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The Cluster Algorithm Using Residual Energy and Position for WSN Application

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Abstract

The network lifetime is one of important requirements for many wireless sensor network applications. An effective protocol must be adopted. In this paper, the cluster algorithm for wireless sensor networks based on residual energy and position is presented, which is termed as MLEACH. It saves much more energy while forming the cluster according to residual energy of sensors and fringe position within clustering. The Algorithm is simulated and tested by MATLAB. The results show that this algorithm is more effective routing protocol that prolongs the network lifetime.

Keywords: *Cluster Algorithm, Residual Energy, Fringe Position, LEACH.*

1. Introduction

Wireless sensor network, one of the most important new technologies in the future which is formed by the combination of sensors, network and communication technologies. WSNs consist of hundreds to thousands of low-power multifunctioning sensor nodes, deployed at high density in regions requiring surveillance and monitoring, with limited computational, sensing capabilities and limited power [1]. It is one of important requirements and one of the most challenging problem for many Wireless sensor network applications to prolonged network lifetime. Clustering techniques can reduce energy consumption and prolong sensor network lifetime. One of these routing protocols is Low Energy Adaptive Clustering Hierarchy (LEACH) [2-3]. In LEACH, cluster are formed periodically by local coordination and each operation are divided into rounds. LEACHNEW [4] is a new version of LEACH, which modified the threshold of nodes to be cluster head, can avoid the nodes which has low energy to become cluster head.

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2. Proposed Algorithm

We propose a cluster algorithm for wireless sensor networks based on Residual Energy and Position, while forming the cluster according to residual energy of sensors and fringe position within clustering. It is a key to obtain the optimal electing coefficient which decides the electing time of new cluster head. The cluster head is elected within the cluster when its residual energy is less than a value which is the multiplication the electing coefficient and cluster head's initialization energy this round. To make energy load distribute evenly among all nodes, it is necessary to seek for the maximum residual energy among the nodes within the cluster, and specify it as the cluster head. The node which is near the edges or in the outer zone of the cluster area and whose residual energy is less than a threshold should not be elected to be cluster head to avoid the accumulated transmission energy of more nodes caused by increased distance [5]. A new electing coefficient can be set dynamically after cluster head selection according to number of nodes within cluster and energy dissipative value between cluster head node and member nodes.

2.1 Selection Coefficient

The electing coefficient (ε) [6] is the key parameter to network lifetime. If it is too high, the residual energy of all nodes will be even in the progress but redundant rounds of election happen. Election also dissipates energy. Some nodes will die early while others are still powerful. When it is too low, some nodes die early but others still have more energy. Although the network might work as normal, the network has to endure the intermittently climbing lack of working nodes and the performance will surely be affected. We believe that the performance of network can be guaranteed more reliably when all the nodes work. The mostly expected result is all the nodes run as long as possible and die at the same time due to exhaustion of energy.

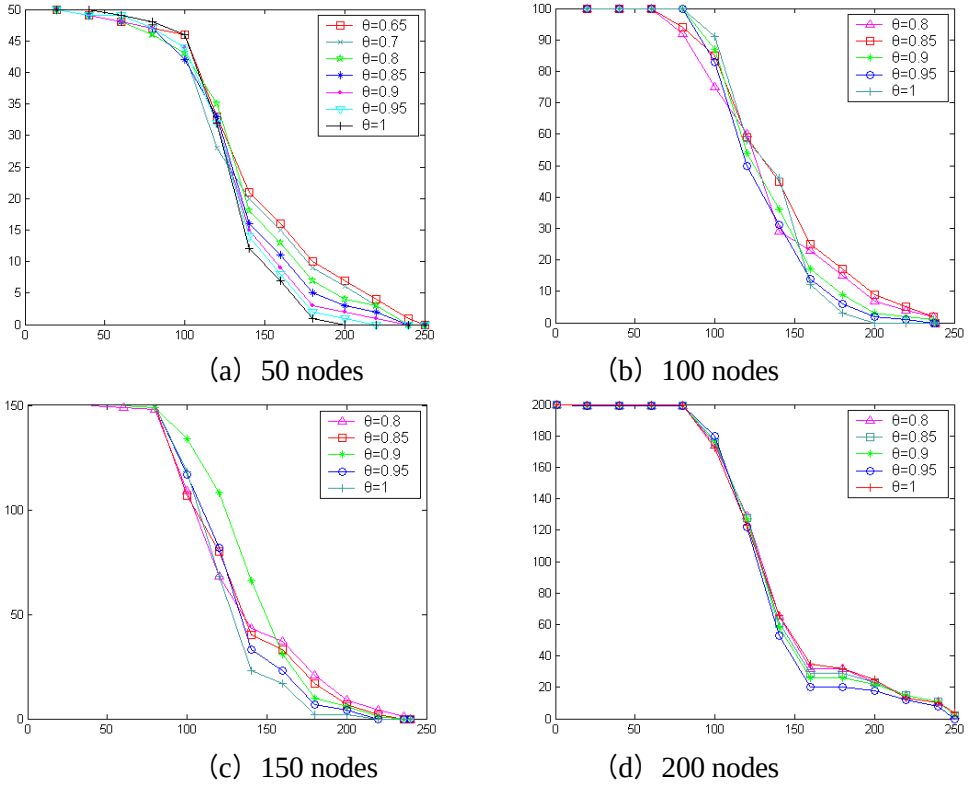
The optical ε value is related to number of nodes (n), energy consumption of cluster head ($ECch$) and energy consumption of cluster member($ECcm$). ε descends when n and $ECcm$ decrease with $ECch$ increases. Experiment shows that network lifetime can be prolonged when cluster head are electing with the optical ε value. So it can be calculated from equation (1) as follows [7]:

$$\varepsilon = 0.003579 \times n + 0.152 \times ECcm - 0.0291 \times ECch + 0.682 \quad (1)$$

2.2 Optimal Fringe Coefficient

Fringe Coefficient (θ) is also a key parameter for decision of a node to be cluster head. If θ is too high or is too low, the performance of network will surely be affected [8]. So Optimal Fringe Coefficient will be acquired by experiment.

We have simulated the performance of fringe coefficient using the simulation parameters with MATLAB. The simulation parameters are same as in [9]. The all parameters can be changed according to the different simulation positions. Four different positions of number of nodes can be tested .The number of nodes is set as 50, 100, 150 and 200, base station at (50,175). The results are shown in Fig 1.



(a) 50 nodes (b) 100 nodes

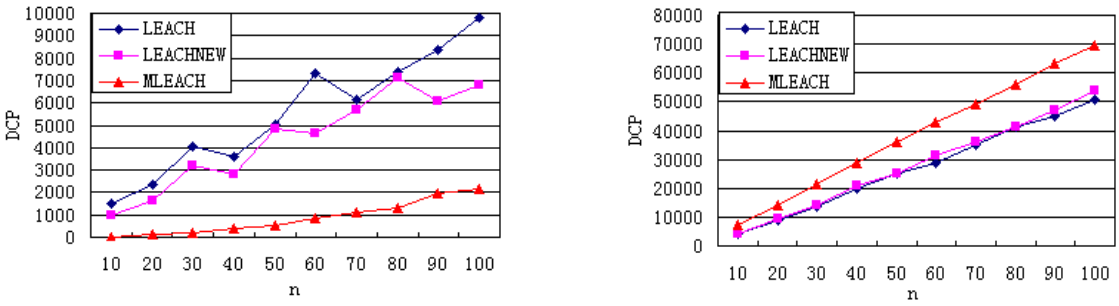
(c) 150 nodes (d) 200 nodes

Figure 1. Fringe Coefficient versus number of alive nodes.

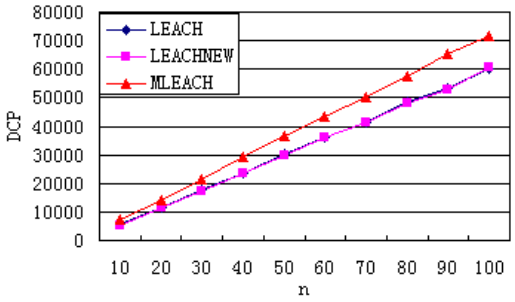
3. Simulation

We use: 1. DCP (data communication procedure) to represent lifetime. DCP means the period of a round of data transfer, including data detection, data transmission and data receipt of a sensor nodes in this cluster ; 2. R. The r means the times of reversion of cluster head.

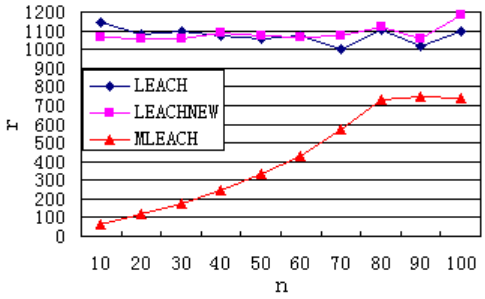
DCP_first and DCP_last mean that DCP when the first node die and the last node die, △DCP means the difference of DCP_last to DCP_first ; r_first and r_last express that round of the first node die and the last node die. We have simulated the performance of LEACH、LEACHNEW[3]. MLEACH in the same situation with initial energy of 0.2J. The variations of △DCP,DCP_first, DCP_last, r_first and r_last are shown in Fig 2, when the number of nodes increase.



(a) Comparation of △DCP (b) Comparation of DCP_first



(c) Comparation of DCP_last



(d) Comparation of r_last

Figure 2. The coparation results of three protocol

In (a), ΔDCP of MLAECH decrease greatly, which mean that all nodes die at the same time due to exhaustion of energy, it can make energy load distribute evenly. The distributed energy load of MLEACH is improved significantly in comparison with that of LEACHNEW and LEACH by 84.53%, 80.36%. In (b), The DCP_first of MLEACH is prolonged significantly in comparison with that of LEACHNEW and LEACH by 43.24%, 37.7%. The larger of DCP_first is, the better superiority of network performance. In (c), The DCP_last of MLEACH is increased significantly in comparison with that of LEACHNEW and LEACH by 21.56%, 21.88%. So, we can say that network lifetime is prolonged. The rotation of the cluster head of MLEACH is decreased greatly, because cluster head are electing with the optical ε value. The simulation results show that this algorithm which is more effective routing protocol prolongs the network lifetime.

4. Conclusion

We proposed MLEACH where the cluster heads are selected according to maximum residual energy of sensors and fringe position within clustering. Improvement of node lifetime is varied for different parameter. The main purpose is to obtain the maximum network lifetime while the initial performance of system should be maintained as possible as normal. The Fringe Coefficient value formula also can be proposed. When the Fringe Coefficient value is adapted in the algorithm, the lifetime can be prolonged while the performance of the network can be maintained unabated. Our research motivation is to introduce the application of WSNs into monitoring drought in agricultural production.

References

[1] Cho S., Yi J. H., Shrestha B., and Seo, C., (2017), Multipath routing technique for responding to sniffing attacks in wireless multimedia sensor network environment, International Journal of Sensor Networks, 24(3), 200-207.

[2] Heinzelman W. R., Chandrakasan A., and Balakrishnan H., (2000, January), Energy-efficient communication protocol for wireless microsensor networks, In System sciences, 2000. Proceedings of the 33rd annual Hawaii international conference on (pp. 10-pp), IEEE.

[3] Gauta G., Cho S., Jung K., and Lee J. Y., (2015), The Energy Efficiency of Improved Routing Technique Based on The LEACH, International Journal of Internet, Broadcasting and Communication, 7(1), 49-56.

[4] Guy C., (2006, October), Wireless sensor networks, In Sixth International Symposium on Instrumentation and Control Technology: Signal Analysis, Measurement Theory, Photo-Electronic Technology, and Artificial

Intelligence (Vol. 6357, p. 63571I), International Society for Optics and Photonics.

[5] Wang W., Jantsch A., and Cai K., The impact of cluster head locations on total hop counts [A], In IEEE Beijing Section: 2nd International Conference on Sensor Networks and Applications (pp. 141-146), Beijing.

[6] Wang W., and Jantsch, A., (2006, July), An algorithm for electing cluster heads based on maximum residual energy, In Proceedings of the 2006 international conference on Wireless communications and mobile computing (pp. 1465-1470), ACM.

[7] Baoxia, S., (2007), Cluster-head Election Algorithm Based on Residual Energy (Doctoral dissertation, Master thesis, South China Agricultural University, 2007: 40-63).

[8] Goyal D., and Tripathy M. R., (2012, January), Routing protocols in wireless sensor networks: a survey, In Advanced Computing and Communication Technologies (ACCT), 2012 Second International Conference on (pp. 474-480), IEEE.

[9] Heinzelman W. B., Chandrakasan A. P., and Balakrishnan, H., (2002), An application-specific protocol architecture for wireless microsensor networks, IEEE Transactions on wireless communications, 1(4), 660-670.