Research Paper

DY NAMIC ROUTING METHOD FOR ENERGY EFFICIENT MULTI MOBILE-SINK SELECTION IN WIRELESS SENSOR NETWORKS

Sivakumar Duraisamy
Lecturer cum Educational Consultant
FTMS College
sivakumar.siet@gmail.com

Sanmukapriya Vivekanandan
Lecturer
FTMS College
priyaftms@gmail.com

Abstract

Energy is the major constraint in Wireless Sensor Networks (WSNs). The mobile sinks are used to reduce the energy consumption of nodes and to prevent the formation of energy holes in WSNs. Depending on the path taken by the mobile sink, particularly in delay-sensitive applications; data sensed must be collected within a given time period. Few approaches used for this challenge is Rendezvous Point (RPs), Weighted Rendezvous Planning (WRP). These approaches lead to problems in identifying the optimal tour path and balancing the energy consumption of sensor nodes to avoid the formation of energy holes. To overcome this drawback, Dynamic Routing Method is proposed. In this approach, if there is energy drop in RPs, then that particular RP is removed from cluster head and another nearby node which contains a high amount of energy is designated as RP, by which we can improve the lifetime of the network, Efficient data forwarding, and delay is reduced. Network simulator version 2 is used for simulation; simulation is done with WRP existing versus Dynamic Routing Method proposed. In the proposed system, energy consumption is constant throughout the data transfer whereas existing work energy level found to be varying. Packet delay is reduced by 30 percentage in the proposed system with throughput being high and constant. High energy first algorithm is used in the proposed system to select the cluster head. Here the cluster head is selected dynamically, so the Cluster Head (CH) failure is avoided here thereby overcoming all the disadvantages of the existing system. In future work, we are going to save the energy of the individual node by sleep/active nodes. To active the node, we are going to use a handshaking process as well as to sleep. In case, any node needs to send data to base station then sender and receiver should be in active mode, remaining nodes can go to sleep.

Key Terms: WSNs-Wireless Sensor Networks; RP-Rendezvous Point; WRP- Weighted Rendezvous Planning.

1.1 Introduction

Wireless sensor networks are composed of a large number of sensor nodes deployed in a field. They have wide-ranging applications, some of which include military, environment monitoring,
agriculture, home automation, smart transportation, and health (Capella.J, et al., 2009). Each sensor node has the capability to collect and process data, and to forward any sensed data back to one or more sink nodes via their wireless transceiver in a multi-hop manner. In addition, it is equipped with a battery, which may be difficult or impractical to replace, given the number of sensor nodes and deployed environment. These constraints have led to intensive research efforts on designing energy-efficient protocols (Almi’ani.K, Viglas.A, and Libman.L, 2010).

In multi-hop communications, nodes that are near a sink tend to become congested as they are responsible for forwarding data from nodes that are farther away. Thus, the closer a sensor node is to a sink, the faster its battery runs out, whereas those farther away may maintain more than 90% of their initial energy. This leads to non-uniform depletion of energy, which results in network partition due to the formation of energy holes (Xiaobing .W, Guihai .C, and Sajal K.D, 2008). As a result, the sink becomes disconnected from other nodes, thereby impairing the WSN. Hence, balancing the energy consumption of sensor nodes to prevent energy holes is a critical issue in WSNs.

To this end, researchers have proposed the use of RPs to bound the tour length. This means a subset of sensor nodes are designated as RPs, and non-RP nodes simply forward their data to RPs. A tour is then computed for the set of RPs. As a result, the problem, which is called rendezvous design, becomes selecting the most suitable RPs that minimize energy consumption in multi-hop communications while meeting a given packet delivery bound. A secondary problem here is to select the set of RPs that result in uniform energy expenditure among sensor nodes to maximize network lifetime. This problem is called as the Delay-aware Energy Efficient Path (DEETP).

In the proposed plan, the data is included with different delay requirements. This means a mobile sink is required to visit some sensor nodes or parts of a WSN more frequently than others while ensuring that energy usage is minimized, and all data are collected within a given deadline.

A problem statement is always the words that will be used to keep the effort on tracking things out to represent a solvable problem with the existing system (Linus, 2014). Below are the problems with the current system.

- Problem in identifying the optimal tour path and collect data within the given deadline.
- Formation of energy holes due to unbalanced energy consumption in sensor nodes.
- Non uniform depletion of energy leads to network partition. Results in disconnection from other nodes in the network.

The fundamental aim to carry out this project is to minimize the energy consumption of sensor nodes and all data are collected within a given deadline.

The objectives of this project are as follows:

The Objective is to increase the life time, minimize energy consumption thereby reducing the formation of holes also reducing the multi-hop transmissions from sensor nodes to RPs (Rendezvous point). This also limits the number of RPs such that the resulting tour does not exceed the required deadline of data packets.

In WSNs with a mobile sink, one fundamental problem is to determine how the mobile sink goes about collecting sensed data. One approach is to visit each sensor node to receive sensed data directly. This is essentially the well-known Travelling Salesman Problem (TSP) (Bi.Y, 2007). A secondary problem here is to select the set of RPs that result in uniform energy expenditure among sensor nodes to maximize network lifetime. This problem is called as the Delay-aware Energy Efficient Path (DEETP).

DEETP is a hard problem and to avoid this problem a heuristic method is proposed, which is called as WRP, and they are used to determine the tour of a mobile-sink node. In WRP, the
sensor nodes with more connections to other nodes and placed farther from the computed tour in terms of hop count are given a higher priority (Hamidreza S, Kwan-Wu C, and Fazel N, 2014).

The design of sustainable wireless sensor networks (WSNs) is a very challenging issue. On the one hand, energy-constrained sensors are expected to run autonomously for long periods. However, it may be cost-prohibitive to replace exhausted batteries or even impossible in hostile environments. On the other hand, unlike other networks, WSNs are designed for specific applications which range from small-size healthcare surveillance systems to large-scale environmental monitoring (Tifenn R, Abdelmadjid B, Yacine C, 2014).

2.1 Literature Review

Existing methods on using a mobile sink in WSNs can be grouped into two categories: 1) direct, where a mobile sink visits each sensor node and collects data via single hop; and 2) rendezvous, where a mobile sink only visits nodes designated as RPs. The main goal of protocols in category-1 is to minimize data collection delays, whereas those in category-2 aims to find a subset of RPs that minimize energy consumption while adhering to the delay bound provided by an application.

2.1.1 Direct Method

Initial studies used a mobile sink that visits sensor nodes randomly and transport collected data back to a fixed sink node (Marios G, and Leonidas G, 2008). An example is the use of animals as mobile-sink nodes to assist in data collection from sensor nodes scattered on a large farm. To reduce the latency of visiting each sensor node randomly, researchers have proposed TSP-based data collection methods. In essence, the problem is reduced to finding the shortest travelling path that visits each sensor node. For example, TSP with neighborhood involves finding the shortest traveling tours for a mobile-sink node that passes through the communication range of all sensor nodes (Gao.S, Zhang.H, and Das.S, 2011). Another TSP-based algorithm called label-covering considers a WSN as a complete graph. For each edge, it calculates a cost and associates a label set. The cost of an edge is the Euclidean distance between nodes, whereas the label set contains sensor nodes whose transmission range intersects with the given edge. The label-covering algorithm selects the minimum number of edges where their associated label set covers all sensor nodes (Basagni S, 2008).

Disadvantage

With an increasing number of nodes, this method becomes intractable and impractical, as the resulting tour length is likely to violate the delay bound of applications.

2.1.2 Rendezvous Points

The problem with collecting data directly from sensor nodes is that it becomes impractical when there are a large number of sensor nodes. Visiting each sensor node increases the mobile sink's traveling path length and results in sensor nodes experiencing buffer overflow due to data collection delays (Wang Z). To address this problem, researchers have proposed a rendezvous-based model, in which a mobile sink only visits a subset of sensor nodes called RPs. The sensor nodes outside the mobile sink path send their data via multi-hop communications to this RPs (Guoliang X, et al., 2008).

Disadvantages:

1) Delay is high

2) Dead packet ratio is high
2.1.3 Review of Existing System

The problem is to find a set of RP to be visited by a mobile sink. The objective is to minimize energy consumption by reducing multi hop transmissions from sensor nodes to RPs. This also limits the number of RPs such that the resulting tour does not exceed the required deadline of data packets. WRP, which is a heuristic method that finds a near-optimal traveling tour that minimizes the energy consumption of sensor nodes. WRP assigns a weight to sensor nodes based on the number of data packets that they forward and hop distance from the tour, and selects the sensor nodes with the highest weight (Hamidreza .S, Kwan-Wu .C, and Fazel .N, 2014).

Disadvantages:

1) There is no awareness about Sink node Tracking.

2) Only one node is used as the cluster head for a particular area. This leads to non-uniform depletion of energy, which results in network partition due to the formation of energy holes.

3.1 Research Design

In the existing system for the entire process the same RPs are used to collect the data and deliver this collected to gateway and hence there is energy drop in RPs. This leads to non-uniform depletion of energy, which results in network partition due to the formation of energy holes. As a result, the sink becomes disconnected from other nodes, thereby impairing the WSN. Hence, balancing the energy consumption of sensor nodes to prevent the formation of energy holes is a critical issue in WSNs (YoungSang .Y and Ye .X, 2010).

To overcome this drawback, dynamic routing method is proposed. In this approach if there is energy drop in RPs then that particular RP is removed from cluster head and another nearby node which contains high amount of energy is designated as RP. In another approach WRP is extended to multiple mobile sinks, by which we can improve the lifetime of the network. Here we include location awareness of sink node, while moving, in which nodes are near to sink node. It will track the position of sink node and they will share to the neighbors. So the sensors can easily monitor the current location of sink node. It will access the sink node in easy way. So we can provide better data forwarding scheme in wireless sensor network.
Advantages
1) Efficient Data Forwarding.
2) Increase the life time of sensors.
3) Delay is reduced.

4.1 Results and Discussion

<table>
<thead>
<tr>
<th>S/NO</th>
<th>TOOLS</th>
<th>JUSTIFICATION</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>NS2.34</td>
<td>Network Simulator (Version 2), widely known as NS2, is simply an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks.</td>
</tr>
<tr>
<td>2.</td>
<td>Windows 7 and above</td>
<td>Widely used platform of Operating system.</td>
</tr>
<tr>
<td>3.</td>
<td>20GB Hard disc space; 3GB RAM</td>
<td>Sufficient space to carry over NS2 simulation.</td>
</tr>
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</table>

Table 4.1: Tools Used

4.2 RESULTS FOR DISCUSSION

Existing Method
The simulation result for the existing method is pictorially depicted below as shown in fig 4.1. In this method, the cluster heads are randomly chosen and the cluster members forward their data to their cluster head. The mobile sinks collect the data from the cluster head and deliver the collected data to the data sink.
4.3 Existing Method

Figure 4.1: Simulation result for existing method.

4.4 Proposed Method

4.4.1 Step-1
Analyze the polling point sensor and cluster head based on the energy level in it. Cluster members forward their data to the cluster head and cluster head to the polling point sensor.

4.4.2 STEP 2
- Mobile sink collects all the data from the polling points.

Figure 4.2: Formation of cluster head
In sensor node 3 only 10% of energy is remaining and hence it forwards this information to nearby nodes.

4.4.3 STEP 3:
- Since there is energy drop in node 3, the remaining nodes send their data to node 1.
- It means node 1 is considered as the next cluster head, automatically.
- For all the areas of the network this process continues.

4.4.4 STEP 4:
- Finally at a particular time period, energy is increases.
- All the mobile collectors send their data to data sink.
- Data transmission time delay is reduced.
- Hence totally an efficient data transmission occurs.
Figure 4.5: Mobile sink send their data to data sink.

4.5 ENHANCEMENT GRAPH WITH MOBILE SINK VERSES WITHOUT MOBILE SINK:

• Without mobile sink, the transmission range is low, because the nodes that are near the data sink are highly affected by congestion, due to which the communication between the nodes and the data sink will breakup.
• With mobile sink, the transmission range is high, because by using mobile sink the congestion in the network is avoided.
4.6 ENERGY CONSUMPTION VERSUS TIME:

In the existing one, if there is more number of data transfers, then the energy consumption is high and if there is less number of data transfer, then the energy consumption level is low. Whereas in the proposed model the energy level is constant throughout the network.

![Figure 4.7: Energy consumption versus time](image)

4.7 THROUGHPUT VERSUS TIME:

From the fig. 4.8 it’s very clear that, compared to the existing model the proposed one has high throughput. In the proposed model, initially there is drop in throughput, which may be due to packet loss.

![Figure 4.8: Throughput versus time](image)

4.8 PACKET DELAY VERSES TIME:
The proposed model has a lower delay when compared to the existing one.

![Packet delay verses time](image)

Fig 4.9: Packet delay verses time

5.1 Conclusion and Future Work

The life time of the network is increased by using multiple sink nodes and also the cluster head life time is increased by selecting the high energy node as a cluster head. High energy first algorithm is used to select the cluster head. Here the cluster head is selected dynamically, so the CH failure is avoided here. Based on this approach the life time of our network is highly improved.

In future work we are going to save the energy of the individual node by sleep/active the nodes. To active the node we are going to use handshaking process as well as to sleep. In case, any node has the data to send to base station then sender and receiver should be in active mode, remaining nodes can go to sleep.

References


