Combining Geospatial Data and Real-time Sensor Data for Calculating an Integrated Health Index

Thomas Everding[1], Simon Jirka[2]

[1]Institute for Geoinformatics, University of Muenster
everdingt@uni-muenster.de

[2]Institute for Geoinformatics, University of Muenster
jirka@uni-muenster.de

1 Introduction

The Sensor Web Enablement (SWE) architecture of the Open Geospatial Consortium (OGC) offers are framework of standards that allow the integration of sensors and sensor data into spatial data infrastructures. It includes standards for services to access sensor measurements, receive notifications from sensors and to control the sensors and their behaviour. In addition standards for the description of sensors and the encoding of measurements are defined [1].

In order to enhance the capabilities of the SWE architecture for handling real time sensor data and to analyze the data with regard to occurrences of certain event patterns two OGC Discussion Papers describing the Sensor Event Service (SES) [2] and the Event Pattern Markup Language (EML) [3] have been created. The EML is a language to describe specific patterns of events including spatial, temporal and causal relations [4]. The SES is an experimental successor of the OGC Sensor Alert Service (SAS) which is capable of detecting patterns in event streams described in EML.

In many cases sensor data is provided as raw data streams by sensors. Thus, the Sensor Event Service (SES) has been designed in order to perform filtering operations on these streams and to couple the sensor data streams with other kinds of geospatial data sources (e.g. feature data, maps, coverages). The SES is able to execute complex event processing rules and to detect certain events involving measurements from different sensors, deriving higher level information but also to aggregate and pre-process the data streams [4].

Within this paper an approach developed within the European GENESIS (www.genesis-fp7.eu) project is illustrated that shows how geospatial data as well as sensor data streams are combined into an Integrated Health Index (IHI) for pulmonary diseases. This index is subsequently used as an input for a warning system [5] for people with according health conditions.

2 Using the SES for Calculating an Integrated Health Index

Within the GENESIS project two SES instances and a WPS are used for executing the calculation of the IHI. For the determination of the IHI for certain areas (defined by ZIP code) and time instants the system takes into account several inputs. These inputs comprise the particulate matter density (PM10), the NO2 concentration, the night land surface temperature and the meteorological temperature.

In a first step a SES instance is used for performing pre-processing steps on incoming sensor data. An example for such a pre-processing task is the calculation of daily partic-

ulate matter mean. The output of the SES is subsequently delivered to a WPS instance which computes in a second step the value of the IHI itself. Finally, the results of the computation performed by the WPS are delivered to a second SES instance which has the task to filter the IHI against certain alert criteria such as a threshold for the IHI value and specific regions.

3 Alerting

For practically using the presented system an according client application has been developed. This application allows on the one hand users to submit their alerting criteria. Currently this is done by submitting according EML documents which contain the definitions of the alert criteria and pre-processing steps the users is interested in.

On the other hand this client application is able to visualize all incoming alerts. For this purpose, the client is able to connect to different types of geospatial data sources (i.e. OGC Web Map Services for displaying background maps). As soon as an alert is triggered by the SES instance, the client visualizes those areas on the map in which the IHI has reached a critical value.

4 Summary

This article has introduced the application of the OGC SES within a complex process chain in order to calculate an Integrated Health Index for pulmonary diseases. To achieve this aim, data streams from several sources (sensor and non-sensor) are used as input for the calculation. Two typical use cases of the SES were shown: the pre-processing of incoming sensor data streams and the filtering of measured or derived values with regard to certain filter criteria.

Future enhancements of the system will be the integration of the two SES instances into a single one. This will make it easier for users as they do not need to create the service chain on their own. This will include changes to the EML specification as automatic WPS requests have to be included. Also the optimization of the user interface will be addressed. Firstly, it is planned to create an interactive menu for allowing users (or experts) to graphically define the alert conditions in a comfortable manner. Secondly, a further potential enhancement is the integration of other means to deliver the IHI alerts (e.g. automatically alerting persons with health problems via mobile phones).

5 References

[1] M. Botts, G. Percivall, C. Reed, J. Davidson (2007): OGC White Paper - OGC Sensor Web Enablement: Overview And High Level Architecture.

[2] J. Echterhoff, T. Everding (2008): OGC Sensor Event Service Interface Specification Discussion Paper.

[3] T. Everding, J. Echterhoff (2008): OGC Event Pattern Markup Language Discussion Paper.

[4] T. Everding, J. Echterhoff, S. Jirka (2009): Event Processing in Sensor Webs, in: Proceedings of Geoinformatik 2009.

[5] GENESIS Consortium (2009): GENESIS Deliverable 2100.2: Air Quality User Requirements Document.