3D GIS based on WebGL for the management of underground utilities. The case of institutions

J.M. Jurado, L. Ortega, A. Graciano, F.R. Feito
Computer Graphics and Geomatics Group. University of Jaén (Spain)
www.Jaen3D.org, www.gggj.ujaen.es

Abstract

This work summarizes a web application related to a research project about underground infrastructures. The idea is to visualize, analyse and manage all underground layers inside 3D urban environments. The result of this research is an application web that offers a 3D perspective to work in underground infrastructures. This is possible using WebGL which provides the capability to add 3D content in a website. This application may be used from mobile devices.

Introduction

- The explosion of virtual reality, the evolution of the Internet and the progress of WebGL [1] allow the development of interesting 3D environments to be published directly in the web.
- World is not flat, so working from 3D perspective gives a real vision to take accurate decisions and express the ideas by a more efficient and effective way.
- The aim of 3D representation is to research new features to improve the current analysis tools.
- The case study for this research is the efficient management of the underground infrastructures in the campus of University of Jaén.

Web3D and Smart Cities

- The development of applications using computer graphics in websites provides a powerful tool to represent and disseminate 3D scenes.
- The main objective of this work is to achieve a perfect and accurate knowledge about underground infrastructures by using 3D web technologies.
- This application area is closer to the concept of the Smart Cities. The sustainability, the resource optimization and the correct planning of resources consumption are challenges by the most enterprises and public institutions.
- This poster presents an application which provides a fast, visual and simple access to review all parts of the underground infrastructures.
- Universities campus, hospitals, sport installations are some examples of places where the professionals need tools to manage their infrastructure of the inventory to be integrated with others process of maintenance.

Study of terrain and spatial database

- The development of this application required additional study about the digital elevation model (DTM).
- The terrain representation defines the slope of the underground infrastructures. In order to obtain the Digital Elevation Model (DEM), the PNOA [2] project provides an accurate LiDAR data with a resolution of 50 cm.
- The LiDAR points cloud is the input data, then elevation grid is calculated and finally the terrain is defined using the orthography photo.
- PostgreSQL [3] is the database management system used to store all data of application. PostGIS extension provides spatial and geographical objects.
- Performing a full conversion of all the input data to the 3D scene is required to perform a detailed study over this map [4].

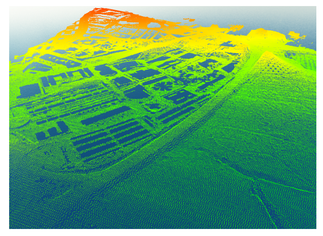


Figure 1. LiDAR points cloud

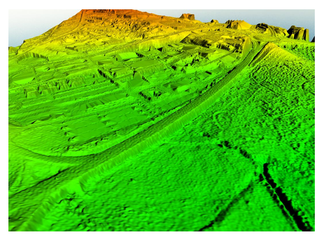


Figure 2. Elevation Grid

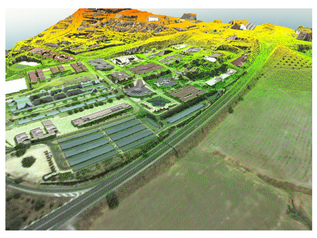
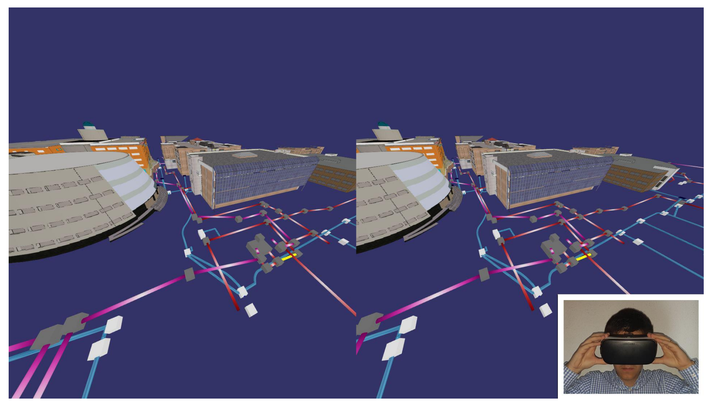


Figure 3. Terrain model

Figure 4. Input CAD data

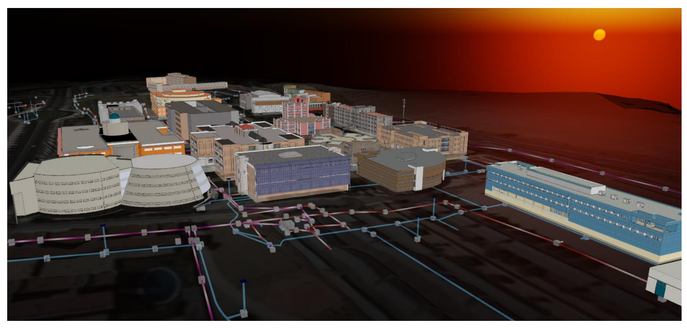
Virtual reality

- Virtual reality is another feature of this application. This mode is available from mobile phone using some of VR headset.
- It offers to users a new immersive navigation system.
- This type of interaction allow a real interaction with the virtual world.
- It offers a complete knowledge with different detail levels about the underground infrastructures.



Web application

- The web application is based on WebGL and describes an efficient management of the underground infrastructure of the University of Jaén.
- The aim of this project is to simplify all tasks made by maintenance enterprise or public administrations. This software meets the followings specific requirements:
  1. Integrate whole technical information relative to the maintenance of the underground infrastructures.
  2. Register all available materials and equipment relative to the repairs about underground infrastructures.
  3. Save spatial information to get precise geolocations of every element, toward a 3D GIS.
  4. Provide a real interaction with all elements of the scene to get the status of this component.



Conclusions

Most of the cities add new technologies of Smart Cities to get a better management of their infrastructures. Frequently, the information associated to these installations is based on CAD tools. The results of this research provided an useful tool to get a whole knowledge about underground services, from 3D perspective.

Acknowledgments
This work has been partially supported by the Ministerio de Economía y Competitividad and the European Union (via ERDF funds) through the research project TIN2014- 58218-R

References

[1] Khronos Group (2017). Connection software to Silicon. [Online] Available at: https://www.khronos.org/webgl/
[2] Instituto Geográfico Nacional (IGN) (2014) Proyecto PNOA [Online] Available at: http://pnoa.ign.es/
[3] PostgreSQL (2013) [Online] Available at: http://www.postgresql.org.es/
[4] Sanat Talmaki, Vinnet R. Kamat, Hubo Cai. Advanced Engineering Informatics, 27:283-298, 2013