Serial Vision Revisited: Prospects of Virtual City Supported Urban Analysis and Design

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Abstract: Following our previous research on developing a dynamic virtual city system (*Sheffield Urban Contextual Databank*, SUCoD), the paper reports on a study of applying the virtual city resources to an undergraduate urban design course. The study focuses on how the multi-dimensional and multiple types of urban contextual data can be used by student designers directly for urban visual analysis and design development. A link is made with the *Serial Vision* in *Townscape* first proposed by Gordon Cullen, which sets out an experiential approach to how a living city environment should be read and understood. Drawing on the project works produced by the students, some patterns of generating urban narratives and 3D spatial designs were observed. Although the current experiment with SUCoD is limited in terms of data scope and modelling capabilities, it reveals a future direction to follow that can turn conventional virtual cities into Web-based online services capable of supporting urban design analyses and syntheses directly.

1 INTRODUCTION

In recent years, there has been a surge of interests in developing innovative urban development programmes targeted at the cities and towns in the UK. Notably, the Urban Task Force commissioned by the UK government has published a strategic framework for what and how to deliver the aims of urban renaissance across the nation (Urban Task Force, 1999). As a response to the current and future demands for better urban and architecture design qualities, the abilities of students to address complex urban contexts in developing architectural design now stand high on the education and research agenda. In the last four years, the Diploma students at the School of Architecture, University of Sheffield, have recently been taught to undertake a large-scale Sheffield Urban Study programme with an aim to develop the students' knowledge and skills of investigating how has the City of Sheffield evolved towards the turn of the 20th century (Blundell Jones et al. 1999). The by-product of the on-going educational programme is the accumulation of rich urban contextual data in the formats of physical scale models, maps and documents according to a superimposed urban grid system. A separate research project was subsequently launched to investigate ways of converting the physical datasets into

digital ones that can be made accessible through the Web. To date, the research outcome is mostly presented in the development of the Sheffield Urban Contextual Databank (SUCoD) system (Peng et al. 2002a, 2002b).

The SUCoD prototype is what we think an example of *Dynamic Virtual City* system that is capable of providing multi-dimensional urban contextual datasets on demand according to user-specified contextual criteria such as spatial and/or temporal location and boundary. For instance, an urban designer or architect can retrieve sets of urban maps and 3D interactive models (in VRML) from SUCoD by specifying an arbitrary area of interest through the JAVA™-enabled interactive maps. It seems to us that many dynamic features supported by the multi-tier Web-based computing architecture can open up new fronts of supporting urban analysis and design that could not be achieved by previous virtual cities. As a further study of the prototype development, we have applied the system to a computer-aided design curriculum at the School of Architecture. The remaining of the paper reports on how the SUCoD system has been used by students to engage in digital urban visualisation and design, and what the current experiment reveals the prospects of dynamic virtual city supported urban analysis and design. Starting with the next section, the theory and practice of Serial Vision and Townscape, which was first expounded by the Gordon Cullen in 1961, is reviewed briefly to discuss its connection with contemporary digital urban visualisation and design. Section 3 gives an account of how the SUCoD resources have been applied in a pedagogical exercise. A reflective observation of the SUCoD experiment is followed in section 4. The paper ends with some conclusions and pointers to future research.

2 SERIAL VISION AND TOWNSCAPE

Gordon Cullen, the humanist and urbanist designer, first published his seminal work "Townscape" in 1961, and a concise version of it was published ten years later (Cullen 1961, 1971). Cullen liked to call his theory and approach to understanding and manipulating the elements of townscape an "Environment Game." He presented his discovery of humanistic urban design in three "gateways": *Motion* (*Serial Vision*), *Position* (*Here and There*), and *Content* (*This and That*). A detailed review of the entire Townscape treatise is not intended here but a short revisit of the serial vision. In concerning "Optics," Cullen calls a series of "jerks or revelations" that we may experience when walking through a town or city at a uniform speed as Serial Vision. He considers that a town can become visible in a deeper sense if vivid contrasts can be felt, as "the human mind reacts to the difference between things," or "the drama of juxtaposition" (Cullen 1971, p. 9).

Serial vision was first published when computer-aided building design was to emerge from design computing laboratories. CAD technologies were not sophisticated enough to large-scale city modelling until at least twenty years later. However, we are now in a position to explore the connection between serial vision and digital urban visualisation that may lead to better digital urban design facilities. The late urbanist and educator David Gosling once pointed out rather explicitly that

Cullen's serial vision could be seen as "a prophesy of present-day computer animation systems in urban design" (Gosling 1994). We believe that an even stronger link could be made between Townscape and the recent developments on Virtual Cities, which provide not only animation but also user-centred navigation. Considering Serial Vision as an important reference, we have conducted an initial study of how a virtual city system might be applied in a Cullenian manner to provoke urban design thinking. Clearly, the study reported below is limited in its present scope and depth; our intention is to look at the initial results as pointers to further experiments.

3 THE SUCoD EXPERIMENT

Having achieved the main objectives of data conversions through the development of the SUCoD system, we soon realized that SUCoD could become a platform for experimenting urban design in, initially, an educational setting. The design and implementation of the additional "Upload VRML" facility in SUCoD was a clear demonstration that we could build a citywide urban databank for depositing various types of historical records about how the city has evolved; the contextual resources could then be used not only for a historical study purpose but also as online references to contemporary urban design processes.

The SUCoD resources (http://sucod.shef.ac.uk) were first introduced to students undertaking the "Computer Applications in Urban Design" course at the School of Architecture in October 2001. An overall aim of the course is to facilitate a learning process through which the students can interrelate their existing CAD skills with knowledge of urban history and design. A total of 23 students have enrolled the course during the 2001/02 session. Apart from sitting in a series of lectures on aspects of computer-based urban mapping and modelling, the students were asked to complete the following urban analysis and design tasks:

1) Online Urban Narrative

   Urban narratives can be defined as tales (stories) about urban places or spaces. An episode of urban narrative is a story written for a specific location, which could be a scene of some urban event in the past, a description of how the urban space and/or buildings were used for an activity/usage, or how an urban place is best navigated (as a tourist guide, for instance), and so on. Students were asked to organise themselves to work in groups (2-3 students per group) and produce a Web-based episode, containing the narrative composed in multimedia (e.g., 2D maps, drawings, sketches, 3D VRML models, hypertexts etc.).

2) Online Urban Design Proposal

   The second exercise involves uploading students' own 3D designs onto SUCoD as a methodology of exploring and communicating urban design proposal online. Students were also asked to give an account of the proposal to accompany the 3D models as a Web document in a way similar

to their previous presentation of the urban narrative.

Apart from a very basic definition, the exact interpretation of what is meant by Urban Narrative was deliberately left open. This is because that most of the students have already gained a considerable amount of urban experiences through their previous education and training. The exact format of how the urban narrative should be presented was also left to the students to decide. The only requirement was that the urban narrative must be viewable on the Web. At beginning, students were introduced to the SUCoD system and the digital resources made available through SUCoD over the Web. They were also encouraged to visit the original physical resources contained in paper folders. The students then decided to work on a city location upon which the narrative could be developed on the basis of the online and physical resources, or of any other materials they found relevant and usable.

The second project on proposing a 3D urban design was designed for students to explore online 3D urban design visualisation using SUCoD's 'UPLOAD VRML' and 'LIST VRML' facilities. At the beginning, four adjacent sites (labelled as A, B, C, D) as seen from the Sheffield 1900 Urban Study were designated for the online modelling project, and each student group was asked to propose a 3D design for their chosen site (Figure 1). The 3D design was not intended to follow any pre-defined urban or architectural programmes regarding what the proposed building or urban landscape was supposed to fulfil. The primary goal of the exercise was to try out simple 3D volumes and shapes that could be 'planted' directly into the urban sites through SUCoD. Additionally, the student groups were asked to produce an urban narrative to account for the design development in a format similar to the previous project.

Figure 1 The four urban sites designated for the *Online Urban Design Proposal*.

To enable their digital modelling, the basic steps of preparing the VRML file, uploading and combining with site models retrieved from SUCoD were explained. Students could use any CAD packages familiar to them that can export VRML models based on their own 3D designs. To construct a multi-stratum VRML world

containing the site and the proposed 3D designs successfully, the only constraint that the students had to follow was to adopt the same CAD modelling scale (1:1) and the SUCoD's coordinate system. The 2D and 3D coordinates of any location within SUCoD can be read from the JAVA-enabled map and the VRML display windows. Once the modelling scale and the coordinates are established in sync with SUCoD, producing online syntheses of a site and alternative design proposals is as simple as ticking the checkboxes and pressing the buttons shown on the Web pages.

4 CREATING URBAN NARRATIVE AND DESIGN ONLINE: AN OBSERVATION

The Urban Narrative Online project lasted for four weeks, and eight student groups were formed. Supported by group tutorials and an interim presentation/review, eight urban narratives were produced in the end. To facilitate collaborative learning, the course tutor devised a common Web site to provide links to the eight narratives submitted so that they could be viewed through a single unified interface on the Web[1]. Given that the definition and purposes of the urban narrative were left open from the beginning, it is rather surprising to see that concurring strategies of narrative development have emerged among the current group works:

- *Virtual tourist guides*. One group told their city stories simply by making short tourist guides focussing on the city routes of their choices. Scanned historical photos, captured images from the digital maps and VRML worlds are displayed as viewers navigate through various locations on the selected routes.
- *Juxtaposition of contemporary and historical views.* Three groups have developed their urban narratives by piecing information together to reveal two parallel lines of illustrations: Sheffield as it is now vs. Sheffield as it was 100 years ago. For the same spatial locations or routes, the students were interested in showing the differences and similarities of the city fabric through different time frames.
- *Sequential analyses*. Three groups produced what they called a "sequential analysis" of the city area. Cullen's method of Serial Vision was applied to establish sequences of views captured from the VRML worlds retrieved from SUCoD. Textual annotations or commentaries were often added to provide further historical or contemporary information.
- *Combined sequencing with juxtaposition.* One group actually used a mix of juxtaposition and sequential analyses in producing their narrative study. A "1900–Narrative Route" was first decided, followed by a "1900–Sequential Analysis." The same 1900 route was then superimposed on a 2001 map and led to a narrative of the urban conditions in 2001 (Figure 2). A selection of

[1] See http://sucod.shef.ac.uk/sucod/gallery/arc202/2001/Proj1/project1/proj1.htm

images captured from the VRML world and from the contemporary urban scene was then put side by side to form a "Direct Comparison."

Skills of HTML authoring were most needed in the production of the online urban narratives. Though commercial software packages such as Microsoft® FrontPage and Macromedia® Dreamweaver offer handy tools in making Web pages, there are still steep learning curves for students new to these software tools. One of the most common problems students experienced was broken hyperlinks across page frames in which the authors simply got lost while trying to make connections among dozens of data files that have not been organised in a disciplined manner. More experienced students could handle the situation better and produced a compact set of HTML pages that are easy to navigate and reflect their narrative strategies. There seemed always a temptation for relatively inexperienced students to end up with complicated page compositions containing not properly formatted texts or graphics that actually clutter the underlying lines of narration. However, the range of HTML authoring tools offered by the software plus the online urban resources provided by SUCoD have clearly induced a fair amount of enthusiasm from the students in creating their Web-based narratives.

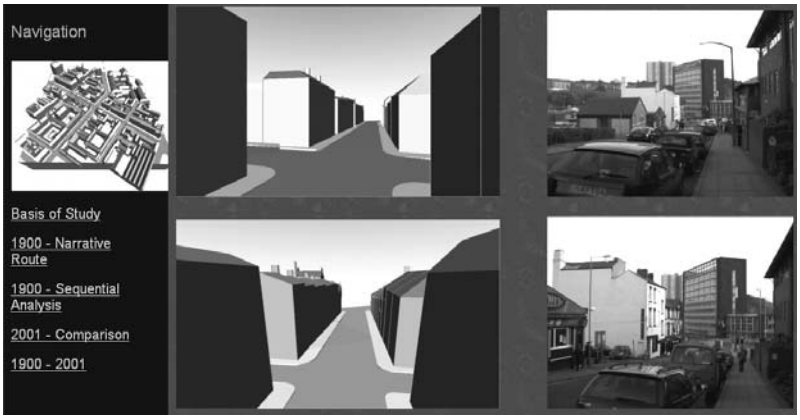

Figure 2 Combined 1900 and 2001 sequential studies of the same urban route.

Having completed the historical narratives, the students started to work on the Online Urban Design Proposal project for another five weeks. Apart from the locations and boundaries of the sites, the students were given very little hints as how the urban proposal might be developed. The course tutor assumed that there would be some sort of intuitive responses to the sites coming out of the students directly, as they have gained substantial experiences of addressing urban sites through many major architectural design projects in the past. The question was that the urban sites in this case were completely 'virtual'—historical sites reconstructed electronically exist only in virtual reality. Again, eight design proposals were generated in the end,

which were evenly distributed among the four designated sites[♠]. Looking at the resultant proposals, there were the following design approaches observed:

- *Contextual analyses*. Using the historical maps and VRML models retrieved from SUCoD, students were able to come up contextual analyses that influenced their proposals. Several groups came to conclude specific building contents of their proposals by evaluating the usages of the buildings and spaces surrounding the sites. Other contextual indicators such as views, axes, accesses, street-frontage and so on also played a role. Annotated explanations produced by adding diagrams onto the maps and models were commonly seen in conveying the contextual analyses.
- *Precedents and design references*. In terms of accounting for why specific built forms were proposed, several groups pointed out explicitly the design precedents or references they have followed. Although there appeared a certain degree of arbitrariness in why particular precedents were chosen, the design references seem to be connected with how the sites were interpreted. For instance, one student perceived the site as an opportunity to place an "urban retreat" and he considered the American artist Vito Acconci's works an inspiration, while another group pointed to the English architect Will Alsop's Peckham Library as an example of putting forward a covered urban space as a transition between the proposed building and the adjacent main street (Figure 3).

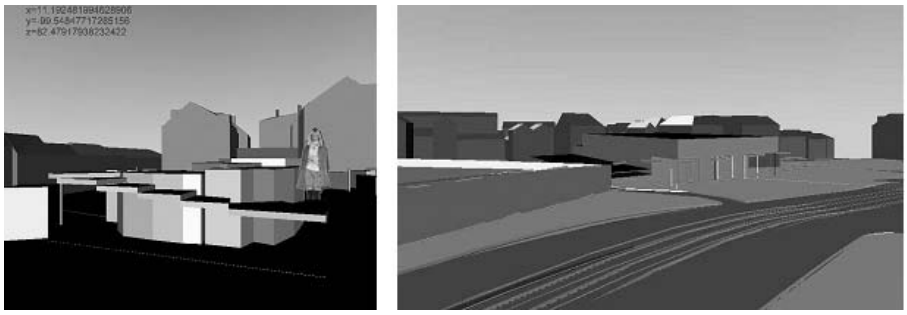

Figure 3 Referencing in creating the urban design proposals. (Left: Vito Acconci's urban retreat. Right: Will Alsop's Peckham Library.)

- *Transparency and colours*. There are many modes of viewing that a user can take within a VRML world such as *Walk*, *Fly*, *Study* (*Examine*) and so on with which the user can navigate to any position and look into any direction in the virtual world. It is therefore possible for the students to arrive at a design argument or narrative that is founded on the ground of 'what is meant to be seen from where.' For example, one group developed a "glass canopy" along their proposed building front so that the pedestrians

♠ See http://sucod.shef.ac.uk/sucod/gallery/arc202/2001/Proj2/project2/proj2.htm

could still see the adjacent St. Paul's Church while walking underneath the canopy (Figure 4). The contextual visions of what actually could be seen through the windows of the proposed building were also simulated through the material attribute of "transparency" in VRML. The attribute of colours was another theme of urban design that the students have taken up. One group considered a "contrast" could be created by introducing "primary colours" into their proposed sculpture-like structure.

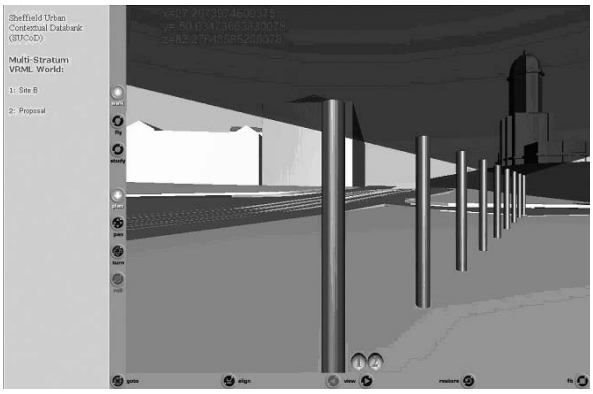

Figure 4 A simulation of seeing through a glass canopy in an urban context.

- *Shapes and volumetric modelling.* In developing the urban proposal, a group of students gave themselves a list of eight "design issues" ranging from Height to Entrance. In dealing with these issues, component shapes and volumes for the proposed building were developed. The group then took a rather innovative approach to visualising how the individual sub-volumes were shaped and interconnected by constructing a multi-stratum VRML model in which parts of the proposal were uploaded separately. Through their multi-stratum modelling, the growth of the proposed built form could therefore be explained layer by layer in relation the surrounding urban form. The resultant multi-stratum VRML model itself becomes a compelling narrative device, as viewers could read into the development of the urban proposal stepwise in nine layers (Figure 5).

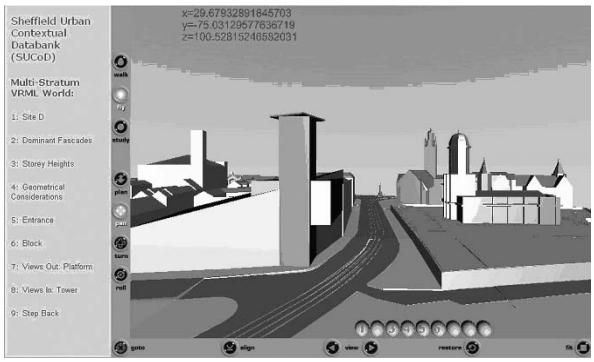

Figure 5 An urban design proposal created as a multi-stratum VRML world showing form development in nine layers.

Clearly, skills of 3D CAD modelling and rendering were essential in making the urban design proposals. All the VRML models submitted by the students were created mainly with 3D CAD packages that the students were familiar with. The 3D modelling capabilities of current VRML-based editors are nowhere near to some of the major CAD platforms such as AutoCAD® or Microstation®. Having done their 3D designs in CAD and checked the modelling scale/coordinates, the students could simply export VRML models that were combinative with sites models retrieved from SUCoD. In addition to the 3D multi-stratum VRML worlds, the students were also asked to provide commentaries on their urban proposals in a format similar to the previous project. The course tutor then set up another Web site to exhibit the eight schemes in a way that each group's VRML world and the design narrative can be viewed jointly. The provisioning of two common Web sites was intended to facilitate students' collaborative learning by browsing through fellow students' schemes at their convenient times or even from home.

5 CONCLUSIONS AND FURTHER RESEARCH

We are certainly not the first to explore how computer-based citywide resources can be applied to urban studies and design education. The ABACUS team at the University of Strathclyde pioneered in the early 1980s 3D computer modelling technologies for a large-scale visual simulation of the City of Glasgow, which have since generated numerous educational and industrial applications until these days (Ennis et al. 1999). From an architecture and landscape standpoint, McCullough and Hoinkes considered that accessing “dynamic, multivalent datasets for collaborative processes” was central to urban design, which could be better supported through a rich substantive urban information gathering and interaction environment (McCullough and Hoinkes 1995). Collaborating with graduate urban design students at the Oxford Brookes University, Michael Batty and colleagues investigated how Geographical Information Systems (GIS) could be linked with CAD to provide intuitive GIS-driven visualisation and communication facilities for participative

urban design (Batty *et al*. 1999). More recently, Susan Pietsch and colleagues reported their experiences of using sections of the city models built for the City of Adelaide in student design projects (Pietsch et al. 2001).

The original aim of the SUCoD project was to find a way to preserve the original urban datasets assembled through the Sheffield Urban Study programme. Our experiments with a Web-based multi-tier computing architecture have produced a new kind of virtual city application that allows end-users to reconstruct urban contexts online according to their own spatial, temporal and thematic interests. More significantly perhaps, as the digital datasets are generated by the SUCoD server *on the fly*, users (i.e., architects, urban designers etc.) can (1) apply other tools to the reconstructed urban contexts for producing analytical studies such as serial vision, and (2) simulate syntheses of existing urban contexts with proposed new urban schemes for exploring and evaluating design alternatives. Given the Web-enabled approach, we have shown that all these can be achieved by the designers directly without going through the middlemen of IT specialists yet the integrity of the original databank remains secured.

On basis of the current SUCoD prototype and its pilot educational use, we would like to experiment more with other analytical tools that can interact with user-constructed virtual worlds linked to multivalent datasets. An important criterion for these new tools is to be Web compatible and deployable. Another interesting question is the level of photo-realism or detail to be provided by the dynamic virtual city system—designers may or may not always find detailed virtual city models useful during design processes. What are the appropriate mechanisms for the right level of realism to be delivered as the users demand? Clearly, the human factors will be crucial here in guiding further system design.

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