To increase the performance of Low Energy Adaptive Clustering Hierarchy Protocol using cluster technique in Wireless Microsensor Network

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Abstract

Clustering provides a very effective method for prolonging the lifetime of a wireless micro sensor network. Current clustering algorithms usually utilize two techniques; selecting cluster heads with more residual energy, and rotating cluster heads periodically to distribute the energy consumption among nodes in each cluster and extend the network lifetime. This type of network consist the hot spot problem in the sensor network. When cluster heads cooperate with each other to forward their data to the base station, the cluster heads closer to the base station are burdened with heavier relay traffic and tend to die much faster, causing network partitions and leaving areas of the network uncovered. To mitigate the hot spot problem, we propose an Unequal Cluster-based Routing (UCR) protocol. It groups the nodes into clusters of unequal sizes. Cluster heads are very close to the base station network that has the smaller cluster size than those farther from the base station, thus they can preserve some energy for the inter-cluster data forwarding. A greedy geographic and energy-aware routing protocol is designed for the inter-cluster communication, which considers the tradeoff between the energy cost of relay paths and the residual energy of relay nodes. Simulation results show that UCR mitigates the hot spot problem and achieves an obvious improvement on the network lifetime. In recent years, there has been a marked increase in the use of wireless sensor networks in various environments such as crisis areas, military operations, and monitoring systems. These networks do not use a fixed network infrastructure and therefore they are a popular choice for highly dynamic environments. One of the main concerns in these networks is the topology management issue, which the clustering method is a subfield for that. The main objective of clustering methods is optimizing the energy consumption. This paper analyze the new clustering protocol scheme that uses the many parameters such as local and general state of nodes, the activity history of each node, and their resources condition to determine the best cluster heads and members of eachcluster that can increase the network lifetime, fair resource consumption and network coverage. Hierarchical architecture is an effective scheme to make wireless sensor networks (WSNs) scalable and energy-efficient. Clustering the sensor nodes is a well-known two-layered architecture suitable for WSNs and has been extensively explored for different purposes and applications. In this paper thwere is following scheme that has the very important role for communication that is novel clustering scheme called the adaptive competition-based clustering approach (ACCA) is analyzed forWSNs. Selecting the cluster heads in the proposed ACCA is performed based upon a hybrid of local competition and the distances among the cluster heads.

Index terms*: *Wireless sensor network (WSN), Distributed management

Introduction

Wireless sensor networks (WSNs) are a type of wireless networks that each node collects data from the environment (sensing), process and exchange them with other nodes [1]. The topology of wireless sensor networks can be static or dynamic [2]. When the nodes are fixed, the network has a fixed topology, but in a dynamic network, nodes usually change their location during the network lifetime that will change the topology. In our proposed method, network nodes have been assumed static. As described in [1], one of themost important advantages of wireless sensor networks is the lack of the fixed infrastructure. This advantage enables users to set up these networks in critical environments such as military environments or natural disasters. Lacking of the fixed infrastructure is as much an advantage, it can be a disadvantage. It can complicate the network management and make it

impossible to achieve a better performance by using a central management system [3]. Resource management is one of the most significant issues in WSNs and energy resources are considered as the most important resource. Each node is powered by a battery which is usually limited and non-rechargeable [4]. In order to increase the network lifetime, power consumption should be minimized. Shahraki et al. [5] show that nodes in WSNs consume their energy resources in 3 ways: (a) collecting data from their environment (b) processing them (c) exchanging information with other nodes. Low-power wireless communication and Rapid technological advances in micro-electro-mechanical systems (MEMS) have enabled the deployment of large scale wireless sensor networks. The potential applications of sensor networks are highly varied, such as environmental monitoring, target tracking, and battlefield surveillance [1, 2]. Sensors technique in such type of network are equipped with data processing, sensing and wireless communication capabilities. Distinguished from traditional wireless networks, sensor networks are characterized by severe power, computation, and memory constraints. Due to limited and non rechargeable energy provision, the energy resource of sensor networks should be managed wisely to extend the lifetime of sensors. Although there is very important thing at which much attention has been paid to low-power hardware design and collaborative signal processing techniques, energy efficient algorithms must be supplied at various networking layers. In addition, it is very important to balance the energy consumption among all sensor nodes to prolong the network lifetime. We assume a network of energy-constrained sensors that are used over a geographic area for monitoring the environment. Each sensor periodically produces information as it monitors its vicinity. This network form the following operation that is transmission of sensed data and systematic gathering to a base station for further processing. In order to achieve high energy efficiency in the network and increase the performance of network scalability, sensor nodes can be organized into clusters. Data collected from sensors are sent to the cluster head first, and then forwarded to the base station. The high density of wireless micro sensor networks need many close sensors to generate the redundant sensed data due to this data aggregation can be used to eliminate the data redundancy and reduce the communication load [3].

Figure 1: Block Diagram of LEACH communication

$$\text{E= Cluster Head (CH)} = \sum_{i=1}^{N} P(t) \ *1$$

Related Work

In the wireless sensor networks routing process has the very important role and very big challenge due to several characteristics that distinguish them from contemporary communication and wireless ad hoc networks [14–16]. The routing protocols are used to mainly due to the energy constrained nature or saving energy of such type of networks [17]. There is following example of routing protocol that is flooding technique in which a given node broadcasts data and controls packets that it has received to the rest of the nodes in the network. This process is applied until when the destination node is reached at final position.. Note that this technique does not take into account the energy constraint imposed by WSNs. As a result, when used for data routing in WSNs, it leads to problems such as implosion and overlap [18, 19]. There is following technique that is, flooding is a blind technique, duplicated packets may keep circulate in the network, and hence sensors will receive those duplicated packets, causing an implosion problem. Two sensors elements when sense the same sector and broadcast their sensed data at the same time, their neighbors will receive duplicated packets. To overcome the shortcomings of flooding, another technique known as gossiping can be applied [20]. When we talk about the receiving a packet, a sensor would select randomly one of its neighbors and send the packet to it. The same process repeats until all sensors receive this packet. Using gossiping, a given sensor would receive only one copy of a packet being sent. Gossiping tackles have a problem in WSNs that is implosion problem; there is a significant delay for

a packet to reach all sensors in a network. These types of inconveniences are highlighted when the number of nodes in the network increases. The limited energy resources of sensor nodes pose challenging issues on the development of routing protocols for WSN. Introducing clustering into the network's topology reduces the number of transmissions in the network.

Result and Simulation

To analysis the Low Energy Adaptive Clustering Hierarchy Protocol (LEACH) to increase performance of Wireless Microsensors Network, I have used the MATLAB software for increase the performance of the system in the terms of quality, latency, system life time and ease of deployment all these parameters are based upon the dead and alive nodes continuously. The figure 1 shows the all dead and alive nodes in complete geographical region that is divided in many cluster. Figure 2 shows the energy per round of the nodes with all iteration and figure 3 shows the alive nodes only per round with all iteration.

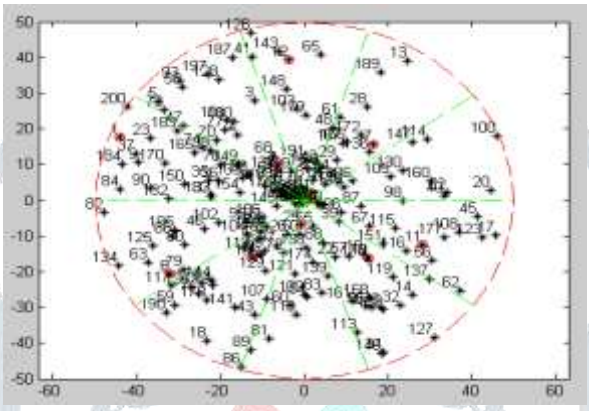

Figure 2: all dead and alive nodes in complete geographical region

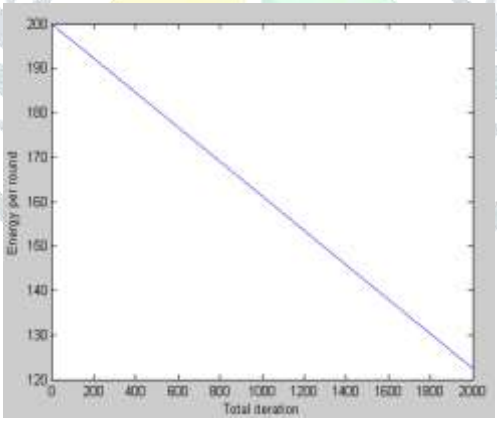

Figure 3: energy per round of the nodes with all iteration

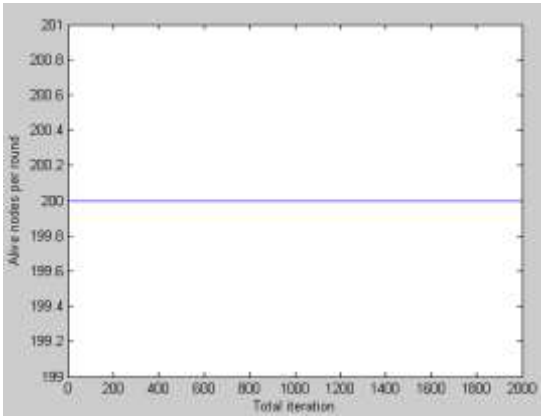

Figure 4: the alive nodes only per round with all iteration

Conclusion

The proposed method in this paper can do a clustering process in WSNs with different densities by using a hierarchical management manner. By providing a suitable clustering process and optimal energy consumption, the proposed method leads to increase the network lifetime. Also, each clustering phase includes a reverse routing, which will reduce extra network overhead and eliminate the routing phase. Different parameters will affect different decisions which enable the clustering process to adjust them based on the network and the environmental situation and eliminate the dependence on the type of network application. Finally, the proposed method can be a good choice for clustering in different environments, because of its easy set-up and low overheads (1 broadcast packet + 1 packet for being a member and 2 packets for choosing a node as a CH). This enables the easy set-up and reduces the needs for high processing power and complex hardware for difficult mathematical computations. Optimal reverse routing and congestion control by the HDMC method have been considered as future works. Also by considering that the values of different parameters are fixed during the network lifetime, a dynamic method that can assign different values based on the environment is a way to improve the proposed method. In addition, manipulating our method to support mobile nodes and changing their CHs in a dynamic manner can be considered as a future work.

References

1. P. Agarwal and C. Procopiuc, “Exact and approximation algorithms for clustering,” in Proc. 9th Annu. ACM-SIAM Symp. Discrete Algorithms, Baltimore, MD, Jan. 1999, pp. 658–667.

2. J. Agre and L. Clare, “An integrated architecture for cooperative sensing networks,” IEEE Computer, vol. 33, pp. 106–108, May 2000.

3. D. Baker, A. Ephremides, and J. Flynn, “The design and simulation of a mobile radio network with distributed control,” IEEE J. Select. Areas Commun., vol. SAC–2, pp. 226–237, Jan. 1984.

4. Chandrakasan, R. Amirtharajah, S.-H. Cho, J. Goodman, G. Kon-duri, J. Kulik, W. Rabiner, and A. Wang, “Design considerations for distributed microsensor systems,” in Proc. IEEE Custom Integrated Cir-cuits Conf. (CICC), San Diego, CA, May 1999, pp. 279–286.

5. L. Clare, G. Pottie, and J. Agre, “Self-organizing distributed sensor net-works,” in Proc. SPIE Conf. Unattended Ground Sensor Technologies and Applications, vol. 3713, Orlando, FL, Apr. 1999, pp. 229–237.

6. M. Dong, K. Yung, and W. Kaiser, "Low power signal processing architectures for network microsensors," in Proc. Int. Symp. Low Power Electronics and Design, Monterey, CA, Aug. 1997, pp. 173–177.

7. D. Estrin, R. Govindan, J. Heidemann, and S. Kumar, "Next century challenges: Scalable coordination in sensor networks," in Proc. 5th Annual ACM International conference Mobile Computing Networking (MobiCom), Seattle, WA, Aug. 1999, pp. 263–270.

8. M. Ettus, "System capacity, latency, and power consumption in multihop-routed SS-CDMA wireless networks," in Proc. Radio and Wireless Conf. (RAWCON), Colorado Springs, CO, Aug. 1998, pp. 55–58.

9. D. Hall, Mathematical Techniques in Multisensor Data Fusion. Boston, MA: Artech House, 1992.

10. W. Heinzelman, "Application-specific protocol architectures for wire-less networks," Ph.D. dissertation, Mass. Inst. Technol., Cambridge, 2000.

11. Xin Guan, L. Guan, X.G.Wang, Tomoaki Ohtsuki "A new load balancing and data collection algorithm for energy saving in wireless sensor networks" Published online: 5 February 2010 © Springer Science Business Media, LLC 2010

12. Nidal Nasser, Anwar Al-Yatama, Kassem Saleh "Zone-based routing protocol with mobility consideration for wireless sensor networks" Published online: 8 March 2012 © Springer Science Business Media, LLC 2012

13. Getsy S Sara, D. Sridharan "Routing in mobile wireless sensor network: a survey" Published online: 3 August 2013 © Springer Science, Business Media New York 2013

14. Fuad Bajaber, Irfan Awan "An efficient cluster-based communication protocol for wireless sensor networks" Published online: 8 August 2013 © Springer Science, Business Media New York 2013

15. Martha Montes-de-Oca, Javier Gomez, Miguel Lopez-Guerrero "DISAGREE: disagreement-based querying in wireless sensor Networks" Published online: 30 August 2013 © Springer Science, Business Media New York 2013

16. M. Guerroumi, N. Badache, S. Moussaoui "Mobile sink and power management for efficient data dissemination in wireless sensor networks" Published online: 27 November 2014 © Springer Science, Business Media New York 2014

17. Sudhanshu Tyagi, Sudeep Tanwar, Sumit Kumar Gupta, Neeraj Kumar, Joel J. P. C. Rodrigues "A lifetime extended multi-levels heterogeneous routing protocol for wireless sensor networks" Published online: 22 January 2015 © Springer Science, Business Media New York 2015

18. Majid Hatamian, Hamid Barati1, Ali Movaghar, Alireza Naghizadeh "CGC: centralized genetic-based clustering protocol for wireless sensor networks using onion approach" Published online: 22 October 2015 © Springer Science, Business Media New York 2015

19. Mehdi Afsar, Mohammad-H. Tayarani-N. Mehdi Aziz "An adaptive competition-based clustering approach for wireless sensor networks" Published online: 27 February 2015 © Springer Science and Business Media New York 2015

20. Amin Shahraki, Marjan Kuchaki Rafsanjani, Arsham Borumand Saeid "Hierarchical distributed management clustering protocol for wireless sensor networks" © Springer Science, Business Media New York 2016

21. Guihai Chen, Chengfa Li, Mao Ye, JieWu "An unequal cluster-based routing protocol in wireless sensor networks" C _ Springer Science and Business Media, LLC 2007

22. Dervis Karaboga, Selcuk Okdem, Celal Ozturk "Cluster based wireless sensor network routing using artificial bee colony algorithm" Published online: 24 April 2012, Springer Science and Business Media, LLC 2012

23. Mustafa Al-Shawaqfeh ,Ahmad Abu-El-Haija, Mohammad J. Abdel Rahman "Collision avoidance slot allocation scheme for multi-cluster wireless sensor networks" Published online: 5 December 2012, Springer Science and Business Media New York 2012

24. Ren-Cheng Jin, Teng Gao, Jin-Yan Song ,Ji-Yan Zou • Li-Ding Wang "Passive cluster-based multipath routing protocol for wireless sensor networks" Published online: 29 March 2013 _ Springer Science and Business Media New York 2013

25. Hooman Ghaffarzadeh, Ali Doustmohammadi "Two-phase data traffic optimization of wireless sensor networks for prolonging network lifetime" Published online: 25 August 2013 _ Springer Science and Business Media New York 2013

26. Ahmed Salim, Walid Osamy, Ahmed M. Khedr "IBLEACH: intra-balanced LEACH protocol for wireless sensor Networks"

27. Songhua Hu, Jianghong Han, Xing Wei, Zhen Chen "A multi-hop heterogeneous cluster-based optimization algorithm for wireless sensor networks" Published online: 6 July 2014 _ Springer Science and Business Media New York 2014

28. Payal Khurana Batra, Krishna Kant "LEACH-MAC: a new cluster head selection algorithm for Wireless Sensor Networks" Published online: 26 April 2015 _ Springer Science and Business Media New York 2014

29. Teng Gao ,Jin-Yan Song, Ji-Yan Zou ,Jin-Hua Ding De-Quan Wang, Ren-Cheng Jin "An overview of performance trade-off mechanisms in routing protocol for green wireless sensor networks" Published online: 13 May 2015 _ Springer Science, Business Media New York 2015

30. Khedr, A.M., & Osamy, W. (2011). Effective target tracking mechanism in a self-organizing wireless sensor network. Journal of Parallel an Distributed Computing, 71, 1318–1326.