Maximizing Lifetime throughEnergy Consumption Using Mobile Sink in WSN

[1]Nilabar Nisha.U and [2]Dr.Mahabubbasha.A,
[1]Assistant Professor, Computer Science and Engineering, Mahendra Institute of Technology, Namakkal, India
[2]Senior Professor, Electronics and Communication Engineering, KSR College of Engineering, Tiruchengode, India

Abstract—Wireless sensor network is a popular and up-and-coming area of research for scientists. The network consists of a huge number of devices called as sensor nodes or motes which are deployed over a particular area or region. Each node is well prepared with energy so as to interact actively in a network and participate in a data exchange over networks. The nodes in a network can be static or dynamic and they can send their data to a base station called as sink node. The mobility of a base station node will help effectively in optimizing energy efficiency and to increase lifetime of a network. A Grid based approach makes the division of entire sensor network field into several numbers of clusters also called as cells. A cluster head is chosen among each cluster which will be responsible in making an optimal path so as to communicate with mobile base station node. As the sink node is moving along the sensor field the route will be automatically updated which will require only minimum number of motes to update their packet delivery path towards sink node. The sink node can be moved with variable speed to add more flexibility in a network. Also, the participating nodes can send the data with variable transmission data rates so as to increase the lifetime of a network. We propose these two parameters so as to make the existing communication more efficient and flexible.

Keywords— *Wireless sensor networks, Grid structure, network lifetime, optimal routing, energy efficient network.*

I. INTRODUCTION

Wireless sensor networks are widely used in several environmental applications, military applications and intelligent transport networks. The network consists of tiny devices which are well equipped with a battery and are able to establish a communication with other nodes in a network. These are spatially distributed autonomous sensors to monitor physical or environmental conditions. Wireless sensor networks can be used to detect dangerous or hazardous networks over an area such as battlefield or disaster one containing leakage of a gas. In suck environments, we should be aware by collecting all the information about dangerous area before entering into it. The nodes in a network are randomly distributed and they form a self-organized network. For example, we can keep some sensor nodes into a disaster zone to detect any arising dangerous situation and take an action accordingly. The general sensing applications include heat, object detection, pressure detection. Each node is limited with a particular local network but they can communicate with each other producing complex information which is ready for further processing and analysis. Some more modern networks are bi-directional and they are able to control the sensing and monitoring activity. The data dissemination process is termed as sending of a relay streams of packets to sink node from a network node. These networks also help in car parking i.e. intelligent transport network by providing warnings to car drivers. There is an energy dissipation of a node due to data exchange which limits the lifetime of a network. Various methodologies of data collections such as tree-based, cluster based are proposed by researchers to facilitate the ease of communication established. Also, algorithms like tree based structure, grid based are used in routing methods. Each one is having its own advantages as well as disadvantages. In this, we will discuss the grid structured approach which will help to find optimal route to a sink node from each individual node. All the nodes are able to send their data to a central one termed as base station or a sink node. Traditional system allows the sink node to be a static and hence all the nodes will form an optimal path to communicate with sink node. Now a days, sink mobility will help in balancing the node's energy utilization and increases the network lifetime.

Figure.1 shows wireless sensor network comprising of sensor nodes, sink node and route established which will be used to send the data. Considering the network topology as dynamic, nodes must be aware of the current position of a sink node and accordingly they will adjust their routing path for the efficient data delivery.

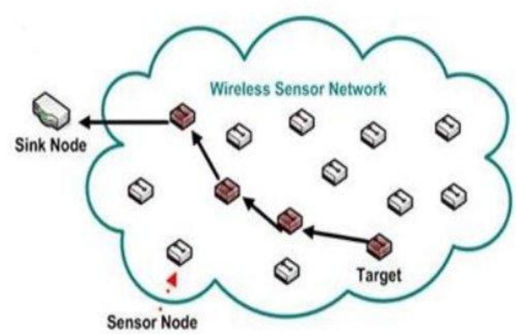

Figure 1: Wireless Sensor Network

In computer science, WSN is a very popular research area for many scientists. There are lot more useful applications for wireless sensor networks and hence it is worth mentioning the increase in network lifetime and reduced the energy consumption. This will be categorized into four sections. The first section describes about the System design of the grid based approach routing method. The second section describes various proposed methods and their evaluation metrics. The third section explains the proposed methodology which aims to decrease the energy consumption and increase the network lifetime. In the last section we have made the conclusions with respect to proposed work.

II. RELATED WORK

In this paper JaehoonJeong [9] describes that the Intelligent Transportation Systems have been developed and been evolving to support the driving safety and transportation efficiency through the information computing and communications among transportation infrastructures and vehicles. This dissertation studies the key technologies in the wireless sensor networking for the security and communications in the road networks as follows: (i) Localization for sensor location, (ii) Road Surveillance for vehicle monitoring, (iii) Data Forwarding for road sensing data delivery and (iv) Reverse Data Forwarding for road condition information sharing.

In this paper Liyang Yu, Neng Wang, XiaoqiaoMeng[11]states that, they propose a wireless sensor network paradigm for real-time forest fire detection. A neural network method is applied to in-network data processing. The neural network takes the measured data as input to produce weather index, which measures the likelihood for the weather to cause a fire. Cluster headers will send weather indexes to a manager node via the sink. Then the manager node concludes the forest fire danger rate based on received weather indexes and some other factors. In certain emergent situations, sensor nodes may detect smoke or abnormal temperature. They will directly send an emergence report to the manager node.

In this paperIlkerBekmezci and FatihAlagoz[3]describes that, a new TDMA based wireless sensor network (WSN), MILMON, is proposed for military monitoring. The most important design considerations of MILMON are energy consumption, delay, scalability, and fault tolerance. There are three main components of the system: a new time synchronization schema based on the sink with a high range transmitter, hr-FTSP; data indicator slot mechanism, DISM; and a new distributed time-scheduling mechanism ft_DTSM. An analytic and simulation model has shown that energy consumption and delay performance of the newly proposed system is better than most of the existing WSN systems.

In this paperDeepneelMajumdar, PragyanParamita Das and Maya Nayak[12] proposed that, Wireless Sensor Networks face unavoidable challenges in the areas of connectivity, network lifetime and energy efficiency inits implementation. At the same time, urgent data captured by the sensor nodes need to be processed at real time with low message latency and maximum utilization of the bandwidth. This paper presents an in-depth analysis of the different data transfer methods available under mobile platform and a performance analysis of different real time bandwidth allocation schemes in a Wireless Sensor Network. An optimal solution for the communication in mobile platform is analyzed and found out to be the Rendezvous based solution implemented with Relayed Data Collection Algorithm to achieve an acceptable value of network lifetime and energy consumption. In case of real time communication, the optimal time slot bandwidth allocation scheme – O-TDMA has been proved to have met all the performance parameters and found out to be the optimal solution in real time communication in a Wireless Sensor Network.

III. PROPOSED METHODOLOGY

We will give the complete and detailed information of our proposed scheme with proper explanation. We form a virtual grid structure which is going to be divided into number of cells also called as clusters. The cell header is chosen considering the physical dimensions of a cell. Also there is a sink node present in a network and it is able to move around the boundary line and thus forming a dynamic topology. Our aim is that minimum number of cell headers should take part in establishing a routing path towards a base station and thus the energy consumption of a network can be reduced.

A. Network Model

The following network characteristics are taken into consideration for constructing a network model.Nodes are deployed randomly throughout the sensing field and all nodes are assumed to be static. All sensor nodes within the sensing field are homogeneous in nature and initially all will have the same energy level (0.5 J) and bandwidth. Sensor nodes will make use of their transmission power based on the distance to reach their destination nodes. The two mobile sinks are highly powered and they do not have any resource constraints. Both of the mobile sinks are allowed to move in counter clockwise direction for every half of the round to reduce the number of hops between the source and sink and to reduce the time taken for completing one round along the periphery of sensing field to collect the data from CHs. Based on the Time Of Arrival (TOA) of sink, latest location of sink and Time of Arrival (TOA) will be communicated to the limited number of cluster head nodes for read justing the routes.

IV.PROPOSED ALGORITHM

Considering all the areas where following assumptions are made at the start in the development of the wireless sensor model.

- Sensors and base station remain stationary.
- All nodes are homogeneous and have the same capabilities with same initial energy.
- Nodes need not to be equipped with GPS- capable precise unit to get precise location.
- Each node is equipped to sense the value for the environment at a fixed rate.
- All sensor nodes have same computing and communication capacity.
- Base station is located far away from the sensor.
- For the better energy efficiency initial high energy processing, like sensor deployment and initial selection of cluster head, are done by base station.
- Every node will always have data to transmit.
- Entire area along with geometric shape of the clusters is rectangle.
- Cluster deployment is in equilateral triangular grid.

V. EXPERIMENTAL RESULTS

In the simulation 2 mobile sinks are allowed to move around the sensing field in counter clockwise direction. One round of data collection is divided into two, half rounds. In total MS1 will cover bottom half of the sensing field and MS2 will cover top half of the sensing field so that load on the cluster head as well as the mobile sink gets shared by limited broadcast of update message. LuoJ[14] say that the packet delivery ratio is 50% when the mobile sinks node moves at 0.5m/sec. It is increased to 80% when the maximum speed of mobile sink is greater than 5m/sec. So the maximum speed of mobile sink 1 & 2 is set to 6m/sec to increase the packet delivery ratio to 85%. To achieve increase in packet delivery ratio, lifetime of the network and reduced delay, energy consumption of the network the following energy model is used.

The energy model uses the following equations for calculating the Communication energy dissipation the free space (d power loss) channel model is used, depending on the distance between the transmitter and the receiver. The energy used up for the transmission of the k-bit packet over distance'd' is given by,

$$\mathbf{E_{CH} = L \times [\, E_{elec} + E_{DA}] + L \times (\varepsilon_{mp} \times d_{BS})}$$

$$\mathbf{ETx(k,d) = kE_{elec} + kd = kEelec + kampd^2 \,,}$$

$$\mathbf{d<d_0 \quad (5)}$$

whered is reference distance.

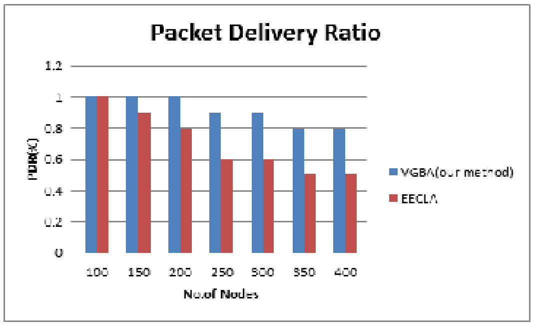

Figure 1: Packet Delivery Ratio with 2 Mobile Sink

Figure. 1 shows the improved packet delivery ratio due to the introduction of 2 mobile sinks when compared to the already existing EECLA scheme with single mobile sink.

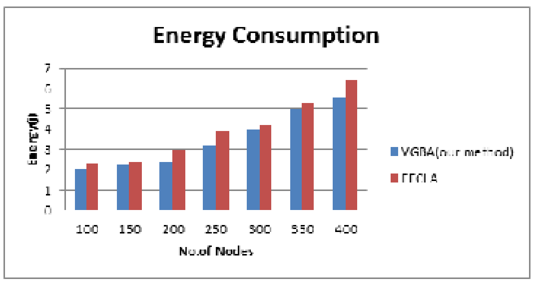

Figure 2: Energy Consumption with 2 Mobile Sink

Figure.2 shows the energy consumption of the network which has been reduced in the proposed approach when compared to the already existing scheme.

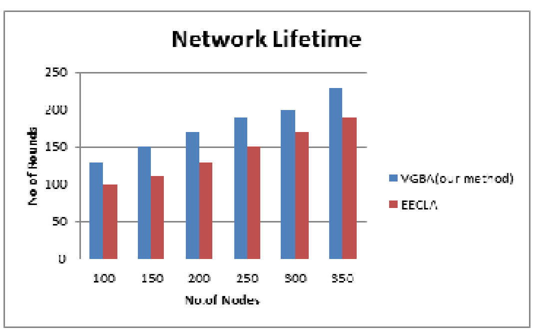

Figure 3: Lifetime of Network with 2 Mobile Sink

Figure 3 shows the improved lifetime of a network with 2 mobile sink of proposed approach. Network life time is calculated in terms of rounds with respect to the number of nodes in a network. Since each round of data collection is divided into two, half rounds the lifetime of the network is increased when compared to the already existing scheme.

CONCLUSION

In this, our aim was to state a scheme that will help to improve network lifetime by saving the energy cost incurred. The idea was to form a grid structured network resulting into numbers of clusters or cells. We select a cell header and form a backbone network of all the cell headers as they are responsible to form a routing path. The nodes will communicate to a base station by making sure of constructing an optimal path. The sink node is able to move along the boundary of sensor field with variable speed. The nodes in a network are capable of sending data with variable transmission rates. These two parameters will help to minimize the energy consumption in a network and will improve the lifetime of a network. If the energy of cell header is decreased beyond the threshold value then the correct replacement for it is done by ensuring that the new cell header will cover the entire cell is almost equidistant from the nodes in that cell. Our proposed scheme will support the dynamic topology of a network. All the cell headers are well updated with the latest location of a sink node which will reduce the cost of path reconstruction when the sink node will move from one cell to other cell.

References

[1] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: A survey," *Comput. Netw.*, vol. 38, no. 4, pp. 393–422, Mar. 2002.

[2] S. Diamond and M. Ceruti, "Application of wireless sensor network to military information integration," in *Proc. 5th IEEE Int. Conf. Ind. Inform.*, Vienna, Austria, Jun. 2007, vol. 1, pp. 317–322.

[3] I. Bekmezci and F. Alagz, "Energy efficient, delay sensitive, fault tolerant wireless sensor network for military monitoring," *Int. J. Distrib. Sens. Netw.*, vol. 5, no. 6, pp. 729–747, 2009.

[4] A. Mainwaring, D. Culler, J. Polastre, R. Szewczyk, and J. Anderson, "Wireless sensor networks for habitat monitoring," in *Proc. 1st ACM Int. Workshop Wireless Sens. Netw. Appl.*, New York, NY, USA, Sep. 2002, pp. 88–97.

[5] J. Zhang, W. Li, Z. Yin, S. Liu, and X. Guo, "Forest fire detection system based on wireless sensor network," in *Proc. 4th IEEE Conf. Ind. Electron. Appl.*, Xi'an, China, May 2009, pp. 520–523.

[6] L. Ruiz-Garcia, L. Lunadei, P. Barreiro, and I. Robla, "A review of wireless sensor technologies and applications in agriculture and food industry: State of the art and current trends," *Sensors*, vol. 9, no. 6, pp. 4728–4750, Jun. 2009.

[7] N. Wang, N. Zhang, and M. Wang, "Wireless sensors in agriculture and food industry–recent development and future perspective," *Comput.Electron. Agriculture*, vol. 50, no. 1, pp. 1–14, Jan. 2006.

[8] A. Wheeler, "Commercial applications of wireless sensor networks using zigbee," *IEEE Commun. Mag.*, vol. 45, no. 4, pp. 70–77, Apr. 2007.

[9] W. Chen, L. Chen, Z. Chen, and S. Tu, "Wits: A wireless sensor network for intelligent transportation system," in *Proc. 1st Int. Multi-Symp. Comput.Comput. Sci.*, Hangzhou, China, Jun. 2006, vol. 2, pp. 635–641.

[10] B. Hull, V. Bychkovsky, Y. Zhang, K. Chen, M. Goraczko, A. Miu, E. Shih, H. Balakrishnan, and S. Madden, "Cartel: A distributed mobile sensor computing system," in *Proc. 4th Int. Conf. Embedded Netw. Sens. Syst.*, New York, NY, USA, Oct. 2006, pp. 125–138.

[11] L. Yu, N. Wang, and X. Meng, "Real-time forest fire detection with wireless sensor networks," in *Proc. Int. Conf. Wireless Commun.*, *Netw. Mobile Comput.*, Wuhan, China, Sep. 2005, vol. 2, pp. 1214–1217.

[12] X. Li, A. Nayak, and I. Stojmenovic, *Sink Mobility in Wireless Sensor Networks*. Hoboken, NJ, USA: Wiley, 2010, pp. 153–184.

[13] E. Ekici, Y. Gu, and D. Bozdag, "Mobility-based communication in wireless sensor networks," *IEEE Commun. Mag.*, vol. 44, no. 7, pp. 56–62,Jul. 2006.

[14] J. Luo, J. Panchard, M. Pirkowski, M. Grossglauser, and J.-P.Hubaux, "Mobiroute: Routing towards a mobile sink for improving lifetime in sensor networks," in *Distributed Computing in Sensor Systems*, P. Gibbons, T. Abdelzaher, J. Aspnes, and R. Rao, Eds. Berlin, Germany: SpringerVerlag, 2006, pp. 480–497.