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ENERGY EFFICIENCY ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORKS BASED ON CLUSTER-TREE

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ABSTRACT

As a typical routing algorithm of hierarchy for wireless sensor networks (WSNs), LEACH is a good solution for energy efficiency. However, LEACH still has some disadvantages, such as unreasonable structure of clustering, direct communication between all cluster heads and sink node, which brings high energy consumption. An improved routing algorithm based on LEACH, known as ILEACH, is proposed in this paper. Firstly, the ILEACH employed the residual energy to form clustering, which can avoid the low energy node becoming a clusterhead. Secondly, an energy function is proposed to balance the energy consumption among clusterheads. Finally, a data aggregation tree is constructed to transmit the data from the clusterheads to sink node. Simulation results show that the proposed algorithm provides higher performance and longer network lifetime, compared with LEACH.

KEYWORDS: WSN, LEACH, ILEACH, Routing

With the rapid development of computer technology, embedded technology, wireless communications, and so on, sensor nodes are becoming smaller, more intelligent, and higher integration, and thus, it is impossible to set up a wireless sensor network (WSN) with these small sensors. A WSN is a self-configured network being composed of a large number of sensors, which provides unprecedented opportunities in several domains ranging from military (battlefield surveillance) to civil use, such as industrial control, environmental monitoring, intelligent house et al [C. Intanagonwiwat-2000]. It is envisioned that the nodes in WSN are used to collect useful information in the physical environments over a long time period for scientific data gathering. Considering the fact, that the nodes in a WSN are powered by battery and the difficulty of replacing and/or recharging their batteries due to the field nature such hostile environment, thus, it need be carefully planned to prolong the network lifetime when battery is the main source of energy. The main source of power consumption is due to communication according to [K. Du, J. Wu,-2005], thus, a high performance routing algorithm is often a crucial part in network system. The function of a routing algorithm is that a source node can send its packets to its destination by one of paths. However, nodes in a WSN are also limited in computational capacity, transmission distance and memory. So, it is not easy to find the route and reserve it. According to the structure of network topology, the routing algorithm can be sorted to three categories, such as flat routing, hierarchical routing and tree routing. In flat routing, each node typically plays the same role and nodes in the network collaborate together to perform the sensing task [J. Yang-2010]. The advantages of the flat routing are simple and robust. The disadvantages of it are that the cost of constructing routing and maintaining routing is high. Thus, the flat routing is fit of small-scale WSN. In tree routing, there is a tree that connects all nodes in the network. The child node transmits data to father node. In order, the data is delayed to root along the tree. The advantage of the tree routing is that it is easy to construct a tree connecting all nodes.

But the scalability of it is not good. Because it need construct the routing tree again when a node moves or be faulty. So it is fit of the small-scale WSN. The hierarchical or cluster routing, are well-known techniques with special advantages related scalability and efficient communication. Thus, it is usually utilized to perform energy-efficient routing in a WSN. In order to efficiently use the power, we design a new version of the self-organized routing algorithm based on LEACH (Low energy adaptive clustering hierarchy) [L. Sun-2005, J. Yick-2008], named as ILEACH, that owns advantages of tree routing and hierarchical routing.

PROBLEM STATEMENT

The design concept is to build a system to be a piece of furniture for a smart home to improve the living quality of the home members and to provide the social interactions with the home members

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RELATED WORK

The main goal of routing algorithms is to efficiently reduce the energy consumption of nodes when it need transmit data to the destination. Currently, the routing problem has been received extensive attention. There are all kinds of routing algorithms being proposed in the WSN. Directed Diffusion (DD) [M. Haenggi-2005] is a typical flat routing. Directed diffusion is data-centric in that all communication is for named data. That can achieve energy saving by selecting empirically good paths and by carrying out data aggregation. The main shortcoming of DD is that the flooding algorithm is used in DD, which reduces the energy efficiency of DD. In [D. Kumar-2009], the authors presented two new algorithms under name PEDAP (Power data gathering and aggregation protocol PEDPA), which are near optimal minimum spanning tree based routing schemes. The proposed algorithms are effective in prolonging the network lifetime. However, PEDAP demands that each node can obtain energy information of its neighbors and needs involve sink in forming spanning tree. So the scalability of the algorithmis not good. Low-Energy Adaptive Clustering Hierarchy protocol (LEACH) [J. Yick-2008] is one of the most popular distributed cluster-based routing algorithms in WSNs. In LEACH, the concept of round is used. That is to say that the CHs is randomly selected by a formulation in each round. And each node in network can get one chance to become a CH. LEACH provides WSN with many good features, such as save energy by data fusion. However, the CHs need directlycommunication with sink, it consume the precious energy of nodes for doing that. In [L. Sun-2005], an enhancement over the LEACH was proposed, named LEACH-C, uses a centralized clustering algorithm. Compared with LEACH, because LEACH-C can evenly disperse the CHs throughout the network, LEACH-C abstain better performance. But LEACH-C needs the global information in the network, so it is fitter of the small-scale network. There are some other algorithms proposed in that used other method to save energy. Although the above typical adaptive algorithms achieve good energy efficiency of WSN, most of them need to know the current knowledge of location and/or othernetwork information. So there are some methods to improve the performance of them.

SYSTEM DESIGN

Existing System

We know some defects ofLEACH. For instance, the selection of cluster heads does not use energy. The direct result is that the low power node can become a cluster head; it will deplete its energy quickly.

The member nodes choose a cluster head to join in only by distance between themselves and a cluster head. It may result in the formation of the minimum cluster or the maxim cluster. That is energy balance against among all nodes of the network.

Proposed System

When nodes compete to become a cluster head, residual energy would be used in the process. When one non-cluster head node chooses to join in a cluster, it will use the residual energy of the cluster head and the distance between the cluster head and sink node. Cluster heads use multi-hop method to communication with sink by a tree.

Working Methodology

We know the fact that ILEACH uses cluster-treestructure to collect data. It can reduce the energyConsumption of cluster heads, thus the load is balancedamong the nodes of the network. ILEACH achieves better energy efficiency. There are threemain reasons contributing the effect.One reason is thatILEACH chooses a cluster head in accordance with itsresidual energy. The second reason is that member nodechooses a CH to join in according to the residual energy of aCH and the distance to a CH. The third reason is that data istransmitted along the tree that connects all nodes. That canreduce the energy consumption of a CH. Because allclusterheads in LEACH directly communicate with sinknode, the energy consumption is higher than that ofILEACH. All nodes in DIRECT directly communicate withthe sink, the energy consumption of it is the highest. Comparison with the other algorithms, ILEACHhas longer network lifetime. The main reason is thatILEACH integrate energy and distance to construct clusters.Thus, the probability of low energy node becoming a CH islow, and it can balance the energy consumption amongnodes of the network by data aggregation tree. So ILEACHachieves longer network lifetime than that of the other twoalgorithms.

CONCLUSION

Selection of routing algorithm for wireless sensor network depends on various factors, such as scalability, band width, network delay, et al. Aiming at the disadvantages of hierarchical routing of LEACH, the paper proposed an improved LEACH algorithm. Firstly, we adapt the formulation of selecting clusterheads and the method of member nodes joining a cluster. That can balance the power consumption in the network. Then the ILEACH uses a data aggregation tree to send data. The method can avoid that the clusterheads directly communicate with sink, thus, it reduces the energy consumption better. The simulation results show that ILEACH has lower energy consumption and longer network lifetime, compared with LEACH.

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