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Taking excavation to a virtual world: importing archaeological spatial data to Second Life and OpenSim

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Abstract

The benefits of analysing and presenting archaeological spatial data in an interactive 3D environment have been discussed extensively in the literature. This paper reports of a R&D project that explored the possibilities of presenting archaeological information in virtual worlds with a specific focus on presenting and using actual documentation data captured by total stations and laser scanners directly in virtual worlds. Field trials were conducted in Second Life and OpenSim environments. The findings indicated that Second Life was a preferred environment because of the relatively large existing ecology of individual and institutional users. The proprietary nature of the environment and the consequent limitations to data transfer and the control of the world did, however, make the importing, linkage and manipulation of data problematic. OpenSim allowed a total control of the environment, but lacked certain technical features implemented in Second Life together with a comparable, large population of users.

1 Introduction

The benefits of analysing and presenting archaeological spatial data in an interactive 3D environment have been discussed extensively in the literature. Researchers have suggested using various techniques from proprietary visualisation technologies (e.g., Rua and Alvito, 2011) to open 3D engines developed for first-person computer games (e.g., Anderson, 2004) and approaches based on open standards such as VRML (Drap and Long, 2001). Several authors have also recognised the benefits of social exploration of data in open online environments such as ActiveWorlds (e.g., Forte and Beltrami, 2000; Prasolova-Forland et al., 2007).

The development of commercial and open non-game 3D virtual worlds has been rapid since the turn of the millennium. Even if the most intensive hype around worlds like Second Life has been relented and some of the pioneers including There.com have been closed, multi-user virtual worlds have shown their usability in several areas including education (Holmberg and Huvila, 2008), cooperative work (Smith et al., 2009), certain leisurely contexts (Crowe and Bradford, 2006) and, for instance, archaeology (Graham, 2007).

This paper reports of a research project that explored the premises of presenting archaeological information in virtual worlds with a specific focus on the affordances and constraints of presenting and using actual spatial data captured by total stations and laser scanners directly in virtual worlds. Field trials were conducted in Second Life and OpenSim environments. The project tested different types and

forms of spatial data from several different sources and evaluated approaches for the presentation of the data in the virtual world environment. There is some earlier research on the archaeological applications of Second Life even if most of the published studies tend to focus on individual archaeological exhibits. In contrast, OpenSim has been discussed to a lesser extent (besides the suggestions for future work by Forte and Kurillo 2010), and upon our knowledge no earlier comparative studies exist.

2 Second Life and OpenSim in archaeology

Second Life has been used for the presentation of archaeological projects and sites since the mid 2000s (Graham, 2007). Potential archaeological applications of virtual worlds have been discussed in the context of a number of different platforms including ActiveWorlds (Prasolova-Forland et al., 2007), Blue Mars (Ober, 2012) and There.com (Pearce, 2009), but there is no doubt that Second Life has been the most popular environment. Forte and Kurillo (2010) make some remarks on the possible future directions of their research and the possibility of using OpenSim for popular presentation of archaeological sites and Open Cobalt for visualising archaeological datasets, but otherwise very little has been published on the archaeological uses of that particular platform. Much of the work has focused on the promotion of archaeological and heritage sites (e.g., Chávez-Aguayo, 2011). Virtual worlds have been conceptualised often as a primarily representational technology (e.g., Grindley, 2007). Museums and archaeological projects have built replicas of archaeological monuments and “visitor centres” for dissemination of information on on-going projects and sites of interests (e.g., Getchell et al., 2009).

Besides the promotional and entertainment use, one of the major areas of the use of Second Life has been education. A large number of educational institutions have participated in Second Life, and even if the general interest has been in slight decline since the peak of the hype in 2006/2007, an extensive corpus of research contains plenty of evidence of the benefits of using virtual worlds for educational purposes (e.g., Holmberg and Huvila, 2008; Olasoji and Henderson-Begg, 2011; Sköld, 2012). In context of archaeology, for instance, Getchell et al. (2009), Graham (2007) and Salmon et al. (2010) describe how Second Life has been used for educational purposes. Students have been given a possibility to visit virtual archaeological sites (Salmon et al., 2010) and re-enactments of cultural environments and to, for instance, curate exhibitions (Getchell et al., 2009). From a scholarly perspective, one of the most ambitious attempts to integrate Second Life into the frameworks of public archaeology and scholarly archaeological processes have been conducted in the context of the Çatalhöyük project (Tringham, 2010). Morgan (2009) has suggested that from the perspective of archaeological scholarship, the most significant benefit of virtual worlds might be their capability to provide archaeologists an easy-to-use sandbox for challenging the “static modes of representation” and at the same time to provide opportunities for non-expert participants and audiences to access archaeological sites and knowledge.

Even if the most of the authors have been rather optimistic about the possibilities of using Second Life and other virtual world environments in archaeology, Harrison (2009) reminds that it is important to consider the consequences of the virtualisation of cultural heritage. Even if the notion of cyber-archaeology of Harrison may be seen as conceptually somewhat problematic term, the necessity of meta-research on the use and consequences of virtual worlds is similarly apparent in the field of archaeology than it is in the context of cultural heritage studies.

3 Archaeology in Virtual Worlds (ArVi)

The present study was conducted under the auspices of the Archaeology in Virtual Worlds (ArVi) project financed by the Finnish Board of Education in 2009-2011. The aim of the project was to test the portability of archaeological research and documentation data and its usability in open three-dimensional virtual environments. The project used Second Life as a primary case example, but evaluated also other platforms. In addition to technical testing, the project looked into how Second Life and other comparable virtual worlds could function as platforms for communicating archaeological information online and as a part of a physically based exhibition. The reason for focusing on open (in the sense of not being restricted for particular institutions and users) virtual worlds was to evaluate the possibilities to take archaeology to virtual environments with an existing user base. The two chosen platforms are relatively stable and provide existing global 'standard' environments for visualisation and exploration of three-dimensional information.

Second Life was chosen as a test platform because of its popularity, the relative openness of the environment for developing and presenting user generated content and because of the earlier positive experiences of its usability as a learning environment (Holmberg and Huvila, 2008).

The project was conducted as a cooperative effort between the municipality of Eura and Muuritutkimus Co., a private archaeology consultancy. The research was conducted by Dr Isto Huvila (Uppsala University) and Dr Kari Uotila (Muuritutkimus) with contributions from Mr Markus Kivistö, Ms Tuija Väisänen and Mr Pekka Mäkitasku.

4 Findings and observations

A significant reason for the popularity of Second Life is undoubtedly the availability of simple and relatively powerful 3D modelling tools directly in the freely available client software. In spite of their virtues, from an archaeological point of view, the tools have certain limitations. The built-in instruments are based on primitives based modelling paradigm and are very simplistic in comparison to professional 3D packages. The processing of 3D data is further complicated by the fact that the number of available polygons in each area of the virtual world is limited because of performance restrictions of the environment. Due to the limitations, it is often preferable to use simple geometry and, as much as possible, to simulate details with texture maps.

At the time when the project started the possibilities to import 3D data into Second Life were severely limited. It was possible to import specifically prepared bitmaps (sculpt maps) for 'sculpting' meshes inside the virtual environment. In addition it was possible to generate and modify objects by using scripts produced by add-ons to external modelling software such as Blender or 3DS Max. In late 2010 a new feature was added to the Second Life software that allowed users to upload meshes directly into the environment in Collada format (www.collada.org). The technique was implemented almost simultaneously to OpenSim environment.

In the ArVi project, the importing of models was tested in both Second Life and OpenSim environments using both primitive and mesh based approaches. The tests were conducted using digitised (scanned and photographed) and born-digital documentation data from the iron age archaeological site of Luistari (located in Eura, south-western Finland), and later on using additional laser scanning and CAD-based documentation data from an excavation conducted in 2011 in the World Heritage site of Old Rauma. Laser-scanning data from Faro Focus 3D was prepared using Faro SCENE 4.8 software and combined with total station measurement data and processed further in AutoCAD Civil 3D version 2012. Both types of data were imported into MeshLab version 1.3.0a for post-processing and conversion to Collada format.

The primitives based approaches were found (as expected) to be largely useless for processing existing documentation data. It was apparent from the beginning that the tools are mainly usable for creating new models. The technical process of preparing and exporting documentation data into Collada format and to Second Life and OpenSim was mostly a relatively straightforward task without major problems. The main limitation related to the size of importable meshes and to the need to keep the level of details very low. In practice, it was apparent that for presentation purposes, the direct use of actual documentation data was possible only for visualisation of individual small objects and details. Because of the need to keep the level of details low, it was necessary to create the main part of any site and landscape using the primitives based modelling tools and bitmap based landscaping of the environment. The tests confirmed the apparent fact that both the embedded modelling tools and the mesh import functionality have not been developed for working with typical archaeological documentation data, but to help 3D designers to develop functional and aesthetic 3D objects and environments from the scratch. In practice, our tests showed that it is relatively unproblematic to import files containing up to 60 000 vertices even if the particular figure is not a definite technical limit. The mesh and scene scales were also limited and occasional stability issues occurred. Even if the OpenSim documentation states that the mesh support is under development and not necessarily 100% Second Life compatible, in our tests OpenSim tended to be more stable than Second Life. The practical tests conducted as a part of the ArVi project confirmed also the possibility to upload and use typically slightly larger and more complex models to OpenSim test environment than to Second Life.

On the basis of the evaluation of the usability of the environments, it could be stated that Second Life had an advantage of providing a relatively large existing ecology of individual and institutional users. This advantage is especially apparent when compared to closed, stand-alone environments (e.g., as in Rua and Alvito, 2011). Second Life provided the best possibilities to take archaeology to an environment with a relatively large 'native population'. At the same time, however, the proprietary nature of the environment and the consequent limitations to data transfer and the control of the world made the importing, linkage and manipulation of data problematic. OpenSim allowed a total control of the environment, but lacked certain technical features implemented in Second Life and a similarly large existing population of users than Second Life.

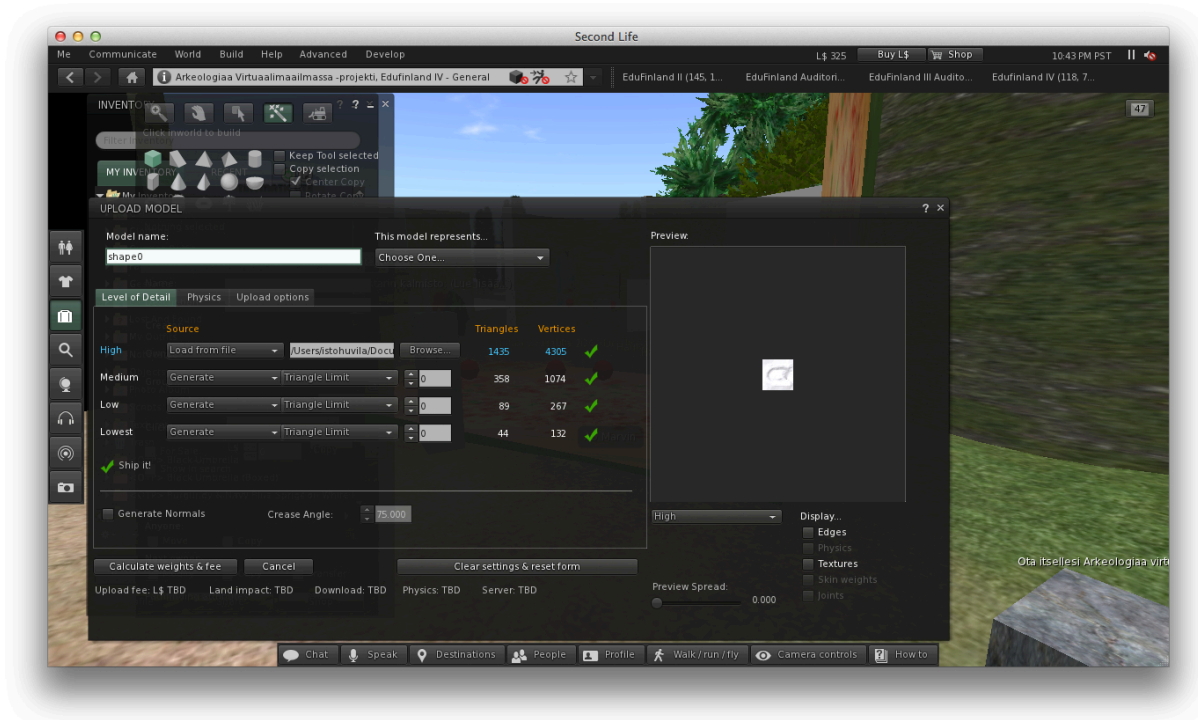


Figure 1: Second Life using Linden Research Second Life Viewer, with Mesh import tools.

Second Life (Figure 1) provides a broad array of tools for presenting and visualising archaeological excavations. In addition to displaying a three-dimensional model, it is possible to use text, audio files and video within the three-dimensional environment. It is also possible to create links between the Web and the virtual environment and to reuse and build on the data that is already available online both in popular ‘web exhibitions’ and open documentation systems and repositories. The virtual environments provide the general public also with a possibility for personal engagement with experts. Archaeologists can organise guided tours in a virtual excavation site and interact directly with the public without a need to travel to a specific physical location. The virtual excavation site can also be used as a site for public programming such as for giving lectures and organising other types of events. A similarly significant aspect of the environment is that the public can engage with the virtual excavation at the time of their choice, an aspect that is seldom possible at an authentic excavation site. From the perspective of the physically based presentation of archaeological sites, the virtual presentation is capable of creating added value as a resource that gets people interested in the site, provides additional in-depth information, possibilities for augmented experiences and modes of interaction that could compromise the preservation of the authentic site.

Technically, in order to be able to interact in the virtual environment, each participant (or resident, using the common Second Life designation of its users) needs to register a free personal Second Life account, to create an avatar and to download and install Second Life client application. The terms of service of Second Life limit the participation for individuals of over 16 years of age. In practice, an adult can show Second Life environment for younger individuals using his or her own avatar, but the experience of watching others navigate in the environment lacks authenticity and engagement. It is obvious that a typical Second Life user is not necessarily a frequent visitor to archaeological sites, but it is reasonable to assume that the original lack of interest may be compensated by their capabilities to interact in the Second Life environment. A Second Life user is likely to have necessary technical skills for navigating in the environment and engaging in a meaningful interaction with a virtual archaeological

site. The learning curve and the need to have a Second Life account limits the usability of the environment in traditional exhibition environment, but does not entirely rule out a possibility to use it as a complement.

One of the challenges of operating in the commercial Second Life environment was experienced in the end of 2010 when the Linden Research, the creators of Second Life, announced the discontinuation of their educational and non-profit pricing scheme of virtual land. Another economic shortcoming of the Second Life environment is the cost of uploading image data into the virtual world. Even if the cost of uploading a single unit of data is low, it became apparent that especially in the test phase when a lot of materials need to be uploaded for testing, costs could be significant even if they are unlikely to become prohibitive if the most of the testing will be conducted in a separate gratis test grid (i.e. world). Another, potentially a more significant issue for the project was the limited possibilities to export data from the virtual world to other environments.

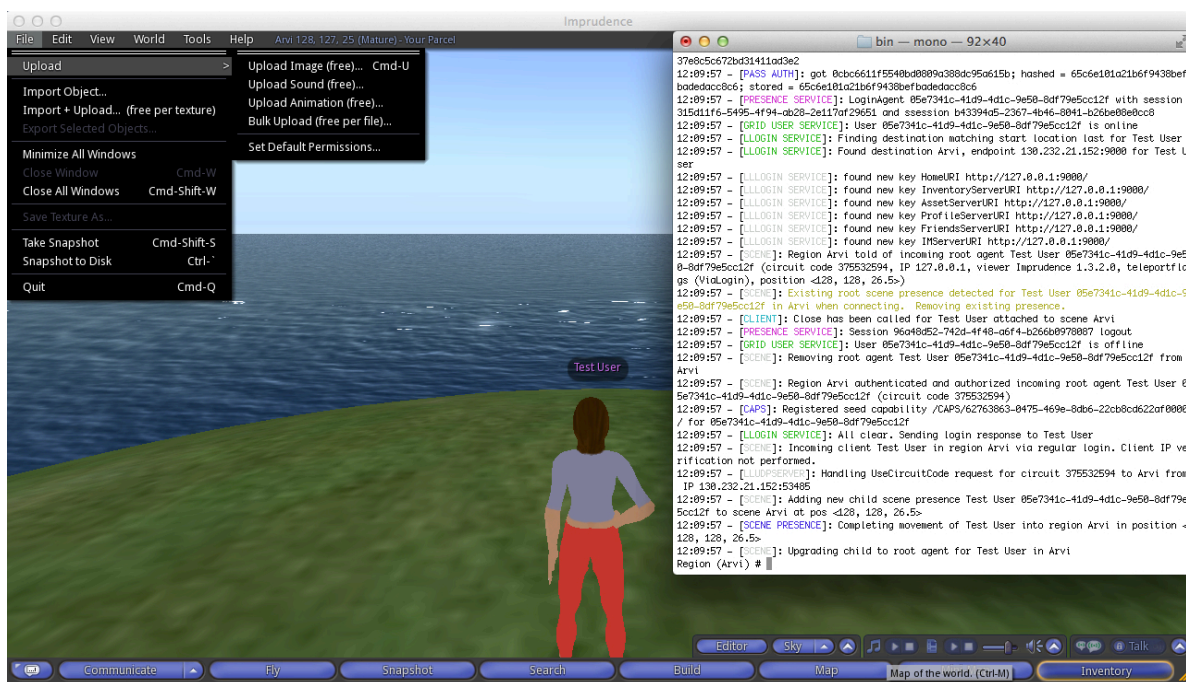


Figure 2: OpenSimulator running on localhost with an alternative client, Imprudence Viewer.

OpenSim provides a largely Second Life compatible open source server environment that can be accessed (similarly to Second Life), using the Linden Lab Second Life viewer software and an array of independent virtual world viewers. The two platforms are visually similar to each other. Even if the two environments are similar and compatible on a protocol level, Second Life is more mature and stable environment with more features. By the time of this writing, it is, however, necessarily to remark that OpenSim is being developed in a fast pace. The possibilities to install a local instance of the OpenSim software or to choose a hosting service provider from a relatively long list of companies and other organisations provide flexibility and better possibilities to control the platform. The use of OpenSim environment eliminates also the need to comply with Second Life age limits and a need to use a personal avatar. In this sense, OpenSim is a more flexible solution for public access terminals. At the same time, however, operating an OpenSim based world does potentially require slightly more technological

expertise either in terms of installing and maintaining own server or in terms of selecting the best possible host organisation. Another more significant shortcoming in comparison to Second Life is the loss of a relatively large virtual world with a population of tens of thousands of users. Even if the OpenSim worlds can be connected to each other into similar grids (i.e. worlds) than Second Life and it is possible to travel between individual grids using so called Hypergrid technology, the user base of OpenSim based worlds is significantly lower than that of Second Life. In the present study, this issue was judged to be of particular significance because the focus of the project was to evaluate open virtual worlds as an alternative to closed ones.

5 Conclusions

In spite of the several technical challenges identified during the process, the virtual worlds provide a highly promising environment for presenting archaeological information using authentic archaeological data. The earlier archaeological projects in virtual worlds such as Second Life have been based on using the environment primarily as an easy-to-use exploratory modelling tool for archaeologists (e.g. Morgan 2009) and a showcase for purposely-built visual re-enactments of sites and monuments (e.g. Getchell et al., 2009). In spite of the presence of certain challenges and limitations, the present study was able to pinpoint several possibilities and benefits of working with real documentation data in these environments.

It is apparent that none of the tested environments was entirely ideal for the evaluated purposes. Second Life had the largest population of existing users, but posed limitations to the level of (technical) control of the environment. The relatively small user base, the need of slightly higher technical skills and the lack of the maturity of the environment limited the usability of OpenSim. It is necessary to note, however, that the fast pace of the development of OpenSim and the emergence of new OpenSim hosts is likely to decrease the impact of the last two issues. At the moment, the selection of a virtual world is a trade-off between available features. If the existing user-base would be the only criteria of significance, an ideal choice at the moment would be an environment like the World of Warcraft or Habbo Hotel, but it is apparent that they lack features that would make them ideal for presenting archaeology, especially, using authentic three-dimensional documentation data.

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