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Real Time Sensor Web Enabled Water Quality Monitoring System Using Service Oriented Architecture (SOA)

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Abstract— "Real Time Sensor Web Enabled Water Quality Monitoring System" is an attempt to develop a general sensor and data model for monitoring water quality. The parameters for determining the quality of water are the pH level, turbidity and temperature. The main aim of this paper is to use a standardized Service Orientated Architecture (SOA), for sensor data representation in universal standards that is the representation should be interoperable with diversified platforms and domains. For achieving data interoperability this application uses a XML-standard for hydrometric data description and WSDL and SOAP for data communication.

Key Words— Sensor Web Enablement(SWE), Service Oriented Architecture (SOA), Simple Object Access Protocol(SOAP), Sensor observation service (SOS).

1 INTRODUCTION

Water is one of the most important and basic natural resources. Approaches of constant monitoring and management of water resources shall promote the implementation of actions that may prevent irreversible damages to the resource and guarantee its quality so that they are always suitable for the domestic agricultural and industrial consumption. Due to current industrial race worldwide, most of the water used by industries and municipalities is often returned to water sources degraded in quality. Since monitoring systems to assess water quality parameters uses in-situ approach hence puts many limitations like real time accessibility and data interoperability in it. This study deals with the application development of water quality monitoring systems through Sensor Web Enablement (SWE) services which presents many opportunities for adding a real-time sensor dimension to the Internet and the Web. The main objective is to create a Real Time Sensor Web Enabled Water Quality Monitoring System to measure water quality parameters, through an efficient sensor and data model where in-situ sensors are connected via an intelligent and versatile network infrastructure (based on web technologies) that enables us to remotely access live sensor information using WWW. To introduce standardized data exchange and the availability of the real-time data in standard interoperable formats, an emerging concept called Sensor Web Enablement (SWE) is introduced and described. OGC SWE provides the interoperable monitoring systems with less redundancy and wider application by using standardized Service Orientated Architecture (SOA), web enabled services and data encodings

2 METHODOLOGY

2.1 Hardware Layer.

This study addresses the threat of water pollution and focuses on the use of sensor networks which monitors the critical water contents like conductivity, dissolved oxygen, pH, turbidity etc and delivers data to the monitoring system for analysis. Development of new technologies brings many ways for water quality monitoring. Sensor Web has a wide range and use of implementation possibilities in water quality monitoring. This study focuses on high level application of sensor web enablement (SWE) for monitoring the water quality using stan-

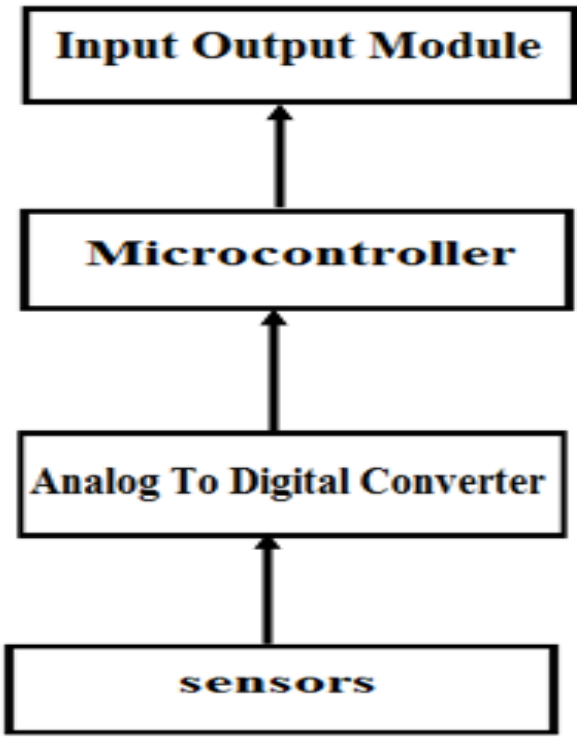


Fig 1 Data Flow

dard activities like sensor, sensor networks, and a concept called the "sensor web". Three different sensor types have

been utilized in the water quality monitoring system: pH sensor that senses the acidity or basicity of the water, temperature sensor and turbidity sensor. The information being gathered by these sensors are then converted into electrical signal and go through the analog to digital converter (ADC0804) circuit. Then it is passed to a microcontroller 8051 that processes it and forwards to the appropriate I/O interface leading to data capturing hardware module and finally forwarded to sensor observation service SOS service. The Informtion flow is shown in Fig 1.

2.2 Software layer

Real Time Sensor Web Enabled Water Quality Monitoring System design follows the open services-oriented architecture OGC SWE. Services-oriented architecture (SOA) relies on a collection of loosely coupled self-contained services that communicate with each other and can be called from multiple clients in a standard fashion. Common benefits associated with SOA include: scalability, security, easier monitoring and auditing; standards-reliance; interoperability across a range of resources; plug-and-play interfaces. Internal service complexity is hidden from service clients, and backend processing is decoupled from client applications. User would be able to access the same service functionality, leading to a more transparent and easier managed system. The core of the Real Time Sensor Web Enabled Water Quality Monitoring System services-oriented architecture is a collection of SOAP web services that provide uniform access to multiple repositories of observation data, both remote and locally-stored.

2.2.1 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.

2.3 System architecture

Fig 2 illustrates the architecture of the Water Quality monitoring system

2.4 Web services and Data layer:

This layer consists of standard web service interfaces of OGC SWE. The functionality of the sensors in sensor web according to the OGC are

- Discovery of sensor systems, observations, and observation processes that meet an application or users immediate needs;
- Determination of a sensor's capabilities and quality of measurements;
- Access to sensor parameters that automatically allow software to process observations;
- Retrieval of real-time or time-series observations and coverages in standard encodings
- Tasking of sensors to acquire observations of interest.
- Subscription to and publishing of alerts to be issued by sensors or sensor services based upon certain criteria. [1]

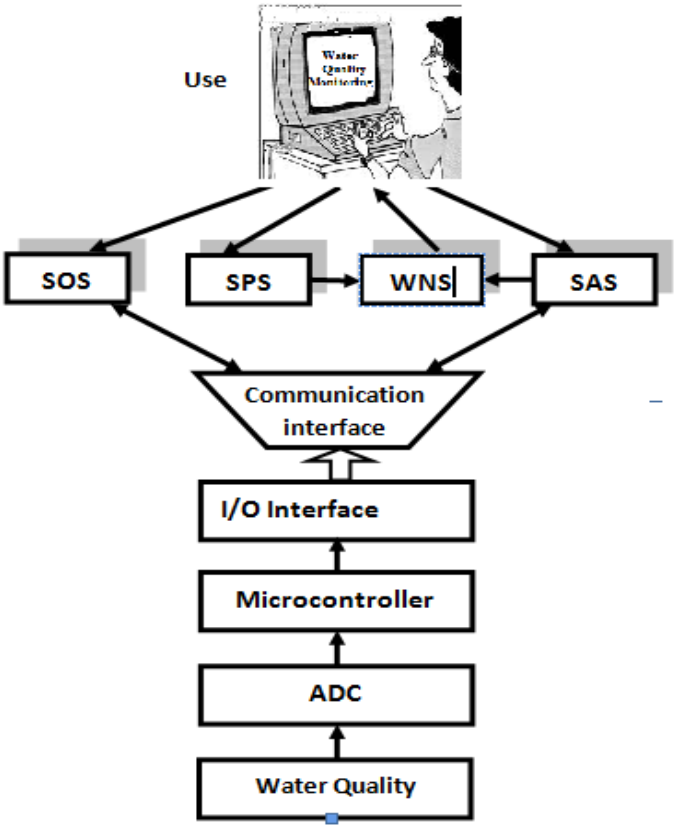


Fig. 2.

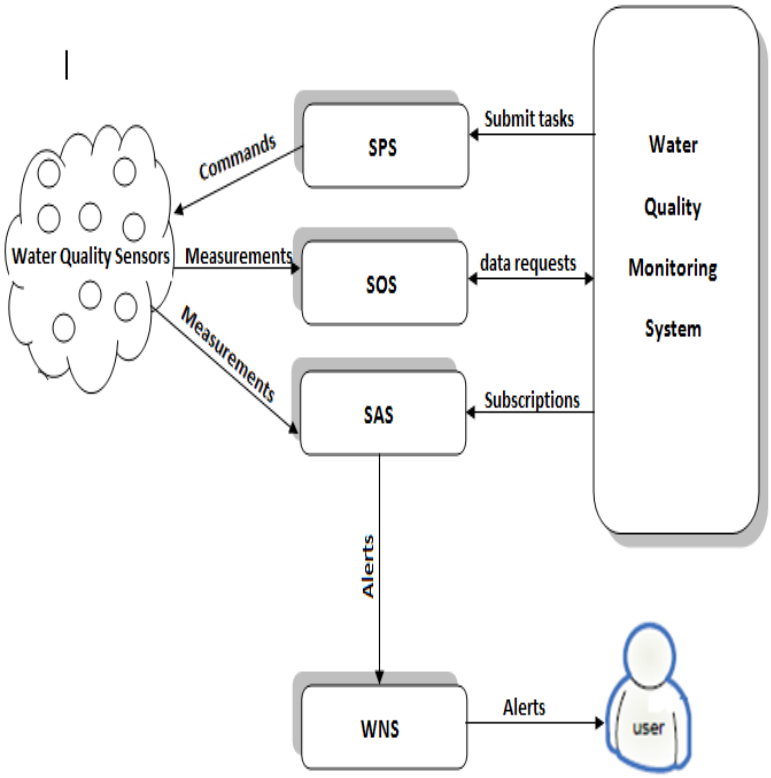
2.4.1 SPS Working

The Sensor Planning Service (SPS) Implementation Specification is designed and developed to enable an interoperable service by which a user can determine collection feasibility for a desired set of collection requests for one or more sensors, or a client may submit collection requests directly to these sensors[1] . The main functionality of the SPS is tasking sensors and setting their measurement parameters[2].

As demonstrated in this document, the numbering for sections upper case Arabic numerals, then upper case Arabic numerals, separated by periods. Initial paragraphs after the section title are not indented. Only the initial, introductory paragraph has a drop cap.

2.4.2 SOS Working

The functionality of SOS is to provide the standard interface for accessing the observations from sensors and sensor systems in a standard way along with sensor description. The OGC Sensor Observation Service specification defines an API



for managing deployed sensors and retrieving sensor data and specifically "observation" data [1].

Fig3 Web Service Layer

2.4.3 SAS Working

Standard Web service interface for publishing and subscribing to alerts from sensors. Users outside this system who would like to receive observation information and alerts can subscribe to this system using SAS [3].

2.4.4 WNS Working

WNS specified an open interface for a service by which a user may conduct asynchronous message interchanges with one or more other services. The Web Notification Service Model includes two different kinds of notifications. First, the "one-way-communication" provides the user with information without expecting a response. Second, the "two-way-communication" provides the user with information and expects some kind of asynchronous response[1].

CONCLUSION

The open standards developed by OGC works on the platform TCP/IP, HTTP, HTML which enables to connect to the computers on communication network to share the information important during the emergency and disaster management. The application developed in this study acts as a prototype for accessibility of sensor information in real time through the WWW and can provide data regarding water quality monitoring to take necessary decisions. The application developed uses the standards developed by the OGC which makes the system of sensor web interoperable for early warning and make it easier for decision makers to obtain information from multiple sensors at any stage in crisis management.

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