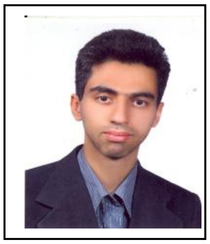
Evaluation of Two Proposed Systems in Sensor Data Storage in Total Data Parameter



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Abstract

With the advent of low-power micro-sensors, actuators, embedded processors, and RF radios, it becomes feasible to deploy large scale networks of sensing devices. Most of sensors provide their energy using battery that has limited energy. The most energy consumer of sensors is transmission. Sensors within a sensor network generate data. These data should be stored somewhere for further information retrieval like answering user’s query. Sensors also have limited storage so we cannot store all generated data. Sensors can send their data to more powerful named sink for further information retrieval. So a good storage has effective impact on the life time of sensor networks. In this paper with the help of j-sim and protégé software’s, we have evaluated two known systems for sensor data storage in total data parameter that received by sink node, names Semantic Sensor Web (SSW) and Semantic Sensor Observation Service (SemSOS). We have presented that SSW stores less data and can response fewer queries against SemSOS.

Key words: sensor data storage, SSW, SemSOS

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1. Introduction

Wireless sensors are deployed in a growing number of applications where they perform a wide variety of tasks like pervasive computing, e.g., monitoring learning behavior of the children, senior care system, environment sensing, etc., generate a large amount of data continuously over a long period of time. Often, the large volumes of data have to be stored somewhere for future retrieval and data analysis.

A big challenge is how to store data efficiently for future information retrieval.

There is some systems that was proposed for storing data like Minos [1]that define a generic, Java-based tool that allows for collecting and storing data collected in wireless sensor

networks., ES3N[2]which uses Semantic Web techniques to manage and query data collected from a minidome Sensor Network. ,Sense and Sens'ability[3]that describes a sensor data ontology which is created according to the Sensor Web Enablement (SWE) and SensorML data component models..
The next section describes background studies and the semantic Web technologies

2. Background

The OGC has recently established the Sensor Web Enablement Group in order to address problem of, Lack of standardization is the primary barrier to the realization of a progressive Sensor Web, by developing a suite of specifications related to sensors, sensor data models, and sensor web services.

2.1 SWE (Sensor Web Enablement)

The main specifications defined by the group are described in the following [4].

- Observations & Measurements (O&M) which define standard models and XML Schema for encoding real-time and archived observations and measurements of sensor data.
- Sensor Model Language (SensorML) is a standard model to describe sensor systems and processes associated with sensor observations in an XML-based structure. The information provided by SensorML can be used for sensor discovery, describing sensor data, and specifying sensor observations.
- Transducer Model Language (TransducerML or TML) provides a conceptual model to describe transducers and to support real-time data to and from sensor systems, sensors and actuators.
- Sensor Observations Service (SOS) is a standard Web service interface for requesting,filtering, and retrieving observations and sensor system information.

The models provided by SWE define a standard framework to deal with sensor data in heterogeneous sensor network applications. Although XML provides a remarkable solution for heterogeneous data representation, there are significant limitations in semantic interoperability and describing the semantics and relationships between different data element using XML representations [5].

2.2 Semantic Web Technologies

The Semantic Web is envisioned as an extension of the current web where, in addition to being human-readable using WWW browsers, documents are annotated with meta-information. This meta-information defines what the information (documents) is about in a machine process able way. The explicit representation of meta-information, accompanied by domain theories (i.e. ontologies), will enable a web that provides a qualitatively new level of service [4].
Ontologies are a key enabling technology for the Semantic Web. They interweave human understanding of symbols with their machine process ability.

2.3 Semantic Sensor Web (SSW)

Sheth and Henson [6] Describes a frameworks that named semantic sensor Web (SSW) in which sensor data is annotated with semantic meta data to increase interoperability as well as provide contextual information essential for situational knowledge. In particular, this involves annotating sensor data with Spatial, temporal, and thematic semantic metadata. The spatial meta-data provides sensor location and data information in terms of a geographical reference system, location reference, or named locations. The temporal meta-data refers to the time interval duration whose sensor data has been captured. Thematic meta-data provides descriptive information about the sensor node which can be derived by sensor data analysis, and utilizing tagging and textual descriptions [7]. The SSW approach presented leverages current standardization efforts of the Open Geospatial Consortium (OGC; www.opengeo spatial.org) and Semantic Web Activity of the World Wide Web Consortium (W3C; www.w3.org/2001/sw/) to provide enhanced descriptions and meaning to sensor data. They'll review relevant components. Also relevant but outside the scope of this article is the semantic community Sensor Standards Harmonization Working Group (http://semanticcommunity.wikis/Sensor_Standards_and_Data_Harmonization) which takes user perspective.

2.4 Semantic Sensor Observation Service (SemSOS)

Sheth and Henson [6] Describes a frameworks that named semantic sensor Web (SSW) in which sensor data is annotated with semantic meta data to increase interoperability as well as provide contextual information essential for situational knowledge. In particular, this involves annotating sensor data with Spatial, temporal, and thematic semantic metadata. The spatial meta-data provides sensor location and data information in terms of a geographical reference system, location reference, or named locations. The temporal meta-data refers to the time interval duration whose sensor data has been captured. Thematic meta-data provides descriptive information about the sensor node which can be derived by sensor data analysis, and utilizing tagging and textual descriptions [7].

3. Simulation and Evaluation

We evaluate two proposed framework named SSW and SemSOS in total data transmitted to sink node.

For our purpose, we use same data once in Semantic annotation of SWE that proposed by SSW, then we represent it in ontology form as proposed by SemSOS for evaluation.

The sample data used is shown below:

```
<swe:componentrdfa:about=“time_1”
rdfa:intanceof=“time:Instant”>
<swe:Timerdfa:property=“xs:date-time”>
2008-03-08T05:00:00
</swe:Time>
</swe:component>
<swe:value name=“satellite-data“
rdfa:about=“Dayton”
rdfa:instanceof=“geo:City”>
00110001110011111 …
</swe:value>
```

This example generates two RDF triples. The first, *time_1 rdf:typetime:Instant*, describes *time_1* as an instance of *time:Instant*(subject is*time_1*, predicate is *rdf:type*, object is*time:Instant*). The second, *time_1 xs:date-time "2008-03-08T05:00:00,"*describes a data-type property of*time_1* specifying the time as a literal value (subject is *time_1*, predicateis *xs:date-time*, object is *"2008-03-08T05:00:00"*).
We have evaluated our simulation using j-sim[9] software in 50 times unit.
Figure 1 shows the amount of data received by sink node.

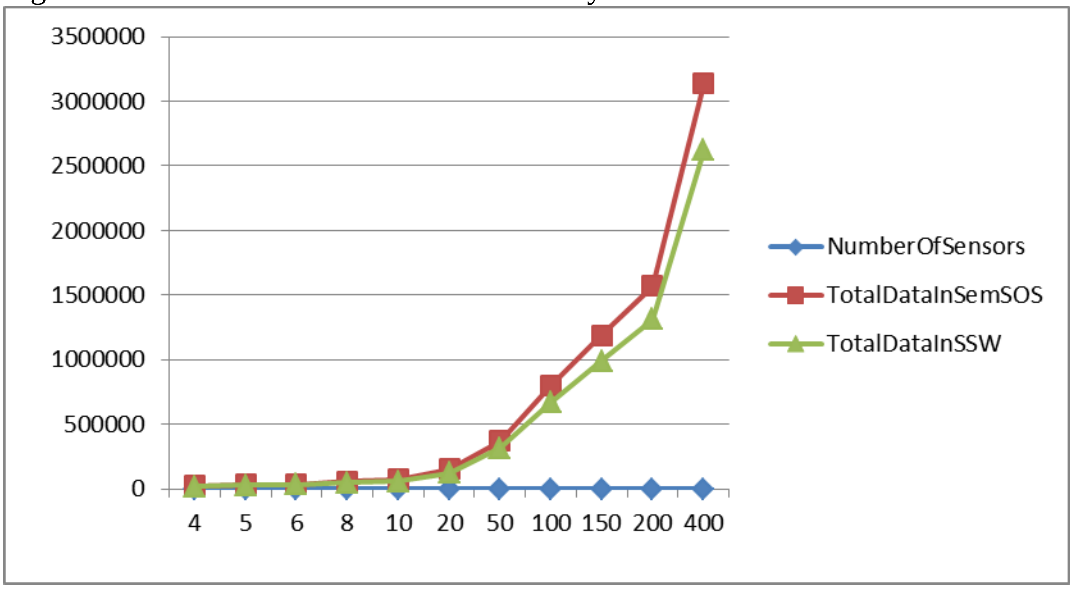

Fig.1 amount of data received by sink

Amount of data received by sink when we have 400 sensors, in SemSOS are 3134490 and in SSW framework are 2619135.as we can see, when we have more sensors, the differences appears more clearly. We should have a trade-off to decide which is more useful depending on the application.
The machine interpretable representation needs more amount of data to be transmitted to the sensor network. This would lead to an increase of sensor nodes power consumption. Most of the overhead consists of self-explanatory meta-data that helps the receiver of the information to interpret the data.

4. Conclusions And Future Works

This paper evaluates two of known sensor data storage that storing data semantically in amount of data transmitted through network.
We have done our simulation when we have more sensors also. And show if data send in ontology form to sink, it should more amount of data to be transmitted to the sensor network. Increasing the power consumption means cutting the lifetime of a battery powered sensor. Such a trade-off between lifetime and machine interpretable data is very critical and needs to be addressed using other components in the sensor network architecture.
The future work will focus on the evaluation of other parameters, and comprise sensor data storage.

Acknowledgements

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