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RESEARCH ARTICLE

A Comparative Study on Data Aggregation in Wireless Sensor Networks by using Directed Diffusion and Ant Colony Algorithm

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Abstract:
Wireless sensor networks uses Data Aggregation concept for reducing energy consumption. Data Aggregation gathers correlated sensing data and aggregates at the intermediate nodes to reduce the number of messages exchanged network. This paper considers the problem of comparing the energy consumptions of Directed Diffusion and Ant Colony Algorithm for data aggregation. Directed diffusion is data-centric. All nodes in a directed diffusion-based network are application-aware. This enables diffusion to achieve energy savings by selecting empirically good paths and by caching and processing data in-network. The ant colony system provides a natural and intrinsic way of exploring search space in determining data aggregation. Every ant will explore all possible paths from the source node to the sink node. The data aggregation tree is constructed by the accumulated pheromone

Index Terms— *Wireless Sensor Networks, Data aggregation, Directed Diffusion, Ant Colony algorithm, interests, data messages, gradients, and reinforcements*

I. INTRODUCTION

Now a Days advances in wireless communications and electronics have enabled the development of low-cost, low-power, multifunctional sensor nodes that are small in size and communicate in short distances. A **wireless sensor network (WSN)** consists of spatially distributed autonomous sensors to *monitor* physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location . The sensor node should have the ability of sensing, processing and communicating. Even though, it was originally developed for military applications. Wireless sensor networks are being applied for many civilian applications like vehicle tracking system, habitat monitoring, forest surveillance, earthquake observation, biomedical or health care applications and building surveillance. In order to effectively utilize wireless sensor nodes, we need to minimize energy consumption in the design of sensor network protocols and algorithms. A large number of sensor nodes have to be networked together. Direct transmission from any specified node to a distant sink node is not used since sensor nodes that are farther away from the sink node will drain their power sources much faster than those nodes that are closer to the sink node. The application of an aggregation approach helps to reduce the amount of information that needs to be transmitted by performing data fusion at the aggregate points before forwarding the data to the end user. Due to the limited energy sources, Sensors requires data dissemination paradigms to save on network energy.

Directed diffusion is a typical data-centric routing paradigm for sensor networks. Data from different sources are opportunistically aggregated. However, opportunistic aggregation on a low-latency tree is not efficient because data may not be aggregated on nodes near the sources.

Ant colony algorithm for data aggregation in wireless sensor networks, every ant will explore all possible paths from the source node to the sink node. In order to increase the probability of intersection of routing paths, our mechanism extends the routing paths. The data aggregation tree is constructed by the accumulation of pheromone. After a short transitory period, the amount of pheromone on the aggregation nodes is sufficiently large to guide ants (the data packets from different sources) to meet together at these nodes for data aggregation

II. **DATA AGGREGATION**

Data aggregation is any process in which information is gathered and expressed in a summary form. And is an important in energy constraint wireless sensor networks which exploits correlated sensing data and aggregates at the intermediate nodes to reduce the number of messages exchanged network. The application of an aggregation approach helps to reduce the amount of information that needs to be transmitted.

III. **DIRECTED DIFFUSION (DD)**

It consists of four basic elements: interests, data messages, gradients, and reinforcements. In DD, a task, which is a list of attribute-value pairs, is flooded into the whole network as an interest for named data. A gradient is a direction state created in each node that receives an interest. Events start flowing toward the originator of interest along the established shortest path. A node requests data by sending *interests* for named data. Data matching the interest is then “drawn” down towards that node. Intermediate nodes can cache, or transform data, and may direct interests based on previously cached data.

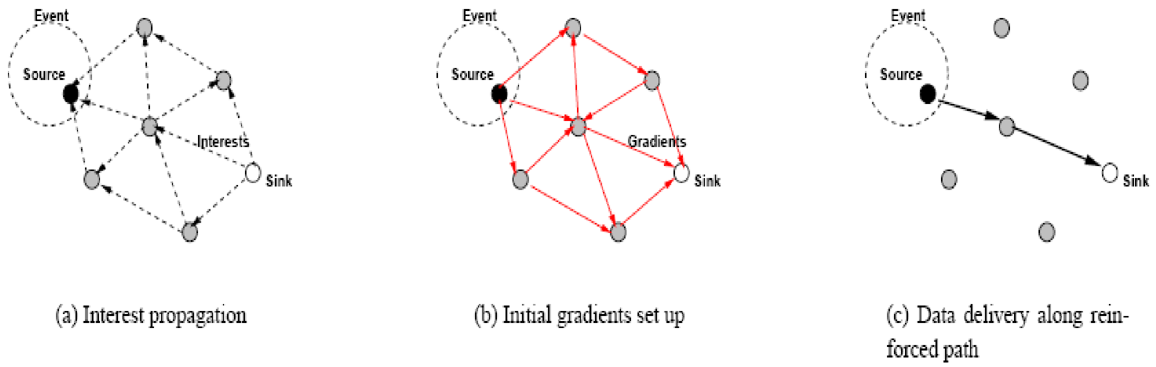

Figure 1: A simplified schematic for directed diffusion.

IV. **ANT COLONY SYSTEM**

The ants search the routes and communicate with the others through pheromones. Each ant iterates to construct the aggregation tree where the internal nodes are aggregate points. The ants either try to find the shortest route to the destination and terminate or finds the closest aggregation point of the route searched by previous ants and terminates. The algorithm iterates on the different nodes located within the extended routing paths.

In the following paragraphs, we will describe how to find the aggregation points using an ant colony algorithm and illustrate how our proposed algorithm works. The ant colony algorithm includes three steps. Step 1 is how to select next hop node; Step 2 is to extend the routing path; Step 3 is to update the pheromone trails on the sensor nodes.

4.1. Next hop node selection

First, the sink node will flood its identity to all the nodes in the network. After the node receives this packet, it will compute the hop count to the sink node. When the source node wants to send data, it will select the next hop node by counting the minimum number of hop nodes.

4.2 Extending the routing path

In order to increase the probability of intersection of the routing paths, our mechanism will extend the routing path. After the node selects its next hop node .It sends a Select packet including the data packet to the next node. As the next node receives the Select packet, the node will send only the Select packet to all of its neighbors. It will build a reaction table.

4.3 Pheromone updating rule

After constructing the reaction table the node will check whether there is any data message existing with it or not .if some data exists means it will aggregate the current data message with the existing data message and will send pheromone update packet to its previous node

V. **COMPARISON RESULTS**

Table 1
Simulation parameters

Symbol	Definition	Values
N	Number of sensor nodes	300–500
S	Number of source nodes	5–20
R	Transmission range	10–14 m
E_{elec}	Radio dissipation	50 nJ/bit
E_{Tx}	Transmitter electronics	50 nJ/bit
E_{Rx}	Receiver electronics	50 nJ/bit
ε_{amp}	Transmit amplifier	0.1 nJ/bit/m^2
CP_{size}	Size of control packet	1 byte
DP_{size}	Size of data packet	64 bytes
S_{energy}	Initial energy of sensor nodes	0.25 J
ρ	Pheromone evaporation	0.3
β	Relative influence of heuristic values $\eta(i, j)$	20

The simulation parameters are given in Table 1. The simulation results presented here are the averages of 30 simulation runs. The first set of experiments is carried out to
investigate the total energy consumption with N = 300 and R = 10, 12, and 14. Fig. 2(a–c) shows the results of the DD method and our proposed ant colony algorithms Ant-0, Ant-1, and Ant-2 with different extended paths of 0, 1, and 2, respectively. We also vary the number of source nodes and observe the behavior. Since the DD method does not apply data aggregation, it has the highest energy consumption. The Ant-0 method generates fewer aggregation nodes than Ant-1 and Ant-2 and thus, requires also more energy. The Ant-1 and Ant-2 methods consume less energy than the other two methods because they can find more aggregation nodes to deliver the data.

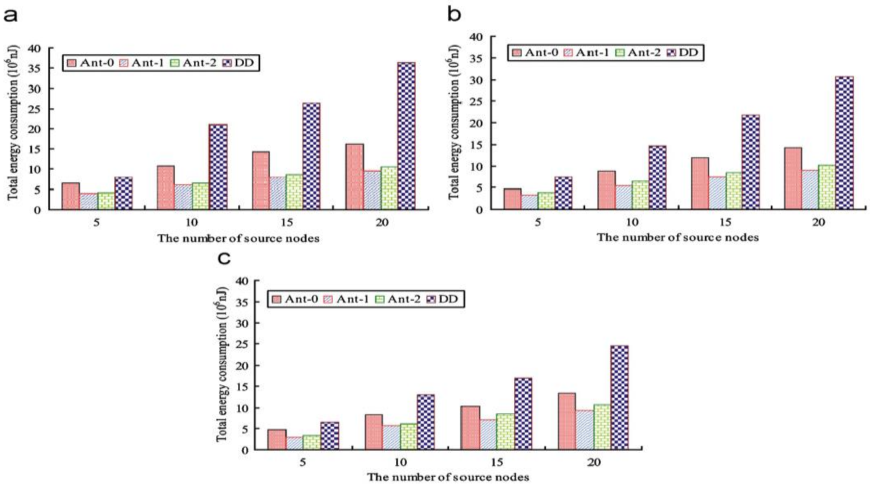

Fig 2: Total energy consumption vs. the number of source nodes for methods Ant-0, Ant-1, Ant-2, and DD: (a) R = 10, (b) R = 12, (c) R=14.

VI. CONCLUSION

By this comparison between Directed Diffusion and Ant Colony Algorithm, we conclude that energy consumption is less in ant colony algorithm. So, we can include this ant colony algorithm for aggregation in any data base or data warehouse.

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