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Tour Planning for Mobile Data-Gathering Mechanisms in Wireless Sensor Networks

P.Anuradha
M.Tech Student,
Department of ECE,
KITS for Women's, kodad, T.S, India.

MS.K.Anuradha
Associate Professor,
Department of ECE,
KITS for Women's, kodad, T.S, India.

ABSTRACT:

In this paper we investigate the tour planning for mobile data gathering in wireless sensor node by introducing mobility into the network. An M-collector starts the data-gathering tour periodically from the static data sink, polls each sensor and then directly collects data from the sensor in single-hop communications, and transports it into the static sink. Our mobile data-gathering scheme improves the scalability and solves intrinsic problems. By introducing the M-collector, data gathering becomes more flexible and adaptable to the unexpected changes of the network topology. M-collector will separate each zone that will reduce the network faults. In addition, data gathering by Mcollectors is perfectly suitable for applications, where sensors are only partially connected. proposed data-gathering scheme can greatly reduce the moving length compared with the covering line algorithm. In addition, it can prolong the network lifetime significantly compared with the scheme that has only a static data collector.

Index Terms:

Covering salesman problem (CSP), data gathering, sensor networks (WSNs).

1. INTRODUCTION:

WIRELESS Sensor Network (WSN) consist of hundreds or thousands of sensor nodes and a small number of data collection devices [1]. The sensor nodes have the form of lowcost, low-power, small-size devices, and are designed to carry out a range of sensing applications, including environmental monitoring, military surveillance, fire detection, animal tracking, and so on.

The sensor nodes gather the information of interest locally and then forward the sensed information over a wireless medium to a remote data collection device (sink), where it is fused and analyzed in order to determine the global status of the sensed area. In many WSN applications, the sensor nodes are required to know their locations with a high degree of precision, such as tracking of goods, forest fire detection, and etc. On the other hand, the data-gathering scheme is the most important factor that determines network lifetime. Although applications of sensor networks may be quite diverse, most of them share a common feature. Their data packets may need to be aggregated at some data sink. In a homogeneous network where sensors are organized into a flat topology, sensors close to the data collector consume much more energy than sensors at the margin of the network, since they need to relay many packets from sensors far away from the data collector.

As a result, after these sensors fail, other sensors cannot reach the data collector and the network becomes disconnected, although most of the nodes can still survive for a long period. Therefore, for a large-scale data-centric sensor network, it is inefficient to use a single static data sink to gather data from all sensors. In some applications, sensors are deployed to monitor separate areas. In each area, sensors are densely deployed and connected, whereas sensors that belong to different areas may be disconnected. Unlike fully connected networks, some sensors cannot forward data to the data sink viawireless links. A mobile data collector is perfectly suitable for such applications. A mobile data collector serves as a mobile "data transporter" that moves through every community and links all separated subnetworks together. The moving path of the mobile data collector acts as virtual links between separated subnetworks.

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2. METHODOLOGY:

Focus on the problem of minimizing the length of each data-gathering tour and refer to this as the single-hop datagathering problem (SHDGP).Formalize the SHDGP into a mixed-integer program and then present a heuristic tourplanning algorithm for the case where a single M-collector is employed. The proposed data-gathering algorithm can greatly shorten the moving distance of the collectors compared with the covering line approximation algorithm and is close to the optimal algorithm for small networks. Thus data-gathering scheme can significantly prolong the network lifetime compared with a network with static data sink We also consider utilizing multiple M-collectors and propose a data-gathering algorithm where multiple M-collectors traverse through several shorter sub tours concurrently to satisfy the distance/time constraints. The effectiveness of our proposed algorithms is verified by comparing with another data-gathering algorithmModule1: network creation and routing In this module, a sample network is to be created. A network with 'n' number of nodes is to be created. All the nodes are deployed randomly across the network.

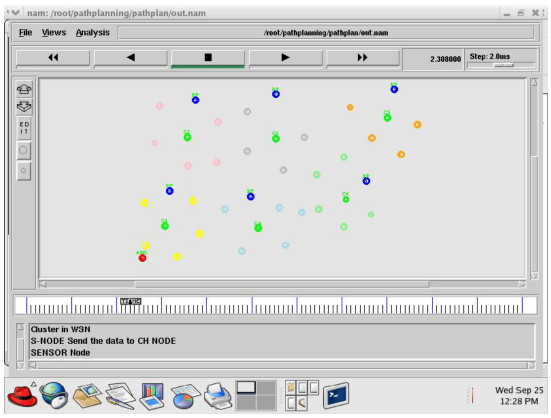
All the nodes can communicate each other. The wireless properties are given to the network. Since our network is Sensor Network, a DATA SINK should be created. To configure the data sink a patch file "sensorsim-2.27" is to be added The normal sensor nodes are to be configured in the network. A protocol called AODV is to be implemented to route the packets across the network. UDP, NULL agents are used to configure the sender and receiver nodes. CBR (constant bit rate) is provided with the sender and receiver that provide the packet flow between the nodes. Module 2: Implementation of data gathering node In this module, each and every node is made to contact with the data sink. The nodes are the network transmits the sensed data to the data sink directly. Energy consumption on sensing is relatively stable because it only depends on the sampling rate and does not depend on the network topology or the location of sensors. applications of sensor networks may be quite diverse, most of them share a common feature. Their data packets may need to be aggregated at some data sink. In a homogeneous network where sensors are organized into a flat topology, sensors close to the data collector consume much more energy than sensors at the margin of the network, since they need to relay many packets from sensors far away from the data collector.

Module :

Module 3: Performance analysis In this module, the efficiency of the nodes to transmit the data and the efficiency of the data sink to collect the data is analyzed. after these sensors fail, other sensors cannot reach the data collector and the network becomes disconnected, although most of the nodes can still survive for a long period. sensors are densely deployed and connected, whereas sensors that belong to different areas may be disconnected. Unlike fully connected networks, some sensors cannot forward data to the data sink via wireless links. Module 4: Implementation of m-collector node In this module we provide a scalable data-gathering scheme for large-scale static sensor networks, we utilize mobile data collectors to gather data from sensors. Specifically, a mobile data collector could be a mobile robot or a vehicle equipped with a powerful transceiver, battery, and large memory. The mobile data collector starts a tour from the data sink, traverses the network, collects sensing data from nearby Polling point nodes while moving, and then returns and uploads data to the data sink. Since the data collector is mobile, it can move close to sensor nodes, such that if the moving path is well planned, the network lifetime can be greatly prolonged. Module 5: Result analysis In this module we demonstrate that our proposed data-gathering scheme can greatly reduce the moving length compared with the covering line algorithm and is close to the optimal algorithm in small networks. In addition, it can prolong the network lifetime significantly compared with the scheme that has only a static data collector and the scheme in which the mobile data collector can only move along straight lines.

I.3. IMPLEMENTATION:

Different cluster region with cluster head and mobile anchor node:



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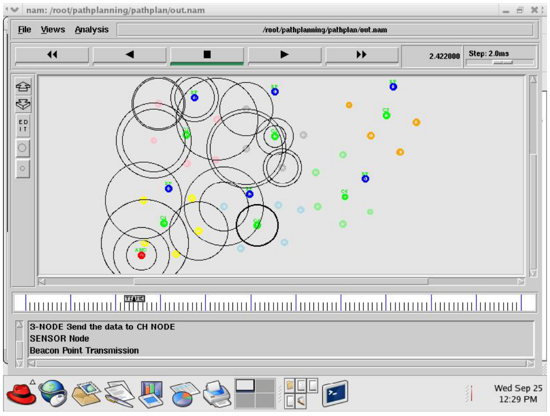
The above fig shows Different cluster regions with cluster head and mobile anchor node which are used to assist the sensor nodes in order to determine the sensing field. The mobile anchor nodes moves randomly through the sensing field.Beacon point transmission:



As the anchor node moves through the sensing field, it broadcasts its coordinates periodically and each sensor node chooses appropriate locations of the anchor node called beacon points. In the localization scheme, a single anchor node moves randomly through the sensing field broadcasting beacon messages containing its current coordinates.

4.DISCUSSION:

In this paper, we consider the data-gathering problem in which the M-collector can visit the transmission range of every static sensor, such that sensing data can be collected by a singlehop communication without any relay. Before we formally describe the data-gathering problem, we first define some terms that will be used in the rest of this paper.

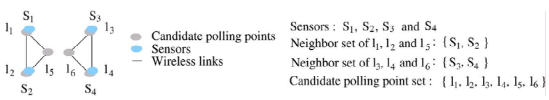


Fig. 1. Examples of polling points, neighbor sets, and candidate polling point set. While an M-collector is moving, it can poll nearby sensors one by one to gather data. Upon receiving the polling message, a sensor simply uploads the data to the M-collector directly without relay. We define the positions where the M-collectorpolls sensors as polling points.When an M-collector moves to a polling point, it polls nearby sensors with the same transmission power as sensors, such that sensors that receive the polling messages can upload packets to the M-collector in one hop. After gathering data from sensors around the polling point, the M-collector moves directly to the next polling point in the tour.

Thus, each data-gathering tour of an M-collector consists of a number of polling points and the straight line segments connecting them. For example, let P = {p1, p2, . . . , pt} denote a set of polling points and DS be the data sink. Then, the moving tour of the M-collector can be represented by DS → p1 → p2 → . . . →pt → DS. Thus, the problem of finding the optimal tour can be considered as the problem of determining the locations of polling points and the order to visit them. Before an Mcollector starts a data-gathering tour, it needs to determine the positions of all polling points and which sensors it can poll at each polling point. We define the neighbor set of a point in the plane as the set of sensors that can upload data to the Mcollector directly without relay, if the M-collector polls sensors at this point. Since the M-collector can only collect data at polling points, each sensor must be in the neighbor set of at least one polling point to upload data without relay. In other words, the union of neighbor sets of all polling points must cover all sensors.

In some existing work, the transmission range of an omnidirectional antenna was simply assumed to be a disk-shaped area around the transceiver. Based on this assumption, given a point in the plane, the neighbor set of this point consists of all sensors within the disk-shaped area around this point. However, due to the uncertainties of a wireless environment, such as signal fading, reflection from walls and obstacles, and interference, it is hard to estimate the boundary of the transmission range without real measurement [42], [43]. Therefore, in practice, it is almost impossible to obtain the neighbor set of an unknown point, unless the M-collector has moved to this point and tested wireless links between it and its one-hop neighbors, or a sensor has been placed at this point and acquired all its onehop neighbors during the neighbor discovering phase. Thus, it is only possible to test a finite number of points and their corresponding neighbor sets in the plane, and we must select polling points from this finite set of points, which we refer to as the candidate polling point set.

If the connection pattern of sensors can be obtained, or in other words, we know the onehop neighbors of every sensor, the position of each sensor can be a candidate polling point, since the neighbor set of this point is already known. However, the connection pattern may not always be available before sending out M-collectors, unless the network is completely connected so that the connection pattern can be reported to the data sink via wireless transmissions.

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To obtain the candidate polling points without the information on the connection pattern, after sensors are deployed, one or more M-collectors need to explore the entire sensing field. While exploring, each M-collector can broadcast "Hello" messages periodically with the same transmission power as sensors. Each sensor that can decode the "Hello" message correctly replies with an "ACK" message to notify the M-collector where it is. Upon receiving the "ACK" message from the sensor, the M-collector marks its current location as a candidate polling point and adds the ID of the sensor into the neighbor set of this candidate polling point.

Thus, all wireless links between sensors and the M-collector at the candidate polling points are bidirectionally tested. In addition, each sensor can also discover its one-hop neighbors by broadcasting the "Hello" messages during the neighbor discovering phase. After the sensor reports the IDs of its one-hop neighbors to the M-collector by including the information into the "ACK" message, the position of the sensor can also become a candidate polling point.

In Fig. 1, we illustrate the definition of polling points, neighbor set, and candidate polling point set by an example, where there are four sensors s1, s2, s3, and s4 deployed at positions l1, l2, l3, and l4, respectively. During the exploration phase, the M-collector discovers the neighbor sets of l5 and l6 by broadcasting "Hello"messages at these points. Thus, l5 and l6 can be added into the candidate polling point set. Since sensors s1, s2, s3, and s4 also report their one-hop neighbors to the M-collector by sending "ACK" to the M-collector, l1, l2, l3, and l4 also become candidate polling points. In Fig. 1, if there is a wireless link between sensor si and position lj , we say that si belongs to the neighbor set of lj , where si {s1, s2, s3, s4} and lj {l1, l2, . . . , l6}.

Thus, candidate polling point set L = {l1, l2, . . . , l6}; neighbor sets of l1, l2, and l5 are {s1, s2}; and neighbor sets of l3, l4, and l6 are {s3, s4}. In summary, a candidate polling point set can contain two types of points in the plane: the positions where sensors are deployed and the points where the M-collector has tested the wireless links between it and its one-hop neighbors. After the discovering phase, we assume that each sensor has knowledge of all its one-hop neighbors and the M-collector acquires the information about the neighbor set of each polling point.

5. Concluding Remarks :

Mobile data-gathering scheme improve the scalability and solves intrinsic problems. By using the Mcollector, data gathering becomes more flexible and adaptable to the unexpected changes of the network topology. Mcollector will separate each zone that will reduce the network faults. In addition, data gathering by M-collectors is perfectly suitable for applications, where sensors are only partially connected. Proposed data-gathering scheme can greatly reduce the moving length compared with the covering line algorithm.

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Aythor’s Details:

Ms.P.Anuradha, MTech student, in M.Tech Student, Dept of ECE in KITS for women’s,kodad, T.S, India

Ms.K.Anuradha, working as a Assistant at ECE in KITS for women’s,kodad, T.S, IndiaJNTUH Hyderabad. She has 5 years of UG/PG Teaching Experience

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