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Review Paper on Data Gathering Techniques Based on Mobile Sink in WSN

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Abstract: The main problem with fixed sink WSN network is energy hole creation near to the fixed sink node. This problem's resolution is explored by distributing the energy consumption in many wireless sensors by using the mobile sink node concept. The mobile sink method of data gathering is much more efficient as compared to static sink design due to which it has attracted so much of attention in recent times. However, the path which the mobile sink follow while moving in the network area is the topic of extensive research. The optimization of the moving trajectory of mobile sink plays a vital role in making a WSN's design energy efficient.

Keywords: Mobile sink, Data gathering, WSN, PDA, MSDG

I. INTRODUCTION

Wireless sensor network is one of the most important technologies for the twenty –first century. Tremendous research work has been done in the of wireless sensor network in the last few years. A WSN is mode of larger number of sensors which are low cost and have low power sources. The purpose of the sensors is to monitor and measure different ambient conditions from the surrounding environment. In WSN sensing nodes cover a specific area and they are distributed in a manner so that they cooperatively monitor environmental or physical condition e.g. pressure, temperature, sound, humidity, vibration, motion and pollutants at different locations.

The density [1] of the sensors nodes for any particular area is high neighbour nodes may be very close to each other. Hence multi hop communication in wireless sensor network is expected to save power than the traditional single hop communication. The wireless sensor network consist of one or more base Station called sink node and any from tense or thousands of sensor nodes which are scattered in a physical space. Some important applications [2] of the wireless sensor network are: Environmental, military surveillances, water monitoring patient monitoring Warehouses, Factories, Gas and electric meters, CO and H2O detectors etc.

II. NETWORK DESIGN CHALLENGES AND ROUTING ISSUES IN WSNS

There are several network constraints faced in design of wireless sensor network. Limited availability of network resources [3] like CPU, energy, bandwidth, storage capacity pose a challenges in these networks. Following are the main aspects involved in the design challenges of these networks.

Limited energy capacity: The energy capacity of a sensor network is limited as they are battery powered. In hostile condition it poses a major challenge like in a battlefield it is impossible to change the battery of the network sensor.

Sensor Locations: managing locations of the sensors in another big challenge faced in design of the wireless sensors.

Limited hardware recourses: along with the problem of limited energy, other common problem faced is of limited storage capacity and limited processing capacity. WSNs have a very limited capability to perform computational functionalities. Massive and random node deployment: The fashion of sensor node deployment also affects the performance of WSN. Sensors can be deployed either in random manner of can be deployed manually.

Network characteristics and unreliable environment: The working environment for a sensor network is often unreliable and dynamic. There are several reasons like node failure due to lack of power, server addition or deletion, damages to nodes or energy depletion which cause network topology to change frequently.

Data aggregation: WSN network may face a condition where sensor nodes may generate packets which are redundant packets from different nodes may be aggregated so that the number of transmissions required is reduced.

Scalability: Routing protocols should be capable to cop up with the network size. Even the sensors deployed in different kind of networks may not have same properties and capabilities like processing capacity, energy and communication.

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III. DIFFERENT TECHNIQUES

The sensor nodes in WSN have limited calculation ability, storage memory, wireless transmission range and energy so the nodes can only perform perception and exchange of information with neighbour nodes. In data gathering applications the sink node makes the routes for data transmission. But sink node mobility bring about the link breaking off. If the route is rebuilt repeatedly the energy consumption of the network will be increased also the continuously data transmission can block the network. Based on these limitations and data gathering applications which support the mobile sink following algorithms are proposed:

3.1 SIDG-MG Algorithm

The SIDG-MG algorithm is derived from the swarm intelligence and techniques of load balancing. Rules of swarm intelligence typically like the preying behaviour has been used in this algorithm. As we know that in case of preying, if any one comes to know about food, others will learn from him and they will learn his territorial behaviour as well[4]. This will enable everyone in the group to find food. This model has been compared with the WSN and the sink node is considered as the food source. The data gathering process is compared to the swarm foraging action. The sink node periodically broadcasts its location so that the other nodes come to know about its location. The nodes within the region receive this information and start sending data to it. The external nodes which are outside of the region sense this event of data transmission between sensor node and sink node and they learn the location of the sink node indirectly. After learning the location of the sink node, they start sending data to it.

3.2 Pre-Diffusion Algorithm

In wireless sensor network the whole network is divided into clusters and each of the sensor node is assigned to any of these clusters based on the clustering algorithm implemented. The sensor node sends its data directly to the CH. The mobile sink which a device having no constraint of buffer location and power, traverses through the network and broadcasts the beacon message informing the sensor nodes about its location. After sensing the sink's location the sensors inform their CH which in turn sends data to sink node. Since the mobile sink moves according to a pattern, its position can be predicted easily.

Whenever the sink broadcasts its beacon its location is exposed[5]. If a CH receives control messages from two of its neighbour CHs then most probably it will communicate with MS if its direction is not suddenly changed. The basic idea of this protocol is that the predicted next CH where MS has to arrive will converge the data before MS actually arrives to it so that the data communication between the CH and MS will be efficient and will take lesser time.

3.3 MSDG Algorithm

Data gathering technique for MSDG uses the sink mobility and routing strategy jointly [6]. First of all an optimal mobile sink trajectory is decided by doing theoretical analysis which also ensures that the data gathering process remains energy efficient. After this dynamically a spanning tree is made starting from the sink to reach each of the CH of the network. In this process the sink communicates to its neighbours directly and sends data query request to them. After clustering, the sink chooses the nearest fixed nodes as root nodes to build the spanning tree. The CH aggregates the data and does the required calculation and then sends the data hop by hop to the sink node following the spanning tree. MSDG is a data gathering protocol based on distributed clustering and mobile sink. It performs optimization of intra cluster scheduling of nodes, parallel division of TDMA time slots within cluster and dynamic formation of routing tree for data gathering according to the decided trajectory of sink.

IV. LITERATURE REVIEW

P. Madhumathy et al. in [7] proposed a mobile sink based reliable and energy efficient data gathering scheme for wsn. The sensor node senses the data and when the data is ready for transmission it encodes and communicates the required data to sink. The mobile sink, upon receiving the encoded data from sensor node, decodes and stores the resulting block in local storage buffer. The original message bundle is reconstructed by the MS after successfully decoding of all the blocks. The problem of packet loss in a particular region can be solved by increasing the halt time of MS in that particular region. Simulation result shows the increased reliability and energy efficiency.

Ke Tian et al. in [8] discussed about the recent attraction that WSN with mobile sync have received recently. The concept of free and unpredicted movement of mobile sync has been discussed. The main focus in this paper is on two efficient protocols for data gathering namely AVRP and TRAIL. The first protocol i.e. AVRP, adopts Voronoi scoping plus dynamic anchor selection to handle the sink mobility issue. In TRAIL which is the second protocol discussed, mobile sync trail is issued to guide packet forwarding for sync movement in the network.
TRAIL uses integration of random walk and trail based forwarding to forward a data packet. The condition when no fresh trail of sync is known, random walk is used; whenever a sensor reaches on a fresh sink trail, data packet is forwarded along the trail. TRAIL is simple protocol to implement. Protocol overhead is also small in case of TRAIL. As per simulation results, AVRP is suitable for heavy traffic mWSNs while TRAIL is suitable for light traffic mWSNs. Yasir Faheem et al. in [9] discussed the mobile sink based data gathering approaches to distribute energy consumption in WSN. In order to ensure multi-hop connectivity, the basic need of sync mobility algorithms is

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that the sink has to periodically update its location to the network. Flow of this additional information in the network increases the control traffic overhead and hence energy consumption is also increased. The author has proposed a mechanism to distributive energy efficient sink location update for mobile sink WSNs, along with a data collection technique for preemptive buffering. The sink location update mechanism is a combination of MPR based broadcast algorithm and a distributed local repair mechanism, whereby, sensor nodes dynamically control the scope of sink location update messages. Sink's neighbor nodes play role of temporary data collection points in preemptive buffering technique, these collection points are called roots, This prevents data loss when sink moves out of their vicinity. This technique effectively reduces the energy consumption and data losses of the network. Weifa Liang et al. in [10] explored the option of mobility of a mobile sink in a WSN to prolong the network lifetime. The movement of mobile sync is assisted either by petrol or electricity hence the total travel distance of the sink shall be bounded. If the data loss during transition of mobile sink from current location to its next location is to be restricted, its movement distance is to be restricted to minimum. The protocol overhead that is generated in tree construction at each sojourn location of the mobile sink requires that the mobile sink halts at each of the sojourn location for at least some amount of time. The emphasis in this paper is on a solution such that the sum of sojourn times in the tour is maximized. The authors first formulated the problem as a mixed integer linear programming (MILP). Due to its NPhardness, then they devised a novel heuristic for it. Then they evaluated the performance of the algorithm in terms of network lifetime. The experimental results demonstrated that the solution delivered by the proposed heuristic is nearly optimal which is comparable with the one by solving the MILP formulation but with much shorter running time.

Hidehisa Nakayama et al. in [11] discussed the advancement in technologies such as micro electro mechanical systems (MEMS) which have empowered more efficient and smaller digital devices. These devices can be deployed in WSNs to collect information pertaining to a particular environment. To effectively control the physical systems in a WSN, actuators can be used to integrate environmental information into the automation control system. Sophisticated entities deployed in wireless sensor and actuator networks (WSANs) act as functional robots. As an example of the actuator to control the sink, the concept of mobile sink has been adopted to achieve high efficiency in terms of gathering data from the sensors. Many methods exist which guide the usage of mobile sink as actuator, but most of these methods fail to ensure that the data is gathered from all the sensor nodes. So, the effort is to be done in the area to ensure the efficiency of data gathering technique. In WSANs, the administrator must be able to easily control the sink node and sensor nodes. So an energy efficient method must be devised to access and control all the nodes in the target network area. The authors of the paper have adopted the set packing algorithm and traveling salesman problem approach to reach the desired goal. They have established the efficiency of their approach using the simulation results.ShaoJie Tang et al. in [12] discussed the benefits of using mobile sink to prolong sensor network lifetime. The authors investigated the optimum routing strategy for the static sink in the sensor network. They further proposed a number of motion patterns for the mobile sink(s) to gather real time data from static sensor network, with the objective to maximize the network lifetime. They considered a more realistic model where the movement speed and path for mobile sinks are constrained. The experiments show that their scheme can significantly prolong entire network lifetime and reduce delivery delay. Deepak Kumar et al in [13] compared the different routing protocol with mobile sink. WSN are categorising as static sink and mobile sink. In static sink energy consumption is not uniformly distributed whereas in mobile sink is used to avoid such problem. Mobile sink accumulate data from other nodes using one hop communication.

Jenq-ShiouLeu et al. in [14] propose a regional energy aware clustering with isolated nodes (REAC-IN) clustering method. In WSN energy efficiency is increase by a suitable clustering algorithm however it requires a additional overhead i.e Cluster head selection and cluster construction. In REAC-IN. CHs are selection is based on its weight whereas weight is determine by the residual energy of the each sensor node and regional average energy of all sensor node in a cluster.

Hiren K.Deva sarma et al. in [15] proposed a novel routing protocol supports mobile sensor node as well as sink. It has two phases such as setup phase and data forwarding phase. After deployment sensor node in the network clustering has to be done, each cluster has a gateway node, cluster head and some normal sensor nodes. This works on the energy consumption and the lifetime of the network. It also minimizes the control overhead and higher throughput. It also takes care of link failure search alternative route for deliver the data in case of link failure. Seungmin Oh et al. in [16] gives a novel communication protocol which finds the shortest path between the source nodes to a sink by interchange its routing table between the neighbouring cluster heads. By the studies find that the data distribution from source node to mobile sink is performed via the shared tree. Mobile sink establish a connection between the current standing clusters in to the root of the shared tree. By this source transfer the data to root and root send the data to the mobile sink. So that data from the source may always bypass to a mobile sink via shared tree this process consumes more energy of the node. So in this work simulation result of propose protocol find the shortest path and consumes less energy. Y. Shi and Y. T. Hou et al. in [17] discussed that complexity of network design is the reason due to which efficient

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algorithm development has been difficult to develop. They have worked on theoretical results of the movement of mobile sync station. They have mentioned that if the sync node can rest on some specified locations then the time span for halt at individual stations can be optimized to enhance the network life time. Depending on this, they concluded that if the sink node can stop at any point, then an algorithm can be developed to approximate the sink node location and data flow path to the sink node so that the life time of the network is maximum. M.Zhao, M.Ma & Y.Yang et al. in [18] discussed the concept of sink mobility and space division multiple access (SDMA) technique. Single hop communication method is used to communicate between any of the sensor node and the mobile sink so that the energy consumption is equal at all the sensor nodes. The concept of SDMA is implemented by equipping the mobile sink with multiple antennas so that multiple sensors can upload data simultaneously. Two techniques have been used to decide the usability of the joint implementation of SDMA and sink mobility. In one method, one mobile sink is used while in other multiple sinks are used. In the first method, the goal is to reduce the total time to gather data from sensor nodes. Trade off between the shortest path and full use of SDMA is consider to reach to optimum result. This study is named as MDG-SDMA. In the second method, the whole network area is divided into parts and each one has its own mobile sink. The data gathering time is now optimized within the region for each of the sink node. This study is named as mobile data gathering with multiple SenCars and SDMA (MDG-MS) problem. Simulations and results have been discussed to support the analysis of the author.

Table 1: Comparison of various optimization techniques

Techniques/ Parameters	SIDG-MS	PDA	MSDG
Node Deployment	Random	Random	Random
Length of data packet	512 bytes	2000bits	1024bits
Initial energy	50J	50J	50J
Sink speed	3 m/s	50 m/s	10 m/s
Energy efficient	better	good	Much better

V. CONCLUSION

In this paper we discuss the overview of different data gathering techniques like SIDG-MS, PDA and MSDG. The process of collecting data from sensor nodes to base station is known as data gathering. By efficient data gathering techniques we can improve the lifetime of the network. SIDG-MS is based on swarm intelligence and load balancing strategies. PDA is not useful for huge data collection in WSN. MSDG has better lifetime compare on other data gathering strategies.

REFERENCES

[1] Vidyasagar Potdar, Atif Sharif, Elizabeth Chang, “Wireless Sensor Networks: A Survey," IEEE International Conference on Advanced Information Networking and Applications Workshops, pp 636-641, 2009

[2] Jennifer Yick, Biswanath Mukherjee, Dipak Ghosal, “Computer Networks,” pp 2292-2330.

[3] Shio Kumar Singh 1, M P Singh 2, and D K Singh, “Routing Protocols in Wireless Sensor Networks –A Survey,” International Journal of Computer Science & Engineering Survey (IJCSES), Vol.1, No.2,pp 64-83, November 2010.

[4] Yongquan CHEN, Yunjian TANG, Guoqing XU, Huihuan QIAN and Yangsheng XU “A Data Gathering Algorithm based on Swarm Intelligence and Load Balancing Strategy for Mobile Sink” ,IEEE World Congress on Intelligent Control and Automation, pp 1002-1007, June 2011.

[5] Zhongyu Zhang, Zunwen He, Jianguang Jia, Cunxiang Chen, “A New Data Gathering Scheme for Trajectory Constrained Mobile Sink in WSN” ,2012

[6] Xu Jianbo, GUO Jian, Long Jing, Zhou Xinlian “Mobile Sink-based Data Gathering Protocol”, IEEE International Forum on Information Technology and Applications, pp 427-430, 2010.

[7] P. Madhumathy, D. Sivakumar, “Reliable Data Gathering by Mobile Sink for Wireless Sensor Networks”, IEEE International Conference on Communication and Signal Processing, pp 1348-1352 , April 3-5, 2014

[8] Ke Tian, Baoxian Zhang Kui Huang and Jian Ma, “Data Gathering Protocols for Wireless Sensor Networks with Mobile Sinks”, IEEE Communications Society, 2010.

[9] Yasir Faheem, Saadi Boudjit, Ken Chen, “Dynamic Sink Location Update Scope control Mechanism for Mobile Sink Wireless Sensor Networks”, eighth international conference on wireless on demand network systems and services, pp 171-178, 2011.

[10] Weifa Liang, Jun Luo, Xu Xu, “Prolonging Network Lifetime via A Controlled Mobile Sink in Wireless Sensor Networks”, IEEE Communications Society, 2010.

[11] Hidehisa Nakayama, Zubair Md. Fadlullah, Nirwan Ansari, Nei Kato, “A Novel Scheme for WSAN Sink Mobility Based on Clustering and Set Packing Techniques”, IEEE transactions on automatic control, Vol 56, NO. 10 pp 2381-2389, OCTOBER 2011.

[12] ShaoJie Tang, Jing Yuan, XiangYang Li, Yunhao Liu, GuiHai Chen, Ming Gu, JiZhong Zhao_ Guojun Dai, “DAWN: Energy Efficient Data Aggregation in WSN with Mobile Sinks”,

[13] Deepak Kumar, Deepali, “A Survey on Routing Protocols in Wireless Sensor Network Using Mobile Sink,” Int. Journal of Electrical & Electronics Engg. Vol. 2, pp 15-17,. Issue 1 2015.

[14] Jenq-Shiou Leu,Tung-Hung Chiang, Min-Chieh Yu, and Kuan-Wu Su, “Energy Efficient clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network With Isolated Nodes,” IEEE COMMUNICATIONS LETTERS, VOL. 19, NO. 2,pp 259-262, FEBRUARY 2015.

[15] Hiren Kumar Deva Sarma, Avijit Kar, Rajib Mall, “Energy Efficient Routing Protocol for Wireless Sensor Networks with Node and Sink Mobility” IEEE Sensors application symposium , pp.239-243, 2011.

[16] Seungmin Oh, Yongbin Yim, Jeongcheol Lee, Hosung Park and Sang-Ha Kim, “Non-Geographical Shortest Path Data Dissemination for Mobile Sinks in Wireless Sensor Networks,” IEEE vehicular technology conference, pp.1-5, sep 2011.

[17] Y. Shi and Y. T. Hou. “Theoretical results on base station movement problem for sensor network,” Proc. IEEE INFOCOM’08, pp. 376-384, 2008.

[18] M.Zhao, M.Ma, Y.Yang, “Efficient data gathering with mobile collectors and space division multiple access technique in wireless sensor networks” IEEE Transactions on Computers, vol.60, No.3, March 2011, pp. 400-417.