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Design and Implementation of Sensor Data Collection with Agent Based Approach for Communication Traffic Reduction in WSN

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Abstract

Wireless sensors network are becoming more popular in environmental monitoring, healthcare applications and etc. Since they are either worn or implanted into human body, these sensors must be very small in size and light in weight. Now a day, many studies exploit cluster head techniques to collect large scale data-base sensor data for environmental observations or weather forecasting. Agent (cluster head) travels in sensing areas and collect data directly from each sensor. By using DPV (Delivering predicted Value) method, data can be collected and drop unused data thus we can say that we reduce communication traffic. However, in many methods, the mobile sink collects data from all sensors that the mobile sink can communicate with. In this project, we propose a communication traffic reduction method by agent approach for sensor data collection. In our proposed method, the agent broadcasts predicted sensor data to each sensor. Only sensors whose sensing data exceeds the admissible error margin from the predicted sensor data transmit their data. At the same time we also concentrate on the energy efficiency of the sensor. Therefore, the communication traffic can be reduced and at the time of implementation results demonstrated the effectiveness of our proposed method.

Keywords: Sensor data, Cluster Head,Communication traffic, wireless sensor network.

1. Introduction

Wireless sensor networks consist of a large number of low-cost sensor nodes which form a multi-hop ad hoc network through wireless communication. In many environmental monitoring applications, since the data periodically sensed by wireless sensor networks usually are of high secular redundancy, prediction-based data aggregation is an important advance for reducing redundant data communications and saving sensor nodes' energy. In this paper, a prediction-based data collection protocol is proposed, the prediction data series of the sensor node and the sink node, and therefore, the cumulative error of continuous predictions is reduced. Recently, there has been an increasing interest on sensor data collection for the weather forecasting and environmental observations and many more. To realize these applications, we have to collect sensor data from many sensors. One of the ways to collect sensor data is to construct a wireless sensor network (WSN) and the sink node by using agent approach collects sensor data. Therefore, recent studies exploit mobile sinks such as taxies or buses equipped with a sink node and as far our proposed method is concern we used an agent based approach for collecting all such data in the sensing area that sensors are deployed and collect data from each sensor directly. This sink is also act as an agent for collecting sensor data and passes this data to the base station .The communication traffic decreases compared with the traditional sensor network approach. Moreover, by using robot as a mobile sink, we can monitor dangerous area which is hard to visit. Although actual sensor value is not always the same as the predicted sensor value, many applications can accept a little error. For example, suppose the case that the agent collects temperature data from sensors for environmental observations.

The accuracy of the sensor data is 0.1 degree. In this case, we can accept the error within 0.1 degree. Admissible error margin means the error margin that the application can accept at the time of programming. That is, when the admissible error margin is 0.1 degree, the application can accept the error of ± 0.1 degree from actual sensor data value by using the agent because whatever the data which has to be collected by the agent is compared to the previous one. If it is same then no need to send it once again, since the redundant communication is eliminated, the communication traffic can be reduced. The agent sends predicted sensor value to the sensors before they transmit their observed sensor value to the mobile sink. Each sensor compares their sensor value with the predicted sensor value that receives from the mobile sink and replies only when the observed sensor value exceeds the admissible error margin from the predicted sensor value. The communication traffic can be reduced because sensors do not have to transmit all data to that each sensor.

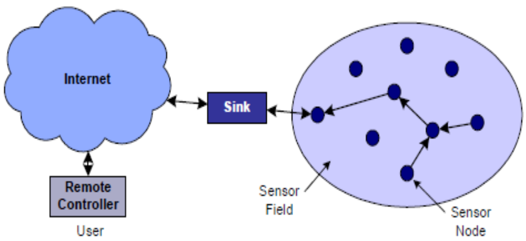

Figure 1: Sensor Network Architecture

2. Literature Survey

In [1] & [2] we have studied that the key idea in this model is to develop mobile entities present in an application scenario. They call these entities MULEs (Mobile Ubiquitous LAN Extensions) because they "bring" data from sensor to access point. For example, in a city traffic monitoring application vehicles can act as MULEs; in a habitat monitoring scenario, the role can be served by animals; in a national park monitoring scenario. MULEs are assumed to be capable of limited wireless communication and can replace data as they pass by sensors and access points as a result of their motion. The MULE architecture provides connectivity by adding an intermediate layer of mobile nodes to the existing relationship between sensors and access-points.. It is clear that much more work remains to be complete to fully understand the cost effectiveness of this approach.

In [3] paper, they have offered a routing protocol, MobiRoute, to sustain wireless sensor networks (WSNs) with a mobile sink. This can prove theoretically, that moving the sink can improve network lifetime without sacrificing data delivery latency. By inventively simulating MobiRoute with TOSSIM (in which real implementation codes are running),they have demonstrated the benefit of using a mobile sink rather than a static one. The results are very promising: a mobile sink, in most cases, improves the network lifetime with only a modestly degraded reliability in packet delivery. We are in the process of performing full-scale field tests with the in-building network. They will also improve MobiRoute based on the skill obtained from the field tests.

In [4] we have studied that the density of the network increases due to increasing number of nodes. Bearing in mind the approach of fixed round trip time for data mule, there are more nodes from which data has to be collect, in the same amount of time. This leads to loss of data due to buffer overflows at the nodes. If the second approach of stopping at each node is used, the data mule will take a longer time to complete a round. In this case, although at time of each service, the buffer of a node is empty, it may not be possible for the data mule to return to this node before its buffer fills again. Again this leads to loss of data. Another issue arises if the network is deployed over a larger area. The distance over which the data mule moves increases. The battery capability may not be sufficient for moving this length, requiring recharge on the path.

In [5] we have studied that, the main objective of our proposed algorithm is to efficiently convey all the traffic destined for the sink and improve the network lifetime. we have investigated the impact of sink mobility on network lifetime. In a typical WSN, all the data generate in the network are routed to a static sink. Nodes near the sink tend to deplete faster in their energy which might cause holes in the network thus limiting the network lifetime. With the introduction of mobile sink, the nodes around the sink always changes, thus balancing the energy consumption in the network and improving the network lifetime. Termite-hill is a routing algorithm for wireless sensor networks that is inspired by the termite behaviors. The algorithm finds its way for improved performance in the reduction of control traffic.

In [6] they enable a user to issue a query to be swamped to the network to build data forwarding and aggregation plans. Such flooding-based systems can be made more energy efficient by exploiting the spatial correlation in sensor data. Clusters base prediction model while CAG forms clusters using real-time sensor values in sensor data while CAG takes advantage of spatial correlation to form clusters. CAG achieves efficient in-network storage and processing by allowing a unified mechanism between query routing (networking) and query processing (application). Instead of gathering and compressing all the data (lossless algorithm), CAG generates synopsis by filtering out insignificant elements in data streams to reduce response time, storage, computation, and communication costs.

3. Proposed System

We propose a communication traffic reduction method by delivering a predicted sensor data. In our proposed method, we assume that the mobile sink which acts as a agent goes around a fixed route in the sensing area. The mobile sink stops and uploads collected data to the base station when it returns to the base station. Our proposed method divides the sensing area into some areas.

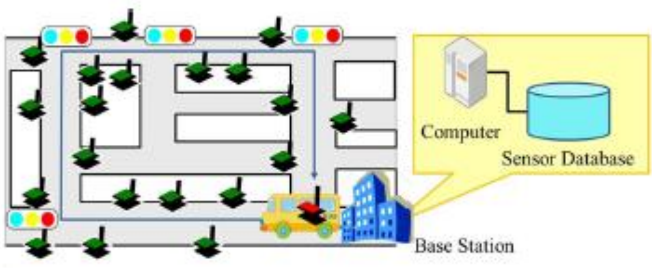

Figure 2: A sensing system using a Mobile Sink(Cluster Heads).

The mobile sink sends predicted sensor value to the sensors before they transmit their observed sensor value to the mobile sink. Each sensor compares their sensor value with the predicted sensor value that receives from the mobile sink and replies only when the observed sensor value exceeds the admissible error margin from the predicted sensor value. The communication traffic can be reduced because sensors do not have to transmit all data that each sensor has to be given.

In this paper, we proposed a sensor data collection method with a mobile sink (i.e Agent) for communication traffic reduction by delivering predicted sensor value. In our proposed DPV method, the mobile sink delivers coefficients of predicted sensor value planes calculated from stored sensor data. When sensors receive these coefficients, the sensor computes predicted sensor value by using their position information and time. After that, only sensors whose sensing data exceeds the admissible error margin from the predicted sensor value transmit their data. From experimental results, we confirmed that the DPV method reduces the communication traffic compared with comparative approach.

The main purpose of this paper is to use efficient energy, and by using agent base approach we are collection data from the sink which is act as a cluster head of the sensor network. In the previous paper data is collected by sink but this sink node is act as a dummy sink node, but in our algorithm data is collected by the sink i.e. agent. Agent is an intelligent agent so whatever data can come together is by removing the false positive. The agent has to collect all sensors data and send to the base station. In next round it can compare the previous data and according to that DPV method can utilize. Our experimental result can give a three major parameter i.e. a) Energy efficiency b) Delay c) Throughput. By comparing with and without using algorithm and this can be done on the Linux platform under NS-2 stimulation.

4. Implementation of Proposed Work

Generally, there are three methods that can be considered as possible networking protocols: direct communication, multi-hop routing, and clustering. As direct communication between the base and a large number of sensors is extremely energy consuming, and the multi-hop routine is considered as globally inefficient, clustering seems to be the appropriate method to use, In order to send information from very high number of sensor nodes to the base station, It is necessary and economical to group sensors into clusters. Each cluster will contain a cluster head (CH)[8]. Each CH gathers and sends data, from its group of sensors, to the base station (Figure 1)

Phase I. Network formation

Here in Figure 3, we deploy number of sensor node, this is actual formation of network in wireless sensor network which can be done by the simulation result in NS.2 simulator. In this network formation there are 'n' numbers of sensor nodes for data collection but for our consideration we can use 30 numbers of nodes, in that node 0 is acts as a base station. Node 1 acts as a cluster head for collecting the data from the sensors. And other node is from Node 2 to Node 30.

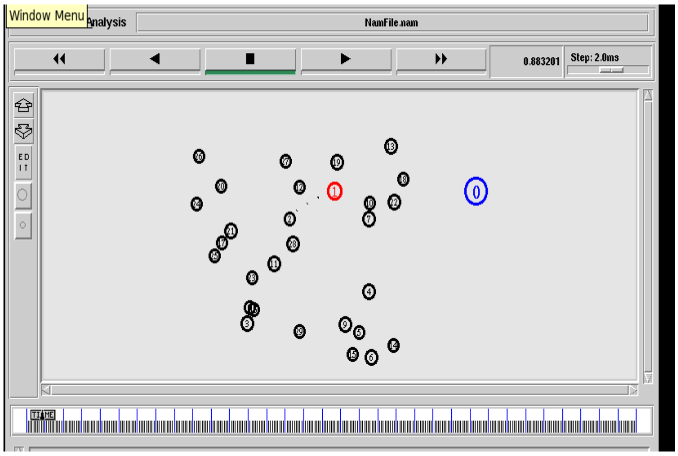

Figure 3: Network Formation

Phase II. Base station and Agent selection module.

An our assumed system environment is shown in Figure 2&3

A. Base Station

The base station has computer and sensor databases to store collected sensor data. The computers at the base station have sufficient computational capacity to predict sensor value that each sensor has in the next round by using store sensor data in the sensor databases.

B. Mobile Sink

The route for the mobile sink is fixed. An example of such mobile sinks is a bus. Buses travel around a town along a fixed route. Since the route is fixed, we can predict from which sensor the mobile sink can collect sensor data. In this paper, we focus on this type. The mobile sink travels in the sensing area and collects data from each sensor. The mobile sink stops and uploads collected data to the base station when returns to the base station. We assume that the mobile sink travels along a fixed route every a fixed interval such as bus in the town or robot. The mobile sink broadcasts beacon data periodically in order to look for sensors within its communication range. Also, the mobile sink has sufficient memory capacity to store collected sensor data.

C. Sensor

There are some sensors in the sensing area. These sensors observe environments and store the observed data to their buffers every a fixed cycle. After transmitting the data to the mobile sink, the transmitted data are deleted from their buffers. We suppose that the buffer has sufficient capacity to store the experiential data. Each sensor has its positional information using GPS. Sensors cannot communicate with other sensors so as not to miss the chance to communicate with the mobile sink. They must always monitor the signal from the mobile sink. Therefore, we only focus on communication between the mobile sink and sensors.

D. Sensor Data

Most of sensor data have spatial and temporal correlation. For example, temperature data for close sensors have similar values. Also, temperature data for a little while ago have similar values to current temperature data. Therefore, we assume that sensor data have spatial and temporal correlations. Even when sensor data do not have such correlations, we can use our proposed method. But, the performance decreases compared with the sensor data that have correlations.

Phase III. Data Communication Module

Prerequisites:

(1.1) each sensor node's lifetime is divided into equal periods. A sensor node produces only one sensed data in one period.The sink node is assumed to have sufficient computing power, storage, and energy.

(1.2) a reliable data delivery is defined as an end-to-end data intercommunication in which the receiver must send an acknowledgement message back to the sender.

In this project we are using AODV protocol. In the AODV, network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time[9].

Much of the complexity of the protocol is to lower the number of messages to conserve the capacity of the network. For example, each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a "time to live" number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request.

The advantage of AODV is that it creates no extra traffic for communication along existing links. Also, distance vector routing is simple, and doesn't require much memory or calculation. However AODV requires more time to establish a connection, and the initial communication to establish a route is heavier than some other approaches.

Here in the Simulating implementation we have shown two results i.e. a) with using AODV Protocol b) without using AODV Protocol. So in this result we found that when we use algorithm the rate of data drop is less as compare to when we apply without using algorithm. We use an simple concept that if the same data is flowing through source to destination at that time don't receive the data. And if the data is predicted then add the data.

In Figure 4 & 5, it shows the difference between both i.e by using algorithm and without using algorithm. Thus the rate of packet drop is also reduced and the redundant communication is also reduce, by using the cluster head (CH) the use of energy is also in the efficient. Thus the communication traffic is reduced between the sensor node and the base station.

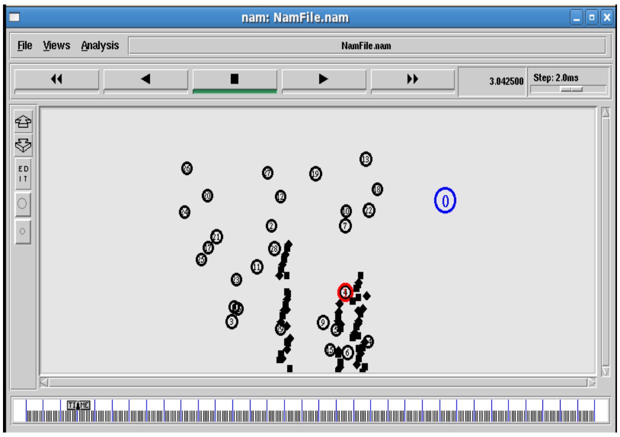

Figure 4: Data Collection without using algorithm

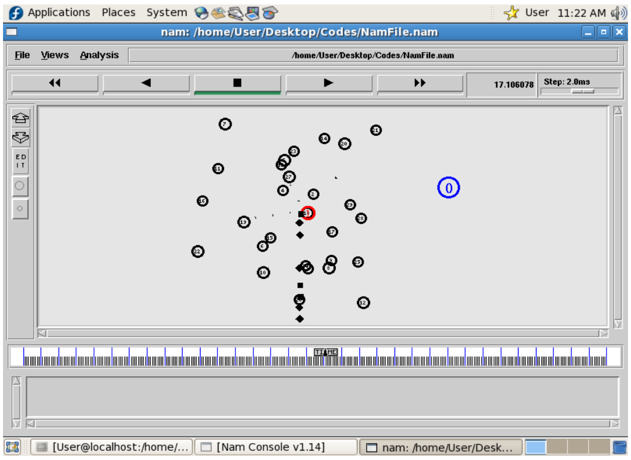

Figure 5: Data Collection with using algorithm.

5. Conclusion

We have proposed and described a sensor data collection method with a mobile sink for communication traffic reduction by delivering predicted sensor value using agent base approach. In our proposed DPV method [7], the mobile sink delivers coefficients of predicted sensor value planes calculated from stored sensor data. Base station has receive data from the agent which has to be collected by the cluster head (CH). When sensors receive these coefficients, the sensor computes predicted sensor value. The cluster head can be used for the efficient energy conservation. The agent has to collect all the sensor data and send it to the base station with the help of admissible error margin that had to be set at the time of programming. By using this method the communication gap is also reduce and by using cluster head (CH) [10] we also used the efficient energy. And finally the result shows the graph related to the energy efficiency, delay and throughput.

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