Time-slicing Wrest Park – Interactive 3D Visualisation of a Historic Garden

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1 Introduction

While architects, landscape architects and urban planners construct 3D models as a matter of routine (LANGE, 1999), visualisation of historic gardens in practice and academia has relied on abstract, two-dimensional representations. A few examples of 3D visualisation of historic gardens can be found, such as the Park Wörlitz Project in Germany (KLEIN 1996), the Koishikawa-Korakuen garden in Japan (HONJO et al. 2001), and the spatial modelling used at Hatfield House, England, for the European Valhalla Project (COUNSEL 2002). While several gardens can be explored by virtual walks based on photos or panoramic photos, on the Internet, or viewed as simple terrain models such as the Royal Botanic Garden, Melbourne. Most recently, King’s Visualisation Lab, King’s College London completed a pre-rendered visualisation of the Royal Botanic Gardens, Kew, entitled “How Kew Grew” (KING’S VISUALISATION LAB 2006).

In landscape and urban planning, public participation, interactivity, and virtual reality become more and more an issue. At present, landscape visualisations seem to have been widely adopted for use in the assessment of controversial or large-scale projects, for simulating landscape changes, and for research purposes (PAAR 2006).

In the history of landscape architecture, REPTON (1803) may be regarded as an exception and early pioneer in the area of landscape visualisation (LANGE 2001). In his ‘Red Books’, he invented a technique of ‘before and after’ perspective representation for landscape designs that is not dissimilar to current digital methods.

About the project

The Great Garden at Wrest Park (Figs. 1 and 2) from an historical perspective is an internationally important designed landscape that shows over three-hundred years of continuity as a garden. From a technical point of view, Wrest Park was chosen as a visualisation case-study due to the wealth of available archive material and especially due to the recent completion of a woody plant survey, identifying the vast majority of tree and shrub species growing in the garden.

The ongoing visualisation project has come about through a partnership between Rowan Blaik (one of the authors), English Heritage (England’s heritage conservation agency, guardian of Wrest Park and former employer of Mr Blaik) and Philip Paar (the second author), Lenné3D GmbH, with whom Mr Blaik took part in an internship with in 2006.
Although the main garden's original structure is extant, the visualisation, as a virtual reconstruction, is intended to allow end users to compare the today's landscape with that of the 18th century through its main phases of development to the present day. As well as working towards the creation of a finished landscape visualisation, the project is an investigation into the creation of large-scale garden visualisations with many layers of temporal data, and how it can be visualised and presented.

Fig. 1: The Long Canal, Wrest Park, c.1912. Source: English Heritage/Country Life

Fig. 2: The Long Canal, Wrest Park, as it appears now. Source: English Heritage, 2005

As well as the obvious interpretation and orientation uses, the visualisation also aims to illustrate main management issues facing the garden today. These issues include; the loss of designed landscape around the garden itself, The Old Park, both of built garden features and vegetation; An over mature and overly dense tree population; Vistas and avenues closing up due to over vegetation or losing their focal points; and the addition of large amounts statuary and other 19th century additions changing the style of the original garden.

As English Heritage is active in a number of conservation projects at Wrest Park, it is hoped that the visualisation will aid any future projects.
2 Material & Methods

2.1 Data sources and preparation

A wealth of conventional archive material exists for the site, which has been collated and summarised in previous conservation management plans\(^\text{vi}\). However, as documents and published sources can never give a complete or wholly reliable guide to the history of a site (LAMBERT ET AL., 2006), fieldwork was carried out by Lear Associates\(^\text{vii}\), to identify, age and plot plant material both living and dead. This is especially useful at Wrest as many ‘lumps and bumps’ and depressions show the locations of previous plantings and features. Once identified, these plants and features were plotted onto existing estate CAD plans in use since the 1980s.

The transition between these CAD plans to GIS maps was carried out using ESRI ArcMap software (Figs. 3 and 4). The post-importation process included manual correction of CAD drawing errors that resulted in poor functionality in GIS software. Known vegetation was converted to point data and areas of unsurveyed vegetation as polygons, with details of their characteristic vegetation types.

Garden areas were defined and designated preset types to map land uses, built features and characteristic vegetation using vector data. This vector data is complimented by the addition of point layers to show the location of past and present tree and shrub.


A series of estate maps and illustrations dating from the 18th century and early ordnance survey maps (Figs. 5 and 6) were then geo-referenced and compared against data gathered from the survey fieldwork and landscape investigation. Earthworks from previous landscape features and planting could then be matched up, especially where large-scale landscape features such as avenues were found.
The data was then combined to create regression maps, to understand and interpret changes to the garden over time, to identify areas where little or no changes have taken place, and to identify potential inaccuracies in the source data.

Included in the original CAD plans were interpolated contour lines showing elevation in the garden. These lines were used to generate a DEM, and eventually, a TIN terrain model. Although not as accurate as high point data taken during the original site survey, the contour lines were at an acceptable resolution (every 25cm in elevation). Due to the simplicity of the garden's topography, these contour lines sufficed for the generation of the terrain model, however, if required LIDAR height data captured by the Environment Agency also exists.

Buildings and other garden structures have been constructed using Google SketchUp's photo matching function. By combining archive photographs with known dimensions and shapes of the buildings' footings from CAD plans, a photo-referenced model can be accurately produced (Figs. 7 and 8). These models are then exported in the COLLADA format for additional shading and texturing work in Blender before placement on the terrain model.
3 Plants and Player Software

The finalised project will be presented using Biosphere3D, an interactive landscape visualisation system, focussed on real-time rendering of vegetation in different scales. Biosphere3D supports multiple scales on a virtual globe reflecting our thoughts on the maximum extent of a landscape, showing gardens in their true landscape context. Unlimited terrain can be visualized due to the spherical terrain model and the efficient data management (CLASEN & HEGE 2007, 2006), however, the main target scale of its predecessor – Lenné3D-Player – will be used to visualise landscape from an eye-level perspective. This enables the user to wander through the planned or predicted landscape (WERNER et al. 2005).

Satellite images, raster digital elevation models (DEM), and aerial views of multiple terabyte can be combined with vegetation plots based on vector shapes and biological sample data to create photorealistic views, e.g. of planned scenarios and reconstructed historical gardens. Since no pre-calculation is required, the data can be edited and reloaded to enable quick development cycles and semi-interactive participation processes. Biosphere3D is compatible to Lenné3D’s plant models, permitting access to one of the largest databases of realistic 3D plants (REKITTKE & PAAR 2006). A wide range of european plant life has been modelled but still a lot of ornamental species and cultivars are lacking.

Habitat and land-use data provide the basis for Lenné3D’s vegetation modelling; the input of further geographical data allows automatic generation of plant distribution maps (RÖHRICHT 2005). Surveyed plant positions can be loaded from point Shapefiles. Three-dimensional plant models are assigned to the distribution map(s) and positioned on the terrain model.

At present, the current alpha version supports the following import formats:
- ERMapper Compressed Wavelets Raster (.ecw)
- JPEG2000 (.jp2)
- ESRI Shapefile (.shp)
- Lenné3D ASCII Ecofile (.eco)
- Lenné3D Flora3D plant files (.flora3d)
- COLLADA 3D object files (.dae)

The final hardware requirements are moderate: a standard dual core PC with 1-2 GB of RAM and a consumer GPU supporting OpenGL 2.0 will be adequate to run the system. Windows XP x64 or Windows Vista 64 bit is recommended. Graphics quality and performance will benefit from more cores, more RAM, and faster GPUs.

4 Results

Two out of the three intended historical periods are currently modelled, those being the present day garden and that of 1882-92. The third period (early 18th century) is in the digitalisation process. The absence of accurate or scale plans for this period will limit the historical accuracy of the visualisation of this period.
Characteristic vegetation, both ecologically and horticulturally correct, for under-storey plantings and conifer shelterbelts plantings have not yet been generated as plant distribution maps. Once these components are added, the visual authenticity of the project will be greatly improved.

Some built elements of the garden, such as building and statuary, have been included into their respective period landscape model. Although representative, improvements, especially to the level of detail of the statuary are being investigated using the EPOCH 3D Webservice.

The project has outgrown and outlived the first generation of Lenné3D player, and will now be presented using Lenné3D’s Biosphere3D player. Investigation into a user interface for temporal interactivity is taking place, with novel methods such as the Khronos Projector being examined.

5 Conclusions & Outlook

Although the visualisation will have great appeal as an interpretive tool for visitors to the garden, it has become apparent in the duration of the project that various new uses for the visualisation and collated data exist. The 2D and 3D plans of the garden can be used for garden management and as a tool for future revision of the Conservation Management Plan (CMP). Increasingly, as CMPs are used in the analysis and management of historic landscape, they have become a prerequisite of many government grants in the UK (WATKINS et al. 2007).

Visualising historic gardens has a number of issues that still must be overcome, compared to much more established visualisations of the built historic environment. Due to fact the landscape is often very well known and horticulturally or stylistically very specific in its appearance, viewers seem to have higher expectations than those of a natural landscape or a garden designed in a modern style. Built structures and statuary too, often highly ornate, pose more challenge in their representation. Once created, data can also facilitate future visualisations of other gardens, where common elements occur.

Real-time visualisation of historic landscape, particularly in Britain, could become an important niche market. The popularity of the heritage sector is clear, with over 56.4 million visits to historic environment attractions in 2005 (VISITBRITAIN 2006). In England alone, 1590 historic gardens and landscapes under heritage protection, make up a sizable 1.3% of the country’s land cover (ENGLISH HERITAGE 2003). Other large-scale organisations also have interest in promoting modern interpretive technology. The National Trust’s Mike CALNAN (2001) states “Interpretation will always include traditional guidebooks, exhibitions and guided tours; but modern technology and more interactive ways of explaining the past are now available to us and in the future will play an increasing part in our presentation of both our properties and our work”.

Especially since the Disability Discrimination Act 2005 has come into force in the UK, visualisations can help fulfil the statutory obligations land owners face when opening a garden to the public. As some garden areas may inaccessible and unmodifiable for those with disabilities, specifically such as the Chinese Bridge at Wrest Park, “alternative forms
of interpretation [such as landscape visualisations] may offer access solutions to difficult areas” (HODSON et al. 2005).

With tools and workflows becoming ever simpler and accessible for practitioners, more than ever with the advance open source and free software in the heritage sector (CALORI et al. 2005), in-house creation of landscape visualisations is getting closer for many gardens. However, the limiting factor and expense will always be the time and skills necessary for their creation (COUNSELL 2006).

References


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