

SenseWeb: An Infrastructure for Shared Sensing

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Many advances in science come from observing previously unobserved phenomena. To observe such phenomena in high spatio-temporal resolution, environmental scientists, for example, have started using densely deployed (typically wireless) sensor networks. Such sensors are capable of revealing the complex interactions between atmospheric and land surface components with enough precision to generate accurate environmental system models. This high-resolution sensing, however, poses many big challenges for scientists. For example, various data management problems such as reliably archiving large volumes (e.g., many terabytes) of data, querying and visualizing it, sharing it with others with access control policies, and maintaining sufficient context and provenance of sensor data often pose significant overhead for scientists. Moreover, due to high costs of sensors, scientists with limited resources are often restricted to use data collected from a small number of sensors that are not sufficient to provide accurate environmental system models.

To address the above challenges, we have built SenseWeb,¹ an infrastructure that automatically manages massive data collected from large collections of sensors and enables sharing the data among many groups of scientists. The key idea is as follows. A group of scientists deploy sensors to observe a phenomenon, say soil moisture, at their site. The sensors are connected to the Internet and then shared over SenseWeb. SenseWeb takes care of generic data

management problems such as archiving, query processing, and visualization. Moreover, other scientists interested in soil moisture can conduct experiments using these sensors through SenseWeb. Further, other ecologists may deploy similar sensors at their sites and share them. A scientist can now use SenseWeb to access not only her own sensors but also these other similar ones. What emerges is a “macro-scope” of shared sensors measuring the phenomenon at a scale that no single scientist could instrument alone. New experiments are enabled, providing new insights by probing a phenomenon from multiple sites. Barrier to discovery is reduced as many experiments can begin without deployment overhead.

In building SenseWeb, we have addressed several challenges related to archiving large datasets collected from heterogeneous sensors, discovering sensors and querying the datasets, visualizing the datasets over a Web-based browsable map, and sharing data with various access control policies.

SenseWeb is publicly available through its Web-based front-end, called SensorMap.² Over the last several years, SenseWeb has been used by nearly a dozen groups of scientists and general users. For example, it has been used for monitoring various environmental parameters in the Swiss Alps, CO₂ concentrations in different parts of the Boston city, soil ecology in forests in the Baltimore area, coral ecosystem in Australia, water levels in different rivers and streams all over the USA, etc.

¹ <http://research.microsoft.com/en-us/projects/senseweb/>

² <http://www.sensormap.org>