3D SIMULATION OF THE TOURIST CORE AREA OF NIAGARA FALLS, CANADA: A TOOL FOR SITE LINE ANALYSIS AND ASSESSMENT

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ABSTRACT

A project has been undertaken to create a 3D photo-realistic, interactive model of the Tourist Core of the City of Niagara Falls. This area lies on the Niagara Escarpment, overlooking the American and Canadian Falls. The objective of this project is to assess and address the planning and visibility issues, which arise with new development in this area. Thought must be given as to whether new developments or renovations of existing buildings will block the view of existing developments. Urban simulation provides an excellent medium for examining these issues and helps both the planner and the public, visualize and understand the implications of a future development.

This paper describes the process undertaken to create the model. An assessment was made of the querying capability, potential future use and municipal standards required of a GIS-based 3D simulation. Arcview 3.2 was used to develop and model a DEM of the Tourist Core Area, the Niagara Gorge and the Canadian Falls. Building footprint themes were created for approximately 30 buildings/hotels from ortho photos and engineering site plans. The themes incorporated extensive databases. Lastly, building, street and landscaping photo-realistic detail was added with MultiGen-Paradigm's SiteBuilder, a visualization software. This project was undertaken in co-operation with the City of Niagara Falls, as a part of a research project for Post Graduate Certification in GIS through the UniGIS Program (Simon Fraser University, Canada).

KEYWORDS: 3D, Urban Simulation, Visualization and Planning

1.0 Introduction

Urban simulation using GIS incorporates the benefits of accurate, georeferenced representations of a cityscape and a tool for assessing the impact of new planning applications on the landscape. In the City of Niagara Falls, Canada, there is intense development pressure in the Tourist Area, located south of Murray Street, east of Stanley Street to the Niagara River and north of Livingstone Street. This is an area of dense hotel/motel and restaurant development.

In 2000, the City of Niagara Falls amended the Official Plan to permit approval of site specific developments of up to 30 storeys in the Tourist Area (City of Niagara Falls, 2000). Consequently, the problem of view obstruction has become a concern. 3D visualization may provide a means for height impact assessment and site line analysis. The proposed Embassy Suites Hotel, located at Fallsview Avenue and Portage Avenue will be used as a Case Study for this tool. At the time this project commenced, the Embassy Suites had not been constructed.

The objective of this paper is to describe the method for creating 3D simulation of an urban setting and to describe the utility of visualization as a tool for planning purposes. A case study of site line analysis will be described as well as the querying capability and potential future use of interactive urban simulation in a municipal organization.

2.0 Procedure

2.1 Evaluation and Choice of Visualization Software

It is important to establish the software to be used early on and to evaluate the compatibility of the GIS software with the visualization software. Arcview 3.2 was chosen as the GIS software as it is already in use. SiteBuilder, produced by MultiGen-Paradigm was chosen as the visualization software because of

its compatibility with Arcview 3.2, user-friendly interface and relatively low cost. Arcview Spatial Analyst is also recommended for the process.

Once the software was chosen, the operation of the visualization software was examined in detail to assess the interdependence between the two. In this way, the creation of the building footprint theme and design of the database was based on the needs of the visualization software.

2.2 Data Collection

The first step in data collection was to conduct an extensive site reconnaissance assessment. This included taking photographs of each of the buildings to be included in the model. A minimum of two pictures was taken of each building. It was important to take perspective photos from various angles and attempt to capture the colour and texture of the building façade. Notes were made of building height, street detail, signage, and locations of landscaping and parking facilities.

The advantage of this type of project is that often much of the base data already exists. Shapefiles of City and Regional roads, hydro corridors, hydrologic features and stoplight locations were kindly provided by the City of Niagara Falls. Niagara Falls Hydro kindly provided digital files of the locations of hydro poles and light standards.

Building Site Plans, available at the City were located, scanned and saved in a .tiff format. These drawings were then georeferenced using ArcGIS and detailed and accurate building footprints created. Alternatively, the building footprints could have been input via the method of digitizing.

Finally, a DEM was obtained. Various sources for a DEM were researched. Numerous DEM are available from the USGS in this overlap area, without charge. However, either the area was not covered adequately or the scale was too small for the purposes of the project (1:250,000). A DEM from the Canada Centre for Topographic Information was obtained at a scale of 1:50,000 (NTS 030M03) and imported into the Arcview Project.

2.3 Creation of Building Footprint Shapefiles and Databases

Site Plans were obtained, where available, for all the buildings within the area. The Site Plan was then scanned and georeferenced. A new shapefile theme was created for the buildings, including the detail from the Site Plans. Developments were often comprised of several sections with varying heights. It was possible to show this detail in the simulation. The database included the name of the hotel, address and facilities information. A height and category attribute field was added for 3D extrusion. A hot link to a field in the database was created for all buildings, to provide a still photograph for easy reference (figure 1).

There are seven large hotel/developments found in the area and it was proposed that greater architectural detail for these buildings would be beneficial. 3D models were created for these developments using Creator, and imported into SiteBuilder. For the remaining buildings for which there was not a Site Plan, building footprints were created based on ortho photos available from the Region of Niagara. These orthos were flown in April 2000 and provided very detailed and recent information for the area. Most of these buildings are very simple one or two storey buildings with a flat roof and lent themselves well to the creation of three-dimensional polygons in SiteBuilder.
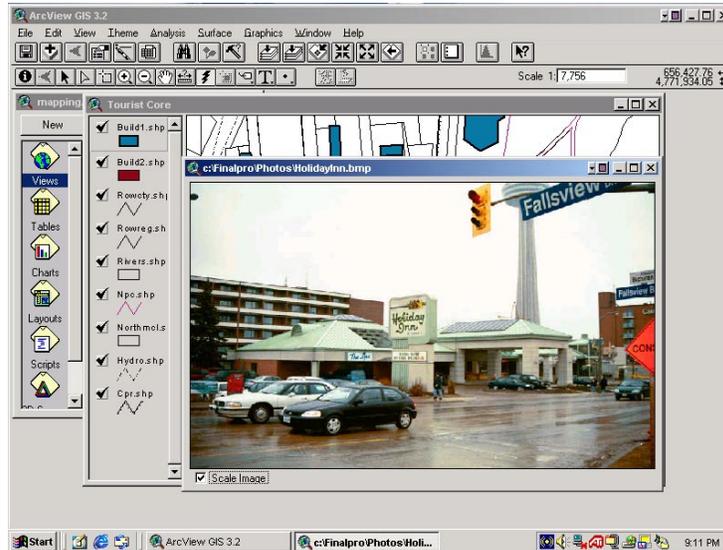
figure 1: A hot link to a still photograph was created for each building footprint

2.4 Creation of Shapefiles to Show Street Detail

New point shapefiles were created for the network of hydro poles, light standards and landscaping features. For the landscaping features, an attribute field was created to classify the features into categories of types of vegetation (i.e. pine tree, bush). Numerous other shapefiles were created to describe parking lots, grassed areas, curbs, gravel road shoulders, fences and point locations of signs (i.e. stop, yield). The amount of detail portrayed may be limited by time and budget constraints.

2.5 Creating the Terrain File/Terrain Skin

Creation of the terrain file and the terrain skin was completed in Arcview with the SiteBuilder extension turned on. Once the grid file had been created, a texture was applied to the terrain. The terrain skin was created from ortho photos displayed in the Arcview View. The ortho photos used to create the building footprints, are black and white and provided a rather dull visualization. Consequently, older colour orthos, taken in 1995 by the Region of Niagara, were utilized as a texture for the Terrain.

2.6 Planting the Features on the 3D Terrain

Placing of features was performed through the Arcview menu. Direction was given as to the steps involved in placing features through various dialogue boxes. For the point themes, an image could be chosen from an extensive library of signage, landscaping and various styles of hydro poles and stoplights (figure 2). It was possible to place library models of whole residential houses or skyscrapers in the 3DViewer. The two houses found in the Tourist Core area on the west side of Stanley Avenue were created in this way.
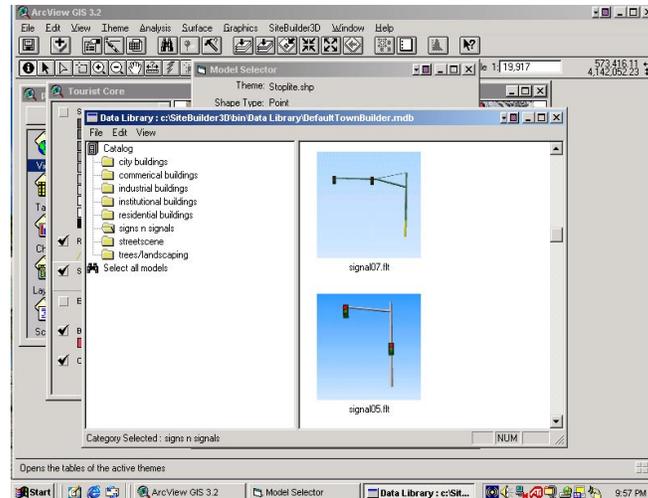
figure 2: A choice of stoplight styles from the SiteBuilder library

For the line themes such as roads, sidewalks and curbs, there was a choice of alternative types of line features including roads (no height), fences (height, no width) and walls (height and width). It was possible to model the feature with a texture or colour.

The planting and texturing of the polygon features was the most complex of the three and afforded the most flexibility. For the polygon features, it was possible to substitute a 3D model created in Creator, or create a three dimensional polygon with colour or texture. 3D models produced in Creator for several large hotel developments were brought into the 3D Viewer. For the three dimensional polygons, height was created through an attribute field in the Arcview database. It was possible to give each building a different colour or texture based on a category attribute field, also in the Arcview database. New photorealistic textures could be created in various image formats and added to the library.

Various settings could be adjusted to change the perspective of view, which was an important feature for site-line analysis. The perspective could be set to walk mode, fly mode, drive mode and UFO mode. The speed of movement could be adjusted from a default setting to 3x to 50x and it was possible to add environmental effects such as clouds or fog for interest.

3.0 Querying Capability

It was possible to query the model library to search for a suitable choice of model for a feature. However, at the time of testing, the interactive querying between Arcview and SiteBuilder was a little disappointing. More extensive querying capability may be possible through Avenue scripts.

4.0 Uses in the Planning Profession

In May 2000, the Official Plan for the City of Niagara Falls was amended to permit site specific zoning by-law amendments, allowing up to a maximum height of 30 storeys in the Tourist Area. This has resulted in numerous new applications with proposed developments of up to 30 storeys in height. For large-scale developments and buildings over 10 storeys, the applicant is required to submit:
- Site Survey, Context Plan
- Concept Plan & Massing Drawing/3D Model Insert
- Landscape Plans & Details, Site Plan & Preliminary Design Details
- Floor and Roof Plans, Sections & Elevations
- Sun/Shadow Diagrams, Pedestrian Level Wind Study
- Transportation & Servicing Impact Study, Architectural Peer Review Report (City of Niagara Falls,2001)

With these plans it is possible to evaluate the development from the perspective of meeting planning regulations and guidelines. The Massing Drawing is meant to provide a view of the development in three dimensional form. Most three dimensional drawing are currently provided by applicants as a 2D hard copy.

However, it is often difficult to visualize the height and size of a development and to assess the overall impact the development may have on the landscape, based on a 2D rendering. Creation of a three-dimensional model of the area permits comparison of a new application with existing developments. The Embassy Suites application has been used as a case study to show the overall utility of the visualization process and the application of site line analysis. The assessment indicated that two large hotels to the north would suffer considerable loss of view.

In future, it may be possible for applicants to submit digital 3D models of applications to be inserted into the existing model for assessment. Visualization standards will need to be devised for this purpose. The following preliminary recommendations are suggested:

- Accurate, scaled representations, georeferenced
- Textured images should be provided with the application for ease of texturing of the model
- The 3D model provided should be in a compatible format with the municipal visualization software

Other potential uses of 3D modeling include use of models in public meetings to present a realistic view of a new development (Chan R, date unknown) The public may better be able to give input on realistic models than the traditional 2D drawings or models. However, visualization has tremendous visual impact, and care must be taken to ensure that models are accurate representations and not simply beautiful art. Use in this case could be deceiving to both the municipal officials and to the public. Standards for the use of visualization, as discussed above, will help in this matter.

5.0 Conclusion

A 3D photorealistic interactive model of the Tourist Core of the City of Niagara Falls was created using ESRI's Arcview 3.2, and Spatial Analyst and MultiGen-Paradigm's SiteBuilder. Existing GIS data was used in shapefile format or was readily available from local sources. Building plans which were scanned and saved in .tiff format were georeferenced in ArcGIS so that accurate 3D models could be created. Some editing of the database was required to meet the needs of SiteBuilder or to enhance the database. The amount of detail portrayed may be limited by time and budget constraints.

Visualization has many applications in planning. It provides the planner with a tool to assess the impact of a new development on the surrounding landscape. The 3D model can be used for site-line analysis to assess whether a new development will block the view of existing developments. Applications in public meetings and for public input may also be useful. It will be necessary to develop standards for visualization as the medium becomes more mainstream to ensure accurate and realistic representations are produced.

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