Web-Based Large-Scale 3D-Geovisualisation Using WebGL: The OpenWebGlobe Project

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ABSTRACT

In this paper, the authors present the OpenWebGlobe project (http://www.openwebglobe.org). The authors also discuss the OpenWebGlobe SDK. OpenWebGlobe SDK is an open source framework for creating massive 3D virtual globe environments and interactively exploiting them in web browsers using HTML5 and WebGL, allowing for the creation of large scale virtual 3D globes with detailed contents and their interactive visualization directly within a broad spectrum of Web browsers.

Keywords: HyperText Markup Language 5 (HTML5), OpenWebGlobe, Software Development Kit, Virtual Globe, Web Graphics Library (WebGL)

INTRODUCTION

Generating and exploiting interactive (geospatial) 3D contents over the World Wide Web (WWW) has been a constant ambition, ever since the creation of the WWW almost 20 years ago. Despite some early formats and standards such as VRML (Bell, Parisi, & Pesce, 1995) and GeoVRML (Reddy, Iverson, & Leclerc, 2000), most efforts of delivering interactive and scalable geospatial contents over the Web required the installation of (proprietary) applications, specific run-time environments (e.g., Java Virtual Machine) or of browser-specific plugins. The emerging WebGL standard (Marrin, 2011) finally promises to provide a universal mechanism for exploiting even massive 3D worlds directly within most Web browsers. WebGL is a cross-platform, royalty-free web standard for a low-level 3D graphics API based on OpenGL ES 2.0. It is exposed through the HTML5 Canvas element as Document Object...
Model interfaces. WebGL is a shader-based API using the OpenGL Shading Language (GLSL), with constructs that are semantically similar to those of the underlying OpenGL ES 2.0 API, adapted for JavaScript, which needs some special considerations as a memory-managed language (http://www.webgl.org). In March 2011 Version 1.0 of the WebGL specification was released. Today WebGL runs in desktop and mobile web-browsers like Mozilla Firefox, Google Chrome, Safari, and Opera. In the Internet Explorer WebGL can currently only be used through plugins.

Virtual globes (VG), sometimes also referred to as 3D geobrowsers, consist of virtual 3D environments capable of streaming and interactively displaying large amounts of georeferenced spatial contents over the Internet (Nebiker, Bleisch, & Christen, 2010a). In their few years of existence, commercial virtual globes such as Google Earth or Microsoft Bing Maps 3D have received enormous attention from both mass media and the geospatial community itself. Recent survey (Nebiker, Bleisch, & Gülch, 2010b), carried out on behalf of the European Spatial Data Research network (EuroSDR), showed the important role and broad usage of VGs by geospatial professionals and mapping agencies. A highly valued feature of VGs is the provision of relatively simple, but effective mechanisms, such as the KML markup language, for integrating user-generated contents, namely points of interest or 3D objects. However, today’s VGs also have a number of shortcomings such as a lack of extensibility in terms of large / complex user-generated or third-party geospatial contents (e.g., own high-resolution DTMs or large to very large customized map or orthoimage data sets). Other potentially more serious shortcomings are the lacking extensibility in terms of functionality and the lacking ease of integration into third party applications and into operational environments which might not be compatible with data and IP right policies of large commercial VG operators. The strive for new applications of VGs together with the above mentioned limitations of the main commercial VGs have been the motivation for developing our own VG technology at the University of Applied Sciences Northwestern Switzerland. In this paper we discuss the evolution of and research activities in Internet- and web-based interactive 3D technologies. We then present the OpenWebGlobe project and architecture. Following a short discussion of the OpenWebGlobe processing functionality, the paper then focusses on OpenWebGlobe viewer component, which is fully based on HTML5 and WebGL, and some of its key features.

RELATED WORK

Early formats and standards such as the Virtual Reality Modeling Language (VRML) (Bell et al., 1995) were defined in the mid 90ies and permitted the authoring and delivery of 3D contents over the web but required applications or browser plugins, such as the first Netscape plug-in in 1995. VRML was developed with the main goal to be platform independent, extendable, and to work well over low-bandwidth internet connections. Important geospatial features such as accurate coordinate system support and a certain level of scalability were added by GeoVRML in the late 90s (Reddy et al., 2000). (Geo)VRML and its successor X3D are text based and don’t provide a capability to access graphics hardware and create custom graphics engines. In parallel to the VRML efforts, numerous approaches for interactively streaming large 3D virtual environments were being developed. However, they all required the installation of a proprietary application or of a specific browser plug-in. Among the earliest technologies for generating and interactively exploiting very large 3D landscape models over the Internet using browser plugins were the DILAS / G-VISTA (Nebiker, 2002) and LandExplorer (Döllner, Baumann, & Kersting, 2003).

The creation and recent release of WebGL has spurred a number of projects and activities with the goal of exploiting large scale 3D geospatial contents directly within the web.
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