

## USING 3D MODELS FOR VISUALIZING ‘THE CITY AS IT MIGHT BE’

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### ABSTRACT:

In Australia, many large cities suffered the loss of important buildings during the building boom of the 1960s. During this time of demolition and re-building the ‘face’ of major cities changed forever. This period of savage removal of heritage and significant buildings has been the subject of much interest and debate till this day. There exists the need to provide virtual models of Australian cities ‘how they might be’ if these buildings remained in place still. This paper describes the first stages of a project that is building a composite 3D model using VRML that combines existing heritage buildings with the ‘missing’ buildings of the city – those that were removed in the heady development days of the 1960s. It outlines the concept of the project and it describes the development of a ‘proof-of-concept’ prototype. Finally it discusses the plans for the future of the project.

### 1. INTRODUCTION

A number of virtual 3D models of urban spaces have been built by a research team at RMIT to test their potential to enhance community discussions of future neighbourhood developments. Starting in 2003 with an online 3D model of the Jewell Station Neighbourhood (JSN) (Nelson *et al.*, 2004) a number of models were constructed to ascertain a number of things, viz: 1. What the model should contain – a trade-off between development costs and usability, 2. How much information needs to be included for professional and public users and 3. How landmarks might be incorporated to facilitate a ‘balance’ between minimal information provision and usability (Cartwright *et al.*, 2005, Pettit *et al.*, 2004).

Using the experience gained with the development and testing of these models it was decided to build a prototype model of part of the Central Business District Melbourne, Australia. This model would ‘fuse’ together existing buildings of significance with the ‘missing’ buildings – those removed hastily in the building boom of the 1950s, 1960s and early 1970s. The aim of producing the model was to develop a simple, accessible demonstration prototype that could be used to familiarize historians with the potential that 3D simulations provide for better appreciating what the city might have been if all significant buildings remained intact. It was also developed as a vehicle to support application for funding to extend the prototype to cover the entire Central Activities District. As the prototype has developed techniques for sourcing imagery (current and historical), capturing and processing images of standing buildings and actually building the model using Virtual Reality Modeling Language (VRML) and delivering usable Web-delivered product, to extend the model to cover the entire Central Business District would hinge only on the access to adequate historical imagery, it would not depend on developing techniques for model development. Therefore the time needed to develop a model for the entire Central Business District would be a fairly straightforward operation.

The paper begins with providing information about ‘Marvelous Melbourne’, when the city was built upon the prosperity of the Gold Rushes in post 1860s (see both editions of Davidson’s

excellent books on this subject – *The Rise and Fall of Marvelous Melbourne*, Melbourne, 1978 and 2004). It then describes the process used to develop the model. Then it gives some impressions on the ‘first cut’ of the prototype. And, finally it provides information about evaluation plans.

### 2. MARVELLOUS MELBOURNE

Melbourne was established on the banks of the River Yarra in 1835 by settlers from Tasmania – formally the Port Phillip Association and led by John Batman. Soon after, in 1837, it was laid out in a formal grid pattern by Robert Hoddle (City of Melbourne, 2006), as shown in the image in Figure 1.



Figure 1. Melbourne in 1880, looking north, with the River Yarra at the bottom of the image. <http://www.macalester.edu/courses/geog61/melbourne/melbourne1880.gif>

By 1860 the city had reached its final form (City of Melbourne, 2006) and during the 1880s the population was almost 500,000, rivalling the size of many European cities at that time (see Stantham, 1989 re Melbourne’s development).

It had ornate office buildings up to 12 storeys high that were compared to those of New York, London and Chicago.

(Museum of Victoria, 2004). The city boomed from 1880 to 1890, fired by the massive amounts of gold being output in the State of Victoria, Melbourne being its capital, and general business optimism of the time. Streetscapes like that shown in Figure 2 displayed this wealth, and grand buildings lined most streets. The city was alive with commerce and frenzied building, and re-building, activities.



Figure 2. Collins St. looking east from Elizabeth St., late 1880s. Photographer: Charles Rudd Source: State Library of Victoria

This came to an abrupt halt in 1891 and by 1892, many banks and building societies closed. By the middle of 1892, 21 financial companies were in suspension (City of Melbourne, 2006). But the grand city buildings had been established. They were a record of what wealth and pure optimism had achieved.

### 3. MELBOURNE AND THE REMOVAL OF SIGNIFICANT BUILDINGS

In 1956 Melbourne hosted the Olympic Games. Post games the re-development of the city took off and during the 1950s, 1960s and the early 1970s many landmark buildings, most irreplaceable, were removed by wreckers, brick-by-brick, stone-by-stone. The boom demolition era was 1962-1971 (Annear, 2005).



Figure 3. The Equitable Life Assurance Society building, demolished in 1959. <http://www.theage.com.au/news/books/wreck-ruin-and-glory/2005/07/31/1122748527204.html>

Grand buildings were demolished like the Equitable Life Assurance Society building, on the corner of Elizabeth and Collins streets in 1959 (Figure 3), in 1960 the 113 year-old Eastern Market (Figure 4) was demolished to make way for the Southern Cross Hotel (a 1960s icon hotel that now has also been demolished to make way for a 2006 version of hotels) and the Federal Hotel (Figure 5).



Figure 4. Eastern Market, Bourke Street Melbourne, ca. 1888 Source: State Library of Victoria <http://www.statelibrary.vic.gov.au>



Figure 5. Federal Hotel, 1965. Photographer Wolfgang Sievers. Source: National Library of Australia. <http://nla.gov.au/nla.pic-vn3305975-v.jpg>

These three buildings illustrate the architectural richness of Melbourne. However, all of these three buildings above suffered the same fate as the Colonial Mutual Life building, shown in Figure 6 being demolished.

Whilst widespread demolition is now a thing of the past, there still exists the potential for government and developer alike to covet sites upon which historic buildings sit atop. As recently as 2004 some of Melbourne's historical buildings were under threat (Rundle, 2004). Hence the interest in developing a model that could be used for better appreciating the existing, and lost, buildings, and vanished streetscapes.



Figure 6. Colonial Mutual Life Building Demolition, 1960. Museum of Victoria. <http://www.museum.vic.gov.au/colonial/demolition.asp>

#### 4. PROTOTYPE WORLD

The prototype model covered two city blocks (Figure 7). These blocks were chosen as they are typical insofar as they contained a number of significant buildings that had not been removed in the haste for redevelopment and a number of ‘holes’ that needed to be filled with sourced, historical photographs. It was significantly large enough to provide a challenging area to model, but not so big that it would be unworkable. The aim was to develop research and production techniques that could be extended to cover the whole of CBD at a later stage.

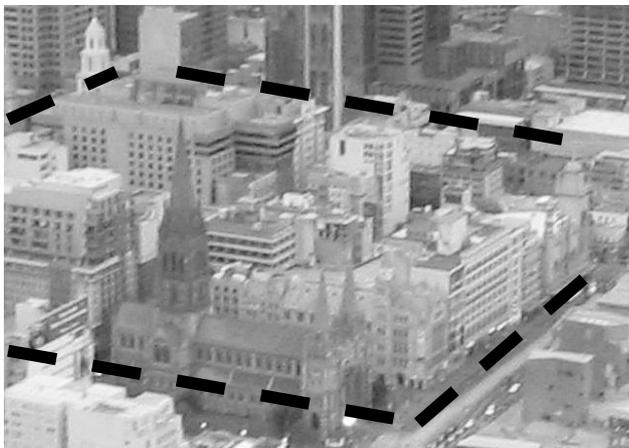


Figure 7. Prototype area. [http://www.jessiandmatt.net/albums/Melbourne/IMG\\_0126.jpg](http://www.jessiandmatt.net/albums/Melbourne/IMG_0126.jpg)

Typical of the buildings that escaped the wrecker’s hammer in the prototype area is the Regent Theatre (Figure 8). The image shows a number of buildings in Collins Street that still exist today. The buildings to the left of the Regent Theatre still stand, whilst the building to the right of the theatre is part of the Queen Victoria Buildings, demolished in the 1960s for the City Square (Monash University, 2006),

The first step was to undertake a survey of the area to record where significant buildings still stand. The map below shows the extent of existing buildings and significant buildings.



Figure 8. Regent Theatre 1970. The Age Research Library [http://150.theage.com.au/view\\_bestofphoto.asp?intid=1378](http://150.theage.com.au/view_bestofphoto.asp?intid=1378)

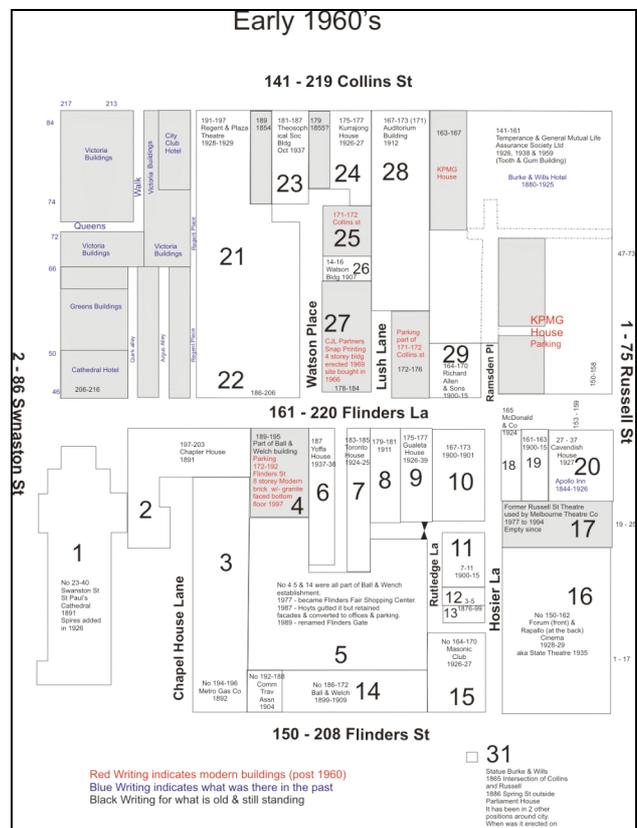


Figure 9. Prototype area: missing buildings in grey

The next stage was to develop the 3D model. VRML was chosen as a development tool as it allowed open, extensible formats to be used and the ‘built’ worlds could be constructed in Web browsers that included a VRML plug-in. VRML is extensible, interpreted language and it became an industry-standard scene description language. It is used for 3D scenes, or worlds, on the Internet. To produce 3D content 2D components are defined / drawn and the viewpoint specified. Once this is defined the drawing package renders the 3D image onto the screen. VRML code defines objects as frameworks that are rendered. This makes file sizes very small. The appearance of rendered surfaces can also be modified using different textures. By using the computer’s fast processing speeds, and specifying multiple, sequential viewpoints ‘walkthroughs’ can be

produced. The *BitNet Management* (Germany) VRML browser plug-in was used with Microsoft's *Internet Explorer* browser.

The buildings of note still standing in the study area were surveyed to ascertain position, use and building height. Each building façade was photographed for use in 'stitching' the images onto the sides of VRML primitive shapes. Considerable time was spent in 'cleaning' the images using *Corel Photopaint*. A number of images were taken and the 'pieced together' to form an uninterrupted image, free of cars, pedestrians and street furniture. What were removed were trees, cars, signage, and any street furniture that, if not removed, would appear as a 2D image in the 3D world, thus degrading the perception of the Virtual World.

Some of the images that would be included as textures in the VRML world were stitched from numerous individual images. As the buildings are constantly screened by vegetation, pedestrians and vehicles some required extensive processing with the image editor. As well, as the buildings are multi-storey the images needed to be further manipulated to remove the scale distortions throughout the image. For example, the Temperance and General Building comprised a composite of many images. The composite image is shown below (Figure 10) and how it appeared in the final world can be seen in Figure 16.



Figure 10. Temperance & General Building composite image

As the images sourced from historical archives were black and white, the final process was to convert colour images to greytone images. Whilst the VRML world loses some impact due to this, this process ensured that a uniform model resulted.

The major change to the study area is at the north-west corner (corner of Swanston and Collins Streets). This area, now mainly open space was once clothed in buildings. These were all demolished in 1965 – Queen Victoria Buildings, City Club Hotel and Cathedral Hotel. As well, these buildings were once separated by alleys and associated alleyways - Queens Walk, Quirk Alley, Argus Alley and Regent Place. These ceased to exist after building demolition and subsequent land parcel consolidation to build the first City Square, which was later removed and redeveloped. This area is shown in Figure 11.

A number of the buildings were gutted and rebuilt with the façade of the old building left on the outside of a modern interior. Some have retained the facades and structural skeleton and were rebuilt to a modern design within. A few buildings have been demolished and replaced with modern designs. These sites were the focus for uncovering historical photographs to 'fill the gaps' in the model's streetscapes. The oldest buildings have not been demolished but the facades have been changed so often over the years they are now unrecognisable as being from the 1850's except for their lack of height at 2 storeys. Similarly, most of the street level shop fronts have been modernised even if the building facades have not. St Paul's Cathedral did not have any spires till 1926 and was not as imposing as it is today. The model was built with the spires included.



Figure 11. Swanston Street looking South from Little Collins Street, 1915. State Library of Victoria [http://www.museum.vic.gov.au/marvellous/image\\_pages/mn001544.asp?URL=http://www.museum.vic.gov.au/marvellous/powered/index.asp](http://www.museum.vic.gov.au/marvellous/image_pages/mn001544.asp?URL=http://www.museum.vic.gov.au/marvellous/powered/index.asp)

The 'missing' building sites were mapped and images retrieved from various sources: the State Library of Victoria; the Museum of Victoria; the National Library of Australia; the City of Melbourne; newspaper archives; and Web sites. Many images, like that in Figure 12, a 642 x 423 pixels image of the Queen Victoria Buildings, were low-resolution, but were used, as no alternatives were available.



Figure 12. Queen Victoria Buildings 642 x 423 pixels image. [http://www.walkingmelbourne.com/building\\_profile.php?ID=604](http://www.walkingmelbourne.com/building_profile.php?ID=604)

Looking at the Queen Victoria Buildings specifically, to be usable a number of images had to be manipulated and joined to produce a composite image. Each 'component' of the image had to be manipulated to remove as much distortion as possible. The VRML model texture dictated that 'front-on' photography was used, however as these images did not exist a 'best fit' path was followed. Whilst unsatisfactory with respect to image quality and integrity, the non-existence of alternative images made this the only path of operation. Figure 13 shows how this composite image appears in the VRML model.

All existing and numerous missing buildings in the study area were subsequently inserted into the model that allowed it to be viewed in a browser. The completed world is shown in Figures 14 and 15, with detail shown in Figures 16 and 17.



Figure 13. Queen Victoria Buildings composite image as it appears in the VRML world

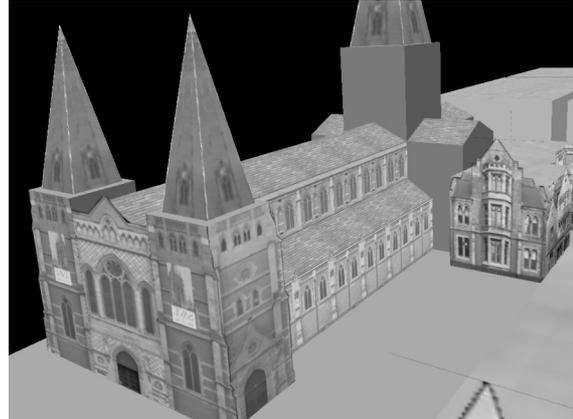


Figure 17. Detail of St. Paul's Cathedral, situated at the south-west corner of the study area

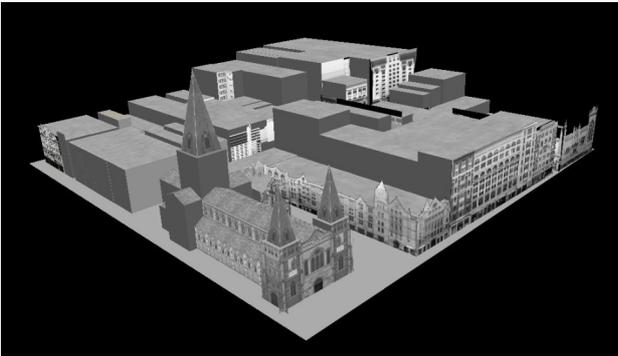


Figure 14. The model – looking towards the north-east from the south-west corner of the study area

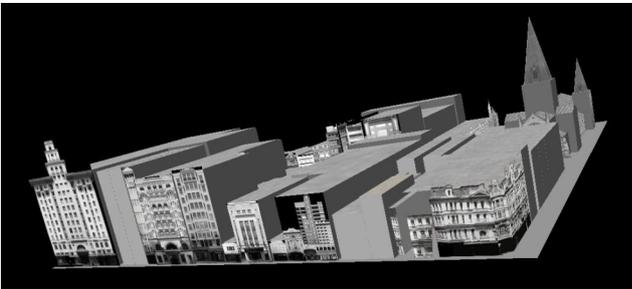


Figure 15. The model – looking towards the south-east from the north-west corner of the study area



Figure 16. Detail of the Temperance and General building, situated at the north-east corner of the study area

## 5. INITIAL IMPRESSIONS

The model works as a tool to illustrate how the study area would look if all significant buildings remained. It works effectively using the combination of Microsoft's *Internet Explorer* browser and the *The BitNet Management* VRML browser plug-in. Whilst odd initially, the black and white model allows the city buildings to be adequately visualized. Buildings still standing are easily recognised and their 'rebuilt' neighbours provide information that was hitherto unavailable in a composite model. As can be seen in Figure 9, some of the building images are still to be sourced. As they are found they will be processed and subsequently added to the model.

The longest part of the project was to manipulate the images of the existing buildings, as noted earlier. Some buildings, like the *Temperance & General Building* shown in Figure 10, required over 30 individual images to be 'stitched into one composite image. This is a production problem that will need to be refined when all of the Central Business District is tackled. The other problem area is getting access to usable images of the buildings that no longer exist. As shown in Figure 12, some of the images are of poor resolution and many are oblique photographs that will require much manipulation. Considerable time effort will be required to source usable front-elevation and side elevation images.

In an initial assessment of the 3D world it was found that the lack of detail in the streets did not detract from the use of the model as a depiction of current and 'missing' buildings. The 'empty' streets drew a focus on the buildings, and away from peripheral areas. However, in previous research on the use of 3D Web-delivered models (Cartwright et al., 2005b) it was found that users preferred that three elements must be added: the sky; images at the end of each street, so that the world did not end abruptly; and navigation resources in the form of simple street signs. These will be added to the model to improve its utility.

It is thought that the model will have applications for planners, historians and decision-makers alike to appreciate how the city might look if buildings were not removed in the 'haste for the new' during the 1960s and 1970s. But, the final verdict about whether the model 'works' needs to be received after the product is evaluated by these user groups. This will ask users two questions – Stage 1 of the evaluation process will ask "Is it usable?" and Stage 2 will ask: "Is it useful?"

## 6. FUTURE PLANS – EVALUATION

The initial evaluation, Stage 1, will be employed to ascertain whether there were any difficulties in its use. This will be undertaken using a qualitative evaluation with an expert group of users to test the tool itself. When evaluating the models developed for previous applications the Reeves and Harmon (1993) User Interface Rating Tool for Interactive Multimedia was used to make an initial evaluation of the product (Cartwright *et al.*, 2005b).

For each of ten user interface dimensions outlined below, users rate the product on a one to ten scale.

- Ease of use – relates to how easy the product is to use, compared to using other materials like paper maps. Here users will also be asked to consider the general use of the VRML interface as well as the use of a 3D package generally.
- Navigation – refers to the ease with which users can move through the product. Users will be asked to consider the general navigation through the product.
- Cognitive load – refers to how much harder, or easier, the product is to use compared to the 2D products. And, whether they had to work harder mentally, or whether it is easier, or more intuitive when using the 3D prototype.
- Mapping – relates to how the program tracks a user as they use the program, and how it provides feedback. This can be graphically, or through the use of some other medium. Users will also be asked to consider whether the 'built-in' navigation and 'world'-finding tools that are part of the general interface also assists by providing 'location in the product' feedback.
- Screen design – refers to the actual design components, colours, text, symbols etc.
- Knowledge space compatibility - focusses on the type of information provided in the product.
- Information presentation – considers whether the information presented is in an understandable form. Have users understood the information contained in the product, and did they comprehend how the city might look if the significant buildings remained.
- Media integration – as this product will provide a combination of VRML pages and mother information, candidates will be asked to consider the different media types used.
- Aesthetics – users will be asked to comment on whether a 3D product looks better (generally) than 2D products that they usually use? Does the 3D product enhance how the information is presented? and
- Overall functionality – perceived utility.

Stage 2 of the evaluation will address the product's usefulness. Here, usability issues will be addressed and used as the basis for formulating qualitative and quantitative evaluation questions.

## 7. CONCLUSION

As stated earlier in the paper, the prototype developed for the study area was completed as a test-bed to develop techniques that could be applied to the whole of Melbourne's Central Business District. The process involved mapping the study area, collecting 'at-site' imagery, manipulating and compositing multiple images, sourcing historical building images, processing historical imagery and coding the VRML world. The completed 'first-cut' model 'works', but it must be evaluated to answer two questions: Does it work? And "Is it usable? These are the foci of the next two stages of the project.

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