Energy Efficient Cluster Algorithms for LEACH Based Wireless Sensor Network

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ABSTRACT

Wireless sensor networks (WSNs) have a broad series of applicability in many engineering and civilian applications such as industrial process monitoring and control, machine health monitoring, home automation, health care applications, nuclear reactor control, fire detection, object tracking and traffic control. A WSN have spatially distributed self-directed sensors those supportively observe the physical or environmental conditions including temperature, vibration, motion, pressure or pollutants. In sensor networks where the environment is needed to be distantly monitored, the data is directed to a central base station (often located far from the network) from the individual sensor nodes, through which the end-user can access data. A number of routing protocols for WSN are designed in this context. Energy utilization and network life time are key issues in design of routing protocols for Wireless sensor network. Many algorithms have been proposed for reducing energy consumption and to enhance network life time of the WSN. Clustering algorithms have received gained attention in this field, because of their approach in cluster head selection and data aggregation. LEACH (distributed) is one of the first clustering routing protocol which is better compared to other such algorithms. TL-LEACH is one of the descendants of LEACH that keeps better the energy consumption by building a two-level hierarchy. In that context they used random rotation of local cluster base stations (primary cluster-heads and secondary cluster-heads) to better dispense the energy load amid the sensors in the network especially when the network density higher. In LEACH and TL-LEACH the clusters are adaptive, hence poor clustering set-up during a round will affect the performance. However, In order to produce better clusters, a central control scheme for cluster is used which is allotting the cluster head nodes throughout the network. LEACH-C (centralized) is another modification to LEACH that realizes the above idea and provides better results through uniform distribution of cluster heads avoiding redundant creation of cluster heads in a small area.

Herein, we have proposed a centralized multilevel scheme called CML-LEACH for energy efficient clustering that adopt random distribution of sensor nodes which are not mobile. The present scheme combine the idea of multilevel hierarchy, where the central control algorithm providing uniform dispersal of cluster heads throughout the network. As compared to LEACH, TL-LEACH and LEACH-C this scheme reduces energy consumption and enhance network life time significantly. The simulation results indicate the comparisons of our scheme with the existing LEACH, TL-LEACH and LEACH-C protocols against chosen performance metrics, using OMNET++.

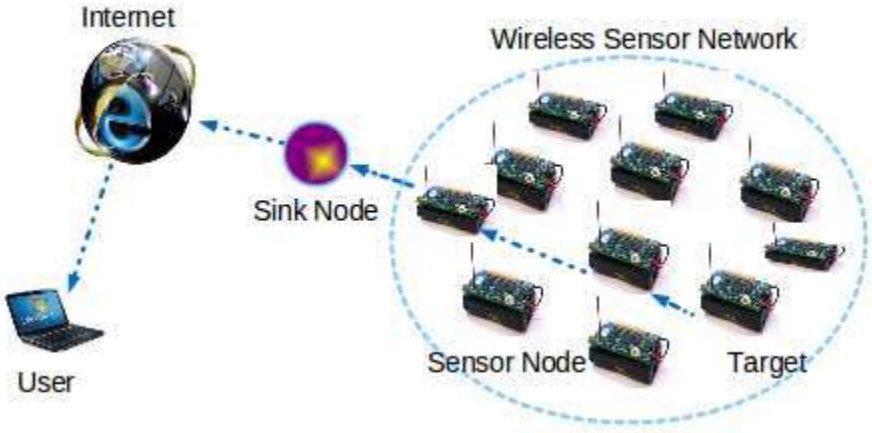
Key Words- Wireless sensors network, LEACH, Sensor node

I. INTRODUCTION

With the advancement in micro-fabrication technology, Wireless Sensor Networks (WSNs) have started to play a vital role in our daily lives. It is because of the reduction in cost of the sensor nodes, leading to increasing deployments of WSNs to a larger extent. Potential applications for wireless sensor networks exist in a variety of fields, including industrial process monitoring and control, environment and habitat monitoring, machine health monitoring, home automation, health care applications, fire detection, object tracking and traffic control. Effective design and execution of wireless sensor networks have become a renowned area of research in recent years, due to the enormous capacity of sensor networks to assist applications connecting the physical world with the virtual world. It is possible to obtain data about physical or environmental phenomena by net- working large number of tiny sensor nodes that was difficult or impossible to obtain in more conventional ways.

Wireless Sensor Network

A wireless sensor network contains of spatially distributed autonomous sensors those supportively observe the physical or environmental conditions such as temperature, sound, vibration, or pollutants. The WSN is made up of "nodes"- from a few to several hundreds or even thousands, where each node is associated to one (or sometimes several) sensors. A structure of a WSN is shown in Figure 1.1.



In sensor networks where the environment is required to be remotely monitored, the data from the individual sensor nodes is directed to a central base station (often located far from the network), through which the end-user can access data. The main characteristics of WSNs include .Ease of use. Ability to cope with node failures .Communication failures. Scalability to large scale deployment. Power consumption constrains for nodes that use batteries or Energy harvesting .Ability to cooperate with harsh environmental conditions, etc.

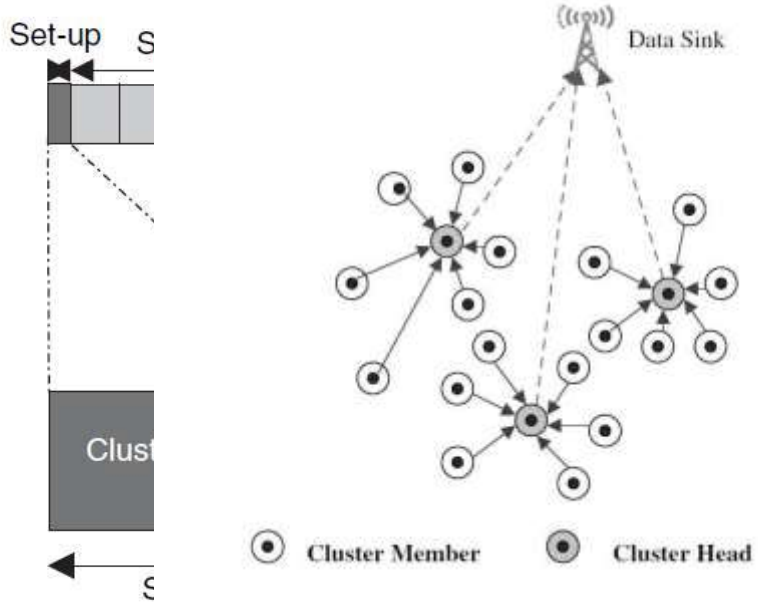
II. LITERATURE REVIEW

LEACH (Low-Energy Adaptive Clustering Hierarchy) is the first clustering routing protocol which is proven to be better compared to other clustering algorithms. It is a dispersed clustering algorithm, first proposed in 2000 by W. R.

Heinzelman et al. [7]. The authors have proposed a ordered adaptive method in which CHs are chosen with a random probability independent of others to organize the nodes into clusters. TL-LEACH is one of the descendants of LEACH proposed by V. Loscri et al. in the year 2005 [8], which introduce a two level hierarchy for cluster formation. In that context, they used random rotation of local cluster base stations (primary cluster-heads and secondary cluster-heads) to better dispense the energy load among the sensors in the network, especially when the density of network is higher. In LEACH and TL-LEACH the clusters are adaptive, hence poor clustering set-up during a round will affect the performance. However, by using a central control scheme for cluster set-up may produce better clusters by distributing the cluster head nodes throughout the network. In 2007 Taewook Kang et al. [9] proposed a centralized clustering algorithm, LEACH-C that realizes the above idea and provides better results through uniform distribution of CHs avoiding their redundant creation of in a small area.

III. LEACH

The main purpose of LEACH, was to find a way to low utilization of energy in the cluster and to enhance the life time of WSN. LEACH adopts a hierarchical and adaptive approach to organize the network into a set of clusters, managed by selected CHs. The CH brings out multiple tasks, such as collect of data from the members of the cluster, collection of data to remove redundancy among correlated values, broadcast of the collected data directly to the base station through a single hop method, creation and advertisement of a TDMA schedule. In the schedule created by the CH, each node of the cluster is allotted a time slot that can be used by non-CH nodes for broadcast. The CHs transmission the schedule to their corresponding cluster members. For reducing the probability of collisions among sensor nodes, LEACH nodes use a code division multiple accesses (CDMA) based scheme for communication. The network model used by LEACH is depicted in Figure 2.1.



3.1 Operations of LEACH

The basic operation of LEACH comprises of many rounds, each round being subdivided into two phases. The phases of LEACH are illustrated in Figure 2.2. The first phase named as the setup phase and it consists of three steps,

(i) Cluster-head advertisement,

(ii) Cluster set-up and

(iii) Transmission schedule creation.

The second phase, the steady-state phase, attetion on,

(i) Data transmission to cluster heads,

(ii) Signal processing (data aggregation/fusion) and

(iii) Delivery to the base station.

To minimize the protocol overhead, the period of the setup phase is supposed to be relatively shorter than the steady-state phase.

IV.EXPECTED RESULT

Primary and secondary CHs are evenly distributed throughout the network and numbers of CHs formed in each round are almost uniform. In this way each node gets enough TDMA slots to transfer, hence improving the number of data signals received at BS.

REFERENCES:

[1] L.J.G. Villalba, A.L.S. Orozco, A.T. Cabrera, and C.J.B. Abbas. Routing protocols in wireless sensor networks. *Sensors*, 9(11):8399–8421, 2009.

[2] S. K. Singh, M. P. Singh, and D. K. Singh. Routing protocols in wireless sensor networks- a survey. *International Journal of Computer Science & Engineering Survey*, 1:63–83, 2010.

[3] Chao SHA, Ru chuan WANG, Hai ping HUANG, and Li juan SUN. Energy efficient clustering algorithm for data aggregation in wireless sensor networks. *The Journal of China Universities of Posts and Telecommunications*, 17, Supplement 2(0):104 – 122, 2010.

[4] D.J. Dechene, A.E.Jardali, and M.L.A. Sauer. *A Survey of Clustering Algorithms for Wireless Sensor Networks, Computer Communications*. Butterworth-Heinemann Newton, MA USA, 2007.

[5] Suchismita Chinara and Santanu Kumar Rath. A survey on one-hop clustering algorithms in mobile ad hoc networks. *Journal of Network and Systems Management*, 17(1-2):183–207, 2009.

[6] V. Geetha, P.V. Kallapur, and S. Tellajeera. Clustering in wireless sensor networks: Performance comparison of leach & leach-c protocols using {NS2}. *Procedia Technology*, 4(0):163 – 170, 2012.

[7] W.R. Heinzelman, A.P. Chandrakasan, and H. Balakrishnan. Energy-efficient communication protocol for wireless microsensor networks. In *Proceedings of the 33rd Hawaii International Conference on System Sciences*, volume 8, pages 8020–8029, Washington, DC, USA, 2000. IEEE Computer Society.

[8] V. Loscri, G. Morabito, and S.Marano. A two-levels hierarchy for low-energy adaptive clustering hierarchy (tl-leach). In *Vehicular Technology Conference. 2005 IEEE 62nd*, volume 3, pages 1809–1813, 2005.

[9] Taewook Kang, Jangkyu Yun, Hoseung Lee, Icksoo Lee, Hyunsook Kim, Byunghwa Lee, Byeongjik Lee, and Kijun Han. A clustering method for energy efficient routing in wireless sensor networks. In *Proceedings of the 6th WSEAS International Conference on Electronics, Hardware, Wireless and Optical Communications*, EHAC'07, pages 133–138, Stevens Point, Wisconsin, USA, 2007. World Scientific and Engineering Academy and Society (WSEAS).

[10] K. Sohraby, D. Minoli, and T. Znati. *Wireless Sensor Networks: Technology, Protocols, and Applications*. Wiley, 2007.