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DATA MANAGEMENT TECHNIQUES FOR WORLDWIDE SENSOR NETWORK

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Abstract: We can envision that future sensor networks (WSNs) are ubiquitous, large-scale, interconnected, which we call worldwide sensor network (WWSN). Currently, most of the WSNs are working as isolated islands. The development of wireless sensor networks was first motivated by military applications such as battlefield surveillance; today such networks are used in several industrial non-industrial and consumer applications, such as industrial process monitoring and control, machine observation, health monitoring, and so on. This paper surveys the state of the art of the techniques used to manage data and queries in wireless sensor networks based on the distributed paradigm. A classification of these techniques is also proposed. The goal of this work is not only to present how data and query management techniques have advanced nowadays, but also show their benefits and drawbacks, and to identify. Open issues providing guidelines for further contributions in this type of distributed architectures

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INTRODUCTION

A sensor network is viewed as a distributed database that collects physical measurements about the environment indexes them, and then serves queries from users. Each sensor node typically generates a stream of data items that are obtained from the sensing devices on the node. Currently, many wireless sensor networks (WSNs) are working as isolated islands, and most of the sensed valuable data is not shared yet. Without sharing sensor data across different domains, the vision of ubiquitous computing will not easily achieve. To satisfy this key requirement, a common means to share distributed sensor data over the Internet is necessary, which requires a large scale underlying infrastructure to be designed for: 1) Easy publishing of sensor data online; 2) Easy searching of sensor data online. Researching on these two goals requires an understanding on:

1) How to connect different WSNs which are spatially deployed in different locations with the Internet and,

2) How to integrate them into a single WWSN for the publishing, sharing and searching of sensor data. Generally, each sensor consists of a small node with sensing, computing, and communication capabilities. Sensor networks have the following physical resource constraints:

• Communication. The bandwidth of wireless links connecting sensor nodes is usually limited, on the order of a few hundred Kbps, and the the wireless networks connecting sensors provide only limited quality of service such as variable latency and dropped packets.

• Power consumption. Wireless sensors have limited supply of energy, and thus energy conservation is a major system design consideration. Current small batteries provide about 100mAh of capacity, powering a small Amtel processor for 3.5 hours (if no power management techniques would be applied). The current generation of sensor platforms uses about 2 microJ per bit of data transmitted. Note that future sensor nodes will have sophisticated power management features; current nodes already have three different sleep modes with several orders of magnitude different power usages [HSW+00].

• Computation. Sensor nodes have limited computing power and memory sizes that restrict the types of data processing algorithms that can be deployed and intermediate results that can be stored on the sensor nodes. I advocate a database approach to sensor networks. In wireless sensor networks, the sensor nodes are battery powered and are considered intelligent with acquisitional, processing, storage, and communication capacities [1][2].

2. MATERIALS AND METHODS

2.1. Data Collection:

Data collection is widely used for applications, which collects all sensed data continuously (SELECT! query). In,

Chu et al have proposed a mechanism, Ken, using conditional data transmission to conserve energy by reporting only if the difference between the sensed Data collection is widely used for applications, which collects all sensed data continuously (SELECT ! query). In Chu et al. have proposed a mechanism, Ken, using conditional data transmission to conserve energy by reporting only if the difference between the sensed value and the predicted value is beyond certain bounds. The replicated dynamic probabilistic model for a sensor node is installed on both the sink and that sensor node. A sensor node does not need to report sensed value normally.

If the predicted error is within the apparently, it is easy to store and access the data at Base station (BS).[3]

2.2. Data Storage:

Many approaches have been proposed to describe how to store data generated by WSNs. One category of such storage solutions is that base station collects and stores all data as might be more applicable to answer continuous queries. Obviously, the mortal drawback of collecting all data is shortening the limited power supply since sending packets costs large amount of energy. Also, shipping all data out of network may be not necessary because users are not interested in all data. Sensor nodes near BS become the bottleneck as a result of forwarding packets. Moreover, the WSNs may not able to transfer all data continuously generated by sensor nodes due to the limitation of bandwidth. Since centralized storage is not practical, naturally distributed in-network data storage is considered. As we know, indexing techniques can significantly improve the data acquiring/query performance. For WSNs, another benefit of using index is reducing cost of data

request dissemination since the destination of data request can be obtained from A Data Management Tool called ES3N[1]uses Semantic Web techniques to manage and query network lifetime for WSNs with the index.[2][3]

3. INNTERCONENECTION ISSUES

Different research works have been conducted for connecting WSNs with Internet: Using IP protocol for direct interconnection, which assumes that sensor nodes are powerful enough to run a u-IP protocol [2]: by running u-IP protocol in WSNs, Internet users can access any sensor node by using IP address. But, the assumption that sensor nodes always have enough resource to support the overhead that brought by IP protocol stack is not feasible. Using only IP protocol is not suitable for application-specific WSNs, since different WSNs may have different requirements from applications.[4]

4. BACKGROUND

As in traditional database systems, the sensor databases try to create an abstraction between the end-users and the sensor nodes. This abstraction aims to permit the users to only concentrate on the needed data to be collected rather than bothering with the complexities of mechanisms deciding how to extract data from a network. As such, the sensor databases have been subject to two main approaches to data storage and query in WSNs: the warehousing approach and the distributed approach.

1. In the warehousing approach, the sensors act as collectors. The data gathered by sensors are periodically sent to a central database where user queries are processed. This model is the most used one in data storage and query processing. However, it has some drawbacks, such as eventually wasting resources and creating a bottleneck with an immense amount of transmitted data. This approach is unsuitable for real-time processing.

2. The distributed approach is the alternative, where each sensor node is considered as a data source, and then the

WSN forms a distributed database where the sensed data are in the form of rows with columns representing sensor attributes. In this second approach, the sensed data are not periodically sent to the database server. They remain in the sensor nodes and some queries are injected in the network through the base station. These queries are disseminated into the network according to the routing techniques as per, and the sensors, thanks to their processing and storage capabilities, process them. There are four essential methods to design a distributed data management system: in-network processing, acquisitional query processing, cross-layer optimization, and data-centric data/query dissemination.

4.1. In-network Processing:

The in-network processing technique generally includes the different types of operation that are traditionally done on the server, for instance, aggregations to inside the sensor nodes themselves. It is generally used, as its name indicated, to process sensing values inside the network nodes so as to filter and reduce the huge and needless data.

4.2 Acquisitional Query Processing:

The acquisitional query processing permits to minimize energy consumption in the network by reducing the number of sensor nodes participating in the query processing. This reduction is done by expressing in the query when or what sensors to sample.

4.3 Cross-layer Optimization:

Unlike the traditional computer networks in which layers in the conventional OSI model are separated and isolated, the cross-layer optimization permits to combine information available on these different layers and profit from this information sharing.

4.4. Data-centric data/query dissemination: In contrast with traditional networks, nodes in WSNs usually do not have a single identifier because of data-centric nature of sensor applications as well as the large number of sensors deployed. Generally, applications are not interested in specific sensors, but rather in data, which they generate. [5]

5. CHALLENGING ISSUES

5.1. Scalability: A WWSN becomes more useful as the number of participant WSNs grows. Aiming at a very large number of data producers and consumers with a variety of application requirements, this introduces a significant challenge for scalability. To keep the resource usage scalable and to avoid unnecessarily denying access to more applications, it's essential for the system to reuse common data and sensing resources among overlapping application needs. This scalability challenge is further compounded by the need for maintaining extensibility to unknown applications and domain-specific data processing & aggregation.

5.2. Publishing and discovering sensor resources: If publishing even a single stream of sensing data requires too much effort, this will discourage data owners to contribute sensing data. So, the effort requested for publishing sensing data is a significant issue, which has direct impact on participant numbers. Not only is the publishing very important, but also the discovering sensor data is a significant issue. The shared WWSN should have the ability to discover and invoke services from heterogeneous WSNs and fuse related data to cater for different applications.

5.3. Query aggregation: There will be a large number of applications over this WWSN, although different applications may seek different sensor data, a subset of data collection tasks is common to some services. Wasting computation and limited energy resource should be avoided if two sensing applications overlap. An arbitrary number of user queries can be merged into a single query, which can avoid the overlapping queries on the same data source and decrease the processing load in the gateway. Therefore, how to aggregate a large number of queries, optimize the processing load in the gateway and efficiently share sensing streams among multiple applications is a big challenge issue[6][7]

6. CONCLUSION

I believe that sensor networks is a research area with challenging data management problems for years to come. Sharing data in worldwide sensor networks poses many challenging issues, which require more research effort and new solutions to be proposed. All of this sensor network research is producing a new technology which is already appearing in many practical areas. The interconnection issue should be solved by adopting the wrappers or translators approach to allow sensor networks to freely choose application-specific routing protocols, and the integration issue should be solved by adopting the P2P approach to: avoid the single point of failure, support live sensor stream and decrease the effort for publishing sensor data.

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