Figure 3. The city navigator system overview

When a user selects the building they wish to locate using the HTML form, the system visualises the query results by automatically navigating the model until the required building and its immediate environment are visible. The building's full database entry is also displayed using images and text.

The prototype city navigator uses HTML and Macromedia Flash technology and is accessible via a web browser. Communication between

the various elements of the system uses CGI and JavaScript protocols (figure 3).

8. Future developments

Our initial multi-modal implementation of the database approach allows users to access historical and architectural information on buildings in Liverpool using widely available and appropriate technology. The incorporation of the pseudo 3D model into the various systems adds value by both making the data more accessible and improving wayfinding.

We are currently working to adapt the techniques in order to improve access to other types of city and building data. One of these pilot projects will focus on developing the city navigator for use as a web-based way-finding aid for visitors to the University of Liverpool campus.

We are also working with a number of local and regional organisations. The aim here is to modify the techniques in order to provide an effective tool to aid strategic city development, and in this regard the current implementation shows great potential.

Acknowledgement

The authors would like to thank the Liverpool Architecture Society for supplying some of the initial building data and the Liverpool Architecture and Design Trust for exhibiting the work as part of the UK's Architecture Week.

References

Belz, C., Jung, H., Santos, L., Strack, R., and Latva-Rasku, P.: 1998, Handling of Dynamic 2D/3-D Graphics in Narrow-Band Mobile Services, *in Virtual Worlds on the Internet*, IEEE Computer Society, p147-156.

Coors, V. and Wiedmann, B.: 1998, Using Wearable GIS in outdoor applications, *in Proceedings of the Symposium on Interactive Applications for Mobile Computing*, IMC'98, Rostock, Germany, November 1998, http://www.egd.igd.fhg.de/~imc98/ Proceedings/imc98-SessionMA4-1.pdf

Davies, N., Mitchell, K., Cheverst, K. and Blair, G.: 1998, Developing a context sensitive tourist guide, *in Proceedings of the First Workshop on Human Computer Interaction for Mobile Devices*, Glasgow, Scotland, May 1998,

http://www.des.gla.ac.uk/~johnson/papers/mobile/HCIMD1.html

Herstad, J., Van Thanh, D. and Kristoffersen, S.: 1998, Wireless Markup Language as a framework for interaction with Mobile Communication Devices, *in Proceedings of the First Workshop on Human Computer Interaction for Mobile Devices*, Glasgow, Scotland, May 1998, http://www.des.gla.ac.uk/~johnson/papers/mobile/HCIMD1.html

Knight, M. and Brown, A.: 1999, Working with Virtual environments through appropriate

physical interfaces, *in* Brown, A., Knight, M. and Berridge, P. (eds), *Architectural Computing: From Turing to 2000*, University of Liverpool, September 1999, p431-436

Lyman, P. and Varian, H. R.: 2000, *How much information*, School of Management and System, University of California at Berkeley, http://www.sims.berkeley.edu/how-much-info/

Maver, T. W.: 1996, The Virtual City*, in Proceedings of CAD & Creativeness*, Bialystock, Poland, 25-27 April 1996, pp. 181-184

Maver, T., Petric, J., Ennis, G. and Lindsay, M.: 2000, Visiting The Virtual City, *in Proceedings of SIGraDi'2000 - Construindo (n)o espacio digital (constructing the digital Space)*, Rio de Janeiro, Brazil, 25-28 September 2000, pp. 135-139

Odlyzko, A.: 2000, Internet growth: myth and reality, use and abuse, *in iMP: Information Impacts Magazine*, November 2000,

http://www.cisp.org/imp/november_2000/odlyzko/11_00odlyzko.htm

Rakkolainen, I., Vainio, T., Kupila, H., Majahalme, T. and Salmenpera, H.: 2001, A GPS-based 3D City Info for Mobile Users, *in Proceedings of SCI 2001 conference*, Orlando, USA, August 2001. http://www.uta.fi/hyper/projektit/tred/

Raposo, A., Neumann, Magalhães, L., and Ricarte,I.: 1997 Visualization in a Mobile WWW Environment, *in Proceedings of WebNet 97 - World Conference of the WWW, Internet and Intranet*, November 1997.

Web references:

[1] CitiKey software, http://www.CitiKey.com/

[2] CitySync, http://www.citysync.com/

[3] The Glasgow VRML model, http://iris.abacus.strath.ac.uk/glasgow/

[4] Virtual Cheltenham, http://www.ralphski.co.uk/3nge/

[5] Deep Map project,

http://www.eml.villabosch.de/deutsch/Forschung/deepmap/deepmap.html

[6] CyPhone project, http://www.ee.oulu.fi/~tino/pihvi.html

[7] Liverpool Architecture project, http://www.liverpoolarchitecture.com

[8] AvantGo, http://www.avantgo.com