Middle-East Journal of Scientific Research 24 (Techniques and Algorithms in Emerging Technologies): 275-280, 2016
ISSN 1990-9233;

DOI: 10.5829/idosi.mejsr.2016.24.TAET23537

Efficient Data Gathering Using Mobile Collectors and Dual Data Uploading in Wireless Sensor Networks

[1]M. Papitha, [2]Dr. C. Suresh Gnana Dhas and [3]V. Shanmugavalli

[1]PG Scholar, Department of CSE,
Vivekanandha College of Engineering for Women, Tamilnadu, India
[2]HOD, Department of CSE, Vivekanandha College of Engineering for Women, Tamilnadu, India
[3]Assistant Professor, Department of CSE,
Vivekanandha College of Engineering for Women, Tamilnadu, India

Abstract: Wireless Sensor Network (WSN) is used as a bridge between the physical world of humans and virtual world of electronics. Wireless sensor networks are practical to collect preferred data using wireless communications but they have limited life because of inadequate power using batteries. Energy efficient data collection method is very important to operate wireless sensor network for a long time. This paper proposes a typical data collection tour using a mobile sink starts from a sensor node close to a base station, whereabouts all nodes of wireless sensor network by visiting each node return to the base station and uploads collected information to the base station. This method is time inefficient and each node spends battery power quickly. To reduce the power consumption in WSN by finding the compatible pairs of polling points becomes to achieve optimal overall spatial diversity. A data collection method is proposed to increase energy efficiency using a mobile sink. This result shows that the proposed data collection method decreases the energy consumption level by prolonging the lifetime of wireless sensor network.

Key words: Wireless sensor networks (WSN) · Compatible pairs · Sensor nodes · Polling Point · Data Gathering · Spatial diversity

INTRODUCTION

The innovation in wireless infrastructure and electronics has enable the expansion of low-cost, low-power and multifunctional sensors. Basically, each sensor node comprise sensing, processing, transmission, power unit and some optional components (e.g. mobilize, position system) [1]. Typically, WSNs contain a large number of sensor nodes. These sensors have the ability to communicate with each other and also can be linked to gateways (sinks or base stations) of WSNs. The measuring and monitoring data packets from multiple sensors are then processed and forwarded to external networks via sinks which act as gateways. This procedure is called data gathering [2]. Each sensor has the ability to collect and route data either to other sensors or to the sinks. The sinks can be fixed stations or mobile nodes that are connected to external infrastructure a network which delivers the data to a network operation control center.

Firstly, the number of sensor nodes in WSNs can be high, thus generate potentially large cumulative traffic. The aggregated traffic volume can be significantly large. Hence routing in WSNs requires fair load balancing of network and equal utilization of gateways. Secondly, sensors nodes are limited in power, computational capability and storage capacity. Thus, careful resource management is required in WSNs, especially energy efficient schemes. Energy efficient schemes extend the functionality of the network and prolong the network lifetime. Thirdly, WSNs are application-specific and the plan requirements of networks modify with different applications. Last but not least, the network topology changes due to power failure of sensors or loss of

Corresponding Author: M. Papitha, PG Scholar, Department of CSE,
Vivekanandha College of Engineering for Women, Tamilnadu, India.

connections of sensors, which requires instant re-organizations. This is to say, the routing algorithm should be adaptable to accommodate the changes of network topologies.

MIMO (Multiple-Input and Multiple-Output) has been proven to be able to offer much higher throughput (Multiplexing (MUX) gain) or more reliable communication (Diversity (DIV) gain) than a Single-Input Single-Output (SISO) system [3] to achieve time and energy saving, both of which are crucial for data collection in WSNs. To harvest MIMO gains in WSNs, self-governing paths between the transmit and receive sides can be realized by having spatially separated nodes functioned as a VMIMO node [4]. The VMIMO technique allows several senor nodes emulate a multi-antenna node to achieve MIMO communications [5]. The VMIMO technique allows small devices to harvest MIMO gains to WSNs and brings benefit of energy and time saving. It has been shown to improve network lifetime, throughput and reduce the communication latency [3].

Related Work

Load Balanced Based Routing: In data collection scenarios, sinks are responsible for aggregating all the data packets generated within WSNs. Thus, in order to route the packets for far-away sensors, the sensors near the sinks are more likely to be energy-drained quickly. Because of the low-cost tiny devices, the operation of the network is highly energy sensitive. The lifetime of the system mainly depends on the power of the sensor nodes, which relays [6] all messages to the sinks on the last hop. The nodes close to the gateways are more likely to deplete their battery supplies. The node death would lead to disruption in the topology and decrease of sensing reporting beside, gateways/sinks may become isolated wherein sensor data would no longer be obtained. Moreover, the self-organizing ad-hoc behaviour of a large number of sensor nodes may cause severe unbalanced traffic through the network. Therefore, routing protocols [7] should incorporate load-balancing in order to reach logical power consumption all through the network. By distributing traffic among different paths properly, network service quality can be guaranteed and network energy consumption levels are able to be fairly distributed, hence ensuring the network QoS performance and prolonging the network lifetime.

Routing Designs with VMIMO: MIMO (Multiple-Input Multiple-Output) is a process for multiply the capability of a radio link using multiple transmit and receive antennas to improve transmission reliability or increase data rate. MIMO is used to send and receive more than one information signal on the same radio channel at the same time via multipath propagation [8]. Under a known authority financial plan and vanishing conditions, MIMO infrastructure offer much higher throughput (Multiplexing (MUX) gain) or more reliable communications (Diversity (DIV) gain) than Single-Input Single-Output (SISO) systems [3]. However, due to the size considerations, it may be impractical to mount multiple antennas on a sensor node. To harvest MIMO gain in WSNs, self-sufficient path connecting the broadcast and obtain sides can be realized by having multiple spatially separated nodes functioned as a VMIMO node [4]. Virtual MIMO, sometimes referred to as distributed MIMO, cooperative MIMO [9], networked MIMO or multi-user MIMO, allows several nodes which are equipped with one or more antennas to emulate a multi-aerial joint, also known as a Virtual Antenna Array (VAA). VMIMO allows small devices to harvest MIMO gains and it has been shown to improve network lifetime, throughput and reduce the communication delay.

Proposed Work: The proposed system includes solving the problem of how to find polling points and compatible pairs for each cluster. A discretization scheme is developed to partition the continuous space to locate the optimal polling point for each cluster. Then finding the compatible pairs becomes a matching problem to achieve optimal overall spatial diversity. The second problem is how to schedule uploading from multiple clusters. An algorithm that adapts to the transmission scheduling algorithms is included.

The initial step in the software development life cycle is the identification of the problem. As the success of the method depends mainly on how exactly a problem is recognized. At present distributed load balanced clustering algorithm is presented at the sensor layer in which the essential operation of clustering is the selection of cluster heads. To prolong network lifetime, it is naturally expected the selected cluster heads are the ones with higher residual energy.

Hence, the percentage of residual energy of each sensor is used as the initial clustering priority. It is also assumed that a set of sensors, denoted by S = {s1, s2, …, sn}, are homogeneous only. Since there is no application with the feature to have heterogeneous nodes in the network and to achieve optimal overall spatial diversity along with schedule uploading from multiple clusters, this project solves the problem through the application.

System Overview:

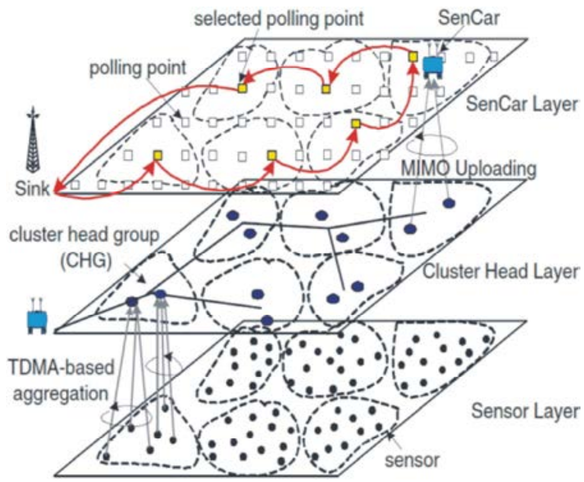

Fig: 3.1 System Overview

Data Collection and Routing Mechanisms for WSNs: The conservative data collection and routing mechanisms for WSNs can be generally divided into two categories:

- Event-based data collection: In this data collection, sensors are in charge for detecting and reporting a particular result to individual or other sinks.
- Periodic data collection: In periodic data collection, all sensor nodes sometimes change their comments to the sink based on the most recent information of the fascinated data. In addition, in multi hop-relay [10] [11] data delivery, typical conventional WSNs relay sensor observations to a sink via a tree-based structure.

However, multi hop-relay [12] approaches without doubt involve huge amounts of data exchange between nodes, as well many outlay to maintain the network architecture.

Clustering in Wireless Sensor Network: In clustering, the sensor nodes are partition into different clusters. Each cluster is supervised by a node referred as cluster head (CH) and other nodes are referred as sensor nodes. Sensor nodes do not communicate directly with the sink node. They have to surpass the collected data to the cluster head. Cluster head will gather the data, received from cluster nodes and transmit it to the base station. Thus minimizes the use of energy and number of messages communicated to BS. Also numbers of active nodes in contact are decreased. The result of clustering the sensor nodes is to expand the network duration.

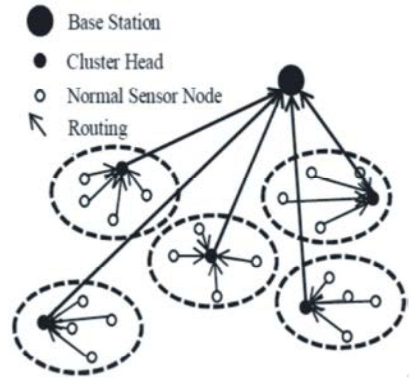

Fig. 3.2: Cluster Sensor Nodes

- Sensor Node: It is the most important component of wireless sensor network that has the capacity of processing, sensing, routing, etc.
- Cluster Head: The Cluster head (CH) is considered as a leader for that exact cluster. And it is in charge for separate actions passed out in the cluster, such as data gather, broadcast of data to BS, scheduling in the cluster, etc.
- Base Station: BS is considered as a principal data gathering [13] node for the entire sensor network. It act as the bridge (via communication link) between the sensor network and the end user. Usually this node is considered as a node with no power constraints.
- Cluster: It is the structural unit of the network, produced to make the Communication straightforward in the sensor network.

Spatial Correlation: Usual WSN applications call for spatially crowded sensor deployment in order to achieve satisfactory coverage. Consequently, multiple sensors trace information about a single particular event in the sensor field. Due to high density in the network topology, spatially proximal sensor explanation are extremely correlated with the degree of correlation increasing with decreasing inter node separation.

An ideal setting of sensor nodes has been considered, i.e., sensors arranged on an N X N grid. The central agent or the base station is assumed to be located at the origin (0, 0). The transmitting power of the sensors has been assumed to be limited such that each sensor node can communicate only with its four neighbors on either side of the grid. Spatial correlation has been modeled by assuming that each sensor can record the information in a K x K square. K is referred to as the correlation parameter that can depend on the intensity of the information individual sense.

For example, a volcanic eruption may be recorded by many more sensors and would correspond to a much higher K than a campfire. The proposed opportunistic aggregation algorithms are expected to work well simultaneously for a wide range of correlation parameter.

RESULTS AND DISCUSSION

In this simulation, input and output for Load Balanced Clustering and Dual Data Uploading by utilizing multi-user multiple-input and multiple-output (MU-MIMO) technique is given below.

The following Table 4.1 describes experimental result for comparison between existing and proposed aggregation data scheme system. The table contains number of cluster, cluster range and amount of aggregated information and standard aggregated information in existing and proposed system details are shown

Table 4.1: Comparison between Existing and proposed Aggregation Scheme

S.no	No.of Cluster	No.of Aggregation Data Ex Scheme	Pro Scheme	Existing Scheme (%)	Proposed Scheme (%)
1	2 Cluster	558	580	69.75	72.5
2	3 Cluster	574	597	71.75	74.62
3	4 Cluster	570	578	71.25	72.25
4	5 Cluster	542	557	67.75	69.62
5	6 Cluster	566	579	70.75	72.37
6	7 Cluster	563	569	70.375	71.12
7	8 Cluster	558	580	69.75	72.5
8	9 Cluster	574	597	71.75	74.62

Key in plan is the procedure of converting user-originated inputs to a computer understandable format. There are two input forms present in the project. The first form is Node addition Form, In this form, the ID of the node, name of the node, initial X and Y Positions of the node details are keyed in and saved in 'Nodes' table. The inputs are obtained from the user. And the typed inputs are keyed in via the TextBox Controls and stored into the database. The second form is Battery Status Update Form In this form, the node id is selected and battery percent is updated. The details are keyed in and saved in 'Battery Status' table.

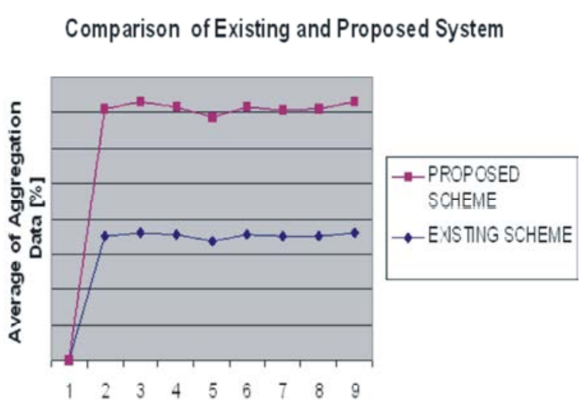

Fig. 4.1: Comparison between Existing and proposed Aggregation Scheme

Output design generally refers to the results and information that are generated by the system for many end-users. There are two output forms implemented the first form is Node List Form the second form is Battery Status List Form in this the status of the battery percentage of the nodes will be displayed as output. In this form, the node id is selected and battery percent is updated. In such a way the forms Mobile Data Gathering [14]-Status Claim, Cluster Forming and Receive Packet Algorithms are used to displays the process output of the proposed scheme through the Rich TextBox Control.

The data collection method is used to collect the aggregate data from the sensor node to the base station. The main object of the data collection [15] process is to reduce the delay and improves the network's lifetime and to find polling points and compatible pairs for each cluster. Then carry out the achievement of optimal overall spatial diversity and to schedule uploading from multiple clusters. By properly selecting polling points in each cluster SenCar can powerfully gather data from cluster heads and transport the data to the static data sink. The following Fig 4.2 describes experimental result for proposed system aggregation scheme analyses are shown.

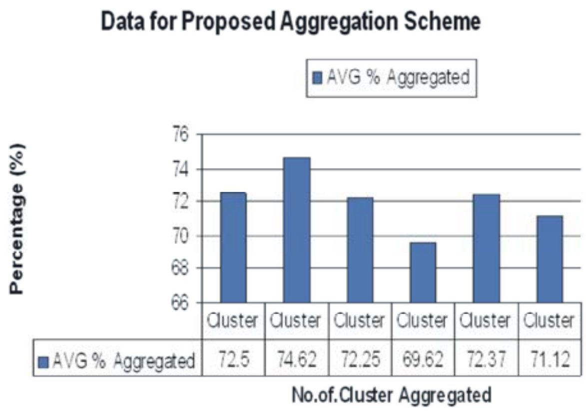

Fig. 4.2: Aggregation Scheme- Proposed System

CONCLUSION AND FUTURE WORK

Through this mobile data gathering framework for mobile data collection is proposed in a Wireless Sensor Network. It consists of sensor layer, cluster head layer and SenCar layer. It employs distributed load balanced clustering for sensor self-organization, adopts collaborative inter-cluster communication for energy-efficient transmissions among CHGs, use dual data uploading for fast data collection. In the cluster head layer, inter-cluster transmission range is selected to undertaking the connectivity between the clusters. Multiple cluster heads within a cluster are cooperating with each other to perform inter-cluster communications. Through inter-cluster transmissions, cluster head information is forwarded for its moving trajectory planning. The performance study demonstrates the effectiveness of the proposed framework. The result can considerably decline power consumption by alleviate routing burdens on nodes and balancing workload among cluster heads. It is also justified the energy overhead and explored the results with different numbers of cluster heads in the framework. A trial run of the system has been made and is giving good results the procedures for processing is simple and regular order. The process of preparing plans been missed out which might be considered for further modification of the application.

REFERENCES

1. Al-Karaki, J. and A. Kamal, 2004. “Routing techniques in wireless sensor networks: a survey," IEEE Wireless Communications, 11(6): 6-28, Dec 2004.
2. Ben Hamida, E. and G. Chelius, 2008. “Strategies for Data Dissemination to Mobile Sinks in Wireless Sensor Networks, "IEEE Wireless Communications, 15(6): 31-37.
3. Nguyen, D.N. and M. Krunz, 2014. “A cooperative MIMO framework for wireless sensor networks," ACM Trans. Sen. Network, 10(3), May 2014.
4. Dohler, M., E. Lefranc and H. Aghvami, 2002. “Virtual antenna arrays for future wireless mobile communication systems," Publishing House of Electronics Industry, 2: 501-505,
5. Yuan, Y., M. Chen and T. Kwon, 2006. “A novel cluster-based cooperative MIMO scheme for multi-hop wireless sensor networks," EURASIP J. Wireless Communication Network, pp: 38-38, Apr. 2006.
6. Ergen, S.C. and P. Varaiya, 2010. “TDMA scheduling algorithms for wireless sensor networks,” Wireless Network, 16(4): 985-997, May 2010.
7. Manjeshwar, A. and D.P. Agrawal, 2001. “Teen: A routing protocol for enhanced efficiency in wireless sensor networks,” in Proc. 15th Int. IEEE Parallel Distributed Process. Symp., Apr. 2001, pp: 2009-2015.
8. Lipfert, H., 2007. MIMO OFDM Space Time Coding-Spatial Multiplexing Increasing Performance and Spectral Efficiency in Wireless Systems, Part I Technical Basis (Technical report). Institute for Rundfunktechnik.
9. Jayaweera, S., 2006. “Virtual MIMO-based cooperative communication for energy-constrained wireless sensor networks,” IEEE Trans. Wireless Communication, 5(5): 984-989, May 2006.
10. Xu, K., H. Hassanein, G. Takahara and Q. Wang, 2010. “Relay node deployment strategies in heterogeneous wireless sensor networks,” IEEE Trans. Mobile Computer, 9(2): 145-159, Feb. 2010.
11. Zhao, M. and Y. Yang, 2012. “Bounded relay hop mobile data gathering in wireless sensor networks,” IEEE Trans. Computer, 61(2): 265--271, Feb. 2012.
12. Lee, E., S. Park, F. Yu and S.H. Kim, 2010. “Data gathering mechanism with local sink in geographic routing for wireless sensor networks,” IEEE Trans. Consumption. Electron, 56(3): 1433-1441, Aug. 2010.
13. Zhao, M., M. Ma and Y. Yang, 2011. “Efficient data gathering with mobile collectors and space-division multiple access technique in wireless sensor networks,” IEEE Trans. Computer, 60(3): 400-417.

14. Zhang, Z., M. Ma and Y. Yang, 2008. "Energy efficient multi-hop polling in clusters of two-layered heterogeneous sensor networks," IEEE Trans. Computer, 57(2): 231-245, Feb. 2008.
15. Gedik, B., L. Liu and P.S. Yu, 2007. "ASAP: An adaptive sampling approach to data collection in sensor networks," IEEE Trans. Parallel Distributed System., 18(12): 1766-1783, Dec. 2007.