Poster Abstract: Sensor Modeling and Sensor Data for UnderWater Acoustic Sensor Networks (UW-ASN) Applications

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ABSTRACT

Wireless sensor networks enabled the development of distributed sensing application in many types of scenes, including application in exploration of natural undersea resources and gathering of scientific data in collaborative monitoring missions. The expected growth in Wireless Sensor Network (WSN) applications requires efficient modeling techniques to sensor data acquisition and their eventual storage and management. This paper proposes a based model for fast and reusable development applications for UnderWater Acoustic Sensor Networks (UW-ASN), converting the primitive data acquisition and raw data in data structure into RDF (Resource Description Framework) files using a *process model*, providing to developers and users an easy way to access useful information about the vehicles that are deployed to perform collaborative monitoring tasks over a given area. This model characterize and describe clearly the sensor nodes, the vehicle under Water and the sensing application, using vocabularies (RDF Schemas) to enrich the information with meta-data about the context environment. With all information modeling in interoperable format (RDF files), analyzes and presentation of the information and remote processing is enabled.

Categories and Subject Descriptors

C.4.1 [**Performance of Systems**]: Modeling Techniques

Keywords

Resource Description Framework, UnderWater Acoustic Sensor Networks, Data Modeling, Wireless Networks

1. INTRODUCTION

Primitive data acquisition methods, complex and owner data process and undefined mechanism for data storage and management, are items more relevant that difficult the interoperability and reusability of sensor data. Primitive data acquisition methods only provide raw data about the sensing phenomenon. Researchers for optimizing the development on WSN developed a framework for sensor network modeling based on general features (topology, network setting, sensor description and data flow)[3]. In this work we provides a mechanism for data acquisition and management.

The traditional approach for ocean-bottom or ocean column monitoring is to deploy underwater sensors that record data during the monitoring mission. Therefore, there is a need to deploy underwater networks that will enable real time monitoring of selected ocean areas, remote configuration and interaction with onshore human operators. This can be obtained by connecting underwater instruments by means of wireless links based on acoustic communication.

We defined ***integration*** such as a model that includes: 1) data acquisition methods, 2) algorithms for processing sensor data and 3) mechanism for evaluate the information in interoperability format. We identficated problems and lacks in the integration process:

Data acquisition: The data acquisition process is primitive, acquiring only raw data values about sensing phenomenon (battery power, temperature, vehicle acceleration, propagation delays, high bit error rates) to be evaluated.

Processing sensor data: Complex algorithms, owner and specific process difficult the interoperability and reusability to the data sensor and data process. The form as the information is showing to the user, depend directly of the algorithm used in the data process.

Mechanism for availably: The availability of the information implies efficient techniques for storage and management sensor data, allowing analyzes and presentation of the information, in-situ and remote processing.

In this poster abstract, we describe a based model for the problem of the integration of the applications for UnderWater Acoustic Sensor Networks (UW-ASN). This model provides usability of the sensor data, data process and information about the physical infrastructure and logical model.

2. ARCHITECTURE

This proposal architecture is based on a set of stages that encapsulate the physical and conceptual environment. These stages are described as:

Definition of the Underwater Sensor: This include sensors to measure the quality of water and to study its characteristics such as temperature, density, salinity (interferometric and refractometric sensors), acidity, chemicals, conductivity, pH (magnetoelastic sensors), oxygen (Clark-type electrode), hydrogen, dissolved methane gas (METS), and turbidity. Disposable sensors exist that detect ricin, the highly poisonous protein found in castor beans and thought to be a potential terrorism agent [1]. DNA micro arrays can

be used to monitor both abundance and activity level variations among natural microbial populations. Other existing underwater sensors include hydrothermal sulfide, silicate, voltammetric sensors for spectrophotometry, gold-amalgam electrode sensors for sediment measurements of metal ions (ion-selective analysis), amperometric microsensors for H2S measurements for studies of anoxygenic photosynthesis, sulfide oxidation, and sulfate reduction of sediments[1].

Definition of vocabularies: Vocabularies or RDF Schemas [2] is using to describe the sensors, the applications, the environment vehicle as resources, describing information in properties, relations and values.

The model process definition: The process model is the mechanism that decode the raw data acquired from the sensors in information relevant to user. For example, the process model for a temperature application implements an algorithm to calculate temperature value and modeling this information in data structure into RDF files.

Use of the information: With the information modeled and stored in RDF files, a mechanics allows permanent store, analyzes and presents the information in real time, off-line, in-situ.

3. STUDY CASE

The objective of this study case is to model an UW-ASN application for temperature, density, salinity, acidity, chemicals, conductivity, pH, oxygen, hydrogen, dissolved methane gas and turbidity.

Definition of the application: Although many application areas for underwater sensor networks can be outlined, to the best of our knowledge the definition of an application layer protocol for UW-ASNs remains largely unexplored. The purpose of an application layer is multifold: (i) to provide a network management protocol that makes *hardware* and software details of the lower layers transparent to management applications; (ii) to provide a language for querying the sensor network as a whole; (iii) to assign tasks and to advertise events and data.

Definition of vocabularies: We defined RDF Schemas or vocabularies for as a instruments to describe and characterize: i)the underwater sensors nodes, ii) the underwater environment and iii) the use of the information. The Figure 1 show the model and data applications for UW-ASN, the interactions of the schemes, and vocabularies.

i) Sensor Schema: Provides a model to describe the sensor node [4], generating a description of the capacities of the sensor and modeling in 4 class components: 1) *Hardware Platform* contains properties of the sensor node to describe the *hardware* capacities such as: memory, microprocessor type, etc. 2) *Software Platform*, contains properties to describe the software capacities such as: operating system, and all installed software into the sensor node. 3) *Network Characteristics* contains properties to describe the network communications technology including the supported bearers. 4)*Sensor Data Characteristics* contains properties to describe specific *hardware* capacities dedicated to sensing the phenomenon, such as: the accuracy, type sensor, etc.

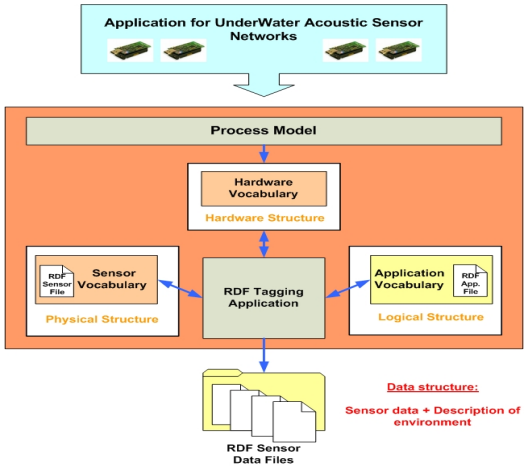

Figure 1: Data and Sensor Modeling applications for UnderWater Acoustic Sensor Networks (UW-ASN).

ii) Underwater Schema: Provides a model to describe the underwater environment, generating a description of the place where was installed a sensor node and the relevant information of this place.

iii) Application Schema: Provides a model to describe the applications installed into sensor nodes. The *Sensor Applications Characteristics* contains properties to describe the conceptual model use for program the sensing application.

The model process definition: A *model process* is a logical structure that uses the defined vocabularies to decode raw data in tags for modeling the data structure into RDF file.

Use of the information: The RDF files about the sensors, underwater applications and the generated sensor data is stored into laptop with a java application.

4. CONCLUSION

UW-ASN application permits remove excessive wires, monitors difficult access areas and easy access to useful information. This poster allows efficient processing of information and usability in a underwater environment trough the representation of the information sensed with RDF files.

5. REFERENCES

[1] I. F. Akyildiz, D. Pompili, and T. Melodia. Underwater acoustic sensor networks: research challenges. *Published by Elsevier B.V.*, pages 257–279, 2005.

[2] D. Brickley, R. Guha, and B. McBride. Rdf vocabulary description language 1.0: Rdf schema w3c recommendation. *<http://www.w3.org/TR/rdf-schema/>*, 2004.

[3] R. Jurdak, C. V. Lopes, and P. Baldi. A framework for modeling sensor networks. In *roceedings of the Building Software for Pervasive Computing Workshop at OOPSLA'04*, 2004.

[4] Moteiv. Tmotesky ultra low power ieee 802.15.4 compliant wireless sensor module. Technical report, Moteiv Corporation, 2007.