ISSN 2229-5518

Developing Online Weather Monitoring System Using OGC SWE

Aijaz Reshi, Shabana Shafi, Dr. M. Sridhar, Dr. M. Rajani

Abstract—This paper explores the potential of Sensor Web Enablement for weather monitoring and process control, illustrated by a weather monitoring prototype [1]. The online weather monitoring system monitors various weather conditions, especially temperature, humidity and rain fall. The weather monitoring system consists of the sensors, 8051 micro controller chips, analog to digital converters, the transmission module, a dedicated computer unit via RS232 interface and web application. The sensors include temperature sensor ,humidity sensor and rain gauge. The task of measuring and interpreting environmental data is becoming increasingly large and complex. Many proprietary and open technologies are in use for observing, communicating, analyzing and reporting the environmental data. Several international initiatives are focusing on interoperability among these systems at technical, organizational, semantic and political levels. Examples include the Open Geospatial Consortium's (OsGC) Sensor Web Enablement (SWE) initiative and the Semantic Web.

Sensor Web Enablement focuses on acquiring real time data from heterogeneous and distributed sensor networks. The goal of sensor web enablement is to create web based sensor network, that is to make all sensors and repositories of sensor data discoverable, accessible and where applicable controllable via the www. In this study we will develop a prototype for online weather monitoring system keeping the OGC SWE architecture in consideration. The prototype will help to demonstrate live data accquistation along with many data output visualisations and to produce useful information to help make new decisions.

.

Key words— Sensor Web Enablement (SWE), Open Geospatial Consortium, Web Service, Sensor Obervation Service, Sensor Planning Service,Web Notification Service ,Sensor Alert Service, Weather Monitoring system,.

1 INTRODUCTION

Sensor networks have emerged as a promising tool to gather and disseminate environmental information. They can be used to monitor environmental changes by recording change in temperature, humidity, atmospheric pressure and rain fall with better accuracy, that is having extraordinary significance for environmental monitoring, public safety, disaster management, agriculture, industrial controls, transportation and many other areas. One the one hand, emerging technology in Sensor networks create new opportunities but on the other hand there are big challenges in development of such applications. One of the major challenges is real time data acquisition from heterogeneous and distributed sensor networks which in turn leads to data interoperability problem. In this paper, we will attempt to present an effort to develop a web application (using OGC SWE architecture) that can help to access, monitor and control the weather monitoring system using WWW and thereby facilitate in live data acquisition along with many data output visualizations.

The rest of the paper is organized as follows: The second chapter deals with the online weather monitoring system requirements. The third Chapter is about the online weather monitoring System architecture. The fourth chapter describes SWE web services incorporated, followed by the description of implementation given in the fifth chapter. The last chapter describes implementation of the web Client.

2 METHODOLOGY

2.1 Software Testbed

The application developed a web-based software testbed to provide a framework for the testing of the SWE Standards and for the management and control of the deployed sensors. This system shall provide automatic weather monitoring conditions especially temperature, humidity and rainfall. The system shall have the means of determining the current time and date so that it can report the highest and lowest values for any of the primary measurements during the previous 24 hours period. Through the use of a keyboard the user may direct the system to display the 24 hour low or high of any measurements, with the time of the reported value. The system shall allow the user to calibrate its sensors against known values, and set the current time and date.

2.2 Software Implementation

The implementation is a Java-based web service package, requiring the components Java Runtime Environment (JRE) and Java Development Kit (JDK) Version 1.6.0 , Glass Fish Version 3.1.1.and MySQL database as backend.

3 System Architecture

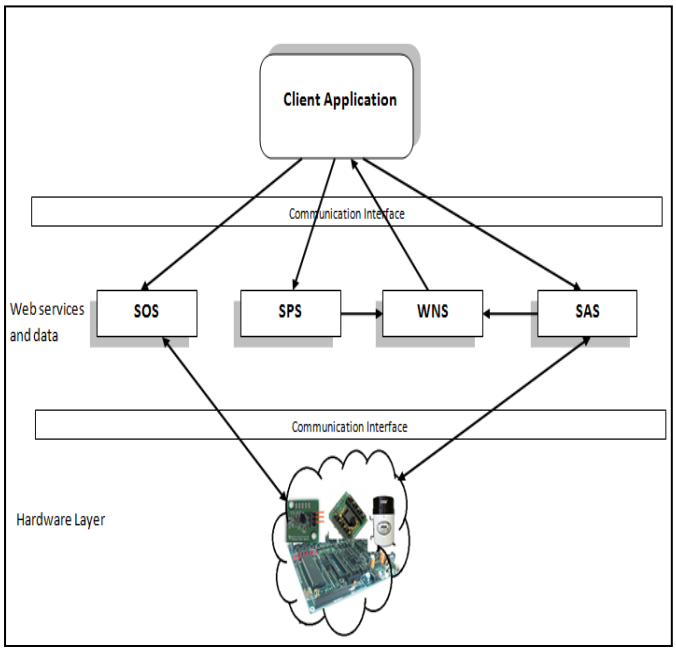

Fig 1. System Architecture

3.1 Hardware layer

Hardware layer comprises of hardware devices like sensors, controlling devices such as microcontrollers and different types of electronic circuits and chips which enable us to interface with sensor measurements in its physical form. Some of the example gadgets used in this layer by our prototype are 8051 microcontroller, 8051 microcontroller development board, LM35 temperature sensor, ADC0804 analog to digital converter etc.

3.2 Web services and Data layer

This layer consists of standard web service interfaces viz. Sensor Observation Service (SOS), Sensor Planning Service (SPS), Web Notification Service (WNS), and Sensor Alert Service (SAS) given by OGC SWE specifications. These web services are responsible for planning, accessing, analyzing the sensor data and notifying the appropriate information to the desired destinations. The description and functionalities of each web service is given in the following sections. Along with these web services each service has its associated data source used to store various types of system data. This includes real time sensor data, sensor node descriptions, some statistical information and user information.

3.2.1 SPS Working

The main role of SPS as shown in fig. 2 is to provide a standard interface to task the sensors. The tasking process starts as; the user submits the task along with the parameters to SPS. The web service instructs the monitoring station accordingly, the appropriate device will be tracked and the observations will be recorded. Then the recorded observation data is uploaded to SOS, and the SPS is acknowledged by sending task finished notification and finally SPS notifies WNS to send notification to the user.

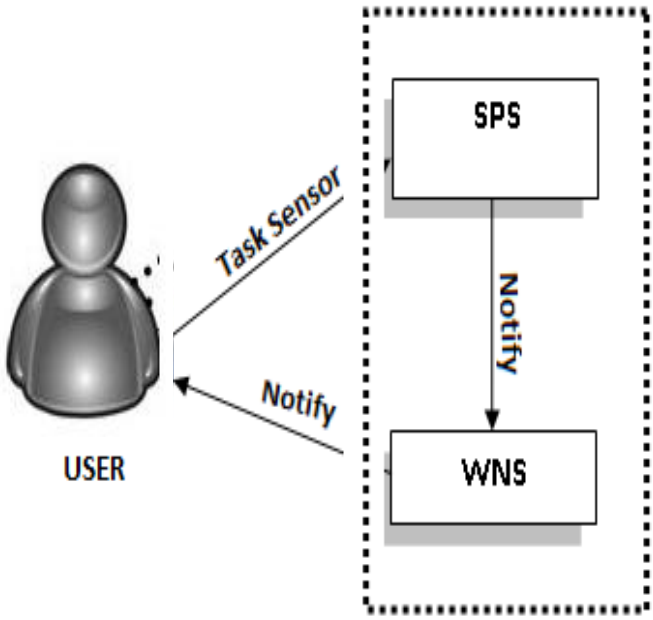

Fig .2. Working Of SPS

3.2.2 SOS Working

The working of SOS is to provide the standard web service interface which allows users to access the observational data along with sensor descriptions. The service description of SOS like other services can be fetched by using getCapabilities operation. In addition to getCapabilities SensorML or TML descriptions of sensors can be fetched using describeSensor operation. The core sensor observations can be accessed by getObservation operation.

3.2.3 SAS Working

SAS provides an open interface for publishing of and subscribing to system alerts by the clients. This corresponds to the publish-subscribe communication pattern and is obviously in contrast to the pull based approach of SOS. The SAS itself offers only operations for managing the event notification system. [1]

The SAS offers the capability for clients to subscribe desired alerts from the system. The System advertises alerts SAS notifies WNS to send notification to the registered clients and the client receives the alert sent by WNS. Fig 3 depits the work flow of SAS web service.

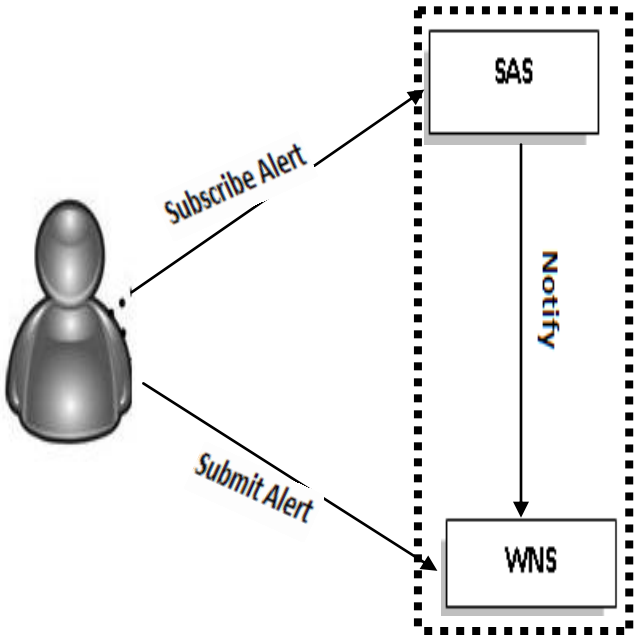

Fig.3. Working of SAS

3.2.4 WNS Working

Web Notification Service is an open interface which maintains an asynchronous dialogues between client and one or more other services for long duration processes, which may be quite useful when many collaborating services are required to satisfy a client request. [2] In the SWE framework, the WNS can be used in conjunction with SPS and SAS instances for allowing asynchronous messaging between service instances and clients. [3]

IMPLEMENTATION

All the Web services have been developed with Java web technologies using Simple Object Access Protocol (SOAP) architecture. The motivation of using the technology was due to the fact that SOAP is a standard web service middleware protocol. It is a protocol based on eXtensible Markup Language (XML) means it can be easily integrated with different programming languages and platforms. For this reason we found it very effective for developing our prototype. Also Java provides a set of technologies which gives the facilities for development of portable applications along with easy development of XML-based Web services. The system has been developed in accordance with the OGC standard specifications. According to these specifications all the communications shall be performed by exchanging XML messages. Means all the request operations must send the request messages in XML format and each operation response is also an XML document. That basically means that each XML schema is mapped into exactly one corresponding java class, which can be instantiated and treated like any other java object.

REFERENCES

[1] Simon Jirka, Arne Bröring, Christoph Stasch , Applying OGC Sensor Web Enablement to Risk Monitoring and Disaster Management
[2] Xingchen Chu , Open Sensor Web Architecture: Core Services
[3] Natasa Veljkovic, Sanja Bogdanovic-Dinic, Leonid Stoimenov, GI-NISSENSE - Applying OGC Sensor Web Enablement
[4] Hsiao-Yuan YIN, Development of Debris Flow Monitoring System in Taiwan.
[5] OGC White Paper OGC® Sensor Web Enablement: Overview And High Level Architecture. Reference number: OGC 07-165 Version: 3
[6] Simon Jirka *, Arne Bröring and Christoph Stasch , Discovery Mechanisms for the Sensor Web
[7] Amit Sheth, Cory Henson, and Satya S. Sahoo Kno.e.sis Center, Wright State University,Semantic Sensor Web
[8] OGC®Event Service - Review and Current State, Reference number of this document: OGC 11-088r1
[9] Broering, A. & S. Jirka (2010): Verwebung von Sozialen Netzwerken und dem Sensor Web. Proceedings of FOSSGIS 2010. March 2.-5. 2010. Osnabrueck, Germany.
[10] Michl, C. 1,2, R. Klipp 1 and M. Mothes 1,Hydrological Sensor Networks in Germany - Introducing SensorWeb-WSV