International Journal of Recent Trends in Engineering & Research
ISSN (ONLINE) : 2455 – 1457
IMPACT FACTOR : 4.101

A Survey on LEACH Protocols in Wireless Sensor Networks

Shreshtha Shrivastava
Computer Science & Engineering

Abstract- Wireless sensor networks (WSNs) have attracted significant attention over the past few years, and can be employed in a wide spectrum of applications in both civilian and military scenarios. The design of effective, robust, and scalable routing protocols for WSNs is a challenging task. On the other hand, clustering routing algorithms, generally, can well match the constraints and the challenges of WSNs. As a result, it is clearly seen so far that, significant efforts have been made in addressing the techniques to design effective and efficient clustering routing protocols for WSNs in the past few years. In this paper, taking into account the shortcomings of wireless sensor networks, LEACH algorithm, the algorithm has been improved on this basis. The design of the E-LEACH algorithm, which extend the network lifetime, improve node energy utilization, and the effectiveness of this algorithm through simulation experiments.

Keywords- Low-Energy Adaptive Clustering Hierarchy (LEACH); Wireless sensor networks (WSN); routing protocols

I. INTRODUCTION

In recent years, Wireless sensor networks came into being due to the rapid development of wireless technology, computer technology and sensor technology and Rapid integration. Wireless sensor network technology as a new type of network technology by researchers' widespread attention and extensive research. There are also some disadvantages inherent in the sensor network, such as: energy low utilization, short life cycle, poor anti-interference ability. Good clustering algorithm can not only reduce the energy consumption of the sensor nodes, can also reduce communication interference, improve the efficiency of the MAC and routing protocols. Therefore, it is proposed that a highly efficient and stable rational algorithm has become an urgent need to solve the problem. In this paper, considering the residual energy for each node, a more efficient, more reasonably low overhead adaptive layered E-LEACH algorithm based on LEACH algorithm.

II. WSN NODE STRUCTURE

In wireless sensor networks, most important, the most fundamental component of the sensor nodes, these sensor nodes have low cost, small size, low power consumption and short-distance wireless communication characteristics. Monitoring of the sensing region, the wireless sensor node, simple processing, the data, and then sending or forwarding data, In addition, wireless sensor nodes need to consume a certain amount of energy itself. WSN there are a lot of different, have their own characteristics, but also a lot of the design and realization of the difficulties and problems, compared with the traditional wired network. To act as nodes in WSN in three roles: the role of data acquisition, data transfer station or cluster head node. As data acquisition, data acquisition modules to collect the data of the surrounding environment, directly or indirectly through communication routing protocol to transfer the data to the remote base station; As a data relay station, the nodes in addition to the completion of the data acquisition task, but

also receives the data of the neighbors will be forwarded to the distance of the base station closer to the neighbors or forwarded directly to the base station; As a cluster-head node, the node responsible for collecting the data collected for all nodes within the cluster, and by the fusion of the data sent to the base station. Be seen, the node has an important role in WSN.

III. LEACH ALGORITHM ANALYSIS

The basic idea of the LEACH protocol: “round " concept, The purpose of random selection of the cluster head node through each round of the cycle, and then rotate the cluster head node, so as to achieve balance and reduce energy consumption, extend the lifetime of the network. In LEACH protocol, each round consists of two parts. The first part is to build a cluster stage; the second part is stable session. In practical wireless sensor network, after several rounds of post-election, the residual energy of each node will have a very different, near the cluster head node remaining energy away from the cluster head node residual energy. But traditional LEACH algorithm, all nodes become cluster head node probability is the same. Therefore, if selected after several rounds of data dissemination cluster head away from the base station node, the node's energy will soon be exhausted, and eventually became the failed node. Too many failed node will lead to paralysis of the entire network. In addition, traditional LEACH algorithm, in every round of the initialization phase, the node to be added according to the strength of the broadcast signal of the cluster head section is received, select clusters. However, this solution is not always the optimal solution. Shown in Figure 1 is selected from the first cluster node, A, B, C, D is a base station, E non-first cluster node. Obviously, from the node E, A, C the distance than the distance of the distance B, however, if the E To the data transmitted to the base station D, the optimal cluster head should be selected B. Because both election C or to vote for A, energy consumption of the entire network is greater than B path.

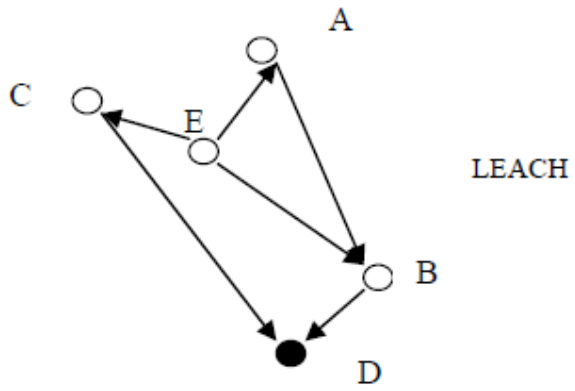

Figure 1 Node locations

IV. RELATED WORK

A survey of state-of-the-art routing techniques for WSNs was presented in [1], whose authors outlined the clustering architecture in WSNs and presented a simple classification based on only three attributes, *i.e.*, parameters used for CH election, whether there exist a centralized control during clustering, and hops between nodes and CH in intra-cluster communication. Furthermore, the survey highlighted the challenges in clustering WSNs and briefly introduced a few clustering routing techniques.

A survey of clustering algorithms for WSNs was presented by Abbasi *et al*. [2]. The authors of that survey presented a taxonomy and classification of typical clustering schemes, then summarized

different clustering algorithms for WSNs based on classification of variable convergence time protocols and constant convergence time algorithms, and highlighted their objectives, features, complexity, *etc*. Finally, these clustering approaches were compared based on a few metrics such as convergence rate, cluster stability, cluster overlapping, location-awareness and support for node mobility.

Arboleda *et al*. [3] presented a comparison survey between different clustering protocols. The authors of the survey discussed some basic concepts related to the clustering process, such as cluster structure, cluster types, clustering advantages, and briefly analyzed LEACH-based protocols as well as proactive and reactive algorithms in WSNs. The main characteristics of these protocols were compared and the evidences where they can be used currently were outlined.

Kumarawadu *et al*. [4] surveyed the clustering algorithms available for WSNs and classified them based on the cluster formation parameters and CH election criteria. The authors of the survey also studied the key design challenges and discussed the performance issues related clustering protocols based on the classification of identity-based clustering algorithms, neighborhood information based clustering algorithms, probabilistic clustering algorithms and biologically inspired clustering algorithms.

Different clustering schemes are discussed by Deosarkar *et al*. [5], with special emphasis on their CH selection strategies based on the classification of deterministic scheme, adaptive scheme and combined metric scheme. The costs of CH selection were compared with respect to cluster formation, distribution of CHs and creation of clusters. Besides, a need of more scalable, energy efficient and stable clustering scheme for data gathering in WSNs was put forward.

Jiang *et al*. [6] discussed a total of three prominent advantages of clustering methods for WSNs, such as more scalability, less overheads, and easy maintenance, and then present a classification of WSN clustering schemes based on a total of eight clustering attributes. The authors also analyzed altogether six popular WSN clustering algorithms, such as LEACH, PEGASIS, HEED, EEUC, and *etc*., and compared these WSN clustering algorithms, including various attributes.

Maimour *et al*. [7] considered clustering routing protocols to achieve energy efficiency in WSNs and presented a review on clustering algorithms from the perspective of data routing. A simple classification of clustering routing protocols is proposed in the review. Totally nine typical clustering protocols including two classes, pre-established clustering routing algorithms and on-demand clustering routing algorithms, are summarized in respectively. Besides, some future research directions are presented in the review.

The operations of some clustering protocols were discussed in the survey presented in [8], and the advantages and limitations of each one of these algorithms were analyzed in brief. The authors of the survey selected only seven popular clustering algorithms for WSNs, such as LEACH, TL-LEACH, EECS, TEEN, APTEEN, and *etc*. Additionally, the survey compared these clustering protocols in terms of energy consumption and network lifetime.

A survey on clustering algorithms for WSNs was presented by Boyinbode *et al*. [9]. The main challenges for clustering algorithms were discussed and altogether nine popular clustering algorithms for WSNs such as LEACH, TL-LEACH, EECS, HEED, EEUC, *etc*. were simply summarized in the survey. The authors also compared these clustering algorithms based on metrics such as residual energy, uniformity of CH distribution, cluster size, delay, hop distance and cluster formation methodology.

V. CONCLUSIONS

In this paper, we have presented a rather extensive survey on clustering routing protocols in WSNs. We have also developed a novel taxonomy of clustering routing methods for WSNs based on rather detailed clustering attributes. Finally, we have systematically analyzed a few classical WSN

clustering routing protocols in deep, and compared these different approaches based on our taxonomy and some primary metrics.

In this paper, the LEACH algorithm based consider the residual energy of each node in each round inconsistencies, selected path is not the most energy-efficient path and proposed the concept of the energy threshold and distance factor, energy threshold and distance factors to determine the preferred cluster head collection selected on the basis of the cluster head node. Optimization algorithm selected by the head of such a cluster, and extends the network lifetime, improve node energy utilization.

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