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Data Aggregation Based Proactive Data Reporting Protocol for Wireless Sensor Network

Ms. Sonali N. Kadam
Department of Electronics & Telecommunication
KCT's Late G.N.Sapkal COE,Anjaneri,
Nashik,India
Sonalinkadam1@gmail.com

Prof.Mrs.Manjusha S. Borse
Department of Electronics & Telecommunication
KCT's Late G.N.Sapkal COE,Anjaneri,
Nashik,India
Manjusha.borse19@gmail.com

Abstract— Wireless sensor networks are the grouping of tiny sensor nodes that gathers the information by sensing activeness from the surroundings similar lands, forests, hills, sea. Power saving is a critical issue in wireless sensor networks since sensor nodes are battery-powered. To achieve optimized network performance at collecting a small portion of sensed data in network is in current researches. There are many protocols available for the successful communication. Sink trail and sink trail-s are the two energy efficient proactive data reporting protocols for mobile sink based on data collection with low complexity and reduced control overhead. In wireless sensor networks, using mobile sinks mobility rather than static sink for data collection is the new trend. Recently the researches are giving the concentration on moving patterns of the mobile sink to achieve optimized network performance, collecting a small area of sensed data in the network and also reducing energy consumption is main motto of the recent searches. Sink trail and sink trail-S protocols aim to conserve energy by turning off unnecessary sensors while simultaneously preserving a constant level of routing fidelity. In the proposed system we proposed the system that provides solution over mobility problems in wireless sensor network with energy saving methodology using aggregation technique.

Keywords- *WSN, sensor network, energy conservation, mobile sink, data aggregation*

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I. INTRODUCTION

A wireless sensor network consists of hundreds of sensor nodes, each equipped with the ability to sense the immediate environment, to communicate with nearby nodes through one to-all broadcasts and to perform local computations based on information gathered from the surroundings. Wireless sensor networks enabled a large spectrum of applications finished networked low-cost low-power sensor nodes, e.g. precision agriculture, environmental monitoring, also the forest fire accident detection. In the above mentioned applications, the sensor network will run under low few human interventions either because of the opposing environment or place management quality for physical maintenance. As sensor nodes have less battery lifetime, energy saving and drive protection is of prime importance in the figure of device meshing protocols. In most cases the sensors are battery constrained which makes the problem of energy-efficiency of paramount importance. The nodes in the network are battery operated, and hence, they have a limited service life since it is generally impossible to recharge the batteries once the sensors have been deployed.

Accordingly, maximizing the lifetime of the network by improving the energy consumption of its nodes is a fundamental concern when designing and maintaining wireless sensor networks. Rather than reporting data through long, error prone, and multi hop routes to a static sink using tree or cluster network structure, allowing sink mobility which is more promising for energy efficient data gathering in the recent research on data collection [1].Resulting in shorter data transmission paths and reduced energy consumption, mobile sinks, such as animal or vehicles equipped with radio devices are sent into a field and communication directly with sensor nodes.

Fig 1[2]. A photograph showing a typical farmland of asymmetrical shapes. A mobile sinks motion in such environment is constrained.

Hence the energy consumption would be highly reduced and data packets handoff would be smoother as the sensors can predict the mobile sink's movement. A proactive data reporting protocol that is self adaptive to various application scenarios and its improved version, Sink Trail S with further control message suppression is proposed. Mobile sinks move continuously in the field in relatively low speed and gather data on the fly in SinkTrail protocol. In existing data collecting protocols, control messages are broadcasted at certain points.

A problem of movement prediction for data gathering with mobile sinks solves the SinkTrail. This is surely a feasible technique for data transfer; it creates a bottleneck in the network. The nodes near the base station transmit the data from nodes that are farther away. This causes a non-uniform reduction of network resources and the nodes near the base station are the first to run out of batteries. If these nodes die, then whole the network is disconnected for all practical purposes [1]. Periodically replacing the battery of the nodes for the large scale deployments is infeasible. A number of researchers have proposed mobility as a solution to this problem of data gathering. Therefore we are proposed new system with energy efficient technique. Our protocol having very low complexity and reduce extra overhead of sensor network. Proposed system is useful for large scale multi hop wireless network with better mobility.

The main contribution of this paper is that we use data aggregation which reduces energy consumption by removing redundancy. Finally proposed system provides solution over mobility problems in wireless sensor network with energy saving methodology. Aggregation technique improves the lifetime of sensor network. Such protocols used to combine and summarize data packets of several sensor nodes to reduce the amount of data transmission. Energy-efficient data aggregation protocols are required to save the node energy and improve the network life cycle due to the fact of energy constraints in sensor nodes. The data in wireless sensor networks is organized in an efficient manner using data aggregation and data dissemination protocols. Using additional sensor nodes in the network reduce the resource constraints but increase the rate of data redundancy. This limitation is calibrated using the data aggregation technique in sensor networks. This technique uses the cluster head node to collect, aggregate and sends the data to the base station.

II. RELATED WORK

In WSN, the sensor nodes have a limited transmission range, their processing and storage capabilities also their energy resources are limited. Routing protocols for wireless sensor networks are responsible for maintaining the routes in the network and have to ensure reliable multi-hop communication under these conditions. C. Chou, K. Ssu, H. Jiau, W. Wang, and C. Wang presented a topology maintenance scheme for the construction of dead-end free topologies chosen randomly at prescribed periodic intervals. It is then used as the starting point for a global topology construction process. In constructing the topology, neighboring nodes to the initial node are activated based on their ability to satisfy the local dead-end free condition. The selected active neighbors then perform a similar activation procedure with their own neighboring nodes. [3]

Energy efficiency is a key concern and challenging research issue during the design of routing algorithms for wireless sensor networks (WSNs). They proposed a mobile-sink routing algorithm based on energy and distance to minimize the overall network overhead, balance the energy consumption and prolongs the network lifetime. By studying the influence of different mobile sink node number on energy consumption and network lifetime, the appropriate mobile sink node number has been elected. Then sojourn positions are chosen from park locations determined by the distribution of boundary neighbor nodes and their transmission range. To improve the energy utilization of each sensor node and network functioning, mobility technology has been largely concerned. Since the implementation of mobile sink node is relatively easier than normal sensor nodes, sink mobility technology has drawn much more attraction in research interest in recent years. [4]

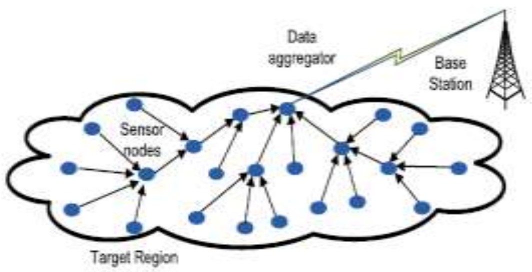

Fig 2: Data Aggregation for WSN

Xinxin Liu, Han Zhao, Xin Yang, and Xiaolin Li, presented the SinkTrail and its improved version, two low-complexity, proactive data reporting protocols for energy-efficient data gathering. It uses logical coordinates to deduce distances, and establishes data reporting routes by greedily selecting the shortest path to the destination reference. In addition, it is capable of tracking multiple mobile sinks simultaneously through multiple logical coordinate spaces. It holds desired features of geographical routing without requiring GPS devices or extra landmarks installed. It is capable of adapting to various sensor field shapes and different moving patterns of mobile sinks. They systematically analyzed energy consumptions of mobile sink and validated analysis through extensive simulations. The results demonstrated that Sink Trail finds short data reporting routes and effectively reduces energy consumption. [1]

Data aggregation is the process of summarizing and combining sensor data in order to reduce the amount of data transmission in the network. Wireless sensor network protocols such as data aggregation protocol, must be designed with security. This paper investigated the relationship between security and data aggregation process in wireless sensor networks. An example data aggregation scheme is presented in Fig. where a group of sensor nodes collect information from a target region. As the base station enquires the network, one of the sensor nodes, called data aggregator, gathers the data from its neighboring nodes, aggregates them and sends the aggregated data to the base station over a multi hop path, instead of sending each sensor node's data to base station. [5]

III. PERFORMANCE EVALUATION

To optimize the energy usage and eliminate unnecessary control messages in the network, we propose new technique as an improvement to the original SinkTrail and SinkTrail-S.

In this session we create normal sensor network with few wireless node and with two mobile sink nodes. We consider a network IN that consists of N sensor nodes and M mobile sinks. All the sensor nodes are nothing but the data sources. We assumed that sensor nodes are deployed in a grid topology. Our analysis can be extended to uniformly distributed topology. Hence the edge of the grid is roughly $\sqrt{N}$. Let the energy cost for transmitting or receiving a control message is γ and the cost for a data packet is σ. As $\sigma >> \gamma$ compared to trail messages, data packets are larger in terms of data size, and is proportional to the energy cost for transmission. In our system, energy utilization mainly includes data packet forwarding cost, $E_{data,}$ routing table maintenance cost, $E_{routing}$, and trail message transmission cost, E_{trail}.

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There are two factors that affect the energy cost of data forwarding: the average route length and number of data packets. The number of data packets is determined by the number of data sources in a network, N. The average route length may vary depending on the locations a mobile sink has travelled. We calculate an upper bound of the average route length by knowing the situation that a mobile sink appears randomly in an area. So we can find pairs of sensor nodes that any one pair of nodes' distances to the mobile sink added up to at most √2N. Thus, the average route length should be upper bounded by N/2. √(2N)/ N. . We use a coefficient c, where $0 < p \leq 0.5$ to describe the average route length. Therefore, we have

$$E_{data} = \delta . p . \sqrt{2N} . N . E_{agree} \quad (1)$$

Where Eagree is the total energy required for the aggregator node or the head node.

Increased number of mobile sink will only decrease the total energy cost for data reporting. According to SinkTrail, the total number of trail messages relays on the network size, N, the number of trail points visited by each mobile sink, Wπ, and the number of mobile sinks, M the energy consumption for trail message transmission is given by

$$E_{trail} = \gamma . M . N . W\pi \quad (2)$$

In SinkTrail if there are multiple mobile sinks, the energy consumption increases since each node keeps a different trail reference for each mobile sink. Due to the broadcast nature of wireless media, such kind of control message only needs to be transmitted once by each sensor node. And hence the energy cost for routing information maintenance is summarized by

$$E_{routing} = \gamma . N . M \quad (3)$$

The total energy consumption of SinkTrail protocol is

$$E_{st} = \delta . p . \sqrt{2N} . N + \gamma . M . N . W\pi + \gamma . N . M \quad (4)$$

Result of above equation show that our proposed system required less energy than the traditional algorithms.

Figure 3 shows the overall energy consumption for three mobile sinks using the proposed system. The graph is calculated using results getting in NS2 simulator.

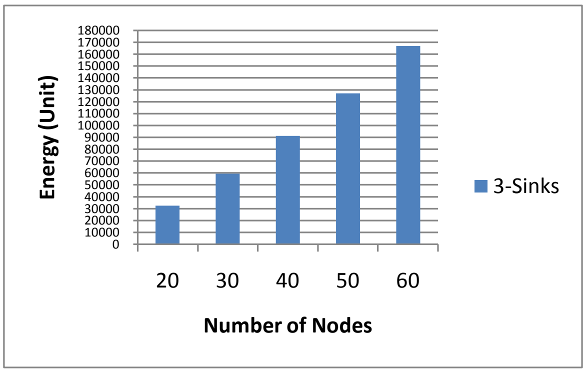

Fig3.Overall energy consumption for 3 mobile sinks

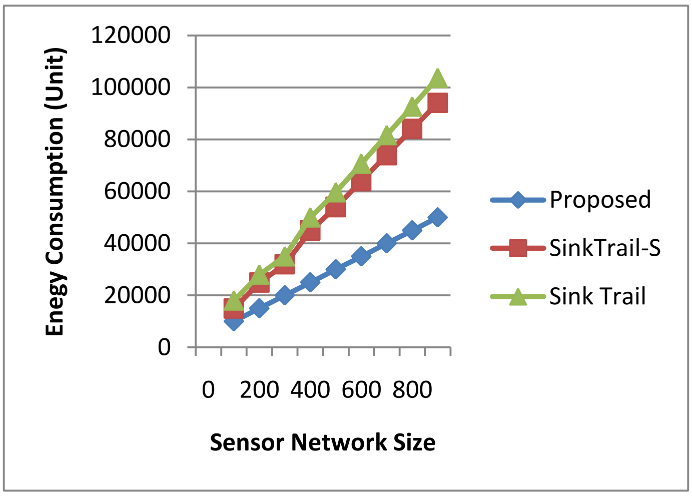

Fig 4. Comparison of overall energy consumption for the proposed system and existing system in case of the 3 mobile sinks

We estimated the total energy consumption for existing system also the proposed system. We compared these two with each other. The figure 4 shows the comparison of both.

IV. RESULTS

We compare our approach with the previous sink trail and s-sink trail protocols. Performance evaluation shows that our system with aggregation having better performance and use less energy. By using our protocol the mobile sink can move freely in the sensor network with efficient synchronization with the other sinks. We execute our system on network simulator (Ns2). The figure 5 shows the overall energy saved by using our system.

V. CONCLUSION

We presented the SinkTrail and its improved version Sink Trail-S, low-complexity, proactive data reporting protocols for energy-efficient data gathering. We systematically analyzed energy consumptions of Sink Trail and Sink trail-S.

We also presented the protocol which improved than both Sink trail and Sink trail-S that saves much more energy than previous protocols. We successfully compared the energy consumption of the Sink Trail, Sink Trail-S and the proposed system.

That result shows our system performance is improved by 5% to 7% and saves near about 5% energy consumption.

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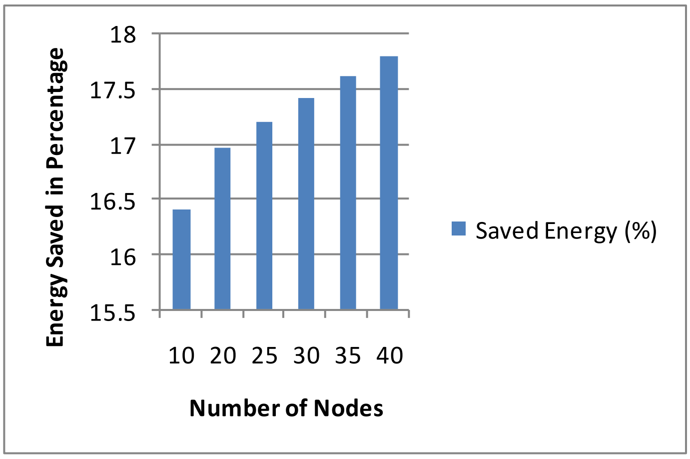

Fig5. Total energy saved using the proposed system