

Spatial Correlation-Based Clustering in Wireless Sensor Network

Manjeet Singh^{*}, Surender Kumar Soni

Department of Electronics & Communication Engineering, National Institute of Technology, Hamirpur (H.P.), India

Received 23 September 2017; received in revised form 30 November 2017; accepted 03 February 2018

Abstract

The wireless sensor networks generally comprised of a large number of sensors. The sensors are disposable and resource-constrained devices. Despite the significant improvement in battery technology, energy conservation is still an imperative function of wireless sensor networks to prolong the network operational lifetime. In the last decade, the clustering approach is normally employed to extend the network operational lifetime, where aggregated sensed information is sent to the base station. The cluster heads are responsible for managing cluster members, information accumulation, and data transmitting. Therefore, the selection of an efficient cluster is a primary concern in the clustered architecture. This paper proposes a correlation model and a localized clustering approach whose goal is to extend the network operational lifetime using fuzzy logic and spatial correlation characteristics. The fuzzy logic is utilized to key out the cluster heads and spatial correlation characteristics are employed to form clusters of closely located sensors in the observing field. Simulation results demonstrate that a significant improvement in energy efficiency can be attained utilizing the proposed approach as compared to the LEACH, CHEF, and DEC approaches.

Keywords: clustering, fuzzy logic, localized, wireless sensor network, correlation

References

- [1] G. Anatasi, M. Conti, M. D. Francesco, and A. Passarella, "Energy conservation in wireless sensor networks: a survey," *Ad hoc networks*, vol. 7, no. 3, pp. 537-568, May 2009.
- [2] M. Singh and S. Soni, "A comprehensive review of fuzzy-based clustering techniques in wireless sensor networks," *Sensor Review*, vol. 37, no. 3, pp. 289-304, June 2017.
- [3] W. B. Heinzelman, A. P. Chandrakasan, and H. Balakrishnan, "An application-specific protocol architecture for wireless microsensor networks," *IEEE Transactions on Wireless Communications*, vol. 1, no. 4, pp. 660-670, Oct. 2002.
- [4] F. A. Aderohunmu, J. D. Deng, and M. K. Purvis, "A deterministic energy-efficient clustering protocol for wireless sensor networks," *Proc. IEEE Intelligent Sensors Networks and Information Processing*, IEEE Press, Dec. 2011, pp. 341-346.
- [5] S. Shi, X. Liu, and X. Gu, "An energy-efficiency optimized LEACH-C for wireless sensor networks," *Proc. IEEE Communications and Networking*, IEEE Press, Aug. 2012, pp. 487-492.
- [6] I. Gupta, D. Riordan, and S. Sampalli, "Cluster-head election using fuzzy logic for wireless sensor networks," *Proc. IEEE Communication Networks and Services Research*, IEEE Press, May 2005, pp. 255-260.
- [7] J. M. Kim, S. H. Park, Y. J. Han, and T. M. Chung, "CHEF: cluster head election mechanism using fuzzy logic in wireless sensor networks," *Proc. IEEE advanced communication technology*, IEEE Press, Feb. 2008, pp. 654-659.
- [8] T. M. Tashtoush and M. A. Okour, "Fuzzy self-clustering for wireless sensor networks," *Proc. IEEE Embedded and Ubiquitous Computing*, IEEE Press, Dec. 2008, pp. 223-229.
- [9] T. Haider and M. Yusuf, "A fuzzy approach to energy optimized routing for wireless sensor networks," *International Arab Journal of Information Technology*, vol. 6, no. 2, pp. 179-185, Apr. 2009.
- [10] G. Ran, H. Zhang, and S. Gong, "Improving on LEACH protocol of wireless sensor networks using fuzzy logic," *Journal of Information & Computational Science*, vol. 7, no. 3, pp. 767-775, Mar. 2010.

^{*} Corresponding author. E-mail address: manjeet.nith@gmail.com

- [11] Y. Shen and H. Ju, "Energy-efficient cluster-head selection based on a fuzzy expert system in wireless sensor networks," Proc. IEEE/ACM Green Computing and Communications, IEEE Press, Aug. 2011, pp. 110-113.
- [12] E. Saeedian, M. N. Torshiz, M. Jalali, G. Tadayon, and M. M. Tajari, "CFGA: Clustering wireless sensor network using fuzzy logic and genetic algorithm," Proc. IEEE Wireless Communications, Networking, and Mobile Computing, IEEE Press, Sep. 2011, pp. 1-4.
- [13] J. S. Lee and W. L. Cheng, "Fuzzy-logic-based clustering approach for wireless sensor networks using energy prediction," IEEE Sensors Journal, vol. 12, no. 9, pp. 2891-2897, Sep. 2012.
- [14] S. B. Alla SB, A. Ezzati, and A. Mohsen, "Gateway and cluster head election using fuzzy logic in heterogeneous wireless sensor networks," Proc. IEEE Multimedia Computing and Systems, IEEE Press, May 2012, pp. 761-766.
- [15] R. Mhemed, N. Aslam, W. Phillips, and F. Comeau, "An energy-efficient fuzzy logic cluster formation protocol in wireless sensor networks," Procedia Computer Science, vol. 10, pp. 255-262, Dec. 2012.
- [16] D. Izadi, J. Abawajy, and S. Ghanavati, "An alternative clustering scheme in wsn," IEEE Sensors Journal, vol. 15, no. 7, pp. 4148-4155, July 2015.
- [17] A. Devasena and B. Sowmya, "Fuzzy-Based BEENISH Protocol for Wireless Sensor Network," Circuits and Systems, vol. 7, no. 8, pp. 1893-1905, Jun. 2016.
- [18] H. E. Alami and A. Najid, "Energy-efficient fuzzy logic cluster head selection in wireless sensor networks," Proc. IEEE Information Technology for Organizations Development, IEEE Press, Apr. 2016, pp. 1-7.
- [19] R. K. Shakya, Y. N. Singh, and N. K. Verma, "Generic correlation model for wireless sensor network applications," IET Wireless Sensor Systems, vol. 3, no. 4, pp. 266-276, Dec. 2013.
- [20] J. Xu, W. Liu, F. Lang, Y. Zhang, and C. Wang, "Distance measurement model based on RSSI in WSN," Wireless Sensor Network, vol. 2, no. 8, pp. 606-611, Aug. 2010.
- [21] Z. Liu, W. Xing, B. Zeng, Y. Wang, and D. Lu, "Distributed spatial correlation-based clustering for approximate data collection in WSNs," Proc. IEEE International Conference on Advanced Information Networking and Applications (AINA), IEEE Press, Mar 2013, pp. 56-63.
- [22] M. Shen and S. Chen, "Unequal distributed spatial correlation-based tree clustering for approximate data collection," Proc. International Conference on Soft Computing in Information Communication Technology (SCICT), Atlantis Press, May 2014, pp. 93-97.
- [23] H. T. Bhavana and J. K. Murthy, "Spatial correlation based clustering algorithm for random and uniform topology in WSNs," International Journal of Research in Engineering and Technology, vol. 3, no. 6, pp. 83-87, June 2014.
- [24] F. D. Rango, N. Palmieri, and S. Ranieri, "Spatial correlation based Low Energy Aware Clustering (LEACH) in a wireless sensor networks," Advances in Electrical and Electronic Engineering, vol. 13, no. 4, pp. 350-358, 2015.
- [25] G. Pau, "Power consumption reduction for wireless sensor networks using a fuzzy approach," International Journal of Engineering & Technology Innovations, vol. 6, no. 1, pp. 55-67, Jan. 2016.