

An Improved Zigbee Routing Algorithm Based on Energy Level Partition

JianQiang Wang

School of information engineering, Yulin University, Yulin, Shaanxi, China

317950860@qq.com

Keywords: AODVjr; WSN(Wireless Sensor Network); Routing algorithm; NS2 software simulation

Abstract. Based on the analysis of large temperature and humidity monitoring system, this paper proposes an improved AODVjr routing algorithm based on node energy level classification. The algorithm is based on the traditional AODVjr algorithm, the tree routing algorithm of node forwarding rules based on parent-child relationship to optimize the network layer treatment, so as to avoid invalid routing and redundant routing of traditional tree routing algorithm, improves the routing efficiency, save the overall energy consumption of the network. The simulation results of the improved AODVjr routing algorithm based on node energy grade are simulated by NS2 software. The simulation results show that the new routing algorithm proposed in this paper is effective and feasible.

Introduction

Large temperature and humidity monitoring system (such as forest fire monitoring system, marine temperature monitoring system, large temperature and humidity monitoring system, etc.) are mostly wide coverage, the number of sensor nodes and other characteristics. Similar to the smart home system and the farmland irrigation system, the small range sensor networks mostly adopt the star topology. Due to the small coverage of wireless signal, the small number of sensor nodes, the simple network structure and other reasons, there is no problem of data conflict and network congestion. However, a large range of sensor networks such as forest fire monitoring system and atmospheric temperature and humidity monitoring system. Due to the wide coverage of wireless signal, the large number of sensor nodes, the complex network structure and other reasons, this type of wireless sensor network has serious problems such as data conflict and network congestion. [1,2].

In this paper, several improvements have been made on the traditional routing algorithm: first, the nodes in the network energy classification, the node residual energy shortage in the conditions allow, will discard the route request packet, so as to avoid the node due to excessive energy consumption and "death", the network provided stability, Second, the AODVjr routing algorithm and tree routing algorithm are combined, and the tree routing algorithm of node forwarding rules based on parent-child relationship to optimize the network layer treatment, so as to avoid invalid routing and redundant routing of traditional tree routing algorithm, improves the routing efficiency, save the overall energy consumption of the network.

Finally, the software is simulated by NS2, and the results verify the effectiveness of the algorithm.

Review

The traditional ZigBee routing algorithm includes ZigBee standard tree routing algorithm and AODVjr algorithm. The limitations of the two algorithms lead to the fact that they can not be applied to the specific sensor networks [3].

Tree Based Routing Algorithm. The tree type routing protocol is a routing protocol with low overhead, low profile, low energy consumption, the data transmission protocol is based on the relationship between nodes and not based on search and update the routing table, because of this, the more close to the coordinator node, the energy consumption is faster [4]. Therefore, the most prominent problem of tree routing algorithm is the uneven distribution of energy consumption. The

research of load balancing based on the protocol has become a hot spot in the research field of routing algorithms in wireless sensor networks. Out of the uneven distribution of node energy consumption, there is a significant disadvantage of tree routing algorithm is that the routing efficiency is not high. [5,6,7]

AODVjr Algorithm. The AODVjr algorithm inherits the main characteristics of the AODV algorithm, simplifies some of the features of the AODV algorithm, is a more sophisticated ZigBee routing algorithm based on demand driven [8,9]. AODV algorithm is mainly used in Ad Hoc network, and AODVjr algorithm is mainly used in ZigBee mesh network. When the source node sends data to the destination node, if the routing path is not found at this time, the routing request packet is sent to each neighboring node in a multicast (Multi-Broadcast) manner. Each node that receives the routing request packet will save a path from the node to the source node help the source node to find the destination node by the way of broadcasting. After receiving the route request packet, the destination node replies a route reply packet to the source node in a unicast (Uni-Broadcast) way by the least path of cost. After the source node receives the route reply packet, it sends the data information to the destination node according to the same path. According to the process of AODVjr algorithm for routing path traversal, it is not difficult to find, although the method can find the optimal path with minimal routing overhead, but in order to find the best path, must first go through Hong Fan search, the search process will greatly aggravate the energy consumption of nodes in the network. Not only that, the maintenance of the routing table puts forward higher requirements to the hardware (memory) of the device, but also improves the hardware cost of the node[10].

In this paper, combined with the inherent characteristics of two kinds of advantages and disadvantages of traditional routing algorithms and their wide range of temperature and humidity monitoring system, puts forward a kind of improved routing algorithm, which can play the advantages of the traditional routing algorithm, and can effectively meet the actual needs of the project, improve routing efficiency, enhance system reliability and stability.

Methods

In general, the routing algorithm based on ZigBee protocol should satisfy three conditions: first, [11,12] make full use of network bandwidth and reduce the network overhead as much as possible under the conditions permit; second, in the premise of ensuring the effectiveness of information transmission, improve routing efficiency, reduce the energy consumption of network nodes; third, with load balancing the effective strategies of avoiding node overload and cause because of node failure, thus affecting the overall performance of the network.

As mentioned above, a wide range of wireless sensor networks due to the wide range of wireless signal coverage, the number of sensor nodes, the network structure is complex and other reasons, there are serious problems such as data conflict and network congestion. In order to solve this problem, this paper proposes an improved AODVjr algorithm based on node energy level classification. In this algorithm, all nodes in the network is divided into low, high energy threshold, three energy levels have different energy level of the nodes on the routing request packet (routing information in ZigBee network is the routing request packet and routing response packet, respectively RREQ and RREP) take a different strategy, thereby reducing energy the node load, on the whole network load balancing process.

Result & Analysis

In order to evaluate the performance of the improved AODVjr routing algorithm proposed in this paper, the NS2 simulation software is used to simulate the algorithm. The specific parameters of setting up the network environment in NS2 software are as follows:

Network coverage: 400M *300m

Network node number: 180

Node initial energy Pinit:12J

Per hop distance: 15M

Maximum number of child nodes: 4

Maximum number of routers to accommodate: 5

Maximum network depth: 8

The network parameters are as follows: $a=0.15$, $b=0.20$, $c=0.6$, $\gamma=0.3$, $k=3$.

The network energy consumption increases with the increase of the number of nodes in the network. The improved AODVjr algorithm based on node energy level classification is better than the traditional AODVjr algorithm in the overall energy consumption of the network, and the average energy consumption is about 20. It should be noted that the 20 energy saving is the number of nodes in the network, when the number of points in the network increases, the energy savings will be greater than the value.

Simulation results of the improved AODVjr algorithm and the traditional AODVjr algorithm in the law of the number of dead nodes with time. In the experimental network environment, in the traditional AODVjr algorithm, when the experimental time is between 150s and 170s, the number of nodes in the network increases exponentially. However, in the improved AODVjr algorithm based on the node energy level, the number of death nodes in the network grows linearly rather than exponentially after over a certain period of time (160s~180s). The performance of the improved routing algorithm in network congestion control is obviously improved.

Summary

This paper analyzes two kinds of traditional routing - tree routing algorithm and AODVjr algorithm based on ZigBee algorithm, then analyzes the characteristics of a wide range of temperature and humidity monitoring system, the system requirements of the network has the characteristics of high efficiency, low energy consumption, routing congestion control ability. In order to solve these problems, this paper designs a new AODVjr routing algorithm based on node energy level classification. Through the NS2 simulation software, the simulation results show that the improved AODVjr algorithm has better performance in network energy consumption and congestion control.

Acknowledgements

This paper is a report of the research project of teaching reform in the Information Engineering Institute of Yulin University.

References

- [1] Li Dong, Liu Wei, Zhao Ze , et al. Demonstration of a WSN Application in Relic Protection and an Optimized System Deployment Tool. Proc of ACM/IEEE International Conference on Information Processing in Sensor Networks. IEEE, 2008.
- [2] Wanzhi Qiu, Efstratios Skafidas, Peng Hao. Enhanced tree routing for wireless sensor networks[J]. AdHoc Networks, 2009, 7: 638-650
- [3] Panayiotis Andreou, Demetrios Zeinalipour-Yazti, Andreas Pamboris. Optimized query routing trees for wireless sensor network[J]. Information Systems, 2011(36): 267-291.
- [4] Olfa Gaddour, Anis Koubaa, Omar Cheikhrouhou. Z-Cast: A Multicasts Routing Mechanism in ZigBee Cluster-Tree Wireless Sensor Networks[C]. IEEE 30th International Conference on Distributed Computing Systems Workshops, 2010.
- [5] Mhatre V, Rosenberg C. Design Guidelines for wireless sensor networks: communication, clustering and aggregation [J]. AdHoc Network Journal, 2004, 2(1): 45-63.

- [6] Francesca Cuomo, Anna Abbagnale, Emanuele Cipollone. Cross-layer network for energy-efficient IEEE 802.15.4/ZigBee Wireless Sensor Networks [J]. *Ad Hoc Networks* 2013, 11(2):8-25.
- [7] A. Ladd, et al, Using Wireless Ethernet for Localization, Proceedings of the 2002 IEEE/RSJ International Conference in Intelligent Robots and Systems, 2002.
- [8] Ryota Yamasaki, et al, TDOA Location System for IEEE 802.11b WLAN, IEEE Communications Society, pp.2338-2343, 2003.
- [9] V. Otsason, A. Varshavsky, Anthony La Marca and Eyal de Lara, Accurate GSM Indoor Localization, The 7th International Conference on Ubiquitous Computing, Tokyo, Japan, September 2005.
- [10] M. Kranz, C. Fischer, and A. Schmidt, A comparative study of dect and wlan signals for indoor localization, in Pervasive Computing and Communications (PerCom), 2010 IEEE International Conference on, 29 April 2010-april 2 2010, pp. 235–243.
- [11] Abhishek Patil, et al, Bluebot: Asset Tracking via Robotic Location Crawling, IEEE International Conference on Pervasive Services 2005, Greece, July 2005.
- [12] D. Hahnel, et al, Mapping and localization with rfid technology, Intel Research Institute, Seattle, WA, Tech. Rep. IRS-TR-03-14, December 2003.