Topological Data Model for Interactive 3D-GIS Systems. The Particular Case of the Underground Sewerage System

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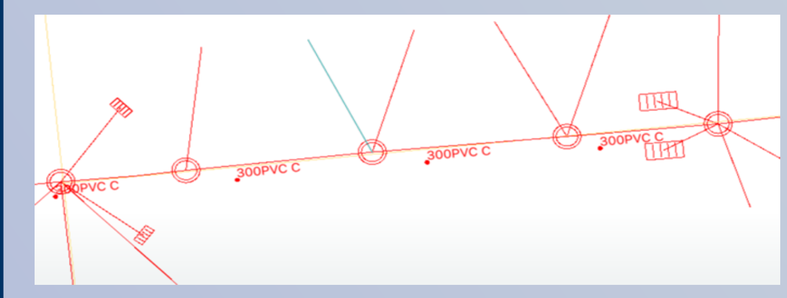
Abstract

3D-GIS are sophisticated tools for visualizing, managing and analyzing data of spatial nature in 3D. Current GIS with 3D capabilities are still far from being appropriate to be used in all phases of the urban infrastructure administration. In this paper, we present the topological data model defined for most of the infrastructures in the subsoil. 3D coordinates allow to solve one of the most important handicap: the direct visualization is not possible. We focus in the particular case of the sewerage system using real and current data. Some of the most important analysis operations are performed by means of the graphical interface with 3D capabilities.

Motivation

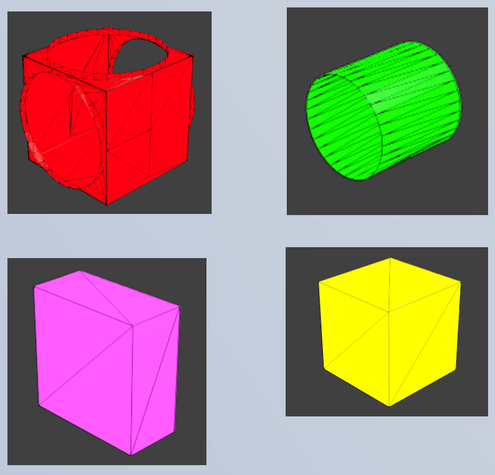


Underground Infrastructure problems:

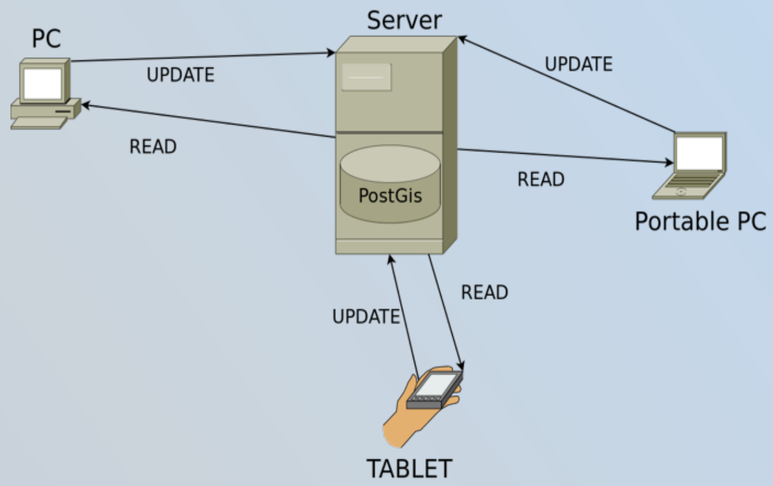
- Are not visible
- Given as 2D layers in DWG file format
- Non-topological information
- Coexisting with obsolete and other infrastructures
- Difficulties for locating elements when digging
- Difficulties for updating information in DWG files
- Lack of tools to manage the whole lifecycle

Sewerage system

Is a connected net that collects sewage and rainwater made up of pipes (green), wells (red), manholes (magenta) and scuppers (yellow)



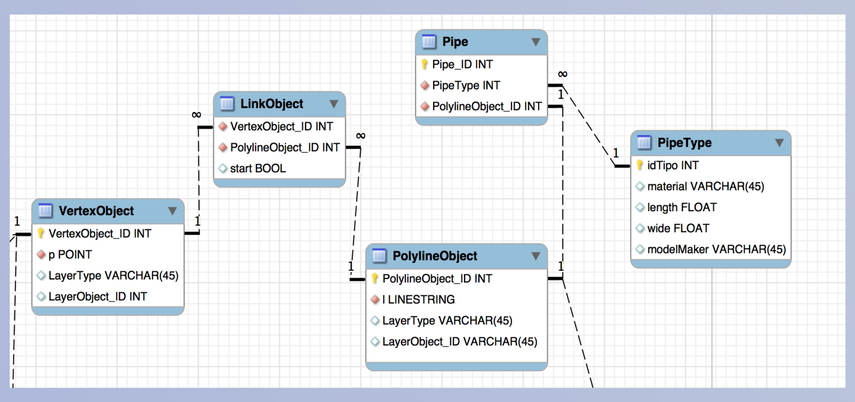
Towards the 3D GIS

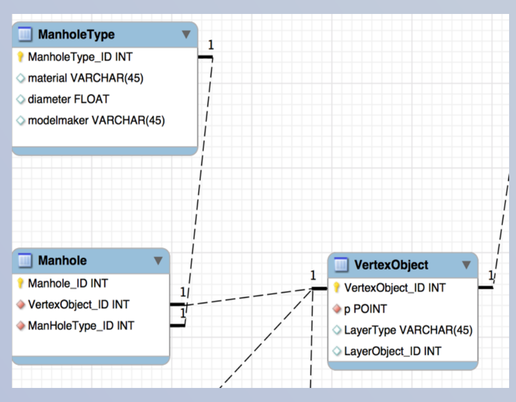


3D GIS desirable characteristics:

- 3D topological information
- One tool for all the lifecycle (Open Source)
- Client-server architecture
- Spatial database (PostGIS) in the server
- Ubiquitous device as client for:
- Visualization in 3D, navigation and interaction with the geometry and editing geometry in situ

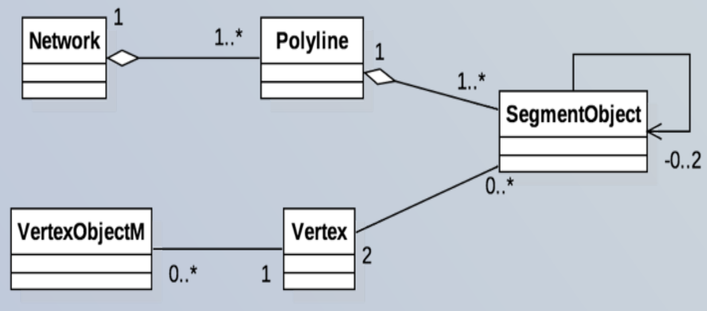
Database data model





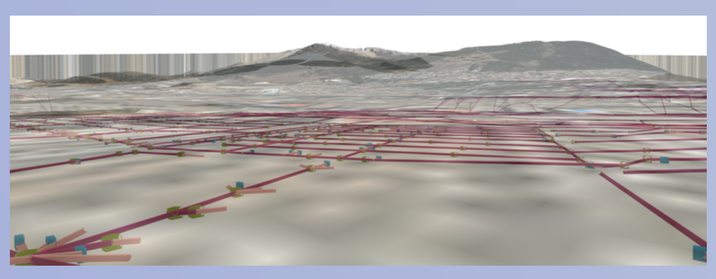
- We manage two data models, one in the spatial database and another in memory. It allows the editing of single elements.
- There are two types of geometric elements: polyline (pipes) and vertex objects (the rest).
- LinkObject solves the many-to-many relationship between Vertex and Polyline objects
- There are additional thematic tables linked to the geometric core: manholes, etc.

Memory data model

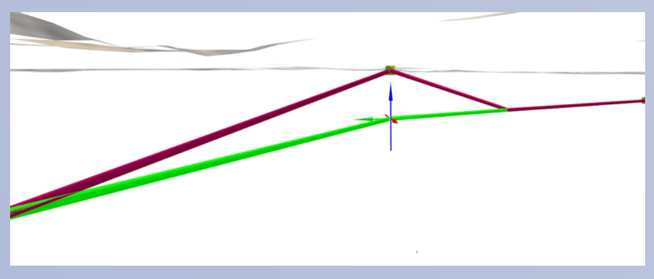


Polylines are decomposed into segment lines in order to be edited individually if necessary.

Results



- Sewerage system considering the terrain orography



- Edition of the geometry of a pipe

Conclusions and future work

- Main objectives achieved towards de 3D-GIS: 3D visualization, interaction, navigation and analysis under the same system.
- Future work: Definition of a CityGML Application Domain Extension (ADE)

Acknowledgment

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