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Energy Efficient Clustering Protocol in Wireless Sensor Networks Using Local Cluster Head Selection Techniques

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ABSTRACT: Unequal clustering is an elementary method for manipulative energy-efficient and mountable in distributed sensor networks. Heed* is top most dynamism efficient clustering protocol. By using this protocol, the message overhead is squat and cluster heads are circulated unequally across the entire network. In our distributed clustering protocol, heed*, which improves heed, leach and equal clustering of heed* protocol to realize energy adeptness with three methods: 1. Native clustering, i.e., whenever a cluster head guzzles a constraint part of its energy, it only notifies its participant nodes to hold cluster head designations for the forthcoming curved. Therefore, clustering is performed natively (in difference to performing it universally). 2. Dropping the number of message interactions and each iteration over abolishing redundant cluster head messages. 3. In heed*, each node with radical amount of residual energy is considered more eligible applicant for determination as a cluster overhead. Also, each node discovers a communication cost, and a consistent (non cluster skull) node picks the cluster skull with the lowest communication rate to connect to. Simulation results show that the protocol outstrips heed, leach and equal heed* protocol in standings of network lifetime.

KEYWORDS: - HEED; HEED*; LEACH; Network Lifetime; Sensor Networks; Unequal Clustering; Sensor Networks.

1 INTRODUCTION

Wireless sensor network (WSN) is an emerging technology that has attracted a great deal of research attention due to the extensive ability to monitor and instrument the physical world. A wide-range of potential applications such as environmental monitoring, industrial sensing, infrastructure protection, battlefield awareness etc., can be developed by this network .A wireless sensor network is a collection of nodes organized into a cooperative network. Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips), may contain multiple types of memory (program, data and flash memories), have a RF transceiver (usually with a single omni- directional antenna), have a power source (e.g., batteries and solar cells), and accommodate various sensors and actuators. The nodes communicate wirelessly and often self-organize after being deployed in an ad hoc fashion. Systems of 1000s or even 10,000 nodes are anticipated. Such systems can revolutionize the way we live and work. Currently, wireless sensor networks are beginning to be deployed at an accelerated pace. It is not unreasonable to expect that in 10-15 years that the world will be covered with wireless sensor networks with access to them via the Internet. This can be considered as the Internet becoming a physical network. This new technology is exciting with unlimited potential for numerous application areas including environmental, medical, military, transportation, entertainment, crisis management, homeland defense, and smart spaces. Node localization is the problem of determining the geographical location of each node in the system. Localization is one of the most fundamental and difficult problems that must be solved for WSN. Localization is a function of many parameters and requirements potentially making it very complex.

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For example, issues to consider include: the cost of extra localization hardware, do beacons (nodes which know their locations) exist and if so, how many and what are their communication ranges, what degree of location accuracy is required, is the system indoors/outdoors, is there line of sight among the nodes, is it a 2D or 3D localization problem. Multihop routing is a critical service required for WSN. Because of this, there has been a large amount of work on this topic.

Wireless Sensor Network (WSN) is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. WSNs are basically data gathering networks in which data are highly correlated and the end user needs a high level description of the environment sensed by the nodes. The requirements of these networks are ease of deployment, long system lifetime, and low-latency data transfers. The main task of a sensor node in a sensor field is to detect events, perform quick local data processing, and then to transmit the data. As mentioned in [Distributed clustering in ad-hoc sensor networks: A hybrid, energy-efficient approach and [A survey on routing protocols for wireless sensor networks], nodes have typically low mobility and are limited in capabilities, energy supply and bandwidth. The sensor network should perform for as long as possible. On the other hand, battery recharging may be inconvenient or impossible. Therefore, all aspects of the sensor node, from the hardware to the protocols, must be designed to be extremely energy efficient [An application-specific protocol architecture for wireless micro-sensor networks]. In direct communication WSN, the sensor nodes directly transmit their sensing data to the Base Station (BS) without any coordination between the two. However, in Cluster-based WSNs, the network is divided into clusters. Each sensor node exchanges its information only with its cluster head (CH), which transmits the aggregated information to the BS. Aggregation and fusion of sensor node data at the CHs because a significant reduction in the amount of data sent to the BS and so results in saving both energy and bandwidth resources. On the other hand, clustering is particularly crucial for scaling the network to hundreds or thousands of nodes [Hausdorff Clustering and Minimum Energy Routing for Wireless Sensor Networks]. In many applications, cluster organization is a natural way to group spatially close sensor nodes in order to exploit the correlation and eliminate the redundancy that often shows up in the sensor readings [Cluster head election techniques for coverage preservation in wireless sensor networks]. However, these benefits, compared to those of the direct communication WSN, result in extra overhead due to the cluster formation's message exchanges. This paper proposes an improvement to the HEED clustering protocol. Clustering is a key technique to improve the network lifetime, reduce the energy consumption and increase the scalability of the sensor network. A scalable sensor network is obtained by means of clusters. A cluster head (CH) could be elected or pre-assigned. The clustering that

- Reduces the size of the routing table by localizing the route setup within the cluster.
- Conserves communication bandwidth
- Prolonged battery life of individual sensor
- No topology maintenance overhead
- Reduce rate of energy consumption

In order to achieve high energy efficiency and assure long network lifetime, sensor nodes can be organized hierarchically by grouping them into clusters. In clustered sensor networks, the sensor nodes do not transmit their collected data to base station (BS), but to designated cluster heads which aggregate the data packet and send them directly or via multi-hop communication to BS. For directly communication, the modes furthest away from the BS are the most critical nodes, while in multi-hop communication; the nodes closest to the BS are burdened with a heavy relay traffic load and die first.

The cluster head role is usually periodically rotated among the nodes to balance the load. Although rotating the cluster head role ensures that sensors consume energy more uniformly, the hot spot problem described above cannot be completely avoided. Thus, choosing the appropriate sizes and number of clusters is essential for the performance of the network lifetime. The cluster's radius is too large, it will host many nodes and a lot of energy is wasted due to inter-cluster collisions. On the other hand, if the radius is too small, a large number of clusters is required to cover the observation area and many of them will have to transmit their data over a large distance to sink.

As one possible solution to this problem is Unequal Clustering Method (UCM). Many routing protocols are developed, but among those protocols unequal clustering method is energy efficient, scalable and prolongs the network lifetime. we analyze an approach where the network is organized into cluster of different sizes. Cluster heads closer to the BS should support greater cluster sizes because of lower energy consumption during sending data packets to the BS. The bigger clusters should be closer to the BS. The clusters radius should increase as its distance to the BS decreases.

2 RELATED WORK

Wireless Sensor Network (WSN) is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. Clustering is one technique that can be used to extend the lifetime of sensor networks by grouping sensors together. But, there exists the hot spot problem which causes unbalanced energy consumption in equally formed clusters. In this paper, we propose UHEED, an unequal clustering algorithm which mitigates this problem and which leads to a more uniform residual energy in the network and improves the network lifetime. clustering algorithms usually utilize two techniques; selecting cluster heads with more residual energy, and rotating cluster heads periodically to distribute the energy consumption among nodes in each cluster and extend the network lifetime. but, they rarely consider the hot spot problem in multi-hop sensor networks. When cluster heads cooperate with each other to forward their data to the base station, the cluster heads closer to the base station are burdened with heavier relay traffic and tend to die much faster, leaving areas of the network uncovered and causing network partitions. To mitigate the hot spot problem, we propose an Unequal Cluster-based Routing (UCR) protocol. It groups the nodes into clusters of unequal sizes. Cluster heads closer to the base station have smaller cluster sizes than those farther from the base station, thus they can preserve some energy for the inter-cluster data forwarding. A greedy geographic and energy-aware routing protocol is designed for the inter-cluster communication. When cluster heads cooperate with each other to forward their data to the base station, the cluster heads closer to the base station are burdened with heavy relay traffic and tend to die early, leaving areas of the network uncovered and causing network partition. To address the problem, we propose an Energy-Efficient Unequal Clustering (EEUC) mechanism for periodical data gathering in wireless sensor networks. It partitions the nodes into clusters of unequal size, and clusters closer to the base station have smaller sizes than those farther away from the base station. Thus cluster heads closer to the base station can preserve some energy for the inter-cluster data forwarding. We also propose an energy-aware multihop routing protocol for the inter-cluster communication. a novel distributed clustering approach for long-lived ad hoc sensor networks. Our proposed approach does not make any assumptions about the presence of infrastructure or about node capabilities, other than the availability of multiple power levels in sensor nodes. We present a protocol, HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. HEED terminates in O(1) iterations, incurs low message overhead, and achieves fairly uniform cluster head distribution across the network. We prove that, with appropriate bounds on node density and intra-cluster and inter-cluster transmission ranges; HEED can asymptotically almost surely guarantee connectivity of clustered networks. Simulation results demonstrate that our proposed approach is effective in prolonging the network lifetime and supporting scalable data aggregation. A wireless network consisting of a large number of small sensors with low-power transceivers can be an effective tool for gathering data in a variety of environments. The data collected by each sensor is communicated through the network to a single processing center that uses all reported data to determine characteristics of the environment or detect an event. The communication or message passing process must be designed to conserve the limited energy resources of the sensors. The large-scale deployment of wireless sensor networks (WSNs) and the need for data aggregation necessitate efficient organization of the network topology for the purpose of balancing the load and prolonging the network lifetime, LEACH (Low-Energy Adaptive clustering Hierarchy), a clustering-based protocol that utilizes randomized rotation of Cluster-Heads (CHs) to evenly distribute the energy among the sensors in the network. But LEACH cannot select CHs uniformly throughout the network. Therefore there is the possibility that the elected CHs will be concentrated in certain area of the network. Hence, some nodes will not have any CHs in their vicinity. LEACH is a cluster-based protocol. LEACH is one of the first hierarchical routing approaches for sensors networks. LEACHES randomly selects a few sensor nodes as cluster heads (CHs) and rotate this role to evenly distribute the energy load among the sensors in the network. In LEACH, the cluster head (CH) nodes compress data arriving from nodes that belong to the respective cluster, and send an aggregated packet to the base station in order to reduce the amount of information that must be transmitted to the base station (negotiation). Wireless sensor networks have led to many new protocols specifically designed for sensor networks where energy awareness is an essential consideration. Most of the attention, however, has been given to the routing protocols since they might differ depending on the application and network architecture [4], data gathering that maximizes lifetime for wireless sensor networks. It involves three parts. First, nodes organize themselves into several static clusters by the Hausdorff clustering algorithm based on location, communication efficiency and network connectivity. Second, clusters are formed only once but the role of cluster-head is optimally scheduled among the cluster members. We formulate the cluster-head scheduling that maximizes the network lifetime as an integer programming problem

3 SYSTEM DESIGN

- Energy Efficiency
- UnCluster Module
- Cluster Head Election
- Energy Consumption
- Comparison Between Heed* with other protocols

3.1 ENERGY EFFICIENCY

Nodes have typically low mobility and are limited in capabilities, energy supply and bandwidth. The sensor network should perform for as long as possible. On the other hand, battery recharging may be inconvenient or impossible. Therefore, all aspects of the sensor node, from the hardware to the protocols, must be designed to be extremely energy efficient. Aggregation and fusion of sensor node data at the CHs cause a significant reduction in the amount of data sent to the BS and so results in saving both energy and bandwidth resources. On the other hand, clustering is particularly crucial for scaling the network to hundreds or thousands of nodes

3.2 UNCLUSTER MODULE

The problem of prolonging the lifetime of a network by determining the optimal cluster size. For a general clustering model, they find the optimal sizes of the cells by which maximum lifetime or minimum energy consumption can be achieved. Based on this result, they propose a location aware hybrid transmission scheme that can further prolong network lifetime. Clustering a wireless sensor network means partitioning nodes into clusters, each one with a cluster head and some. Data is locally collected from the cluster at the cluster heads, there is a potential benefit of compressing the data messages into a packet of smaller size before transmitting it to the BS. Let us assume that a cluster consists of $N_t$nodes and each transmits a data message of length *Len*to the cluster head. The cluster head receives these messages and fuses it together with its own measured data to a single packet.

To improve network lifetime by reducing the number of cluster head elections. It uses a battery depletion ratio to determine when new cluster head elections should occur, providing a balanced distribution of load on nodes in the network. The protocol Simulation results demonstrate that the benefits of unequal HEED* over HEED* and LEACH protocol, in terms of improving network lifetime and energy savings are noticeable.

3.3 CLUSTER HEAD ELECTION

`An improvement to the HEED* and LEACH clustering protocol, called Unequal HEED*, to improve network lifetime by reducing the number of cluster head elections. CH node has dropped by a certain percent. That CH node sends elec-msg to its member, all the nodes in that cluster perform CH election again to find new CH node. Therefore, the CH election is performed locally i.e. all the nodes in the network will not participate in the CH election. The second primary difference is that Unequal HEED* diminishes the messaging overhead, by integrating communication cost value in CH messages. The simulation results by comparing network lifetime, and the number of CH elections with HEED* and LEACH protocol. Finally, the conclusion is presented.

3.4 COMPARISON OF HEED* WITH OTHER PROTOCOLS

The performance of the Unequal HEED* is compared with HEED protocol and LEACH protocol and the results are obtained. The results shows that Unequal HEED * performs extremely well compared to other two protocols. The Energy and nodes lives of the Unequal HEED* is extremely improved. The resulted graphs are given in the paper.

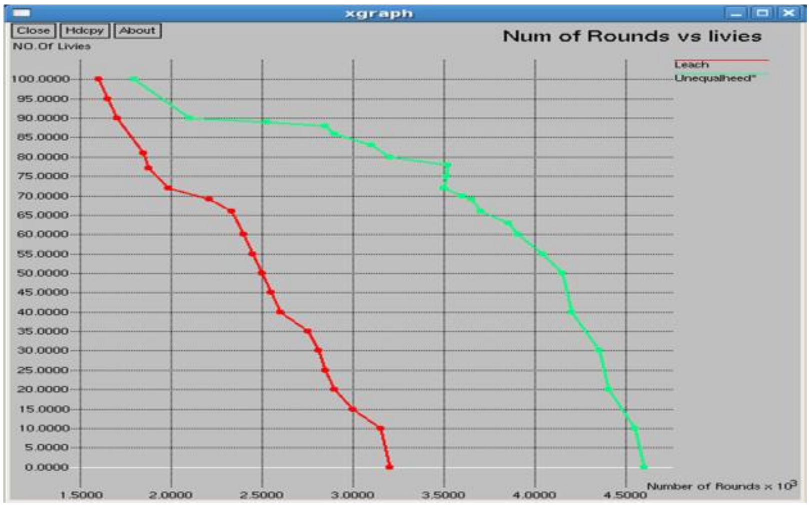

Fig {Comparison between UNEQUAL HEED* and HEED* protocol}

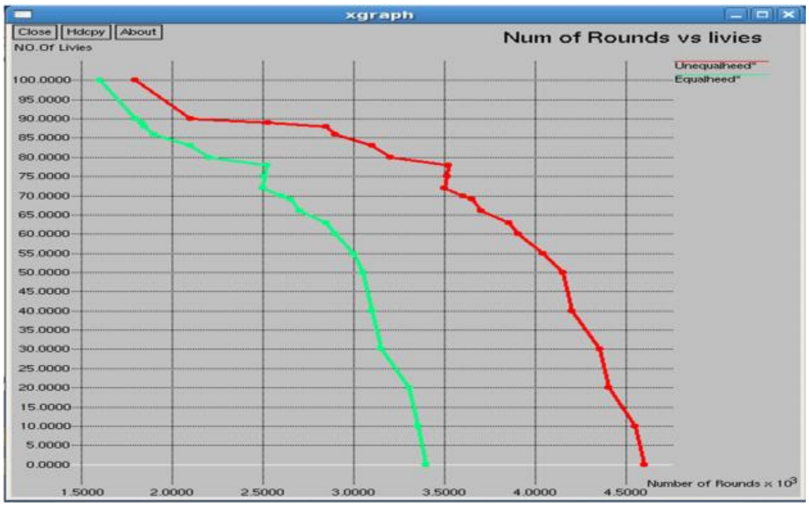

Fig {Comparison between UNEQUALHEED* and LEACH Protocol}

4 ALGORITHM

4.1 UNEQUAL CLUSTEING METHOD

In Unequal clustering Method, the circles of unequal size represent our clusters of unequal size and the traffic among the cluster heads .In clustered sensor networks, the sensor nodes do not transmit their collected data to the base station (BS), but designated cluster heads which aggregate the data brackets and send them directly or via multi-hop communication to BS. In Single-hop communication every sensor node can directly reach the destination. In Multi-hop communication nodes have limited transmission range and they are forced to route their data over several hops until the data reach the final destination. Cluster heads closer to the BS should support greater cluster sizes because of lower energy consumption during sending data packets to the BS. The bigger clusters should be closer to the BS. The clusters radius should increase as its distance to the BS decreases. Unequal Clustering Method (UCM) which is an effective method to deal with the hot spot problem. It can prevent the premature creation of energy holes in wireless sensor networks.

The operation of Unequal HEED* is divided into rounds and each round is comprised of two phases:

• The setup phase, which includes CH election and consequently cluster formation. In addition, in this phase, every CH coordinates with its members to send sensing data during the following phase.

• The steady state phase, which is broken up into TDMA frames. During each frame, every regular node, at the time of its respective time slot, sends sensing data to its CH. At the end of each TDMA frame, every CH forwards the aggregated data to the BS through the CHs

5 CONCLUSION

We propose Unequal HEED*, an extension to HEED*which is a popular distributed algorithm for energy-efficient clustering in WSN. Main differences with the original contribution, rely on that Unequal HEED* does not trigger reorganization at each round, but only when one of the elected CHs goes below a certain fraction of the energy level it had once elected. On the other hand, only that uncluttered CH node and its cluster members participate in Unclustering process, i.e., unclustering is performed locally. HEED* also diminishes the messaging overhead, by integrating communication cost value in CH messages. Besides, it takes the residual battery level of a node into account for holding a new round of election and forming uncluster nodes. The simulation results demonstrate that Unclustered HEED* outperforms the clustered HEED* protocol in terms of network lifetime.

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