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Genetic Algorithm Based Data Aggregation Using Mobile Sink In Wireless Sensor Networks

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***Abstract*— Most of the recent advances in wireless sensor networks have led to many new algorithms specifically designed for sensor networks. Based on the trajectory of the mobile sink, existing research on sink mobility can be classified into three categories: random path, constrained path, and controllable path. In sensor networks where the path is random the mobile sinks are often mounted on some people or animals moving randomly to collect interested information sensed by the sensor nodes. Due to random mobility, it is difficult to bound the data transfer latency and the data delivery ratio. On the other hand, it is possible to guarantee the data delivery efficiency with the help of efficient communication protocols and data collection schemes while the trajectories of the mobile sinks are constrained or controllable. The data collection approaches in WSNs with path-constrained mobile sinks and path-controllable mobile sinks, which can be sub classified according to the communication mode (single or multiple hops) and the number of mobile sinks. In this article, we propose Genetic algorithm to collect data efficiently. Simulation results have demonstrated the effectiveness of the algorithm for different metrics.**

***Keywords*- Data Aggregation, Sink mobility, MASP, Genetic algorithm**

I. INTRODUCTION

Wireless sensor networks have attracted increasing attentions considering their potentials for being widely adopted in both emerging civil and military applications. A common practice of sensor networks is to collect data from the sensors and report the data to the sinks or to some pre-defined data rendezvous points via multi-hop communications. A large number of small and simple sensor devices communicate over short range wireless interfaces to deliver observations over multiple hops to central locations called sinks. With these properties, WSNs are considered for several critical application scenarios including battlefield surveillance, habitat monitoring, traffic monitoring, industrial process monitoring and control, machine health monitoring and security applications. Sensor nodes, and hence these applications, are subject to constraints such as limited processing, storage, communication capabilities, and limited power supplies.

WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size, microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. Mobility based communication can prolong the lifetime of WSNs and increase the connectivity of sensor nodes and clusters. Depending on the needs of the applications and on sensors to be deployed, the block of signal conditioning can be replaced or re-programmed.

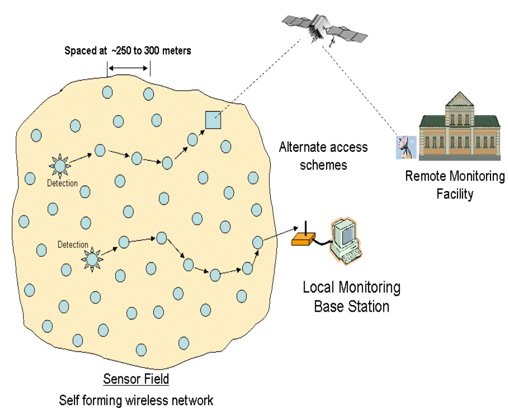

Figure 1. Wireless Sensor Network Architecture

Recently sink mobility has become an important research topic in wireless sensor networks (WSNs). Sink mobility can improve the performance of WSNs [1], [2], [3]. In [1], [2], mobile sinks are mounted on some people or animals moving randomly to collect information of interest sensed by the sensor nodes where the sink trajectories are random. In [3], [4], [5], path constrained sink mobility is used to improve the energy efficiency of singlehop sensor networks which may be infeasible due to the limits of the path location and communication power. Based on the above-mentioned related work, this paper focuses on large-scale dense WSNs with path-constrained mobile sinks that may exist in real world applications, such as ecological environment monitoring and health monitoring of large buildings. Path constrained sink mobility is used to improve the energy efficiency of singlehop sensor networks which may be infeasible due to the limits of the path location and communication power [6]. Some of, the authors propose multihop sensor networks with a path-constrained mobile sink where the Shortest Path Tree (SPT) method is used to choose the cluster heads and route data that may result in low energy efficiency for data collection. A routing protocol called MobiRoute [7] is suggested in for WSNs with a path predictable mobile sink where all sensor nodes need to be aware of the movement of the mobile sink.

II. PROBLEM STATEMENT AND SOLUTION

A. *Genetic algorithm*

Long communication distances between sensors and a sink (or destination) in a sensor network can greatly drain the energy of sensors and reduce the lifetime of a network. By clustering a sensor network into a number of independent clusters using a GA, we can greatly minimize the total communication distance, thus prolonging the network lifetime. This approach is also applicable to multiple network topologies (uniform or non-uniform) or shortest distance optimization problems .

A genetic algorithm (GA) is used to create energy efficient clusters for data dissemination in wireless sensor networks. Since energy consumption during communication is a major energy depletion factor, the number of transmissions must be reduced to achieve extended battery life. A Genetic Algorithm performs fitness tests on new structures to select the best population. Fitness determines the quality of the individual on the basis of the defined criteria. In nature, an individual's fitness is its ability to pass on its genetic material. Anything that contributes to this ability contributes to the organism's overall fitness. This ability includes traits that enable it to survive and further reproduce. In a GA, fitness is evaluated by the function defining the problem. The fate of an individual chromosome depends on the fitness value; the better the fitness value, the better the chance of survival.

B. *Existing system*

In existing system ,focus is on large-scale dense WSNs with path-constrained mobile sinks that may exist in real world applications, such as ecological environment monitoring and health monitoring of large buildings. Assuming that sensor nodes are randomly deployed in the neighborhood of the trajectory. The mobile sink collects data from sensor nodes while moving close to them. According to the communication range of Mobile sink, the monitored region is divided into two parts, the direct communication area (DCA) and the multihop communication area (MCA) for far-off sensors. Sensor nodes within the DCA, called subsinks, can directly transmit data to the mobile sink due to their closer proximity.

An efficient data collection scheme called MASP for wireless sensor networks with path-constrained mobile sinks is used in existing system[1]. In MASP, the mapping between sensor nodes and subsinks is optimized to maximize the amount of data collected by mobile sinks and also balance the energy consumption. MASP has good scalability to support sensor networks with low density and multiple mobile sinks. In addition, a communication protocol that supports MASP is designed and adapts to dynamic topology changes. To reduce the computational complexity, we develop two practical algorithms, a zone partitioning-based solution and a distributed solution (MASP-D). The impacts of different overlapping time partitioning methods and present an optimal partitioning scheme (OptShareOT) is studied. Simulation experiments under OMNET++ shows that MASP improves the energy utilization efficiency and outperforms SPT and static sink methods in terms of total amount of data with almost the same energy consumption.

C. *Proposed system*

Aiming at the data delivery problem in large-scale wireless sensor networks with mobile sinks which move along fixed paths with constant speed, we propose an efficient data collection scheme, that simultaneously improves the total amount of data and reduces the energy consumption. In this scheme, the members within the MCA are assigned to the corresponding subsinks within the DCA according to the length of the communication time between the mobile sink and the subsinks, thus improving the network throughput.

In the proposed system the network is divided into different regions. Each region has one or more subsinks based on the number of members in the region. After the regions are splitted a path is formed and in that path the mobile sink moves to collect the data. The member nodes in the region can send the data to mobile sink only via the subsink the subsink will transmit the data to mobile sink. This Subsink and mobile sink will perform the data aggregation. The main advantage is that maximum amount of data is collected using genetic algorithm which avoids repeated data by aggregation. Data aggregation is easy using genetic algorithm. Less energy is required to collect the data when genetic algorithm is implemented. Network lifetime is improved due to less energy consumption.

III. EXPERIMENTAL RESULTS

The sensor network architecture is depicted in Fig. 2. In the architecture sensor nodes are randomly deployed and regions are splitted. Sensors are only capable of radio-based short-

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haul communication and are responsible for probing the environment to detect a target/event. After the region splitting a path is made in the network through which the mobile sink moves to collect the data. Every region has one or more subsink based on the number of member nodes in the region. Regions can be formed based on many criteria such as communication range, number and type of sensors and geographical location. In this paper, we assume that member and subsink nodes are stationary and a mobile sink node. The stationary sensor node creation is the first step in network formation. These stationary nodes are randomly deployed with different angles. Stationary nodes are stable in a position and they sense the environment and sends the information to the sink. These have their own responsibilities of sensing the information and managing the network if any link break occurs due to node failure.

This stationary nodes are programmed such they transfer information in single hop to the sub sink in the region which it is located. These stationary nodes does not transfer the information directly to the sink. Each region is allotted with a sub sink which directly communicates with the mobile sink. The subsink acts as a head to the region and it collects data from all the nodes in that region and transfers it to the mobile sink. The data is transferred to mobile sink when it crosses the region. Mobile sink collects the information from all subsinks and transfers it to the sink server. Sink server may be a destination or through the sink server the data can be transferred to the destination. These mobile sinks have more capabilities than the other stationary nodes due to its mobility.

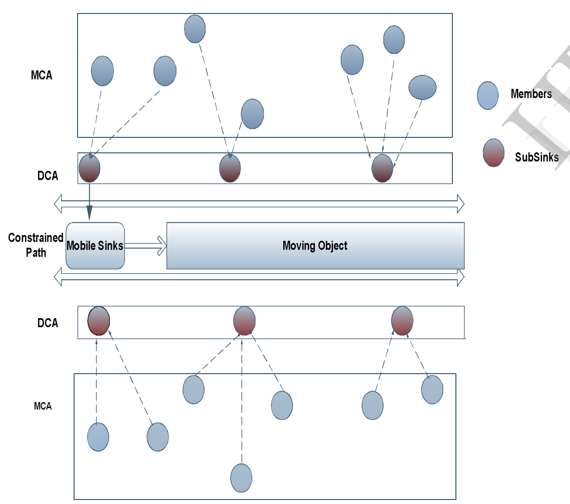

Figure 2. Design of Sensor Network Architecture

The subsinks have direct communication with the mobile sink. This region is said to be direct communication area. Other member nodes in the region are in multihop communication area because they don't have direct communication with the mobile sink. Only through the subsink they can transmit the data to the mobile sink. The mobile sink moves along the path to collect the data from the subsinks of all the regions. When the subsinks get signal from the mobile sink that it is near to the region the subsink starts collecting data from the member nodes in the region. Once the mobile sink comes closer to the subsink, it transmits the data to the mobile sink. The mobile sink after collecting data from all the subsinks , it aggregates the data and transmits it to the mobile sink server.

Figure3. Shows the node assignment. First step is to initialize the sensor nodes and after that the nodes are assigned with there role. Some nodes are assigned as member node and other may be the subsink, based on the nodes position role of each nodes are assigned. The node indicated with blue color is the Mobile sink which will collect data from all the subsinks. And the red colored nodes are the subsink nodes and the pink colored nodes are the member nodes in the network.

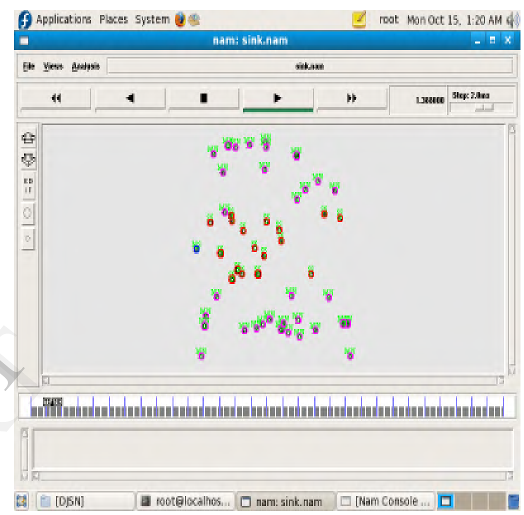

Figure 3. Node Assignment

Figure 4. Initialization of Sensing

After the nodes are assigned with their particular roles sensing is initialized in the network by the sensor nodes. Figure 4. Shows the initialization of sensing. Mobile Sink starts moving around the network and collects the data from all the subsinks. Then the algorithm is implemented and regions are splitted to collect the data from all the regions subsink. After the data collection the mobilesink aggregates the data and transfer it to the sink server which will transfer the data to the actual destination. This results in improved efficiency and data accuracy. Also the network lifetime is improved.

It is difficult to form the network each time to find the accuracy, so it is preferable to implement the network in the software platforms to analyse the performance of the network. Also it is cost effective because, it is very expensive to implement the network using sensors and replacing them when any failure occurs in real time. But in the case of using software it is easy. Network Simulator software is used in this paper to implement the network and analyse the performance of the network.

IV. CONCLUSION

In this work the efficient information gathering and improved network lifetime is aimed. Mobile sink is used to collect datas from the subsinks. The NS2 simulator is used as software platform to simulate the results. Mobile sinks are used to collect information from the subsinks in each region. This helps to avoid increased energy consumption due to long distance transmissions. Node creation, subsink and mobile sink creations are programmed ,without region splitting the datas are collected and simulation results are obtained. Even then it is not much efficient due to multiple hop transmissions and long distance transmissions to the sinks. The network is splitted into different regions and Genetic algorithm is implemented to improve the efficiency and network lifetime. This also makes the data delivery easy. The loss of data can be reduced with improved accuracy. Another main advantage is that the subsink collects the data from all other nodes, aggregates the data and sends it to mobile sink. So, no repeated data will be sent and energy can be utilized efficiently which improves the network lifetime..

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