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Energy Efficient Data Gathering Mechanism In Wireless Sensor Networks Using Mobile Collectors

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Abstract:

Wireless sensor networks (WSNs) have emerged as an effective solution for a wide range of applications. Most of the traditional WSN architectures consist of static nodes which are densely deployed over a sensing area. We introduce a new data-gathering mechanism for large-scale wireless sensor networks by introducing mobility into the network. An M-collector (mobile data collector) starts the data-gathering tour periodically from the static data sink, polls each sensor while traversing its transmission range, then directly collects data from the sensor in single-hop communications, and finally transports the data to the static sink. In this paper, we mainly focus on the problem of minimizing the length of each data-gathering tour and refer to this as the single-hop data-gathering problem (SHDGP). We propose a data-gathering algorithm where multiple M-collectors traverse through several shorter sub tours concurrently to satisfy the distance/time constraints. Simulation results demonstrate that the proposed data-gathering algorithm can greatly shorten the moving distance of the collectors and significantly prolong the network lifetime.

***Index Terms*—Covering salesman problem (CSP), data gathering, M-collector, mobile data collector.**

I. INTRODUCTION

A wireless sensor network (WSN) consists of sensor nodes capable of collecting information from the environment and communicating with each other via wireless transceivers. The collected data will be delivered to one or more sinks, generally via multi-hop communication. The sensor nodes are typically expected to operate with batteries and are often deployed to not-easily-accessible or hostile environment, sometimes in large quantities. It can be difficult or impossible to replace the batteries of the sensor nodes. On the other hand, the sink is typically rich in energy. Since the sensor energy is the most precious resource in the WSN, The communications in the WSN has the many-to-one property in that data from a large number of sensor nodes tend to be concentrated into a few sinks. Since multi-hop routing is generally needed for distant sensor nodes from the sinks to save energy, the nodes near a sink can be burdened with relaying a large amount of traffic from other nodes. Sensor nodes are resource constrained in term of energy, processor and memory and low range communication and bandwidth. Limited battery power is used to operate the sensor nodes and is very difficult to replace or recharge it, when the nodes die. This will affect the network performance. Energy conservation and harvesting increase lifetime of the network. Optimize the communication range and minimize the energy usage, we need to conserve the energy of sensor nodes .Sensor nodes are deployed to gather information and desired that all the nodes works continuously and transmit information as long as possible. This address the lifetime problem in wireless sensor networks. Sensor nodes spend their energy during transmitting the data, receiving and relaying packets. Hence, designing routing algorithms that maximize the life time until the first battery expires is an important consideration. Designing energy aware algorithms increase the lifetime of sensor nodes. In some applications the network size is larger required scalable architectures. Energy conservation in wireless sensor networks has been the primary objective, but however, this constrain is not the only consideration for efficient working of wireless sensor networks. There are other objectives like scalable architecture, routing and latency. In most of the applications of wireless sensor networks are envisioned to handled critical.

The WSN is built of "nodes" from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

II. PREVIOUS WORKS

Here, we briefly outline some related work on data-gathering mechanisms in WSNs .It has been widely known that data routing can cost significant energy expenditure in sensor networks with a flat topology. To overcome this problem, some works in the literature have introduced a hierarchy to the network. In such a network, sensor nodes are organized into clusters and form the lower layer of the network. At the higher layer, cluster heads collect sensing data from sensors and forward data to the outside data sink. In general, such two-layered hybrid networks are more scalable and energy-efficient than homogeneous sensor networks.

A cluster head acts not only as a data aggregation point for collecting sensing data from sensors but also as a sensors. Two variants were studied based on whether ferries or nodes initiate proactive movement. A number of mobile observers, called data *mules*, pick up data directly from the sensors when they are in close range, buffer the data, and drop off the data to wired controller/scheduler to make various routing and scheduling decisions. In a homogeneous network, where all nodes have identical capability and energy at the beginning, some of the nodes are selected to serve as cluster heads . However, cluster heads will inevitably consume more energy than other sensor nodes. To avoid the problem of cluster heads failing faster than other nodes, sensor nodes can become cluster heads rotationally. In this type of network, since every sensor node may possibly become a cluster head, each of them has to be “powerful” enough to handle incoming and outgoing traffic and cache sensing data, which will increase the overall cost of the entire sensor network. Furthermore, selecting cluster heads dynamically results in high overhead due to the frequent information exchange among sensor nodes. Some efforts have been made to improve the intrinsic disadvantage of homogeneous networks by introducing a small number of resource rich nodes. Unlike homogeneous networks, a heterogeneous sensor network contains a small number of resource-rich nodes together with a large number of resource-limited basic sensor nodes. Basic sensor nodes have limited communication capability and mainly focus on sensing the environment, whereas resource-rich nodes are equipped with more powerful transceivers and batteries. In , resource-rich nodes act as cluster heads, and the network is organized into a two layered hierarchical network. However, it is generally difficult to deploy powerful cluster heads to appropriate positions without learning the network topology. Recently, mobility of sensor networks has been extensively studied. Radio tagged zebras and whales were used as mobile nodes to collect sensing data in a wild environment. These animal-based nodes randomly wander in the sensing field and exchange sensing data only when they move close to each other. Thus, sensor nodes in such a network are not necessarily connected all thetime. Moreover, the mobility of randomly moving animals is hard to predict and control; thus, the maximum packet delay cannot be guaranteed. For sensor networks deployed in an urban area, public transportation vehicles such as buses and trains, which always move along fixed routes, can be mounted with transceivers to act as mobile base stations . Compared with the randomly moving animals, the moving path and timing are predictable in this case. However, data exchange still depends on the existing routes and schedules of the public transportation and, thus, is very restrictive. In , controlled movement was exploited to improve data delivery performance. Some mobile observers, called message ferries, were used to collect data from access points. The movement of mules is modeled as 2-D random walk. In , mobile observers traverse the sensing field along parallel straight lines and gather data from sensors. To reduce latency, packets sent by some sensors are allowed to be relayed by other sensors to reach mobile observers. This scheme works well in a large-scale uniformly distributed sensor network.

III.SINGLE-HOP DATA GATHERING

We propose new data-gathering mechanisms for large-scale sensor networks when single or multiple M-collectors are used. In our data-gathering scheme with multiple M-collectors, only one M-collector needs to visit the transmission range of the data sink. While the entire network can be divided into sub networks .In each sub network, an M-collector is responsible for gathering data from local sensors in the subarea. Once in a while, the M-collector forwards the sensing data to one of the other nearby M-collectors, when two M-collectors move close enough. Finally, data can be forwarded to the M-collector that will visit the data sink via relays of other M-collectors. All data are forwarded to M-collector 1 from othr collectors, and then, M-collector 1 carries and uploads data to the data sink.

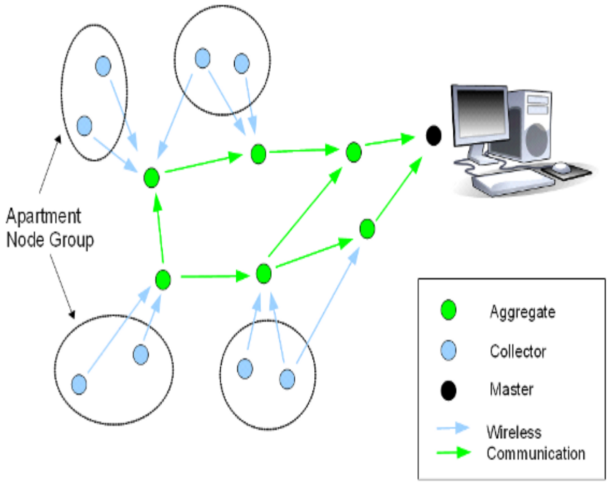

Fig.1: Single Hop Data Gathering Problem

3.1 Modules: --Analyzing the data sink details

- Setting less hop count transmission.
  - -Problem in static forward node.
  - -Dynamic forward node.
- Select sensor as polling point.
  - -Static polling point.

- Find and collect data from polling points.
- Handover the data o base station.

3.2 Analyzing the data sink details:

Handover the data to data sink when data sink within the transmission coverage area of sensors. The sensors which are located in the range of data sink it transforms all the information to the data sink with minimum hops.

3.3 Setting less hop count transmission:

Multi-hop routing, packets have to experience multiple relays before reaching the data sink. Minimizing energy consumption on the forwarding path does not necessarily prolong network lifetime as some popular sensors on the path. So to avoid the problem in multi-hop routing we are setting the less hop count transmission.

-Static forward node: When the node forwarding the data continuously, then that node will loss more energy. It may causes node failure.

-Dynamic forward node: If the forward node is dynamically changed with less hop count node then energy loss of node should be very less.

3.4 Select sensor as polling point:

A subset of sensors will be selected as the polling points, each aggregating the local data from its affiliated sensors within a certain number of relay hops. These polling points will temporarily cache the data and upload them to the mobile collector when it arrives. The polling points can simply be a subset of sensors in the network or some other special devices, such as storage nodes with larger memory and more battery power.

2.5 Find and collect data from polling points:

Since the mobile collector has the freedom to move to any location in the sensing field, it provides an opportunity to plan an optimal tour for it. Our basic idea is to find a set of special nodes referred to as polling points in the network and determine the tour of the mobile collector by visiting each polling point in a specific sequence. When the mobile collector arrives, it polls each polling point to request data uploading. And then upload the data to mobile collector.

3.6 Handover the data to base station:

A PP uploads data packets to the mobile collector in a single hop. The mobile collector starts its tour from the static data sink, which is located either inside or outside the sensing field, collects data packets at the polling points and then returns the data to the data sink. Finally mobile collector handover the data to data sink, such as base station.

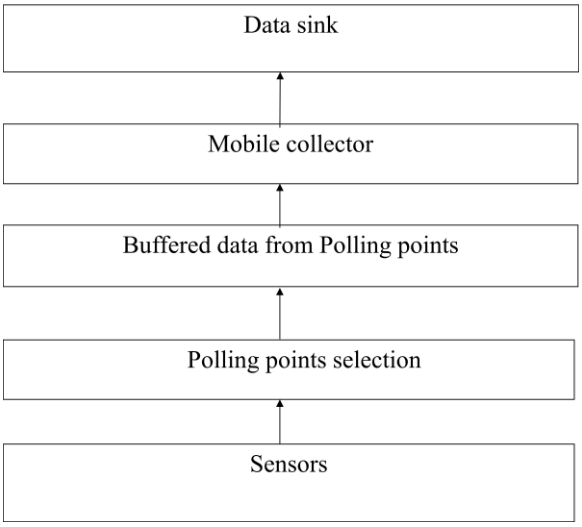

Fig.2 System Architecture

3.7 Algorithm:

```
########Polling point Selection########
Create a list E(all); #An empty set
Create a list S(all); #contains all sensors in network
Create a list G(all); #contains sub-region information
Calculate distance between each and every sensor in the
G(0), G(1),……
Select the nearer sensor as polling point for each sub-region
Create a list of all polling points P(all)
#########Data-gathering###############
Create a list M(all); #for storing mobile collector position information
Calculate the distance between polling points present in P(all) and M(all)
Assign a nearest mobile collector to every polling point
If { PP--->Sd} {
    MC< ---Rd(PP)
    MC--->Sd(BS)
}
```

IV. SIMULATION RESULTS

In wireless sensor networks are shows the output two types 1.Nam window 2. X-graph Finally, we have carried out asset of simulations to investigate the number of M-collectors as a functions between time and packet data. This is reasonable as each sub tour can link up more remote sensors in a single hop with a larger transmission range such that it requires fewer sub tours to cover the entire sensing field.

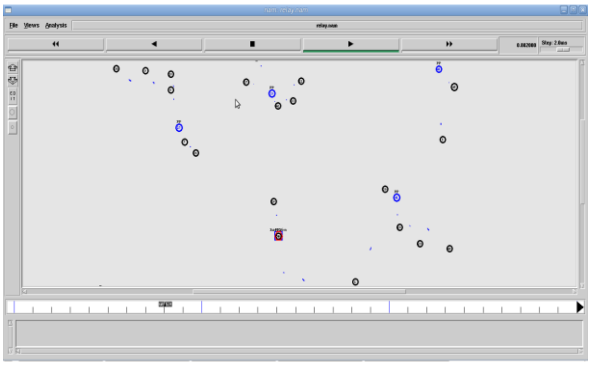

Fig: deploying of sensors.

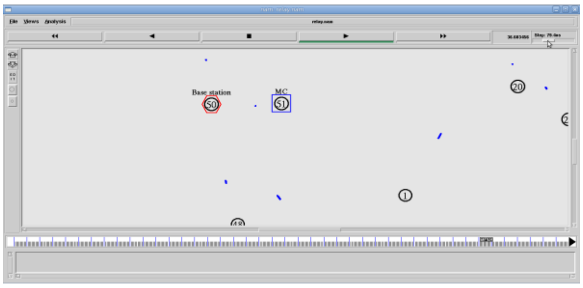

Fig: communication between sensors and polling points.

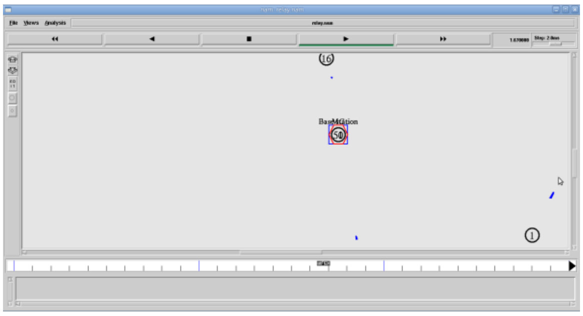

Fig: communication between sensors and base station.

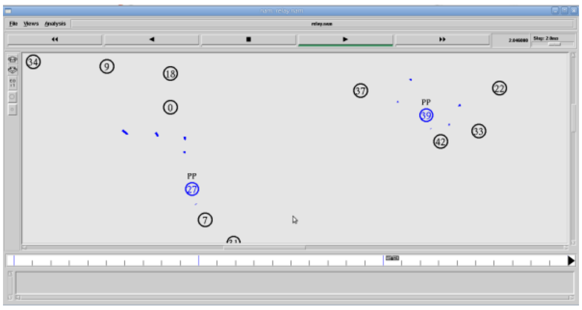

Fig: polling points collecting data from sensors.

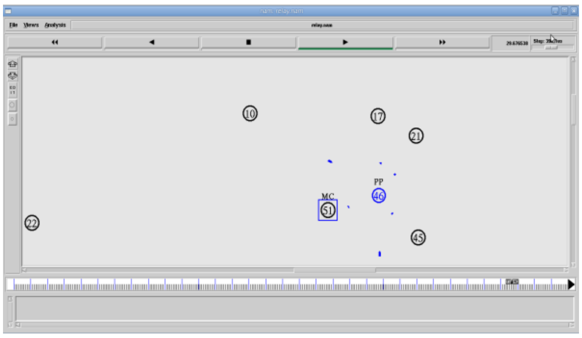

Fig: mobile collector transmitting collected information to base station.

X-graph: X-graph can shows the output between the time and packet data, in this condition it can verify the each point distance and neglete the without covering the packet data. It is similar to Nam animator.

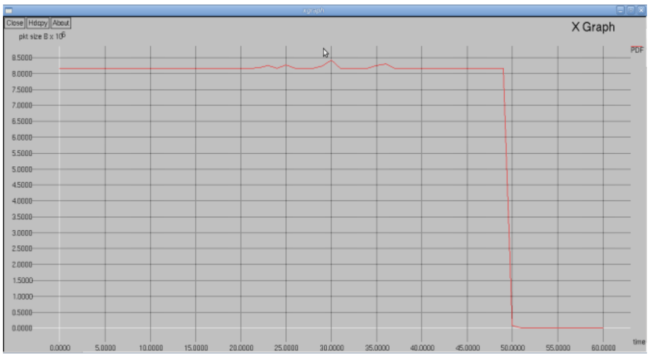

Fig: packet delivery ratio.

V. CONCLUSION

In this paper, we proposed a mobile data-gathering scheme for large-scale sensor networks. We introduced a mobile data collector, called an M-collector, which works like a mobile base station in the network. An M-collector starts the data-gathering tour periodically from the static data sink, traverses the entire sensor network, polls sensors and gathers the data from sensors one by one, and finally returns and uploads data to the data sink. In addition, it can prolong the network life time significantly compared with the scheme that has only a static data collector and scheme in which the mobile data collector can only move along straight lines.

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