

The Open 3D GIS Project – A Free Tool to Enable 3D Geographic Systems on the Web

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Abstract. *This paper describes the first steps taken in order to create an Open Source project that enables MapServer to display 3D objects (and in the near future, perform analysis on them) on the web. 3D objects are exported to a viewer (integrated to the browser) in the X3D format, which is the preferred format for displaying 3D objects, according to the World Wide Web Consortium. In this paper, the first results related to the development of this solution are shown, as well as the basic procedures in order to prepare a 3D database to be fit within Open3DGIS' specifications.*

1. Introduction

The concept of a WebGIS (acronym for Web-based Geographical Information System) is nowadays very widespread [Mitchell, 2005]. Solutions such as Google Maps have become very popular in the last few years, thanks to the availability of free geographic data on the World Wide Web.

Free and Open Source Software (FOSS) related to geomatics and geosciences are still somehow scarce, but there has been a huge increase in the number of projects available nowadays.

One of the most mature of them surely is MapServer. Simply put, this is a renderer that displays spatial data organized in a database, or in different files (the most common files would be: shapefiles – for vectors, and tiff – for images). MapServer, as described in its manual, is not a full Geographical Information System. It intends to excel at rendering spatial data for the web, as described

in [CGI MapServer Reference Manual].

MapServer has been used throughout the years in many projects where it was needed to display 2D Geographical Data over the Internet. It is, nowadays, a cheap and stable solution for doing so, being comparable to many of the most modern commercial web applications currently available.

MapServer relies on OpenGIS specifications. These specifications represent a consensus on how spatial data should be stored, queried and retrieved.

However, neither MapServer, nor the latest OpenGIS specifications define precisely how to deal with tri-dimensional data. Albeit almost all spatial phenomena can be satisfactorily modelled using 2D data, in some applications, the knowledge of 3D position is crucial for dealing with them. As an example, many subterranean tubes can be found under the sewer system of any urban scenario. If a subway needs to be constructed under this area, it is necessary to know the spatial tri-dimensional distance between those tubes, otherwise there would probably be undesirable accidents. In this case, a 2D GIS would not fit. So, there is a need for 3D data to be correctly displayed and analyzed in a Web GIS. As MapServer is already Open Source, a natural solution would be giving it 3D web features, developed as a plug-in, and also distributed as FOSS. This idea (of developing it freely) was also in agreement with the philosophy of the institutions that are currently sponsoring this project.

2. The Idea behind Open 3D GIS

Open 3D GIS intends to enable a geographic database (geodatabase) to be viewed in a 3D visualization on the web, using a web browser (such as Mozilla, Mozilla Firefox, Opera or Internet Explorer).

Basically, it consists of a series of scripts, written in Python, which extract spatial data obtained from several sources and loaded into a database (in this case, PostgreSQL with the module PostGIS). The user can choose between two options: export 3D features directly to this through the `cgi_o3dg.py` script loading them from an already opened MapServer rendering window using HTML query methods, or loading tridimensional meshes directly from PostgreSQL. This script calls Open 3D GIS and then converts all objects represented in 3D to a surface, through Delaunay triangulations.

The modelling script uses Blender's Python API to generate a 3D scene from that tridimensional surface. Blender is an open source software for 3D modeling, animation, rendering, post-production, interactive creation and playback. It is well known among the FOSS community.

The scene is stored as a “.blend” file by default. Another option is the generation of a X3D scene. Albeit X3D has some limitations, if compared to Blender, it is an open format, widely recommended by the World Wide Web Consortium (W3C) and fully integrated with the most used web-browsers (although it requires an additional plug-in in order to be correctly shown). X3D

is a XML-based format and has evolved from VRML.

After the generation of the X3D file, the model is exported to the browser, and can be freely viewed by the user. Figure 1 explains graphically the procedures described above.

3. Procedures and Examples

In order to test how Open 3D GIS works, a random set of level curves (generated automatically by a script developed at OpenGEO) was loaded into MapServer (Figure 2). This experiment is widely accessible through the web address <http://www.opengeo.com.br/ms/o3dg/>.

At first, the whole area is loaded into the browser window. After that, the user can select a subset of that area, that will be seen in a larger zoom. When ready, it is possible to generate the 3D rendering of the selected area, through a button located at the left of this window.

Figure 3 shows five different renderings that were created through this interface.

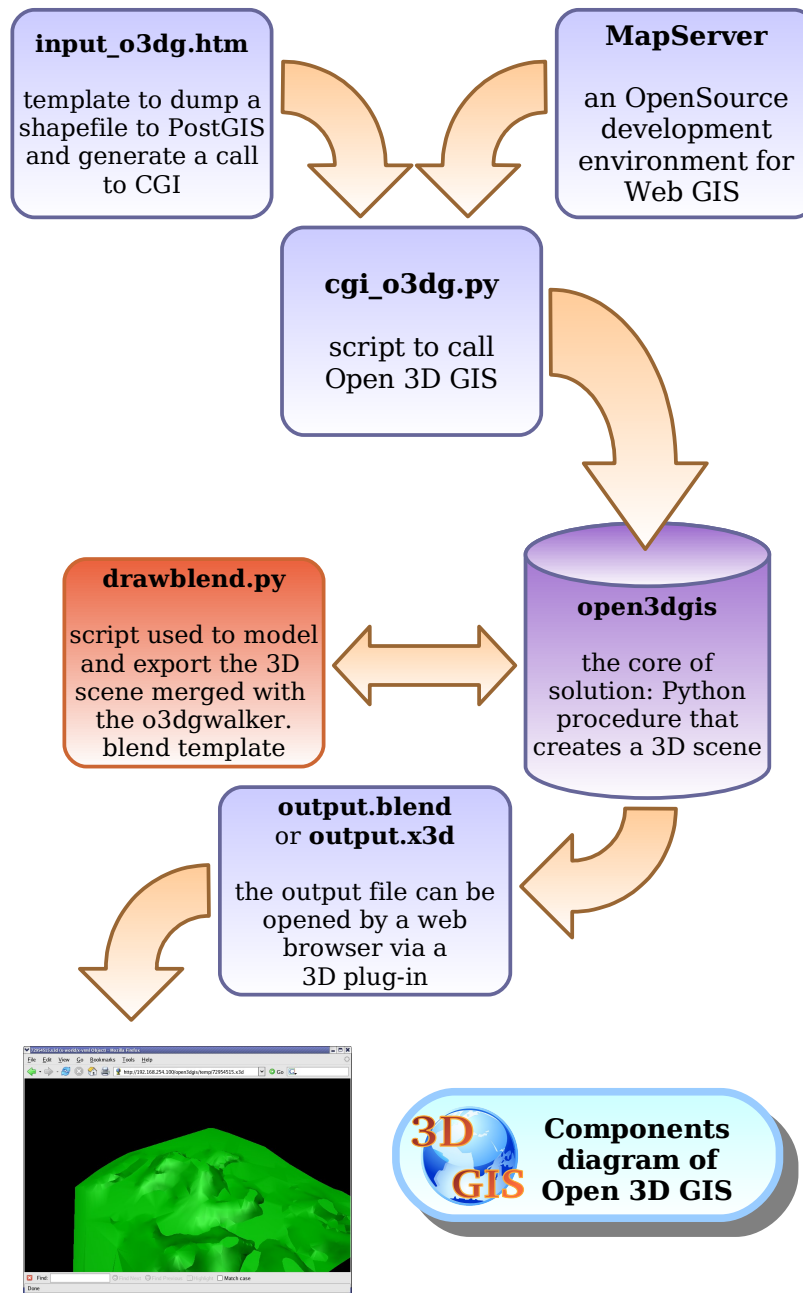


Figure 1. This diagram shows how Open 3D GIS works

4. Conclusions

This article shows the first steps towards fully integrating MapServer in order to provide a full 3D web environment. This first version of Open 3D GIS serves for visualization purposes only, and was developed with the intent to experiment the trade-offs of dealing with 3D data through the web.

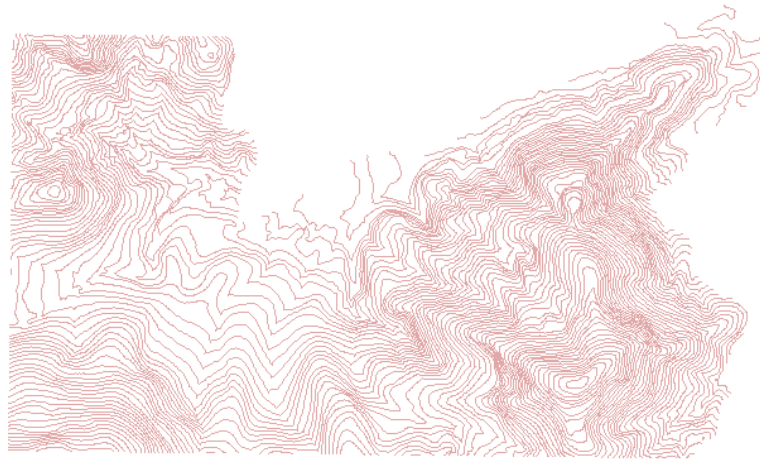


Figure 2. Random curves from which the tri-dimensional mesh was extracted

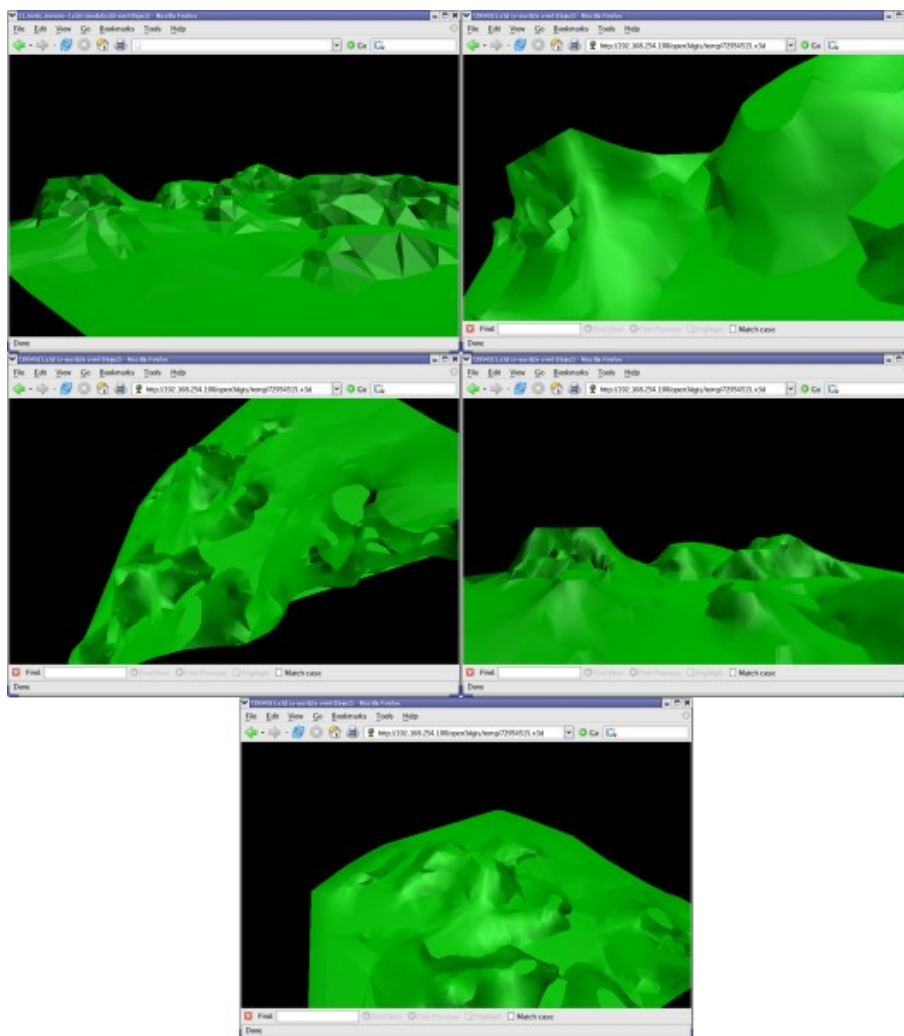


Figure 3. X3D renderings for the study area

Even though the results shown here are somehow very simple, it is expected in the near future that new versions should include the capability of representing 3D objects, such as buildings, roads and trees, and a basic query model, with which the user will be able to ask the database about such 3D objects.

Also, through the project's official page, located at <http://www.open3dgis.org>, it is possible to download the current version of Open 3D GIS. It is distributed through the GNU GPL license and has also a SourceForge project page, located at <http://sourceforge.net/projects/open3dgis/>.

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