Big City 3D Visual Analysis

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Abstract

A big city visual analysis platform based on Web Virtual Reality Geographical Information System (WEBVRGIS) is presented. Extensive model editing functions and spatial analysis functions are available, including terrain analysis, spatial analysis, sunlight analysis, traffic analysis, population analysis and community analysis.

Categories and Subject Descriptors (according to ACM CCS): Computer Graphics [1.3.7]: Three-Dimensional Graphics and Realism—Virtual reality

1. Introduction

Virtual Reality Geographical Information System (VRGIS) has been widely used for diverse applications such as landscape planning, resource management, urban modeling and etc. It becomes ever important in the era of big data [big08] [Bri12], and functions as a fundamental infrastructure of smart cities. Coming along with the high demands is higher challenge, mostly regarding to the capacity of managing multi-source geospatial data sets, integrating into a uniformed structure, performing advanced analysis and simulation, effectively visualizing large volumes of simulated and real-time data, and finally, sharing information by efficient means [BZ11]. In view of this situation, we consider WebVRGIS platform as a solution to meet these requirements, furthermore, we find that many issues can be overcome by enhanced virtual reality technology. This work presents a mature system developed in such line, which is loaded with 3D Shenzhen data as a demonstration.

2. Data

We utilize 3D Shenzhen as a convincing case to present WebVRGIS [Le13], as shown in figure 1. Shenzhen is a thirty-years new city, however, it has the highest population density in China, which reaches 7785 people per square kilometer (2013). It causes some embarrassments to the city information management. The presented platform can assistant the social service agencies to make full use of Virtual Reality and database technology to improve the comprehensive level of the city's service management, it can achieve shares of information resources of all departments and the dynamic tracking for the population and companies, geospatial information.

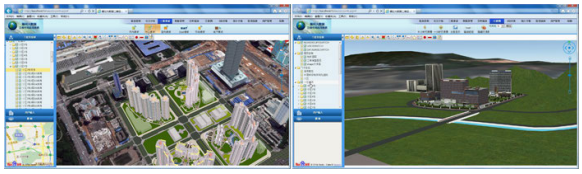

Figure 1: *The UI of the proposed system.*

Figure 2: *Left: Passenger flow of various stations; Right: Real-time traffic visualization*

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3. System Design

Graphic User Interface WebVR render engine [LYH*11] and spatial index technology is adopted to realize high-performance mapping of massive model data, realize special effects of rich scenes and smooth roaming, and truly simulate 3D urban space environment. Extensive model editing functions and spatial analysis functions are available, including terrain analysis, spatial analysis, sunlight analysis, traffic analysis, population analysis and community analysis. Users can realize dynamic loading of various kinds of spatial data, and change plane GIS data into more intuitive 3D symbols, as shown in figure 1.

Big data handling and analysis Virtual community [LCZ*12] [ZLZ*09] based big data management service is used to supply big data access service to various city information management systems and to manage the big data system. Various city information management systems can be enabled to obtain data and information from the big data platform in the form of service through access control over the data aggregation processing platform. Analysis function can have a comprehensive observation to the 3D model of a community and analyze and display various data, including population age composition, education background composition, etc. It counts the population distribution in various areas of the city and can manage the urban traffic and real-time road condition, as well as forecast the passenger flow, as shown in figure 2.

4. Implementation

The platform is developed by C++, OpenGL for rendering and HTML, javascript, C# for website distribution. The city bigdata contains the land and ocean [SLG*14] [LS14] [LSLF15], the above-ground and underground, outdoor and indoor, building and people, real-time and history as well as the forecast [LLZ*15]. Spatiotemporal database model and visualization has been considered in the design of the system [ZWZA12].

5. Conclusion

The 3D Shenzhen case proves 3D city visualization and analysis platform is a useful tool for the social service agencies and citizens for browsing and analyzing city big data directly, and is agreed upon as being both immediately useful and generally extensible for future applications. It also demonstrates that WebVRGIS engine is a state-of-the-art practical research. Some novel interaction approaches are considered to integrate in our future work [Lv13] [LFLF14] [LFFL15].

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