Clustering Modeling for Making Long Life of Hot Spot Node in WSNs

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1. Introduction

Wireless sensor networks (WSNs) are embedded autonomous sensors used to monitor different aspects of their environment, including both physical and locational parameters. They are used to monitor temperature, pressure and particulate density of air; the triggering of a landslide or the start of a fire; the launch of a chemical or biological agent; vital signs of a patient as part of either ambient or implanted devices; and in many other applications. The sensors used in a WSN are essentially low cost, mass produced, minute modules that typically have low power output and low processing capabilities. They usually have their own embedded operating systems and communicate with each other through specially developed network protocols. The sensors are usually deployed in such a manner that many of them can communicate with a nearby gateway or base station and take part in data communication. They are expected to become an important part of smart environments in the future with diverse industrial, commercial and military applications[1,2].

2. Related works

One of the grade routing protocols widely used for WSNs is the lower energy adaptive clustering hierarchy (LEACH), but it is somewhat faulty and has complex performance parameters. While many modifications have been suggested, two such were energy-LEACH and multihop-LEACH, proposed by Xiangning and Yulin[3]. The LEACH protocol contains algorithms that create distributed, adaptive clusters and repeatedly change the position of the CH. This ensures self-organization of the nodes and prevents rapid energy dissipation in any one of them. The proposed energy-LEACH improved the CH selection process by taking the residual energy of a node as its main parameter and thereby deciding whether it would become a CH or not. The proposed multihop-LEACH protocol attempted to reduce energy consumption by creating an optimum multi-hop path between a BS and many nodes. Simulating their protocols, the authors observed that energy-LEACH resulted in higher residual energies of nodes than LEACH as time progressed. An even higher residual energy state was obtained by using multihop-LEACH. The authors concluded that both their proposed modifications performed better than simple LEACH.

An energy efficient cluster based routing protocol for use in an ad hoc wireless sensor network (WSNs) was presented by Lai, Fan and Lin[4]. Important considerations for WSNs include their area coverage, power consumption, fault tolerance and security. Since WSNs typically have restrictions on power usage and computing capability, they cannot use conventional wireless routing protocols; while many alternatives have been proposed, hierarchical ones have been found to be effective due to their ability to utilize clusters which transmit data to the base station (BS) and thereby reduce power consumption at node level. The cluster heads (CHs) nearer to the station, however, have heavy traffic load and drain faster than those at the periphery. To overcome this difficulty the authors proposed a protocol to reduce the size of CHs nearer to the BS by making the radius of nearby CH smaller and the radius of a more distant CH larger (Lai, Fan and Lin 118). They also proposed increasing network lifetime by allowing the BS to broadcast messages such that it can receive transmissions directly from different hierarchical levels of sensor nodes. They performed simulations and obtained better results than existing protocols such as LEACH, MR-LEACH and BCDCP [5].

One of the characteristics of wireless sensor nodes participating in a network is that these have low power batteries that cannot be replaced easily after deployment. As a result they should have high energy efficiency, and a centralized routing protocol that takes this into account was proposed by Muruganathan, Ma, Bhasin and Fapojuwo[4]. The protocol was named base station controlled dynamic clustering protocol (BCDCP) since it proposed creation of clusters and data routing paths by a high energy BS. In addition the BS also attempted to minimize energy consumption of the sensors by randomly rotating the CHs, as well as by performing cluster setup, CH selection and other computationally difficult tasks. The BCDCP protocol created balanced clusters in which each CH was allocated a uniform number of nodes and transmitted data to the BS through CH-to-CH routing. It had two key elements, the sensor nodes and the BS; the former could function either as a CH or as a relaying sensor. Using MATLAB to simulate their protocol, the authors obtained better performance than other protocols such as LEACH and PEGASUS. They also observed that BCDCP performed better as the sensor network area was increased.

3. Modeling method of clustering technique for hot spot nodes

WSN network are employed in data collection within a given physical environment. WSN are employed in different fields. The idea in this proposal is to balance network consumption in WSNs; this can be achieved by reducing the energy consumed by HSN die through new clustering techniques within the WSN. In a WSN, energy consumption is critical, it is important to create a means of minimizing energy consumption within a WSN by employing effective clustering techniques.

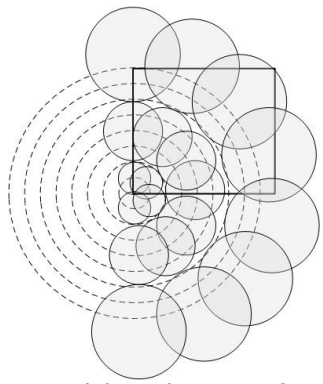

Figure 1. Modeling clustering for HSN

Typically, optimal cluster size depends on the correlation amount of data originating from the source; correlation is depicted by © . Correlation is high in sensor nodes close to each other and decreases as nodes separation increase. After achieving optimal clustering from correlation, aggregation is done for nodes within a cluster before being routed to the sink. The metrics for evaluation of the scheme is as follows: Es© is the energy cost (in bit-hops), this is for cluster size (s) and correlation © . Size sopt© is the optimal cluster that reduces cost for © given. As a result, the optimal energy is represented as E_(c) = Esopt © . NB: Es© is the energy cost presented in bit-hops and © is the correlation. The rationale for this equation is to show the existing optimal energy that provides the basis for modification of network elements. The aim of this research is to propose clustering relationship techniques of WSN in order to reduce energy consumption in HSN, this will be achieved by varying element within a cluster and defining new relationship of hot spot nodes within a cluster. By doing so, the WSN efficiency will be improved because the energy used within the WSN network will be reduced while aggregation and transmission will not be compromised.

4. Conclusion

WSNs are expected to become an integral part of future communication networks, but they have their power and processing limitations. Due to this researchers are actively developing communication standards and protocols that can perform within their hardware imposed limitations and yet take full advantage of their potential. It is expected that recent developments, such as cluster based routing protocols, will allow network designers to efficiently utilize WSNs and improve end-user experience. This research will focus on exploring and elaborating clustering techniques that can improve WSN. HSN as an important part of WSN should also be improved in order to foster energy efficiency.

5. Reference

[1] Winkler, M. et al. “Theoretical and practical aspects of military wireless sensor networks”, Journal of Telecommunications and Information Technology, 2008, pp. 37-45

[2] Mainetti, L., Patrono, L. and Vilei, A. “Evolution of wireless sensor networks towards the Internet of Things: A survey.” In 19th International Conference on Software, Telecommunications and Computer Networks SoftCOM, 2011. pp. 1-6.

[3] Xiangning, Fan and Song Yulin. “Improvement on LEACH Protocol of Wireless Sensor Network.” In International Conference on Sensor Technologies and Applications, SensorComm, Valencia, 2007, pp. 260-264.

[4] Lai, Wei Kuang, Chung Shuo Fan and Lin Yan Lin. “Arranging cluster sizes and transmission ranges for wireless sensor networks.” Information Sciences, 2012. pp.117–131.

[5] Muruganathan, Siva D., Daniel C. F. Ma, Rolly I. Bhasin and Abraham O. Fapojuwo. “A Centralized Energy-Efficient Routing Protocol for Wireless Sensor Networks”, IEEE Radio Communications, 2005, pp.S8-S13.