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RESEARCH ARTICLE

Analyze the Performance of Divide and Conquer Scheme for Wireless Sensor Network

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Abstract: Wireless sensor network (WSN) is a network of small light weight wireless nodes which are highly distributed and deployed in large numbers. There are some issues in wsn like scalability, deployment, energy consumption and many more. There are also many energy efficient techniques in wireless sensor network like LEACH, HEAP etc. Divide and conquer is also one of the efficient technique which is based upon manually deployment. In this paper, divide and conquer scheme is explained in detail.

Keywords: LEACH, HEAP, Sensor nodes, Relay Nodes

1. INTRODUCTION

In sensor network architecture, we can possibly deployed in extremely large number of sensor nodes or devices. Sensor network consist of a sensor field, where the sensor nodes are deployed that is physical environment. Sensor nodes should have a low cost [5]. A low-cost device can thus be expected to have fairly limited computational and communication capabilities, considering the fact that sensing capabilities are also to be included in the device. Sensor nodes are deployed in many applications, where human intervention is not easy to maintain the sensor node. These type of sensor nodes where human intervention is not possible there sensor nodes are operate on limited battery power. These batteries are not easily replaced. Sensor nodes have a [7] limited power, so they have to be designed in such way, that sensor nodes use the power in an efficient way. For more specific applications like physical intrusion detection, sensor nodes have more advanced capabilities which are not in other nodes that are used in simple fields. Thus, sensor devices may range from millimeter-sized devices fabricated on custom silicon to more general purpose cell-phone-sized devices with advanced capabilities. Wireless sensor node is microelectronic device means it is equipped with a limited number of power source [8].

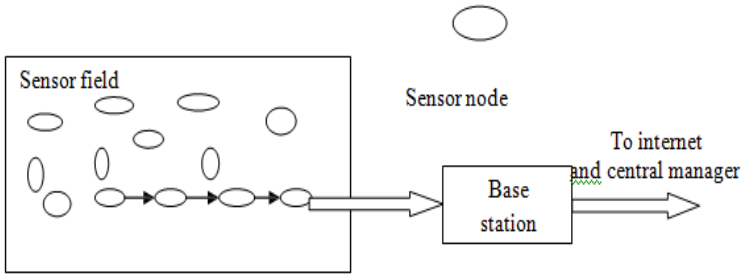

Fig. 1.1: Wireless sensor networks

Nodes are dependent on battery for their power. Hence power conservation and power management is an important issue in wireless sensor network [9]. Due to this reason researchers are focusing on the design of power aware protocols and algorithm for sensors network. In this paper main focus is about analysis battery consumption. A Wireless Sensor Network may consist of multiple sinks which may be mobile or static. If any system has more than one sink, then it can generate the same query into the WSN. For such a system each sink will have its own path developed to the source node which is somehow not required or there can be a way which avoids this. There are some issues in wireless sensor network like network deployment, energy consumption, dynamic changes and unattended operation. Battery consumption is a major issue which degrades the performance of the system. Sensor nodes can use up their limited supply of energy performing computations and transmitting information in a wireless environment but their lifetime is strongly battery dependent and hence energy-conserving forms of communication and computation are essential.

2. Review of Literature

In [1] *Kiran Maraiya et.al* presented an overview of wireless sensor network, how wireless sensor networks works and various applications of wireless sensor networks. In this paper it has been described that characteristics of wireless sensor network are dynamic network topology, lower power, node failure and mobility of nodes, short-range broadcast communication and multi-hop routing and large scale of deployment. But low power of sensor nodes is one of the limitation of wireless sensor network as in harsh environments it is difficult to replace sensor nodes so low power may cause energy hole in wireless sensor networks. Also multi-hop routing may cause more nodes deplete their energy while routing as compared to single hop routing. *Basilis Mamalis et.al* [7], describe the concept of Clustering and described various design challenges of clustering in Wireless Sensor networks. The paper also describes various clustering Protocols including Probabilistic Clustering Approaches and Non-Probabilistic Clustering Approaches. The algorithms discussed in these protocols consider periodically re-election of Cluster Heads (rotation of Cluster Head role) among all nodes. The main drawback of these algorithms is that the time complexity of these algorithms is difficult to be kept low as the size of the Wireless sensor Networks becomes larger and larger, the extension in multi-hop communication patterns is unavoidable which increases the routing path. In [2] *H.Dubois-Ferries et.al* proposed an algorithm based on Voronoi clusters to handle multiple sink nodes. This Voronoi algorithm designates a sink for each cluster to perform data acquisition from sensors in cluster. Each node keeps a record of its closest sink and of the network distance to that sink. When a message arrives from a sink, the recipient checks whether the distance traversed by the packet is less than the current estimate of closet sink distance. If so, the node updates its closest sink and parent entries and resends the message. A node also re-forwards the message if the distance traversed is equal to closest distance and the message came from the closet sink. A drawback of this algorithm is that it does not consider residual energy sensor node. *Sudhanshu Tyagi et.al* [4], have presented the most popular protocol for clustering in WSNs that is Low Energy Adaptive Clustering Hierarchy (LEACH) which is based on adaptive clustering technique. This paper provides the taxonomy of various clustering and routing

techniques in WSNs based upon metrics such as power management, energy management, network lifetime, optimal cluster head selection, multihop data transmission etc. LEACH forms clusters based on the received signal strength and use the Cluster Head nodes as routers to the base-station. All the data processing such as data fusion and aggregation are local to the cluster. LEACH forms clusters by using a distributed algorithm, where nodes make autonomous decisions without any centralized control. Initially a node decides to be a Cluster Head with a probability p and broadcasts its decision. A node becomes a Cluster Head for the current rotation round if the number is less than the pre-defined threshold. The limitation of this approach is that since the decision to change the Cluster Head is probabilistic, there is a chance that a node with very low energy gets selected as a Cluster Head. When this node dies, the whole cell becomes dysfunctional. Also, the Cluster Head is assumed to have a long communication range so that the data can reach the base-station from the Cluster Head directly. This is not always a realistic assumption since the Cluster Heads are regular sensors and the base-station is often not directly reachable to all nodes due to signal propagation problems, e.g., due to the presence of obstacles. Consequently, it is not applicable to networks deployed in large regions. *K. Latif et. al* [5], have presented routing technique called Divide-and-Rule which is based on static clustering and minimum distance based Cluster Head selection. Network area is logically divided into small regions (clusters). Old fashioned routing techniques such as LEACH, LEACH-C are not as energy efficient as present day clustering techniques such as Divide-and-Rule scheme. The benefit of Divide-and-Rule scheme is that when it is compared with LEACH and LEACH-C this scheme provides better results in terms of stability period, network life time, area coverage and throughput. But the limitation of this scheme is that during routing each node in Os region sends its data to Primary level Cluster Heads which then forwards the aggregated data to the secondary level Cluster Head present in the Ms. Secondary level Cluster Heads then, aggregate all collected data and forward it to Base Station which will lead to more energy consumption of CH nodes present in the Middle Square and Inner Square regions which may lead to energy hole and may cause data routing problems.

3. Divide and Conquer Scheme

Network area is logically divided into small regions (clusters). The beauty of this technique is the formation of square and rectangular regions, which divides the network field into small regions, as a result the communication distance for intra cluster and inter cluster reduces. It has following Steps:

1. ***Formation of Regions:***

In first step, network is divided into *n* equal distant concentric squares. Network is divided into three equal distance concentric squares: Internal square (Is), Middle square(Ms) and Outer square(Os).BS is located in the centre of network field therefore; its coordinates are taken as reference point for formation of concentric squares. Division of network field into concentric squares can be obtained from some equations.

2. ***Cluster Head Selection:***

Divide-and-Rule protocol considers multi-hop communication for inter-cluster communication. It has two types of approach that will be followed in it. These are:

1. **Primary Cluster Head Selection**
2. **Secondary Cluster Head Selection**

In Primary, nodes whose co-ordinates lie in (*Is*) are nearer to BS therefore, they send data directly to BS, (ii) as clusters are static, therefore one CH is selected in each NCR, (iii) midpoint of each NCR is considered as reference point for selection of CH in that region, (iv) nearest node from central reference point is selected as CH and, (iv) next nearest node from the reference point is selected as CH for next round and so on[10].

3. Secondary Level Cluster Head

Steps followed in selection of secondary level CHs are:

(i) CHs in Os regions send data to CHs of exactly one level above adjacent region's CH. These CHs are also known as secondary level CHs (ii) secondary level CHs aggregate their own cluster nodes data and, data of the primary level CH then, transmit data to BS.

4. Protocol Operation

In setup phase BS divides the network field into small regions, on the bases of their co-ordinates nodes send data directly to BS. In each region one CH is selected per round. CHs of Os regions, select front neighboring CHs of Ms regions as their next hop CH. Nodes of CR selects, BS or neighboring CHs as their CH, based on minimum distance [10].

4. Problem Formulation

The communication between sensor node to sink is based upon multi-hop message relay. The batteries of the sensor nodes placed near the sink will exhaust faster as compared to those that are placed far away. This is because nearby sensors are shared by more sensor-to-sink paths, heavier message relay load and therefore consume more energy. Energy depletion causes energy holes which degrade the network performance. Researchers have develop many energy models to give proper explanation but these models still need to be improved. Clustering technique in routing protocols plays a key role to prolong the stability period and lifetime of the network. One of the energy efficient routing protocols for wireless sensor network is Divide and Rule scheme.

In Divide and Rule scheme, Cluster Head in Outer Square (Os) regions send data to Cluster Head of exactly one level above adjacent region's Cluster Head. These Cluster Heads are also known as secondary level Cluster Heads, secondary level Cluster Heads aggregate their own cluster nodes data and, data of the primary level Cluster Head then, transmit data to Base Station this will lead to more energy consumption of Cluster Head nodes present in the Middle Square (Ms) and nodes present in the Inner Square (Is) regions which may lead to energy hole and may cause data routing problems. So there is need to improve this scheme to increase the life of nodes in Middle Square (Ms) and Inner Square (Is) regions. In existing technique, suppose we had corner node which wants to communicate with sink through intermediate nodes. First of all it sends request to its cluster head of nearest cluster. Then this cluster head further sends data to its nearest available region. The nodes which are deployed near sink are main nodes which participate to communicate with sink and intermediate nodes. The problem arises when battery of the nodes near sink goes down communication stop. Because sink node can communicate only with the help of region nearby node not directly. The main reason is that nearest sensor nodes are out of range of sink. So battery degrades and communicate stop as shown in fig. 3.1. To overcome this problem relay nodes will be used instead of sensor nodes.

5. Conclusion

Wireless Sensor networks have various types of energy issues. In this paper ,we focused on the divide and conquer scheme to degrade energy consumption problem. It is concluded that energy consumption problem can be reduced using relay nodes in future.

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