# REPRESENTATION AND DELIVERY OF CITY MODELS

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**Abstract.** City modelling has a considerable range of potential applications and because of this, as a field of research has attracted a great deal of attention over recent years. Here we reflect on work already reported by the authors in this area, describe some more recent work on improving the system that had been developed and show an example of how city modelling is being applied in practice as a planning tool in the UK.

## 1. City Models—universal delivery

For several years there has been an appreciation that providing City Models in a form that can be accessed via internet connection can have numerous productive applications. An early example of this was by Maver et.al. (2000) who showed that basic geometric data describing the city could be enriched by layers of supplementary textual information, or alternative graphical information such as vrml.

Rakkolainen et. al. (2001) demonstrated that city information could be delivered to mobile devices and considered some of the problems associated with this, including the introduction of location-sensitive modelling using GPS.

Further developments were investigated by Fukuda et. al. (2002) who considered how contemporary hardware and software could be employed to effectively deliver interactive city models for visualisation and planning. Umlauft et.al. (2003) have demonstrated that three-dimensional models enable users to understand cityscapes and identify locations better than symbolic 2D maps. Consequently such representations are used in the LoL@ project which has embodies a location-based system that employs UMTS (Universal Mobile Telecommunications Systems) and GPS.

Berridge et. al (2003) looked at the potential for delivering models and associated textural and graphic information using optimised techniques, so that graphic files were small. This meant that the city information system could be potentially accessed via a pda using wireless connection. Consequently, data could be updated and customised on site. This information could, because of the techniques employed, include an animated pan/guide to the city.

Delivering city model information in the ways described means that there is the potential to enhance the information dissemination process within the community

and the city dwellers. It also means that partners in the design process have access to a potentially richer and more dynamic tool for planning purposes. We consider some applications of the processes described for the north-western region of the UK, principally; Liverpool and Manchester.

## 2. The Liverpool Example

In the project described by Berridge et. al. (2003) the base information was held in a web site (www.liverpoolarchitecture.com). The site is shown in Figure 1. In the centre panel textual information was given above and right digital photographs could be accessed. But in the left hand window a pseudo 3D model of Liverpool was presented in a form that involved very small packets of data (20–30k), which would appear to show a pan movement to the next location in 3D. In fact the viewer is simply seeing a set of 3D views saved as 2D files that are exchanged and switched to give the impression of true 3D and movement.


*Figure 1.* Liverpool Architecture site.

The Liverpool web site data could be downloaded to a pda and the city model (with ability to move to selected locations) could be seen as a full screen view on the pda, as shown in Figure 2 (left). The graphical view could be swapped for text view to allow the user to search for new locations in the city to view or visit (Figure 2; right). Alternatively the text could show information in buildings such as architectural, historic, rental values and so on.

When on site the pda can be used as a source of information: as a tourist guide, as a property finder for instance. Because of the wireless capability of the system

(using Avant Go technology) the associated data can be updated dynamically on site. So if the user has failed to download information in a building, or part of the city whilst directly connected to the site then they can access the information database by wireless connection and update the information on their pda dynamically.

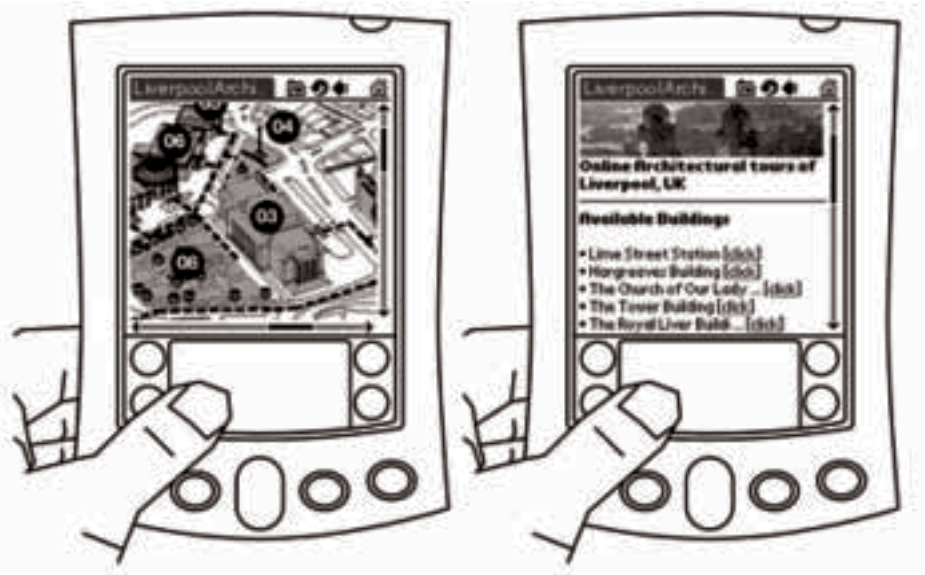


*Figure 2* View of the pda on site.

There appears to be increasing potential for this kind of technology in city modelling. In terms of route planning for some of the applications envisaged, techniques are becoming more sophisticated, as noted by Agrawala and Stolte (2002).

As indicated above, the work of Umlauft et.al. (2003) point to the apparent benefits of 3D representations of city models, compared to 2D maps. Consequently, more recent work on the Liverpool City model has involved the investigation of a Games Engine approach to delivering the 3D view. Figure 3 shows a view of the Liverpool City Model generated using the Unreal games software.

The games engine has the advantage of fuller 3D representation, but is the additional detail worth the overhead? Although data files are still relatively small they are still much larger than those associated with the Pseudo 3D method described earlier.

In addition the general problems associated with small screen mobile devices remain. Smooth scrolling and panning can be difficult, on-site, and screen visibility can be difficult in certain lighting conditions. Also, would such a system suggest an always-on approach? Furthermore, the problem of how best to switch to the associated textual information still remains. Short bursts of text can be added as an overlay to views of the model such as that in Figure 3, but at what point does the information become too complex as an overlay?


*Figure 3:* Liverpool model in Unreal.

The experience and investigations undertaken demonstrate the potential of mobile city information systems. The points immediately above investigate some important issues that need to be taken into account and responded to in developing such systems further.

## 3. Application in practice: Arup

### 3.1. AIDS TO URBAN REGENERATION

Holmgren et. al. (2004) have described how the city of Copenhagen has supported the Electronic Neighbourhood project (2000–2004) to aid urban regeneration. Researchers there have developed and tested a system that has a games engine model of part of the city as the graphic interface. The system is used for supporting 'dialogue and cooperation between professionals and citizens'. The Danish Agency for Enterprise and Housing, the Ministry for Refugees, Immigration and Integration and Copenhagen Municipality have financed the research seeing the value in online interactive city modelling systems.

An interesting application of city modelling to the issue of urban regeneration in the UK can be seen in the work of Arups (Arup, 2005); both on parts of the City of Manchester Model and in a model for the neighbouring town of Wigan. These projects are outlined as follows.

## 3.2 ANCOATS URBAN VILLAGE

The Ancoats Urban Village Company (AUVC) has been established as the organization charged with comprehensive regeneration of the Ancoats area of Manchester. This is part of a broader regeneration plan to revitalize other parts of the City of Manchester. The Ancoats area contains a unique collection of former mills and associated early industrial and commercial buildings. The strategy for the area is aimed at revitalization through a mix of new projects and refurbishment and reuse of the exiting buildings stock and infrastructure.

The core idea in the *urban village* concept in Ancoats, is to establish a new urban neighbourhood. Key elements in the strategy are that the new neighbourhood should be both diverse and sustainable. The aim is to achieve a suburb that will attract people to live there, but will also provide a mix of facilities for work and leisure.

AUVC appointed Arup to 'implement, manage, maintain and update a City Model with the intention of delivering the following:

- A 3D record of the area prior to redevelopment;
- A development control tool;

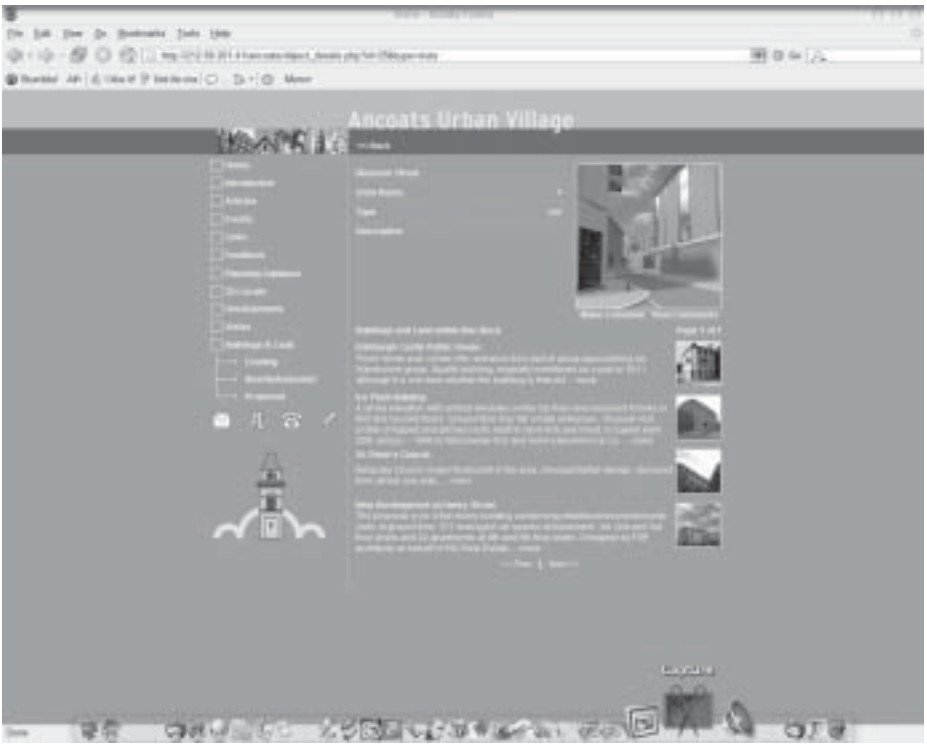


*Figure 4*. Ancoats Urban Village site.

- A web-based consultation tool;
- A web-based database that could be accessed and edited by the client;
- A tool for designers and other professionals to use in the development of proposals for new developments in the area.'

Figure 4 shows the Ancoats Urban Village web site. Apart from conventional information the site gives access to the virtual model of the area shown in Figure 5. The model has thus become a vehicle for aiding planning decisions and involving a range of parties in the development and decision-making process.

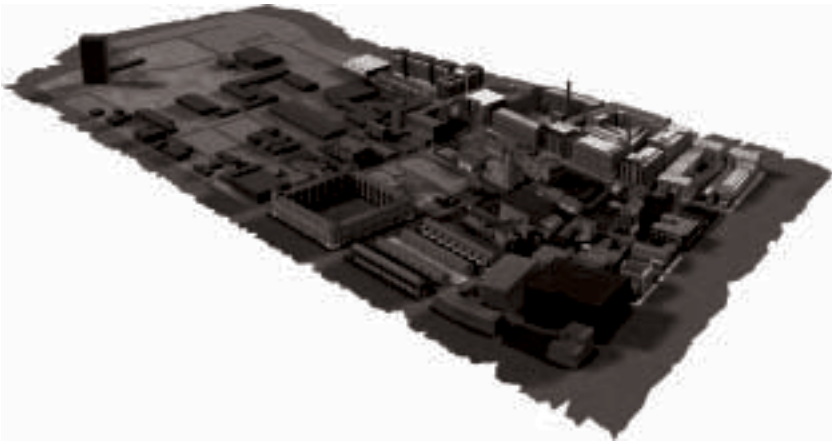

*Figure 5.* Ancoats virtual model.

New schemes can be inserted into the model, and the updated model can then be accessed by a range of parties involved in the development and planning processes. It can simply be a case of looking around the updated model (Figure 6), or the model can be used as a more formal part of the decision-making process.

*Figure 6.* Avatar in the Manchester model.

### 3.3. WIGAN

Arup were appointed by Wigan Metropolitan Borough Council (WMBC) to produce a masterplan for part of Wigan encompassing the two stations in the town. That masterplan took in urban design, transport planning, highways engineering and environmental appraisal.

However, the potential benefits of a city model along the lines of the Ancoats model were quickly appreciated and WMBC commissioned a similar model.

Subsequently the model has been used as the basis for discussion and decision making within WMBC. Alternative planning and design proposals are evaluated by inserting proposed changes into the games engine model of the redevelopment area.

The model is also then used as the vehicle to announce proposals to the public; this allows new suggestions and plans to be tested, and feedback from the community obtained before going ahead with development.

## 5. Conclusion

The potential benefits of a set of interactive city modelling techniques in practice have been described.

In the first case of Liverpool the particular advantages and possibilities offered by mobile communications technologies have been described. It seems clear that next generation mobile services and devices will combine a wider range of functions with the ease of use. Such technology will become increasingly pervasive, and city modelling/information systems that mesh well with these technologies offer particular potential.

We will see systems that offer higher processing power, higher data transfer rates, hardware graphic acceleration, advanced audio and a more user-centred design of user interface. The current mass production of integrated mobile telecommunication and palmtop devices means that this is a rapidly growing area for technological development and it seems that systems will increasingly take advantage of multimodality and location awareness.

In the second examples of Ancoats (Manchester) and Wigan, the application of interactive city modelling techniques enabled by games engine technology is illustrated. One of the problems facing those working in this area is the issue of bringing all those involved in the participation, planning and development processes together within a common framework of understanding. City models that use games engine technology have the advantage that they can be viewed interactively, from a range of locations, both synchronously and asynchronously. But we need to be aware that having a common model to view does not answer all the questions. We need to consider how best to attach and access layers of additional (to visual)

information. We also need to note that different groups involved in the development process may see the model representation from a range of different (social and psychological) perspectives.

Brown and Berridge (2001) noted the need for establishing a common framework of understanding and common language if effective discussion and development is to take place. Simply having the same visual and textual data to work with in the kind of city modelling environments described above is not enough. In planning and development many parties from different backgrounds are involved and more recently Voigt et.al. (2004) have shown that above all it is imperative that these systems are supported by 'common terminology and concepts to facilitate the communication between all those involved'.

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