Indonesian Journal of Electrical Engineering and Computer Science
Vol. 8, No. 3, December 2017, pp. 715 ~ 718
DOI: 10.11591/ijeecs.v8.i3.pp715-718

Tentative Route Selection Approach for Irregular Clustered Wireless Sensor Networks

Mahendra Sharma*, Dr Santhosh Kumar Singh
AMET University, Chennai

Abstract

Wireless Sensor Networks (WSNs) assume a crucial part in the field of mechanization and control where detecting of data is the initial step before any automated job could be performed. So as to encourage such perpetual assignments with less vitality utilization proportion, clustering is consolidated everywhere to upgrade the system lifetime. Unequal Cluster-based Routing (UCR) [7] is a standout amongst the most productive answers for draw out the system lifetime and to take care of the hotspot issue that is generally found in equivalent clustering method. In this paper, we propose Tentative Route (TRS) Selection approach for irregular Clustered Wireless Sensor Networks that facilitates in decision an efficient next relay to send the data cumulative by Cluster Heads to the Base Station. Simulation analysis is achieved using the network simulator to demonstrate the effectiveness of the TRS method.

Keywords*: Clustering, Network Simulation, Routing, WSN*

1. Introduction

Wireless Sensor Network (WSN) consists of sensor nodes that observes physical or conditions for example radiation, temperature, pressure, sound etc. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. Limited processor bandwidth and small memory are two arguable constraints in sensor networks that are almost disappearing with the development of fabrication techniques, whereas the energy constraint is unlikely to be solved soon due to slow progress in developing battery capacity. The untended nature of sensor nodes and hazardous sensing environments preclude battery replacement as a feasible solution.

Number of research work provides only energy efficient results. One such solution is an irregular clustered routing mechanism that is used to form irregular clusters based on competitive communication range. The protocol proposes a mechanism not only to achieve clustering also this protocol send the data aggregated by various clusters to the Base Station (BS) using an Inter-cluster transmission mechanism. However, the efficiency of this transmission system is only in terms of energy efficiency. This means that the other elements of a node that certainly cause interruption or throughput degradation are not measured. In order to resolve the challenges thrown by an irregular clustered network, we propose Tentative Cluster based Routing not only considers the energy but also improve quality of service and network lifetime.

2. Related Work

Energy-efficient communication protocol [1] that utilizes randomized rotation of local cluster based station to distribute the energy load among the sensors in the network. This protocol increases the scalability, robustness also it incorporates data fusion to reduce the amount of information that must be transmitted to the base station. In addition, it increases the network lifetime. Power Efficient Gathering in Sensor Information Systems (PEGASIS) [2] forms chains from sensor nodes so that each node transmits and receives from a neighbor and only one node is selected from that chain to transmit to the sink. The data is gathered and moves from node to node, aggregated and eventually sent to the base station. The chain construction is performed in a greedy way. While, a sensor fails or dies due to low battery power, the chain is

Received August 2, 2017; Revised October 22, 2017; Accepted November 8, 2017

constructed using the same greedy approach by bypassing the failed sensor. Finally, the chain will transmit the aggregated data to the BS, hence minimizing the utilization of energy.

Hybrid Energy-Efficient Distributed Clustering (HEED) [3] operated in multi-hop networks, using an adaptive transmission power in the inter-clustering communication. Periodically selects Cluster Heads (CHs) according to two clustering parameters such as residual energy of each sensor node and node degree. The residual energy parameter is used to select a CHs and node degree is used for breaking ties. The HEED clustering improves network lifetime. Dynamic Minimal Spanning Tree Routing Protocol (DMSTRP) [4] utilized the Minimum Spanning Tree algorithm to replace clubs in two layers of the network such as intra-cluster and inter-cluster. In DMSTRP, energy dissipation of transmitting data is potentially reduced. Also, the transmission collision is alleviated and DMSTRP can achieve shorter delay. However, the transmission schedule creates additional overhead.

Distributed and Effective Cluster Routing Protocol (DECROP) [5] purpose of decreasing the number of control messages, shortening the average end-to-end delay in the network. DECROP consist of three phases such as cluster formation, data transmission and route maintenance. During cluster formation, a cluster is formed concurrently to combined packets from cluster members to the BS. The cluster formation, is finished then it constructed the forwarding path thus reduces both the time waste and overhead. However, the cluster is larger, the energy consumption of the CH is increased another disadvantage is the nodes closer to the BS consume energy faster which reduce the overall network lifespan.

Energy Efficient Homogenous Clustering Algorithm [6] proposed for wireless sensor network that saves power and prolongs network life. The life span of the network is increased by ensuring a homogeneous distribution of nodes in the clusters. In this scheme, CH is selected on the basis of the residual energy of existing cluster heads, holdback value, and nearest hop distance of the node. Further, in the proposed protocol, only cluster heads broadcast cluster formation message and not the every node. Hence, it prolongs the life of the sensor networks. The emphasis of this approach is to increase the life span of the network by ensuring a homogeneous distribution of nodes in the clusters so that there is not too much receiving and transmitting overhead on a CH. Genetic algorithms based enhanced K Strange points clustering algorithm was proposed and described in [8, 9]. Divisive Hierarchical Bisecting descriptive for Min–Max Clustering Algorithm was proposed. It includes irregular clustering algorithm division based on cluster size [10].

3. Proposed Method

Clustering protocol provides an effective technique for extending the network lifetime. In this paper, Tentative Route Selection approach for irregular Clustered WSN is proposed. In TRS, groups the nodes into clusters of unequal sizes. Figure 1 shows that the architecture of TRS scheme.

The initial probability for each node to become a tentative CH depends on its residual energy as well as the final heads are selected according to the intra-cluster communication cost. First, several tentative CHs are randomly selected to compete for final CH. Ordinary nodes become tentative CHs with the same probability which is a predefined threshold. Nodes that fail to be tentative heads keep sleeping until the CH selection stage ends. Each tentative CH has a competition range. Different competition ranges are used to produce clusters of unequal sizes. Only one final CH is allowed in each competition range. Tentative CHs are randomly selected based on their residual energy. Therefore, sensors with low residual energy can still become CHs because it uses the intra-cluster communication cost to select final CHs. This clustering algorithm selecting CHs with highest residual energy as well as rotating CHs sporadically to disseminate the energy utilization among nodes in each cluster thus extend the network lifetime.

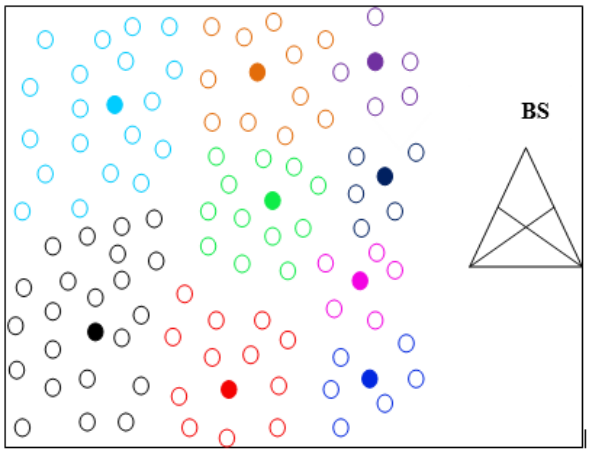

Figure 1. Architecture of TRS

4. Simulation Results

To facilitate that evaluate the efficiency of the TRS with UCR, a thorough analysis and comparison is presented here. To assess the efficiency two simulation experiments were conducted. The simulation parameters used for the simulation analysis are tabulated in table 1.

Table 1. Simulation Parameters of TRS and UCR

Parameter	Value
Channel Type	Wireless Phy
Radio Propagation Model	TwoRayGround
Queue Type	DropTail/PriQueue
Number of nodes	50
Simulation Area	200 X 200sq.m
Initial Energy	1000J
Transmission range	250m
Traffic model	CBR

The network lifetime is received from the simulation analysis of the TRS and UCR schemes. The node energy is plotted against the number of rounds. Figures 2 demonstrate the UCR curves falls after the death of the first few nodes. This is simply owing to the better election of the most appropriate CH as the next hop when data is sent to the BS.

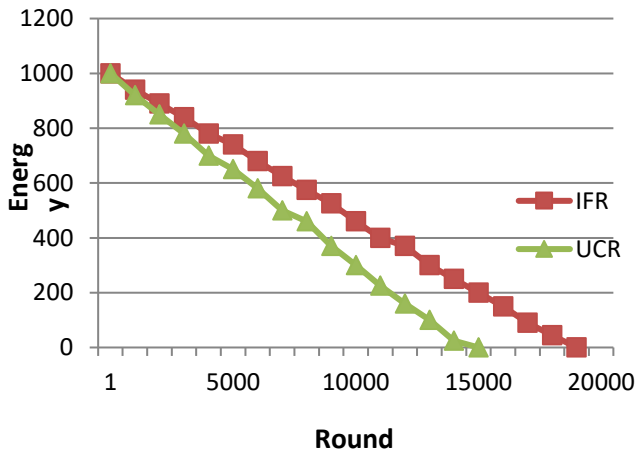

Figure 2. Lifetime of UCR and TRS

5. Conclusion

Wireless Sensor Networks assume a crucial part in the field of mechanization and control where detecting of data is the initial step before any automated job could be performed. Clustering protocol provides an effective technique for extending the WSN lifetime. In TRS, the Tentative CHs are randomly selected based on their residual energy. Therefore, sensors with low residual energy can still become CHs because it uses the intra-cluster communication cost to select final CHs. Simulation results show that TRS clearly improves the network lifetime.

References

[1] Heinzelman B. *Application-Specific Protocol Archi-tectures for Wireless Networks*. PhD thesis, Massachusetts Institute of Technology. 2000.

[2] Lindsey & Raghavendra CS. *PEGASIS: Power-efficient Gathering in Sensor Information System*. Proceedings IEEE Aerospace Conference, Big Sky, MT. 2002; 3: 1125-1130.

[3] Ossama Younis & Sonia Fahmy. Heed: A hybrid, Energy-efficient, Distributed Clustering Approach for Ad-hoc Networks. *IEEE Transactions on Mobile Computing*. 2004; 3(4): 366-369.

[4] Huang G, Li X & He J. *Dynamic minimal spanning tree routing protocol for large wireless sensor networks*. In Proceedings of 1st IEEE Conference on Industrial Electronics and Applications, Singapore. 2006: 1531-1535.

[5] J Chen, Z Yin, D Li and T Sun. A Distributed and Effective Cluster Routing Protocol of Sensor Networks. *2008 First International Conference on Intelligent Networks and Intelligent Systems*, Wuhan. 2008: 271-275.

[6] Singh SK, Singh MP & Singh DK. Energy-efficient homogeneous clustering algorithm for wireless sensor network. *International Journal of Wireless & Mobile Networks (IJWMN)*. 2010; 2(3): 49-61.

[7] Chen G, Li C, Ye M and Wu J. An unequal cluster-based routing protocol in wireless sensor networks. *Wireless Networks*. 2009; 15(2).

[8] Johnson T and Singh SK. Genetic algorithms based enhanced K Strange points clustering algorithm. In 2015 International Conference on Computing and Network Communications (CoCoNet), *IEEE*. 2015: 737-741.

[9] Johnson T and Singh SK. K-strange points clustering algorithm. In *Computational Intelligence in Data Mining*. Springer India. 2015; 1: 415-425.

[10] Johnson T and Singh SK. *Divisive Hierarchical Bisecting Min–Max Clustering Algorithm*. In Proceedings of the International Conference on Data Engineering and Communication Technology. Springer Singapore. 2017: 579-592.