VR WebGIS: an OpenSource approach to 3D real-time landscape management

Calori L., Camporesi C., Forte M., Pescarin S.
CINECA Supercomputing Center, Bologna Italy, [l.calori], [a.guidazzoli], [s.imboden]@cineca.it
CNR ITABC (National Council of Research - Institute of Technologies Applied to Cultural Heritage), Rome, Italy. [maurizio.forte], [sofia.pescarin]@itabc.cnr.it
BOLOGNA CITY COUNCIL, mauro.Felcini@comune.bologna.it

En todos estos casos los modelos originales dieron un referente válido y reconocible a las Propuestas. La posteriores utilización de otros modeladores y equipos computacionales más poderosos permitieron mejores resultados tanto en las imágenes obtenidas como en los tiempos involucrados en el proceso de renderización. Un caso puntual: sobre el equipo Macintosh PowerPC a 300 mhz y 64 MB Ram con el cual desarrollamos el Video del Modernismo; comparado con un iMac a 333 Mhz, G3 y 128 MB Ram con el cual realizamos el Deco, los tiempos de renderización se redujeron a un tercio de los tiempos iniciales para un mismo trabajo.

La utilización de un programa de animación como Cinema 4D permitió aportar a las animaciones una mejor calidad de imagen y, posteriormente, significó la incorporación de objetos animados, agregando un elemento más al proceso ya que sincronizamos éstos junto con las cámaras obligada a una mejor comprensión y definición de los tiempos para que se coordinen las situaciones que queríamos mostrar.

Si bien esto se aleja de la modelación en sí de los edificios, su aporte implica aprovechar la herramienta que está disponible para ocuparla en su máxima expresión. Por ello no descartamos utilizar MoirCAD (actualmente VectorWorks) como un modelador ya que su poder está en la precisión. Las otras herramientas entran en una etapa posterior y ayudan a darle vida al modelo, incluso aportándole aquellos elementos que sobre un programa Cad son una limitación por tamaño de los archivos (como incorporar árboles o vehículos) los cuales sobre Cinema 4D son muy pequeños y no incrementan el tamaño final. Claro está que Cinema 4D aporta realismo pero significó aumentar nuestra curva de aprendizaje.

6.- Conclusiones:
Ver la ciudad como nuestro campo de estudio arqueológico y pensar que nuestros estratos son de información más que de tierra y que se reparten más horizontal que verticalmente, nos hacen pensar que podemos explorar la ciudad y recuperar lo oculto o perdido al re-valorar la historia oculta de cada obra re-construida. Posteriormente que montemos estos edificios somos los que más hemos aprendido de ellos ya que no sólo los estudiamos y analizamos sino que también los dibujamos y este proceso es, tal vez, el más revelador. El Patrimonio y la Memoria son frágiles como el mundo virtual que las re-construye, pero la ciudad es fuerte y duradera y esperamos que sea presente cada vez más legible al conservar orgullosa su historia.
getation, animals, etc. (based on xml) or inserting directly on the scene, in a defined geographical absolute coordinate, the models. We then implemented OSG potentialsities of the file publication over the Web, allowing VT Enviro to export the modified landscape. We realised an ActiveX plug-in for Internet Explorer to load the paged landscape from a Web server in the browser.

The final goal is to realise a system, useful for Public Administrations, Research Institutions and other public institutions, but also for the worldwide community. This system let a user not only navigate in real time through the Web even large territories, but also interact dynamically with them, adding for instance point of views, personal paths, activating or deactivating vectorial layers that can be added on the terrain, better understanding in this way the landscape.

In the process that brings to the reconstruction and the virtual navigation of entire landscapes, even through the Internet, the spatial component of the data is a central issue.

Thanks to the spatial component of the data, it’s possible, inside a VR system, to do some analysis and interpretation of those data and create new information that can be transformed into new layers back in the GIS, starting something like a “virtuous circle” that connect the bottom-up and top-down approaches (Forti, Pescarin 2004). More open is the process more virtuous are its results (fig 1).

Even for this reason, we tried to construct a system that could use the same philosophy followed, in the last years, by the two teams involved of CNR ITABC and CINECA Visual Lab (Calori, Diamanter et al 2004), that was based on Virtual Reality Desktop solutions and, in the meanwhile, that could be as much distributed and sustainable as possible.

After two years of research, still in progress, what we obtained is a Virtual Reality application based on Geographical Information Systems, that gives the possibility to exchange information, to share data, to open discussions, to test different hypothesis and eventually to revise some data and that can be published on the Web.

OpenSource offered us some solutions since it’s first adoption in the projects we used as testing-cases, showing that this approach could be a possible challenge for the future of sectors such as Cultural Heritage or environment management, giving a possible alternative to actual commercial solution, strengthening the investments on human resources, focusing on contents and on new tools developments.

Appia Antica Project

In the case study we choose at the beginning, we worked developing a part of a complex four-years project. It was a good chance, since it allowed a continuous comparison with other VR techniques thought for PC installation and based on commercial software and it gave also the possibility to follow the entire process of data production: from the fieldwork to virtual reality.

The Appia Park (the archaeological park of the Roman Via Appia, in Rome, Italy) project was developed by the interdisciplinary team of CNR ITABC, together with Rome Municipal Archaeological Superintendency. It was characterized by an intense activity of archaeological and architectonic survey (topographical and architectonic mapping and “micro-topographical” and “micro-architectonic” mapping), with the goal of acquiring data for a real-time spatial interactive system. All the techniques used (DGPS, Total Laser Station, 3D Scanner Laser, 3D Stereo Photogrammetry, Photo Modelling Techniques) were integrated, while the entire set of data acquired was post-processed, overlaid in a GIS project based on their spatial reference, connected with external multimedia databases (fig. 3). Even 3D information was geo-located and processed in order to be used together with GIS data, DEMs and Geomages - inside a Desktop Virtual Reality environment, based on VTTools for the off-line museum application (www.virtools.org).

We developed also an on-line VR application based on OpenSceneGraph and VTerrain libraries (www.appia.tabc.cn.it). The project, through the Appia Antica case study, confirmed that the use of integrated technologies and the combination of different typological data is extremely useful in order to manage archaeological and historical information inside GIS and Virtual Reality Systems, in a 3dimensional, interactive and flexible way. At the same time, this approach allows “scaled” version, useful even for cultural content dissemination, at different level, without losing any scientific precision.

Fig 2. Fieldwork activities

VR WebGIS

In order to develop our VR WebGIS system we found two OpenSource libraries that seemed quite promising: Virtual Terrain (VTP) and OpenSceneGraph (OSG). We start our work with Virtual Terrain Project because it offered a ready user interface, a good integration with geographical formats, projections, 3d models formats, etc. and a good integration with the workflow we were following before, for landscape reconstruction (Forti, Williams, 2002).

Virtual Terrain Project is first of all a project and a community interested to 3D digital reconstruction of large territories. VTP have also developed an Open Source tool for real time landscape visualisation (VTEnviro) and a series of other tools for geospatial data processing and models or vector layers managing (VTBuilder, CManger...).

The tools used for the project were mainly two: a good chance and an approach.

VTBuilder is a GIS-like software that allows to manipulate geospatial data. GIS file formats are imported and then prepared and exported for an optimised use inside the viewer. It produces DEM as height-field files (3D). Geomages are adapted and wrapped on the. txt file with a simple LOD-like function. Enviro is a complete viewer, partially based on OpenSceneGraph, that allows a navigation on large terrains, enabling or disabling parts of the models. The fundamental characteristic of this viewer is that with Enviro it's possible to modify in real time and in 3D all the objects included in the landscape. In this way any operation seems extremely natural, allowing to concentrate on reconstruction problems. With Enviro it's possible to add, put and cancel 3d models; to modify fences parameters procedurally, etc.

Unfortunately VTP doesn't manage terrain databases realised in hierarchical way, paged and with LOD (ag. ft. top). This didn't let the publication on the Web of the files or the management of large geomages with a proper LOD approach.

Even for these reasons we planned to extend VTP, integrating it fully with OpenSceneGraph.

The entire set of tools for terrain generation, reconstruction, navigation and interaction even through the Web in real-time, was possible, indeed, thanks to the use and partial extension of the 3D rendering library OSG and the tools Enviro and VATBuilder of VTP kit. VTP’s adjustments, become a real platform to generate, model and modify geographic scenarios.

It was enabled the utility of importing, inside VTP, different terrain database formats (ag. nod terrains - ft, topo, osg, nvp or other 3d models formats). Moreover an export utility has been created. With this functionality it’s possible to modify the landscape dynamically and then export it in OSG or in several 3D models formats.
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A virtuous circle that connect the bottom-up and top-down approaches [Forta, Pescarin 2004]. More open is the process more virtuous its results (fig 1). Even for this reason, we tried to construct a system that could use the same philosophy followed, in the last years, by the two teams involved of CNR ITABC and CINECA VisLab [Calori, Diaman-teri et al, 2004], that was based on Virtual Reality Desktop solutions and, in the meanwhile, that could be as much distributed and sustainable as possible. After two years of research, still in progress, what we obtained is a Virtual Reality application based on Geographical Information Systems, that gives the possibility to exchange information, to share data, to open discussions, to test different hypothesis and eventually to revise some data and that can be published on the Web.

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In the case of Appia Antica project, after the creation of the terrain hierarchy with OSGdem, we used VTEnviro uploading the OSG terrain instead of the proprietary "monolithic" terrain format. With VT-Build and Enviro we imported culture data (3d models, plants, characters, animals, vector layers, etc.) and we modified them directly in the 3d environment. The archaeological landscape was reconstructed in this way. Low-polygon 3d models, built with photo-modeling techniques [Pescarin, Piotroni et alii, 2005] could be added, together with vegetation information on the park, vector thematic layers on the ancient aspects of the landscapes and so on (fig. 5).

After this phase it was possible to export culture data into an "live or - osg format (fig. 6).

The landscape could be then published through an Activex we have written, where all the components of the landscape could be managed, kept organised inside a Web database (based on postgresQL and PHP) (fig. 7).

The web site is now available at www.appia.it/landscape. At present there are some requirements that we would like to modify in the future: broadband or ADSL connection, OpenGL graphic card, Internet Explorer.
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Fig 4. LOD and paged terrain reconstructed with OSGdem

Fig 5.
ACKNOWLEDGEMENTS

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The work of opening the system to as many formats as possible gave the possibility to use it also with other commercial or open software and for other uses. Terrains and 3d models generated by other external programs (paved terrain, 3d photo-modelled objects, 3d studio models etc.) can be fully integrated in the system. This allowed to take all the advantages of VTP kit, inside a wider and more effective working flow, and to create a medium useful to add, even on imported terrains, their own cultures, modifying and then exporting them in order to be used by other software.

After these experiences we are planning to go further on, toward a more ambitious and advanced project: the creation of a real “shared working system web-based”. The idea is the integration of different OpenSource technologies, mainly based on OSG library, with the goal of create a system and put territorial data on a server, letting a user to navigate freely in the landscape adding or modifying part of the territory, uploading models from a web repository.

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• GAMMA, HELM, JOHNSON, and VLISSIDES. Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley, 1994.
• OpenSceneGraph web site: http://www.openscenegraph.org.

Fig 7b. Modifying the landscape

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