Advanced Science and Technology Letters
Vol.31 (MulGraB 2013), pp.105-108
http://dx.doi.org/10.14257/astl.2013.31.24

Study on Mobile Sink based Meteorological Data Transmission Method for Wireless Sensor Networks

Yinghui Peng[1], Bo Tang[2], Jin Wang[2], Yuan Xin[1]

1 China Meteorological Administration Research Centre for Strategic Development, Beijing 100081, China
2 Jiangsu Engineering Center of Network Monitoring, Nanjing University of Information Science & Technology, Nanjing 210044, China

Abstract. Sink mobility has been viewed as an important technique to improve meteorological data transmission performance for wireless sensor networks (WSNs) such as energy consumption, network lifetime, throughput, end-to-end delay etc. Also, it can largely mitigate the hot spots near sink node as sink node moves randomly or autonomously. In many applications of WSNs like meteorological observation, sensors are deployed in areas accessed by laid roads and sinks can be assembled on mobile devices like bus or handcart. In this paper, we propose a Global Best Path (GBP) meteorological data gathering algorithm based on wireless Sensor Networks with single Mobile Sink (GBP-MSSN). It aims at determining the best position for the single mobile sink and further using global sensors information to generate the best scheme to gather data from specified node. Generating of best scheme is conducted by GBP algorithm which can balance energy consumption among whole sensor networks and further prolong the network lifetime. Simulation results show that our GBP-MSSN algorithm outperforms conventional algorithms like LEACH, GAF, etc.

Keywords: Wireless sensor networks, global best path (GBP), mobile sink

1 Introduction

Wireless sensor networks (WSNs) are composed of a large number of wireless sensor nodes that are densely deployed either inside the phenomenon or very close to it. WSNs can be used in many application areas such as meteorological observation, military application, environment monitoring, healthcare, smart home, structure status monitoring etc. [1]. Nowadays, many communications protocols or algorithms are proposed such as LEACH [2], TSA-MSSN [3] etc.

The tiny and low cost sensor nodes are usually energy limited and have no energy supply. Thus, energy efficient routing protocols for WSNs are very important. It is desired that all nodes can have a synchronous speed of energy consumption so that there always are some living nodes in the area we deployed sensors in and network lifetime can be as long as possible.

ISSN: 2287-1233 ASTL

With the unceasingly thorough exploitation of nature, many regions like mountains, forest, boondocks which are inaccessible or hard to access by vehicles become easy to access by vehicles because of roads and other infrastructures. In many large-scale industries, sensors used to gather air, water or other quality parameters are deployed in areas around the factory, and these areas can be easy to access by vehicles.

In these scenarios, sensor fields always changes or are monitored for just several periods of time, thus it is not cheap or wise to build a good-sized and fixed base station (BS), namely sink. Mobile sink can solve these problems effectively. Furthermore, it outperforms fixed sink both in energy economization, delay decrease and lifetime prolongation of networks.

2 Related Work

Many studies focus on movement patterns of mobile sink and their main mentality is determining the best position for mobile sink previously based on the assumption that the mobile sink can arrive everywhere in sensor fields [4]. Actually, it is not practical in most real applications. In our proposed mechanism, we consider the sink's position based on its reachable position set, and this is more realistic for most applications.

In [5], an novel architecture of MSSNs in which sensors are sparsely deployed on both sides of roads or other routes is proposed. Based on this architecture, the authors further propose a transmission scheduling algorithm (TSA-MSSN). However, TSA-MSSN is only applicable to sparsely and along-roads deployed WSNs.

In [6], network guided data collection (NGDC) is proposed as a novel mobility control solution. It achieves a trade-off between the delay and energy consumption. However, this method acquiesces that any position in sensor field is accessible while it is not practical in real applications. It also asks for mass storage to the DG nodes.

3 Our Proposed GBP-MSSN Algorithm

There are four phases for mobile sink to gather data from a specified node.

(1) Phase 1: Input available position set

One problem is how to get the available position set. There are two methods to get available position set. One is traveling the available position and writing down each position. The other one is computing the possible positions based-on precise map.

Another problem is how to transform the continuous position lines into discrete position points. A road is commonly a continuous line and there are unnumbered position points on it. It is not necessary to write down each point on the road. We can divide the road into many sub segments and write down endpoints of each of them.

(2) Phase 2: Scheme generating

For each position at phase 1, we compute the energy cost to gather data from a specified source node. We consider the network which has N nodes identified by 1 to n and the n+1 node is the mobile sink. We denote position set as $P\ \{p_1, p_2, p_3 \dots p_l\}$.

After getting the optimum gathering scheme with the best weight value *BestA*(g) for position p_g, we further compare it with the best weight value of last position, namely *BestA*($g-1$), and choose the scheme with lower weight value as the current best scheme. After j-1 times of comparisons, we can get the final best scheme with the best position p_{best} and the lowest weight value.

(3) Phase 3: Vehicle orientation & order broadcast

Mobile sink first moves to position p_{best}, then it broadcasts orders to start a query.

(4) Phase 4: Data transmission

When all related nodes receive orders from sink, they execute these orders. Channel assigning in MAC layer of this procedure can be conducted by time division multiple access (TDMA) protocols.

4 Performance Evaluation

As is shown in Fig.1, average residual energy of the network using GBP-MSSN decreases most slowly and steadily. That stands for GBP-MSSN achieves balancing energy consumption among all nodes of the network.

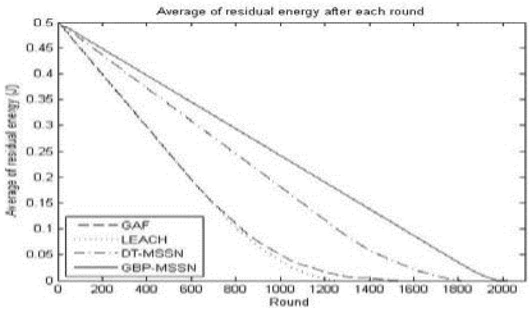

Fig. 1. Average residual energy for different algorithms

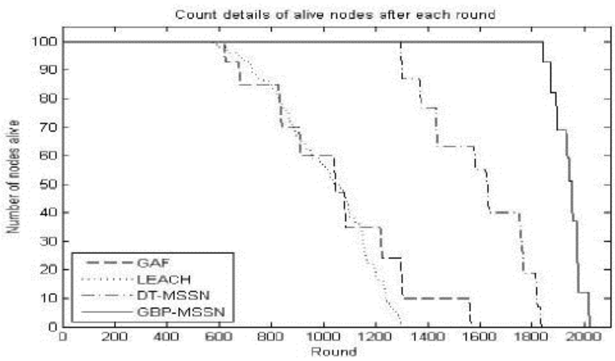

Fig. 2. Number of nodes alive for different algorithms

Fig. 2 shows the detail number of nodes alive after each round, and the result is consistent with the analysis above.

5 Conclusion

This paper exploited a novel and efficient data gathering algorithm called GBP-MSSN which is based on wireless Sensor Networks with single Mobile Sink (MSSN). Simulation results reveal that GBP-MSSN outperforms other algorithms.

References

1. Zhongmin Pei, Zhidong Deng, Bo Yang, and Xiaoliang Cheng, "Application-oriented wireless sensor network communication protocols and hardware platforms: A survey," Industrial Technology, 2008. ICIT 2008. IEEE International Conference on , pp.1-6, 2124 April 2008
2. Heinzelman, W.R., Chandrakasan, A., and Balakrishnan, H., "Energy-efficient communication protocol for wireless microsensor networks," System Sciences, 2000. Proceedings of the 33rd Annual Hawaii International Conference on , vol.2, 4-7 Jan. 2000
3. Song, L.. and Hatzinakos, D.., "Architecture of Wireless Sensor Networks With Mobile Sinks: Sparsely Deployed Sensors," Vehicular Technology, IEEE Transactions on , vol.56, no.4, pp.1826-1836, July 2007
4. Konstantopoulos, C., Pantziou, G. and Gavalas, D.; Mpitziopoulos, A. and Mamalis, B., "A Rendezvous-Based Approach Enabling Energy-Efficient Sensory Data Collection with Mobile Sinks," Parallel and Distributed Systems, IEEE Transactions on , vol.23, no.5, pp.809-817, May 2012
5. Y. Bi, L. Sun, J. Ma, N. Li, I.Khan, and C. Chen, "Hums: An autonomous moving strategy in data gathering sensor networks," Journal On Wireless Communication and Networking, 2007
6. J. Luo and J. Hubaux, "Jiont mobility and routing for lifetime elongation in wireless sensor networks," INFOCOM 2005, pp1735-1746, 2005

