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Data Collection Scheme to Preserve Energy of Sensor Nodes for Wireless Sensor Networks

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Abstract: Preserving the energy of sensor nodes during data collection is always one of the most crucial problems in wireless sensor networks. In this project, the DCS scheme is proposed to exploit the appearing temporal-spatial correlation in most observable event for energy-efficient data collection of wireless sensor networks. Particularly, for temporal correlation between sensor nodes, to build lightweight Autoregressive model locally to capture data distribution at sensor node; for spatial correlation, by making use of similarity measure between sensor nodes and to perform centralized model clustering, where, this kind of clustering used to emphasizes data similarity between nodes but ignores the distance geographically, to make a group of sensor nodes with similar data distribution on both magnitude and trend into the same cluster. Through scheduling sensor nodes to report readings alternately and performing dual-prediction at both sensor nodes and Sink, Data Collection Scheme obtain sensing readings without compromising too much data accuracy loss. The wireless sensor networks are being deployed at escalating rate for various application fields. Wireless sensor networks (WSN) are mainly useful for obtaining data concerning events limited to a well-defined geographic region, like a disaster site or an agriculture dataset. The critical issue in wireless sensor networks is power saving since sensor nodes are battery-powered. Hence, developing secure and energy-efficient routing algorithm to guard WSNs against these attacks while efficiently utilizing the energy of the deployed nodes has become essential.

Keywords: Time Series Analysis, Energy Efficient technique, Temporal-Spatial, Data Collection, Wireless Sensor Network.

I. INTRODUCTION

Wireless Sensor Networks (WSN) consists of many sensor enable nodes which uses batteries as energy resource and distributed in an environment. These tiny sensor nodes, which consist of components for communication, data processing, and sensing data, result in the idea of sensor networks based on collaborative effort of a large number of nodes. Such sensor nodes could be deployed in the area of military, industry, science, and home applications such as health care, disaster recovery, transportation, security, industrial warfare, and building automation, and even space exploration. Among a large variety of applications, current environment monitoring is one of the key areas in wireless sensor networks and in such networks, can query the physical quantities of the environment.

In fact, a typical wireless sensor network is composed of a large number of sensor nodes, which are randomly spread over the interested area, picking up the signals by all kinds of sensors and the data acquiring unit, processing and transmitting them to a node which is called sink node. The sink node requests the information which is sensed by sending a query throughout the sensor field. This query is received at sensor nodes (or sources). When the node finds data matching the query, the data (or response) is routed back to the sink. For example, if the sensors nodes be in a tree like structure, the base station roles as the root of the tree and each node will have a parent. Therefore, the data items can be transmitted hop by hop from the leaf nodes to the root.

In WSNs, to reduce the amount of bytes required to code the different pieces of information the data compression refers to the use of compression techniques and, thus, the traffic load which needs to be processed within the network. As the sensor nodes are small and battery enable devices, they have limited energy which should be used precisely. Thus, the scarce sensor resources (in particular, the battery power) are easily over consumed. Thus, the key challenge in such phenomena monitoring is conserving the sensor energy, so as to maximize their lifetime. Most of the approaches tried to response to this challenge and this will be continue to gain a better solution.

Wireless sensor networks enable people to observe details of real-world phenomena in both temporal and spatial dimensions. Data collection is the fundamental function of WSNs, but also a challenging task due to limited resources of those tiny sensor nodes. Among all activities of a sensor node, it is well-known that data communication causes the maximum energy drain. Therefore, data collection scheme, which avoids abundant communication overhead yet keeps the data quality, becomes the effective method to achieve a longer network lifetime of WSNs for data-driven applications, which require sensor nodes to perform data sampling and transmit data to Sink periodically, such as environmental monitoring.

Though most of the previous work have taken advantage of temporal correlation among consecutive samples of a

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sensor node, they have overlooked the ubiquitous spatial correlation among neighboring sensor nodes. Some schemes were so complicated that related domain knowledge was needed.

The proposed system is an energy-efficient Data Collection Scheme (DCS) to perform long-term data acquisition without losing too much data accuracy. Specifically, each sensor node builds and transmits its AR model to Sink firstly. With help of our novel definition on similarity measure, it perform model clustering to group nodes with similar data distribution and variation trend into the same cluster. It is worthy to note that model clustering in DCS is based on the AR models but not the predicted values. Subsequently, sensor nodes in the same cluster are arranged to report sensing readings alternately. Furthermore, schedule making and dynamic model cluster maintaining strategies are also designed

II. LITERATURE SURVEY

A. PROBLEM STATEMENT OF PROPOSED SYSTEM

Among all activities of a sensor node, it is well-known that data communication causes the maximum energy drain. Preserving the scarce energy of sensor nodes during data collection is always one of the most crucial problems in wireless sensor networks.
Therefore, data collection scheme, which avoids abundant communication overhead by finding representative node among each cluster to send data to sink.

B. PROPOSED SYSTEM

- It effectively exploits the ubiquitous temporal – spatial correlation in most natural phenomena for energy efficient data collection of WSNs.
- It acquires sensing readings without compromising too much data accuracy loss.
- Avoids abundant communication overhead yet keeps the data quality.
- It is an effective method to achieve a longer network lifetime of WSNs for data driven applications.
- It conserves the finite resources, such as energy, network bandwidth and CPU usage.

C. SURVEY

To conserve the finite resources, such as energy, network bandwidth and CPU usage, extensive research work has been done and various energy-saving protocols and algorithms have been proposed for these data-driven applications [1]. Among of these work, model-driven data acquisition has been proved to be an effective approach to reduce communication without compromising data quality, not only in theory but also in practice [2][4]. BBQ and Ken approximate the data with user-specified confidence by keeping statistical model local and global in sync. However, both BBQ and Ken need amount of data to train an appropriate statistical model at expensive communication cost. Besides, these two frameworks are so complicated that related domain knowledge is needed [6].
As typical time series data, sensing readings can be modeled and analyzed with methods of time series analysis. L.Chong et al. firstly apply the ARIMA model in energy efficient data collection for WSNs. In their data collection scheme, Sink node builds suitable ARIMA model for each sensor node at first [9]. During the adaptive data collection phase, both node and Sink perform forecasting for next sampling value with the same model, and Sink keeps the prediction value as sampling data if it does not receive the real value from sensor node, which sends the actual value only when the prediction error is beyond a pre-defined error-tolerance threshold. With models built by Sink, large amount of data communication are triggered [8].

Compared to ARIMA, AR model is more lightweight but still offers competitive prediction accuracy. PAQ and SAF both adopt AR model to capture the underlying trend of data distribution [7]. With dual-prediction at both node and Sink, redundant data communications are suppressed and energy is conserved. Furthermore, PAQ has proposed monitoring algorithm to maintain a local dynamic model to adapt to the changing phenomenon. Similar works relying on linear regression to perform data collecting are also presented [10].

III. SOFTWARE REQUIREMENT

1. NetBeans:
NetBeans is a software development platform written in Java. The NetBeans Platform allows applications to be developed from a set of modular software components called modules. Applications based on the NetBeans Platform, including the NetBeans integrated development environment (IDE), can be extended by third party developers.The NetBeans IDE is primarily intended for development in Java, but also supports other languages, in particular PHP, C/C++and HTML5. NetBeans is cross-platform and runs on Microsoft Windows, Mac OS X, Linux, Solaris and other platforms supporting a compatible JVM. The NetBeans Team actively support the product and seek feature suggestions from the wider community. Every release is preceded by a time for Community testing and feedback

2. Jfreechart:
JFreeChart is an open-source framework for the programming language Java, which allows the creation of a wide variety of both interactive and non-interactive charts.

3. Jprowler:
The JProwler tool is a discrete event simulator for prototyping, verifying and analyzing communication protocols of Tiny OS ad-hoc wireless networks. The

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simulator supports pluggable radio models and MAC protocols and multiple application modules.

IV. SYSTEM ANALYSIS AND DESIGN

Design is a creative process; a good design is the key to effective system. The system "Design" is defined as "The process of applying various techniques and principles for the purpose of defining a process or a system in sufficient detail to permit its physical recognition". Several designing methods are carried out to develop the system. The design specification describes the features of the system, the elements or components of the system and their appearance to end-users.

A. HIGH LEVEL DESIGN

A high-level design provides an overview of a system, solution, product, platform, service, or process. Such an overview is important in a multi-project development to make sure that each supporting component design will be compatible with its neighboring designs and with the big picture.
Below figure shows the High Level Design of the whole system which includes all three modules such as local model, centralized model clustering and data collection.

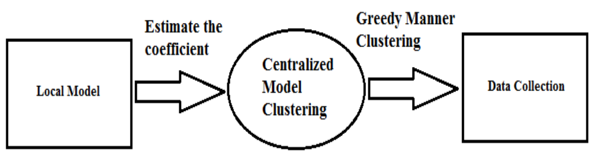

Figure 1.1: High Level Design

B. LOW LEVEL DESIGN

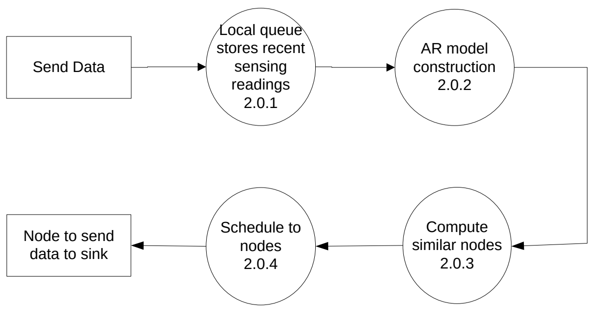

Figure 1.2: Level 1 Data Flow Diagram

C. MODULES

Detailed Design of a system provides us the deep knowledge of most components described in the protocol less approach application. In this section, flowcharts and algorithms of each module has been provided.

- Local model learning Module:- This module will help in creating the network with clusters.
- Centralized model clustering Module:- This module will help in emphasizes data similarity between nodes but ignores geographical distance, to group sensor nodes with similar data distribution on both magnitude and trend into the same cluster.
- Approximate data collection Module:- In this module through scheduling sensor nodes to report readings alternately and performing dual-prediction at both sensor nodes and Sink, DCS acquires sensing readings without compromising too much data accuracy loss.

V. INTERPRETATION OF RESULT

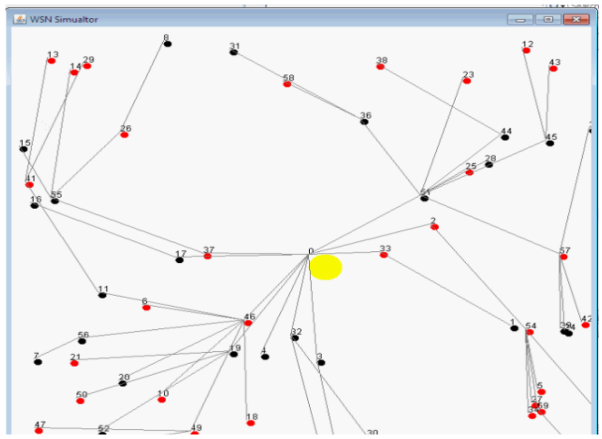

Figure 1.3: Network showing working nodes

Data collection network shows representative nodes by making red in color and in active nodes are black in color.

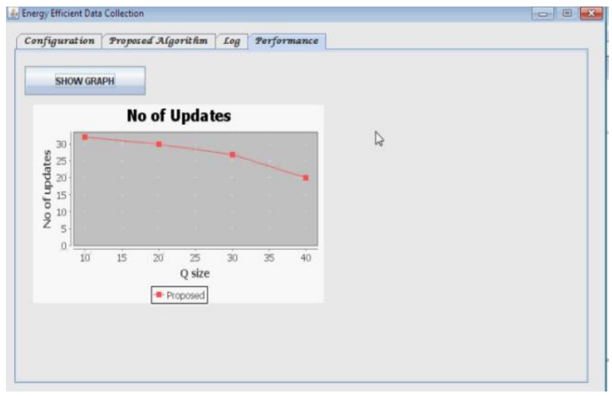

Figure 1.4: The graphical representation based on number of updates vs Q size

Figure shows the graph which display the performance. As the number of Q size increases the number of updates decreases. Once the number of updates decreases the energy of sensor nodes can preserve.

VI. ADVANTAGES

- It effectively exploits the ubiquitous temporal – spatial correlation in most natural phenomena for energy efficient data collection of WSNs.
- It acquires sensing readings without compromising too much data accuracy loss.
- Avoids abundant communication overhead yet keeps

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the data quality.

- It is an effective method to achieve a longer network lifetime of WSNs for data driven applications.
- It conserves the finite resources, such as energy, network bandwidth and CPU usage.

VII. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, proposed an algorithm named DCS, an energy-efficient data collection scheme method, for WSNs to reduce communication overhead yet keep data acquisition without too much accuracy loss. Taking advantages of lightweight AR model and novel concept of model clustering, DCS performs data collection by perfectly exploiting temporal-spatial correlation in WSNs. Simulation results illustrate the efficiency of our model clustering algorithm and data collection scheme. Specifically, DCS can reduce communication overhead, which are much better than previous dual-prediction based data collection schemes on both communication overhead reducing and accuracy retaining.

This concept could be enhanced in future by considering the following: -

- The energy of each sensor nodes and based on the available energy, representative node can be selected.
- Performance can be compared by different data collection methods.
- User-defined error-tolerance threshold can be set for approximate error prediction.

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