

Visualizing the real world: Creating a virtual 3D historic representation of Oxwich Castle

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Abstract

Using Trimble Sketchup to produce a 3D model of Oxwich Castle.

Keywords - Geovizualisation. Oxwich Castle. 3D reconstruction.

Virtual scene. Geographic Information Systems. Sketchup.

1. INTRODUCTION

Using the tools and techniques known as Geovisualization, short for Geographic Visualization, this paper will discuss and show a process for creating a 3D representation of Oxwich Castle within a historic setting. Although called a castle, it is in fact “a grand Tudor house, built in a courtyard style.” (*Oxwich Castle*, 2011)

“Geovisualization works by providing graphical ideation to render a place, a phenomenon or a process visible, enabling human’s most powerful information-processing abilities – those of spatial cognition associated with our eye-brain vision system – to be directly brought to bear” (Aitken and Valentine, 2014)

This paper will discuss potential techniques while using the author’s experience in Cartography and 3D software techniques to create a scene which returns the castle to its former glory. The project will show a visual walkthrough of the chosen process, clearly defining the steps involved, while identifying any issues and how they were overcome.

1.1. History of Oxwich Castle

Oxwich Castle is located approximately 10 miles to the west of Swansea, on the south coast of the Gower peninsula overlooking the small village of Oxwich and its beach.

Oxwich Castle is a Tudor mansion house built by Sir Rice Mansel and his family, over many years during the 16th Century, and is positioned high up on the hill overlooking the sweep of Oxwich Bay to the east, and the sea to the south-east. On a day with favourable weather, the coast of Devon can be easily seen from such a lofty location.

“We know from the antiquarian, Rice Merrick, writing about 1578, that Oxwich was built partly by Sir Rice Mansel and was “lately re-edified or repaired” by his son, Sir Edward. The work perhaps extended over a period of about sixty years, between 1520 and 1580. Surviving architectural details suggest that the two-story southern range and gateway were the work of Sir Rice, probably around 1520-38. The east range was designed and built on an altogether much grander scale by Sir Edward, perhaps about 1559-80. Central to the house was an impressive two-story hall with an elegant long gallery above. Three tower-like projections to the rear of the building provided very extensive, and almost tenement-like accommodation.” (Diane M. Williams, 1995)

After only a few decades the family moved out and leased the property during the early 17th Century.

“Gradually, the east range at Oxwich fell into disrepair, though the south range continued in use as a farmhouse. In 1949, Oxwich was rescued from demolition by Lady Apsley and placed into State care.” (Diane M. Williams, 1995)

Only a portion of Oxwich Castle remains standing today, as large sections of it are only ruins since parts of the building collapsed in the 18th Century.

In 1968 the Environment Agency were tasked with restoring a very dilapidated building/ruin. Figures 1, 2 and 3 show the poor state of the outside of the building, while figure 4 shows the dilapidated inside of the house.



Figure 3: Oxwich Castle, south east tower from the North, taken by Department of Environment, 1964.



Figure 4: General view of Oxwich Castle (circa. 1968)



Figure 5: Oxwich Castle, inside the house, taken by Department of Environment, 1968.



Figure 6: View of Oxwich Castle and dovecot.

Figures 3 – 6 came from the following source:-
http://map.coflein.gov.uk/index.php?action=do_details&cache_name=&numlink=19554#tabs-4
(Coflein Mapping, no date)

1.2. Oxwich Castle now (2017)

After extensive restoration of the site it is now run by CADW and is open to visitors between mid-March and early November.

<http://cadw.gov.wales/daysout/oxwichcastle/>



Figure 7: Oxwich Castle, south east corner of courtyard, taken by Department of Environment, 1964

Based on the early photos, the restoration has gone very well. Both the internal space of the house and the external ruins have been made safe allowing access to the outside as well as the



Figure 8: Old courtyard at Oxwich Castle

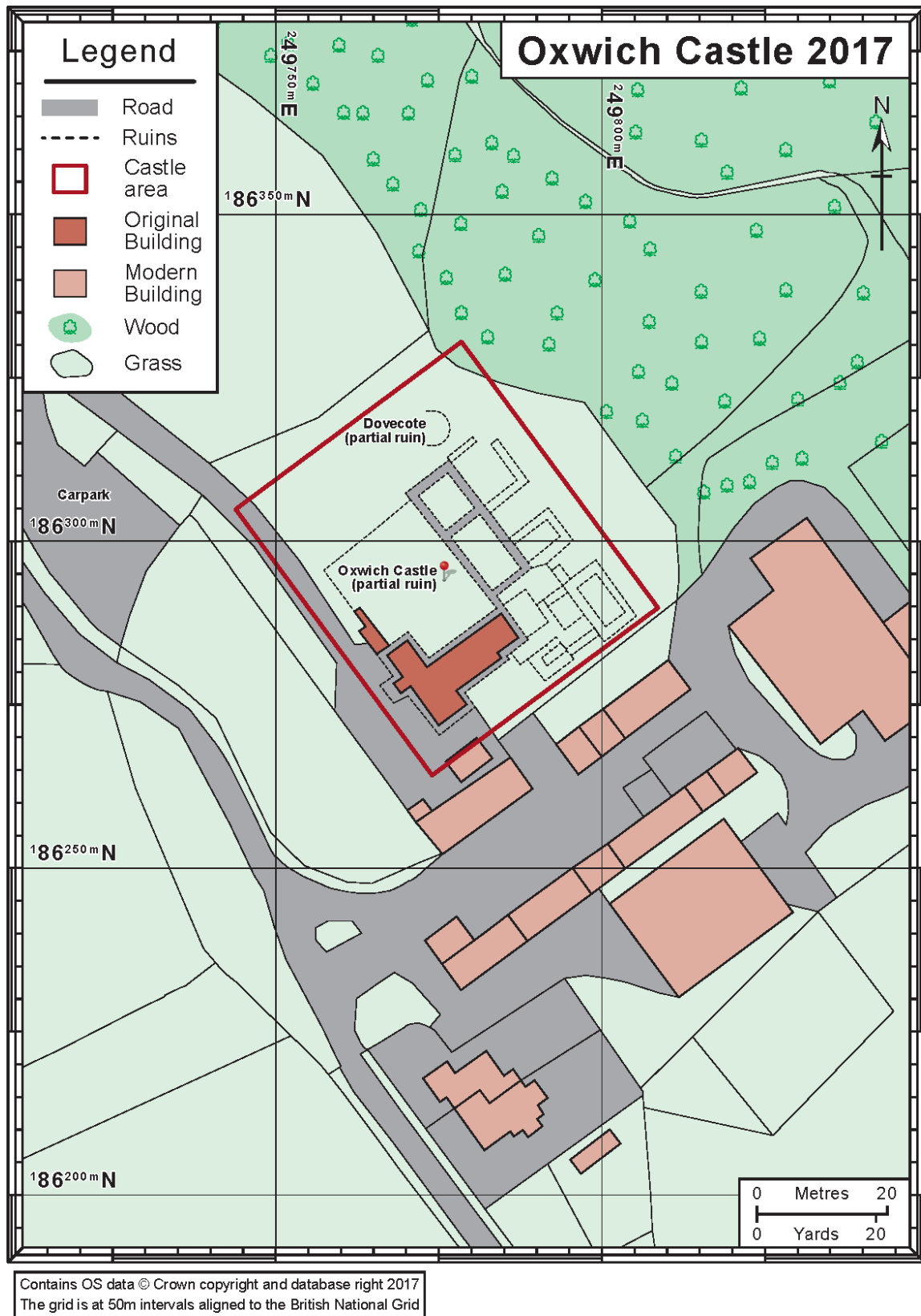


Figure 9: Map of the Oxwich Castle site in 2017, created using Adobe Illustrator CC 2017 in conjunction with the Avenza MaPublisher plugin using map data from the Ordnance Survey accessed through the Edina Digimap portal located at <https://digimap.edina.ac.uk>.



Figure 10: Map of the Oxwich Castle site in 1600, created using Adobe Illustrator CC 2017 in conjunction with the Avenza MaPublisher plugin using map data from the Ordnance Survey accessed through the Edina Digimap portal located at <https://digimap.edina.ac.uk>.

2. METHODOLOGY

The research methods for this project are qualitative in nature, as it is a creative practice paper using a practice-led approach to the research.

The research undertaken is as follows:-

Analysing the existing workflows and processes of Geovisualization techniques and how they can be applied to this project, through the reading of existing research.

Analysing the hardware and software capabilities in relation to the workflow/processes.

Creating a piece of work on the computer, using the following software:-

- Adobe Illustrator
- Adobe Photoshop
- Esri ArcGIS
- Trimble Sketchup
- Autodesk Maya
- Blender
- Eon Vue
- Unreal Engine
- Unity

From basic research undertaken so far, Image-based modelling technique has been identified as the most suitable method for this project. This will use a combination of the scaled plan drawings and hand-drawn pictures of the fully constructed house from the following website:

http://map.coflein.gov.uk/index.php?action=do_details&numlink=19554 ("Coflein Mapping," n.d.)

Gather data and use suitable software to construct a 3D model of a building, starting with Spatial Data from the Ordnance Survey. Using the raw map data for a positional reference and combined with the set of scaled plans, a model of the building will be created.

2.1. Suggested workflow

A simplified potential workflow will look like the following:-

1. Locate data
2. Process any Spatial Data in a Geographic Information System software (ArcGIS)
3. Choose suitable programs (Sketchup, Maya, 3DS Max, Blender, Vue, Unreal, Unity)

4. Convert the data for the chosen software programs
5. Import the data
6. Building the model
7. Create the remainder of the scene
8. Set up lighting and camera
9. Create camera movement
10. Render image or animation

2.2. Constraints

Although (El-Hakim *et al.*, 2004) outline their approach "for selecting the most effective technique for modelling large-scale heritage sites..." and discuss the different techniques and how they combine them to maximise their potential, the major constraint of this project will be the lack of certain equipment. Only a basic computer approach will be used at this time.

2.3. Choosing the software

2.3.1 Adobe Illustrator

Is a vector 2D software package capable of pseudo 3D object creation. It is used, in conjunction with Avenza MaPublisher to create beautiful maps in many forms, while retaining the spatial data.

2.3.2 Adobe Photoshop

Is a raster 2D software package, specialising in image manipulation. In later releases it can import 3D obj files, which retain their 3D characteristics

2.3.3 Esri ArcGIS

A fully professional mapping package with a wide industry usage. Has become the standard for lots of spatial data.

2.3.4 Trimble Sketchup

Specialises in modelling of engineering and architectural objects, ranging in size from the minute to the gigantic. It also works well with creating buildings for visualisation purposes.

2.3.5 Autodesk Maya

The industry standard 3D animation software, doesn't have any particular specialisation.

2.3.6 Blender

An up and coming open source 3D animation software. Good at lots of things but doesn't specialise in anything.

2.3.7 Eon Vue

Another 3D animation software, this time specialising in creating photorealistic landscapes and environments full of plants.

2.3.8 Unreal Engine

A very popular game engine, used to create many 3D games. Has a very good scripting element to it. Good at modelling in game environments.

2.3.9 Unity

Another popular game engine, again used to create many 3D games and has a good scripting engine also. A bit more complicated to use than Unreal.

2.4. Software and workflow

For simplicity the workflow will be

- Sketchup for the model of the castle
- ArcGIS for processing real world terrain data suitable for the following
- Either Unreal or Vue for the environment creation.
- Finishing in Maya for the final touch-ups and rendering.

3. CRITICAL AND CONTEXTUAL REVIEW

There are a vast number of existing texts relating to geovisualization. Most are very niche in their topics and therefore not relevant.

- Analysing the existing workflows and processes of Geovisualization techniques and how they can be applied to this project, through the reading of existing research.

4. PROJECT-SPECIFIC RESEARCH

4.1. Project Aims

The aim of this project is to attempt to create a virtual 3D scene depicting Oxwich Castle as a complete construction within its original historical setting. The intention is to use mapping and 3D techniques and software to produce a basic visualization.

The overarching objectives of this research project are:

- Examine the workflows and processes for creating virtual real-world historic environments.
- Explore the reasons for creating a CGI environment over using a real location.

- Create a photorealistic scene of Oxwich Castle in its original form within its historic 16th Century setting.

4.2. Existing research

(El-Hakim *et al.*, 2004) stipulate a set of motives for 3D reconstruction of heritage sites:

- documenting historic buildings and objects for reconstruction or restoration in case of fire, earthquake, flood, war, erosion, and so on;
- creating educational resources for history and culture students and researchers;
- reconstructing historic monuments that no longer or only partially exist;
- visualizing scenes from viewpoints impossible in the real world due to size or accessibility issues;
- interacting with objects without risk of damage; and
- providing virtual tourism and virtual museum exhibits.

(El-Hakim *et al.*, 2004) also mention a number of requirements that need to be considered when undertaking a reconstruction project, such as level of detail, geometric accuracy, the capture of all details, photorealism, low cost, portability, application flexibility, automation levels and model size, and how their order of importance will be determined by whichever objectives listed above are chosen for a particular project. They add “the ultimate goal of all 3D reconstruction methods is to satisfy all the listed requirements”, which has yet to be achieved to a satisfactory level.

The techniques covered by (El-Hakim *et al.*, 2004) are Image-based modelling, Range-based modelling and Image-based rendering.

- Image-based modelling:- Use a set of 2D images from different directions to create a 3D object, i.e. front, side and top of an object. The objects are created manually using suitable software.
- Range-based modelling:- Use of a light-based system to detect the edges of objects, i.e. a laser scanner. Points are created, which have to be processed to create the shapes.
- Image-based rendering:- Use of arbitrarily located images which rely on knowing the position of the camera accurately in relation to the object. Image matching software is used to put the images together.

The intention of this project, based on the objectives above, will be to provide a suitable scene for tourism and museum exhibition purposes. The model won't be highly detailed but a satisfactory level of photorealism, using known 3D Animation techniques, will be attempted. The author hopes this paper could be the first step in the process of visualizing historic / heritage sites around the Swansea area.

4.3. Software considerations

There are many choices of software that could meet the criteria to complete the project. The main options for most people are two fold, first is the creation of the model itself and the second is the creation of suitable environmental surrounds.

For the object modelling the considerations are far and wide, as most software will allow for easy creation of both models, environments and whole scenes.

5. RESULTS

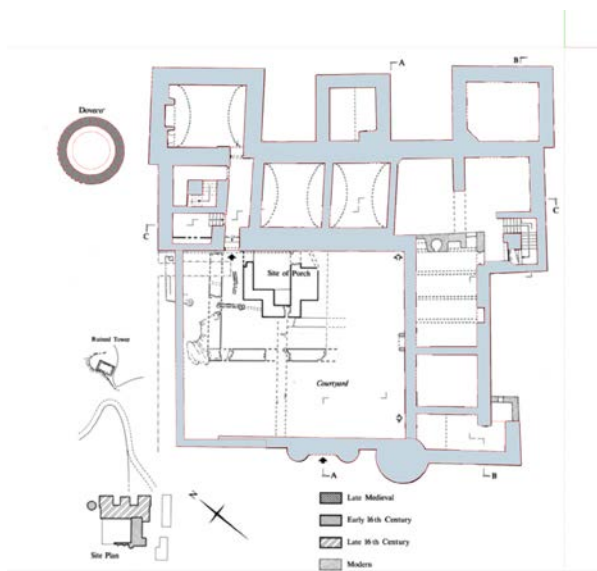
The suggested workflow from the previous chapter was used with Sketchup and Unreal being the software of choice, with Maya and Vue being the other choices.

5.1. Using Sketchup

Starting with Sketchup, a plan view of the site from the Royal Commission on the Ancient and Historical Monuments of Wales.

Step one – Import the plan of the site into Sketchup ready for tracing.

Step two - The initial 2D line work was drawn on top of the plan.

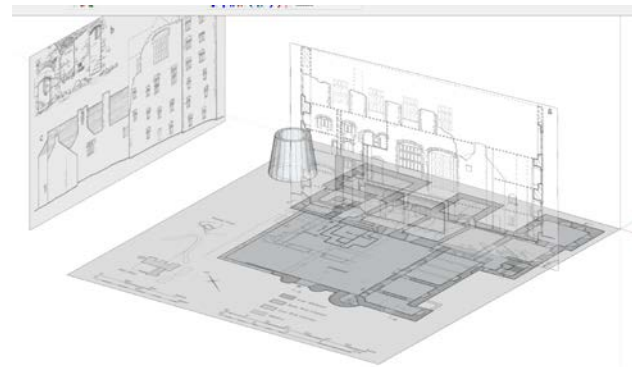


Step 3 – Objects could be extruded from the 2D

linework using a simple push/pull tool on one of the faces.

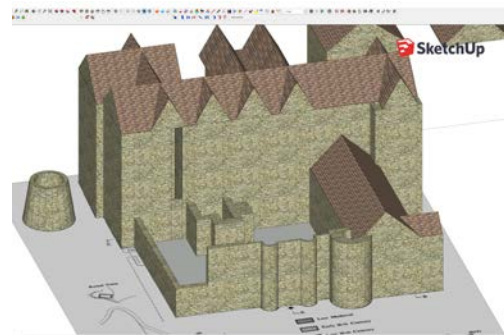


Step 4 - Other images can be added and lined up with the base plan for getting height information.

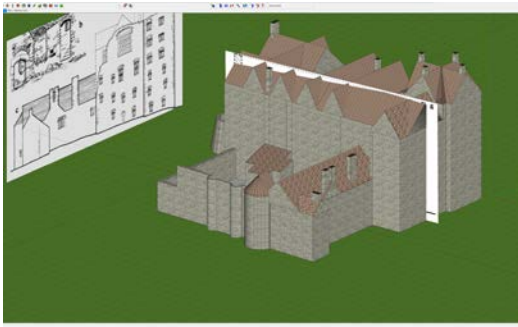


Step 5 – The objects are given heights based on the plan.

Step Six – Basic textures can be added to walls and roofs.



Step Seven – Bring in rough terrain through a Google earth plugin.



With more time the little details can be added to the buildings.

There is an option to geo-locate the model using Google Earth. Once that is done, a basic terrain can be brought in.

Using a simple technique of adding multiple planes at set height of anything such as 1 metre or 5 metre intervals. The planes can be intersected by the terrain to give pseudo contours and converted into a simple shaped mesh. The model is correctly located on the mesh and can be exported together for use in another package.

This technique, although not as accurate as using a Digital Elevation Model from the Ordnance Survey and processing it through ArcGIS to get it correctly formatted for either Unreal, Unity, Vue or Maya, can give a 'good enough' shape for a suitable realistic environment to be based upon.

5.2. Using Unreal/Vue

Didn't get as far as using Unreal but I did attempt to put the model with terrain, using the technique mentioned above, into both Vue and Maya with mixed results. The scale was wrong when it came into Maya and Vue, as the model's units needed to be set to metres in Sketchup, which it wasn't. So a terrain of a few hundred metres was coming in at a few hundred kilometres instead.

6. EVALUATION AND CONCLUSIONS

After completing the majority of the workflow I now have a much better understanding of item one, partial understanding of item two and three.

1. A better understanding of the workflow for 3D reconstructions using geovisualization techniques.
2. Why virtual 3D reconstructions are produced and what value they add to society.
3. A rendered scene or short animation of the chosen project site.

With more time available, other suitable techniques may be found and those approaches can be

considered, within the mentioned constraint above, and if viable, can be undertaken.

6.1. Continuing work

Use of other software to properly evaluation their merits.

A consideration for a simple software based solution is needed.

To add more detail to the structure, both internally and externally.

Create the surrounding environment in either Unreal, Vue or Maya.

Work on different camera positions for more atmospheric rendering.

6.2. Future possibilities

Walkthroughs using Augmented Reality and/or Virtual Reality.

6.3. Final thoughts

Overall this has been a very good experience with Sketchup, which I think I will be using a lot more in the future.

7. REFERENCES

Aitken, S. C., & Valentine, G. (2014). *Approaches to Human Geography: Philosophies, Theories, People and Practices*. SAGE.

Coflein Mapping. (n.d.). Retrieved November 7, 2017, from http://map.coflein.gov.uk/index.php?action=do_details&numlink=19554

El-Hakim, S. F., Beraldin, J. A., Picard, M., & Godin, G. (2004). Detailed 3D reconstruction of large-scale heritage sites with integrated techniques. *IEEE Computer Graphics and Applications*, 24(3), 21–29. <https://doi.org/10.1109/MCG.2004.1318815>

Image-based modelling and rendering. (2017, September 1). In *Wikipedia*. Retrieved from https://en.wikipedia.org/w/index.php?title=Image-based_modeling_and_rendering&oldid=79829161

Oxwich Castle. (2011, June 7). Retrieved November 7, 2017, from <http://cadw.gov.wales/daysout/oxwichcastle/?lang=en>