Chapter 43
Client-Side Processing for Sensor Web

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ABSTRACT

Nowadays, the whole of society can benefit by collecting, sharing, and exploiting sensor data to offer valuable information to decision makers regarding human health, global environment protection, and improvement of water resources, energy, and agricultural management. This chapter explores data processing aspects for Sensor Web that let users process and use real-time sensor data from heterogeneous distributed sensors, identifying basic requirements to build geospatial processing applications such as encodings, metadata, standards for describing sensors, et cetera. These aspects are presented as part of the development process of an SOS client with versions targeted to desktop and mobile environments. The client is developed as a plug-in for the open source GIS gvSIG, which allows the combination of sensor data with other data coming from several different sources.

INTRODUCTION

People usually make decisions based on observations collected from the surrounding environment. For instance, someone may scan the sky for rain and make day-to-day actions based to some extent on how he or she interprets this information. This is still true nowadays but at different level of complexity because of the proliferation of data-collection instruments, sensors attached to

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personal devices such as PDAs and smart phones, and the progress of computer networks and the Internet. *In situ* and remote sensors are increasingly frequent as for example video cameras that assist with the management of traffic on motorway networks, temperature and air pollution sensors along major streets in our cities, and satellites continuously observing the Earth from space. The whole of society can benefit of collecting, sharing and exploiting sensor data, not only by personal and business reasons, but also offering valuable information to decision makers regarding human health, global environment protection, and improvement of water resources, energy, and agricultural management.

The Group on Earth Observation (GEO, 2009) is an international, collaborative community (nations, countries, organizations, etc.) created to exploit the growing potential of Earth observations to support decision making, especially in the realm of nine Societal Benefit Areas defined by GEO (disaster, health, energy, climate, water, weather, ecosystems, agriculture, and biodiversity). Its aim is to build and maintain a system of systems over the coming years called Global Earth Observing System of Systems (GEOSS) that aspires to cover observations relevant to large parts of the world to provide comprehensive information to a wide variety of users (Battrick, 2005). This requires continuous observation of the processes and phenomena that occur on and near the Earth's surface at all scales, increasing then the knowledge and understanding of our planet. The GEOSS implementation architecture will be an open, integrated system consisting of interoperable components mainly for Earth observation, data exploration and processing capabilities through open, international standards and specifications. In essence, science and technology are serving society to address the main challenges for today's world.

Some of these GEOSS components are devoted to the task of managing observational data from sensors and sensor networks. Related individual sensors form a sensor system that offers a single interface. A sensor network is a set of sensor systems providing not only a large amount of observational data from sensor networks but also establishing a communication framework among the set of sensor systems. While a weather station is considered a sensor system where various sensors are aggregated to monitor similar conditions (temperature, pressure, etc.), multiples weather stations connected each other to monitor meteorological conditions in a given watershed is then considered a sensor network. The Sensor Web vision encompasses heterogeneous individual sensors, sensor systems, and sensor networks leading to an open infrastructure that supports access to sensors, sensor networks, observational datasets and corresponding sensor metadata (van Zyl et al., 2009).

The Open Geospatial Consortium (OGC) has proposed a set of open standards to deal with the complexity of the multi-layered approach of the Sensor Web (measurements, observations, metadata, sensors, sensor systems, sensor networks, etc.) known as Sensor Web Enablement (SWE) (Botts et al., 2007; Reed & Percivall, 2006). SWE standards provide service interfaces to sensor networks enabling thus remote access to observations and measurements using open standard protocols and application program interfaces (APIs). This chapter will focus on the set of data models, standardized encodings and interfaces within the SWE framework that enables data interoperability among producers and consumers of sensor data.

Recent research efforts in Sensor Web and SWE standards, focused mostly on accessing and presenting sensor data across distributed computing environments using tools like Digital Earth systems (NASA World Wind, etc.), are gaining importance. Nevertheless, these approaches are still limited to provide distributed geospatial solutions that process sensor data from its raw observational state to produce meaningful information that meets user's needs. It is necessary then a flexible, scalable framework that allows integrating and process sensor networks data with