Use of Marble in Engineering Projects

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Abstract

We present here a brief overview regarding the use of Marble in two scientific projects: Overhead Power Line Inspection and Agent Based Spatial Load Forecasting; exploring the use of this KDE tool in areas different from its original educational purpose.

Marble can be easily integrated with other geospatial technologies such as PostgreSQL combined with PostGIS to give support for geographic objects in databases. Generally, Marble is solely used as a tool for visualizing geospatial data. However, we believe that the use of other Marble's services, such as routing, can provide a significant added value to engineering projects at a minimum integration and computational cost.

Description

A significant amount of engineering projects require geospatial information, either for their development or as a complement to avoid simplifications on the models used. These projects rely on the use of geographic information systems (GIS) which include a variety of features such as geospatial data filtering, processing and visualization.

Marble, a KDE educational tool for visualizing geospatial information, offers a wide set of features to interact, pinpoint and acquire a general overview of geographical data. In order to reduce the gap between these tools and the developers, the KDE community supplies both an API and a documentation that gives access to all the functionalities available in Marble.

This paper presents two projects in which Marble has been used to support their development and to provide visual results to the final user.

a) Overhead Power Line Inspection

Overhead power lines of high and medium voltage are the means by which the distribution networks transmit the electricity. The inspection of overhead power lines plays an essential factor in maintaining the electricity transmission. Surveillance and maintenance of electrical infrastructures is the key to ensuring and improving the quality of service. An inspection system can prevent and predict future damages.

Within this project, an automatic overhead power line inspection system by UAV (Unmanned Aerial Vehicle) has been developed. The UAV flies along the power lines gathering images and data, which are processed by different computer vision algorithms to obtain the inspection reports. The inspection system must have outstanding information about the key elements for the inspection of the power lines defined in the legislation, such as electric pylons, buildings, roads, railroads,

power line crossings or vegetation. The objective is to obtain the coordinates and characteristic distances of these elements to the power lines. The necessary cartographic data have been obtained from GeoEuskadi, the Harmonized Topographic Database of the Basque Government.

All this geographic information is filtered to extract the key elements surrounding the power lines, necessary to improve the inspection power system. At this point, Marble provides a tool for visualizing the geographic data obtained from GeoEuskadi and the results of the filtering process. Moreover, this tool could also be used to clearly visualize where and why the inspection is more necessary.

In this project Marble has been integrated using C++ in the Qt Creator IDE with different layers generated and edited by the application to be shown in the Marble widget. These layers have been made in KML 2.2 (Keyhole Markup Language – OpenGIS KML Encoding Standard) for its flexibility and portability to other environments.

b) Agent Based Spatial Load Forecasting

Long-term load forecasting aims at predicting the evolution of the energy consumption in a certain area, so as to resize the electrical grid in accordance and to provide a reliable service to the final customers. The study of load forecasting can be divided into two areas in relation to the type of demand growth: vertical growth (related to the increment in the electric consumption of already existing customers) and horizontal growth (related to the apparition of new customers on a certain location).

Focusing on the horizontal growth, the objective of the system is to forecast the apparition of new electrical clients and estimate their future demand within a certain area in the next 5 to 10 years. The agent system needs information regarding the location, layout and type of infrastructures, which is obtained from the specific public cadaster. With these inputs, the system predicts and provides a geospatial view in Marble of the city growth in terms of both number of customers and energy needs. This approach would let the utility manager analyze whether the grid needs to be upgraded in order to give a reliable response to future energy needs.

In this project, Marble has been integrated with the python-based agent framework SPADE and the PyQt toolkit, through the use of the python bindings available. However, the state of development of these bindings and the documentation available made it difficult to exploit the benefits of all the features available in Marble.

Biographies

Oihane Kamara, Degree in Computer Science by the University of Deusto in 2010. M.S. in Development and Integrated Software Solutions by the University of Deusto in 2012. She has been working in DeustoTech Energy since 2010 in projects related to smart-metering systems, evaluation and calculus of ecological footprint, and the integration of artificial intelligence to improve energy efficiency in industrial processes.

Gorka Sorrosal, Automatic and Industrial Electronic Engineer by the University of Deusto in 2011 and NI Certified LabVIEW Associate Developer in 2010. He has been working in DeustoTech Energy since 2009 in projects related to artificial vision systems and the automation of the inspection for overhead power-lines by UAV. Nowadays, he is studying a Master in Control, Automation and Robotic Engineering at the University of the Basque Country, where he is developing his Master Final Project in the area of process modelling and control with neural networks and genetic algorithms.

Cruz E. Borges, Ph.D in Mathematics. His thesis was related to Root finding and Symbolic Regression Problems. He has also worked in Genetic Programming and Numerical and Evolutionary Methods for Decision Problems. Now he is working on prediction models of power demand and energy consumptions as well as the introduction of Automatic Modelling in catalyst design processes.