IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 4, April 2017

Energy Efficient Routing and Data Gathering With Load Balanced Clustering in Wireless Sensor Networks

D. Mohana Divya B.E., M.E. [1], B. Prasath B.E., M.E.,[2]

CSI College of Engineering, The Nilgiris[1]

Assistant Professor, CSE Dept, CSI College of Engineering, The Nilgiris[2]

Abstract: Data gathering is a common but critical operation in many applications of wireless sensor networks. Innovative techniques that improve energy efficiency to prolong the network lifetime are highly required. Clustering is an effective topology control approach in wireless sensor networks, which can increase network scalability and lifetime. The framework employs distributed load balanced Clustering and dual data uploading, which is referred to as LBC. A distributed load balanced clustering (LBC) algorithm is proposed for sensors to self-organize themselves into clusters. We used mobile divider for split the data about cluster and cluster head calculation. In contrast to existing clustering methods, our scheme generates multiple cluster heads in each cluster to balance the work load and facilitate dual data uploading. The trajectory planning for Mobile collector is optimized to fully utilize dual data uploading capability by properly selecting polling points in each cluster. By visiting each selected polling point, Mobile collector can efficiently gather data from cluster heads and transport the data to the static data sink. Extensive simulations are conducted to evaluate the effectiveness of the proposed LBC schemes.

Keywords: Wireless Sensor Networks, Load balanced Clustering, Energy Data Gathering.

I. INTRODUCTION

A wireless sensor network (WSN) of spatially distributed autonomoussensors 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. wireless sensor networks was motivated by military applications such as battlefield surveillance; consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. In such applications, sensors are generally densely deployed and randomly scattered over a sensing field and left unattended after being deployed, which makes it difficult to recharge or replace their batteries. After sensors form into autonomous organizations, those sensors near the data sink typically deplete their batteries much faster than others due to more relaying traffic. When sensors around the data sink deplete their energy, network connectivity and coverage may not be guaranteed. Due to these constraints, it is crucial to design an energy-efficient data collection scheme that consumes energy uniformly across the sensing field to achieve long network lifetime.

In previous framework, we used scheme called Ring Routing, a novel, distributed, energy-efficient mobile sink routing protocol, suitable for time-sensitive applications, which aims to minimize this overhead while preserving the advantages of mobile sinks. Ring Routing is a routing protocol targeted for large scale WSNs deployed outdoors with stationary sensor nodes and a mobile sink. Ring Routing uses greedy geographic routing as the underlying routing solution. Geographic routing is scalable and energy-efficient; therefore, it is an attractive routing solution for WSNs with position-aware sensors.
To overcome the difficulties in finding routes in case of topology defects many protocols that extend Load balanced clustering and routing have been proposed. A distributed load balanced clustering (LBC) algorithm is proposed for sensors to self-organize themselves into clusters. We used mobile divider for split the data about cluster and cluster head calculation.

In contrast to existing clustering methods, our scheme generates multiple cluster heads in each cluster to balance the work load and facilitate dual data uploading. The trajectory planning for Mobile collector is optimized to fully utilize dual data uploading capability by properly selecting polling points in each cluster. By visiting each selected polling point, Mobile collector can efficiently gather data from cluster heads and transport the data to the static data sink. Extensive simulations are conducted to evaluate the effectiveness of the proposed LBC schemes. Simulator to perform the current method. part II explain the background information about the energy efficiency routing schemes. part III discuss about the new proposed method. Finally simulation and results are discussed in part IV.

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 4, April 2017

II. RELATED WORK

It describes the concept of sensor networks which has been made viable by the convergence of micro-electro-mechanical systems technology, wireless communications and digital electronics. First, the sensing tasks and the potential sensor networks applications are explored, Sensor nodes are densely deployed. Sensor nodes are prone to failures. The topology of a sensor network changes very frequently. [3] [4] This approach provides significant performance improvements under various degrees and types of network congestions. To show this, we give a comprehensive comparison study of the various approaches to the data collection problem which considers performance, robustness, and adaptation characteristics of the different data collection methods. [5] Two novel random deployment strategies for RNs in both communication models, namely, lifetime-oriented deployment and hybrid deployment. We then analyze and compare the three deployment strategies (uniform, lifetime-oriented, and hybrid). Both theoretical analysis and simulated evaluation show that the new deployment strategies can effectively alleviate the BECR problem and extend the system lifetime. [7] data generated from the sources in the region are often redundant and highly correlated. Accordingly, gathering and aggregating data from the region in the sensor networks is important and necessary to save the energy and wireless resources of sensor nodes. The local sink is a sensor node in the region, in which the sensor node is temporarily selected by a global sink for gathering and aggregating data from sources in the region and delivering the aggregated data to the global sink. [8] study the construction of a data-gathering tree when there is a single base station in the network. The objective is to maximize the network lifetime, which is defined as the time until the first node depletes its energy. We prove that this problem is NP-complete, and hence too computationally expensive to solve exactly. By exploiting the unique structure of the problem, we obtain an algorithm that starts from an arbitrary tree and iteratively reduces the load on bottleneck nodes, i.e., nodes likely to soon deplete their energy due to either high degree or low remaining energy. [9] an adaptive strategy that makes data update decisions on the fly based on sensor readings to meet network lifetime requirements. The basic strategy applies directly to individual data collection where the application monitors the reading of an individual sensor node. The key idea is to take into consideration the possibility of update losses in estimating the importance of sensor readings. [10] analyze low-energy adaptive clustering hierarchy (LEACH), a protocol architecture for micro sensor networks that combines the ideas of energy-efficient cluster-based routing and media access together with application-specific data aggregation to achieve good performance in terms of system lifetime, latency, and application-perceived quality. [11] HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of their residual energy, such as nude proximity to its neighbors or node degree. HEED does not make any assumptions about the distribution or density of nudes, or about node capabilities, e.g., location-awareness. The clustering process terminates in O(1) iterations. And not depend on the network topology or sue. The protocol incurs low overhead in terms of processing cycles and messages exchanged. [12] novel clustering scheme for WSNs with mobile collectors, with the objective to maximizing network lifetime (number of rounds of data collection until the first node dies), by taking the lossy nature of wireless links into consideration. We first give a network model for lossy WSNs, formulate the one-hop clustering problem under lossy links into an integer program, and prove that the problem is NP-hard. We then present a heuristic algorithm to construct one-hop clusters in a distributed manner. We further extend the clustering algorithm to form k-hop clusters, such that a sensor node selects the cluster head to which it has the most reliable path in its k-hop neighborhood.

III. PROPOSED METHOD

The main motivation is to utilize distributed clustering for scalability, to employ mobility for energy saving and uniform energy consumption, and to exploit Multiple-Input and Multiple-Output (MU-MIMO) technique for concurrent data uploading to shorten latency. The main contributions of this work can be summarized as follows.

We propose a mobile data collection framework, named Load Balanced Clustering (LBC). The main motivation is to utilize distributed clustering for scalability, to employ mobility for energy saving and uniform energy consumption.We propose a distributed algorithm to organize sensors into clusters, where each cluster has multiple cluster heads.Second, multiple cluster heads within a cluster can collaborate with each other to perform energy efficient inter-cluster transmissions.Third, we deploy a mobile collector with two antennas to allow concurrent uploading from two cluster heads by using MIMO communication. We used mobile divider for split the data about cluster and cluster head calculation. The Mobile collector collects data from the cluster heads by visiting each cluster. It chooses the stop locations inside each cluster and determines the sequence to visit them, such that data collection can be done in minimum time. Our work mainly distinguishes from other mobile collection schemes in the utilization of MU-MIMO technique, which enables dual data uploading to shorten data transmission latency. We coordinate the mobility of Mobile collector to fully enjoy the benefits of dual data uploading, which ultimately leads to a data collection tour with both short moving trajectory and short data uploading time. Here Achieve good scalability.Long network lifetime and low data collection latency. Reduced increased energy consumption. Energy balanced and high energy efficient.And to

DOI10.17148/IJARCCE.2017.64137

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 4, April 2017

exploit Multi-User Multiple-Input and Multiple-Output (MU-MIMO) technique for concurrent data uploading to shorten latency.

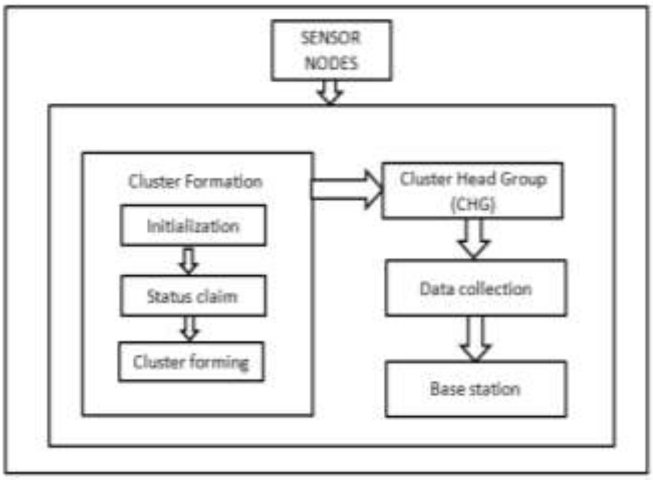


Fig.1. Proposed system design

Proposed Techniques
A. Load Balanced Clustering
The distributed load balanced clustering algorithm at the sensor layer. The essential operation of clustering is the selection of cluster heads. To prolong network lifetime, we naturally expect the selected cluster heads are the ones with higher residual energy. Hence, we use the percentage of residual energy of each sensor as the initial clustering priority.
Assume that a set of sensors, denoted by S={ s1;s2;...;sn}, are homogeneous and each of them independently makes the decision on its status based on local information. After running the LBC algorithm, each cluster will have at most M (1) cluster heads, which means that the size of CHG of each cluster is no more than M. Each sensor is covered by at least one cluster head inside a cluster. The LBC algorithm is comprised of four phases: (i) Initialization; (ii) Status claim; (iii) Cluster forming and (iv) Cluster head synchronization.

(i) Initialization
In the initialization phase, each sensor acquaints itself with all the neighbors in its proximity. If a sensor is an isolated node (i.e., no neighbor exists), it claims itself to be a cluster head and the cluster only contains itself. Otherwise, a sensor, say, si, first sets its status as “tentative” and its initial priority by the percentage of residual energy. Here neighbors with the highest initial priorities, which are temporarily treated as its candidate peers. We denote the set of all the candidate peers of a sensor byA. It implies that once si successfully claims to be a cluster head, its up-to-date candidate peers would also automatically become the cluster heads, and all of them form the CHG of their cluster.si sets its priority by summing up its initial priority with those of its candidate peers. In this way, a sensor can choose its favorable peers along with its status decision.
Algorithm 1, Initalization
1. Check sensor is an isolated node.
2. If isolated declare status
3. Cluster Head
4. Otherwise, first sets its status as “tentative
5. Sorts its neighbors by their initial priorities
6. Select highest initial priorities
7. Its candidate peers
8. successfully claims to be a cluster head

(ii) Status Claim
In the second phase, each sensor determines its status by iteratively updating its local information, refraining from promptly claiming to be a cluster head. We use the node degree to control the maximum number of iterations for each sensor. Whether a sensor can finally become a cluster head primarily depends on its priority. Specifically, we partition the priority into three zones by two thresholds, th and tm (th>tm), which enable a sensor to declare itself to be a cluster head or member, respectively, before reaching its maximum number of iterations. During the iterations, in some cases, if the priority of a sensor is greater than th or less than tm compared with its neighbors, it can immediately decide its final status and quit from the iteration.

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 4, April 2017

Algorithm 2, Status Claim
1. A sensor determines its status
2. iteratively updating its local information
3. Check its priority-high
4. declare itself to be a cluster head
5. Check priority-low
6. declare itself to be a cluster
7. packet includes its node ID
8. Receive packet
9. Send packet

(iii) Cluster Forming

The cluster head layer as aforementioned, the multiple cluster heads in a CHG coordinate among cluster members and collaborate to communicate with other CHGs. Hence, the inter-cluster communication in LBCDDU is essentially the communication among CHGs. By employing the mobile collector, cluster heads in a CHG need not to forward data packets from other clusters. Instead, the inter-cluster transmissions are only used to forward the information of each CHG to Base station.

The third phase is cluster forming that decides which cluster head a sensor should be associated with. The criteria can be described as follows: for a sensor with tentative status or being a cluster member, it would randomly affiliate itself with a cluster head among its candidate peers for load balance purpose. In the rare case that there is no cluster head among the candidate peers of a sensor with tentative status, the sensor would claim itself and its current candidate peers as the cluster heads. The details are given in Algorithm 3. It shows the final result of clusters, where each cluster has two cluster heads and sensors are affiliated with different cluster heads in thetwo clusters.

Algorithm 3 steps Cluster forming
1. Check status
2. If cluster head includes its ID
3. If cluster member send packet
4. Then status-cluster head
5. Send packet ID list

(iv) Cluster head synchronization.

In this phase, several cluster heads are elected. Nodes become CANDIDATE nodes with a probability T and then broadcast the COMPETE HEAD MSGs within radio range R compete to advertise their wills. Each CANDIDATE node checks whether there is a CANDIDATE node with more residual energy within the radius R compete. Once the CANDIDATE node finds a more powerful CANDIDATE node, it will give up the competition without receiving sub sequential COMPETE HEAD MSGs. Otherwise, it will be elected as HEAD in the end. It is necessary to propose a metric that quantifies how good a sensor node could be as a CH. This metric needs to take into account both the residual energy of sensor nodes in addition to the energy expenditure in transmitting data in intra-cluster communication.

B. Trajectory Planning

Optimize the trajectory of Base station for the data collection tour with the CHG information, which is referred to as the mobility control at the Base station layer. As mentioned in Section, Base station would stop at some selected polling points within each cluster to collect data from multiple cluster heads via single-hop transmissions. Thus, finding the optimal trajectory for Base station can be reduced to finding selected polling points for each cluster and determining the sequence to visit them.

The case that Base station is equipped with two antennas, as it is not difficult to mount two antennas on Base station, while it likely becomes difficult and even infeasible to mount more antennas due to the constraint on the distances between antennas to ensure independent fading. Note that each cluster head has only one antenna.

(i)Properties of Polling Points

We consider the case that SenCar is equipped with two antennas, as it is not difficult to mount two antennas on mobile collector, while it likely becomes difficult and even infeasible to mount more antennas due to the constraint on the distances between antennas to ensure independent fading. Note that each cluster head has only one antenna. The multiple antennas of mobile collector, which act as the receiving antennas in data uploading, make it possible for multiple cluster heads in a CHG to transmit distinct data simultaneously. To guarantee successful decoding when mobile collector receives the mixed streams, we need to limit the number of simultaneous data streams to no more than the number of receiving antennas.

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 4, April 2017

(ii) MU-MIMO Uploading
We jointly consider the selections of the schedule pattern and selected polling points for the corresponding scheduling pairs, aiming at achieving the maximum sum of MIMO uplink capacity in a cluster. We assume that mobile collector utilizes the minimum mean square error receiver with successive interference cancellation (MMSE-SIC) as the receiving structure for each MIMO data uploading.

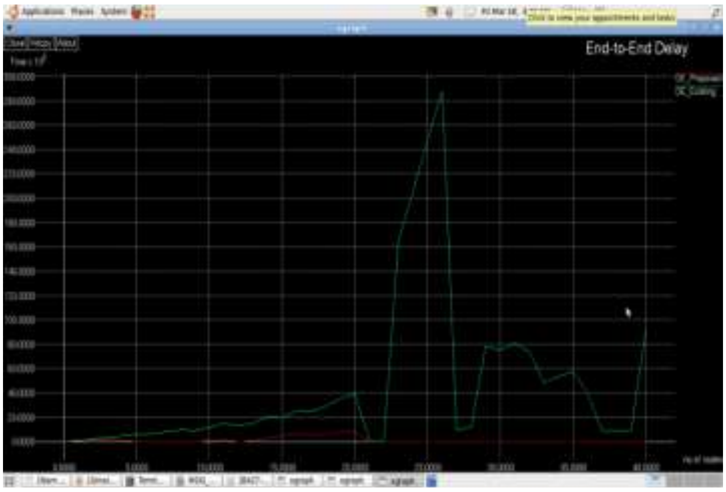
C. Data Collection with Time Constraints
When there are time constraints on data messages. In practice, it is common for some emergent data messages to be delivered within a specified deadline. If the deadline has expired and the message is yet to arrive at the destination, it would carry less value and cause performance degradation. In mobile data collection with dynamic deadline was considered and an earliest deadline first algorithm was proposed. In their solution, the mobile collector would visit the nodes with messages of the earliest deadline. Here, we extend and adapt their solutions to the clustered network. Our method is described in the following. First, the cluster heads collect data messages and calculate a deadline by averaging all the deadlines from messages in the cluster. All the clusters then forward their deadline information to Base station. The Base station selects the cluster with the earliest average deadline and moves to the polling point to collect data via MU-MIMO transmissions. After Base station finishes data gathering, it checks to see whether collecting data from the next polling point would cause any violations of deadline in its buffer. If yes, it immediately moves back to the data sink to upload buffered data and resumes data collection in the same way. By prioritizing messages with earlier deadlines, Base station would do its best to avoid missing deadlines. The results show that LBC-DDU can greatly reduce energy consumptions by alleviating routing burdens on nodes and balancing workload among cluster heads, which achieves 20 percent less data collection time compared to SISO mobile data gathering and over 60 percent energy saving on cluster heads. We have also justified the energy overhead and explored the results with different numbers of cluster heads in the framework.

IV. RESULTS AND DISCUSSION

We use Network simulator version-2 (NS2) to show the performance of our proposed scheme. A wireless sensor network consists of sensor nodes are randomly deployed in this simulation. We compared to existing scheme, our proposed scheme has better performance in terms of energy efficiency, Delay, and throughput. The following section shows the simulation parameters, results and comparison performance of the proposed system.

Performance Results
In this section, the performance of our protocol is compared with the existing method in terms of Delay, energy efficiency, and throughput.

Delay



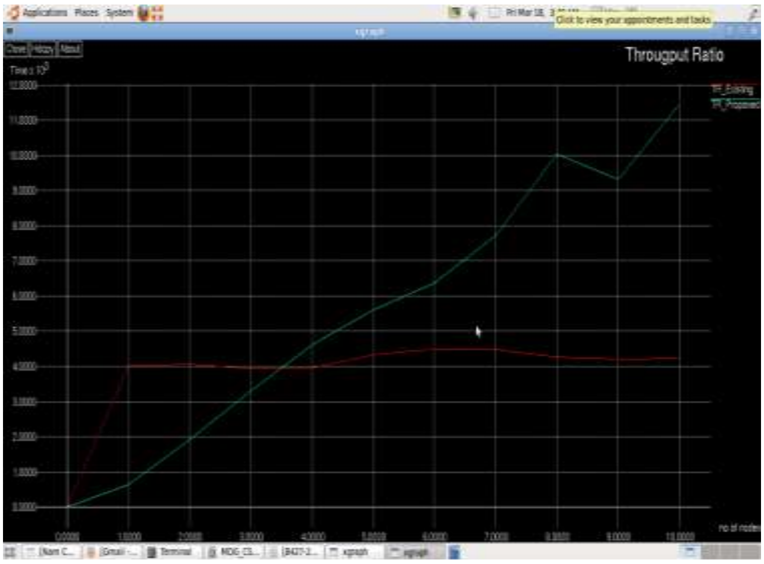
Above graph shows the comparison of existing and proposed scheme in terms of Delay. In this figure, the performance of proposed management scheme is reduced delay ratio level as compared to existing scheme.

ThroughputRatio
The following graph shows the comparison of existing and proposed scheme in terms of Throughput. In this figure, the performance of proposed scheme is good Throughput level as compared to existing scheme.

 DOI10.17148/IJARCCE.2017.64137

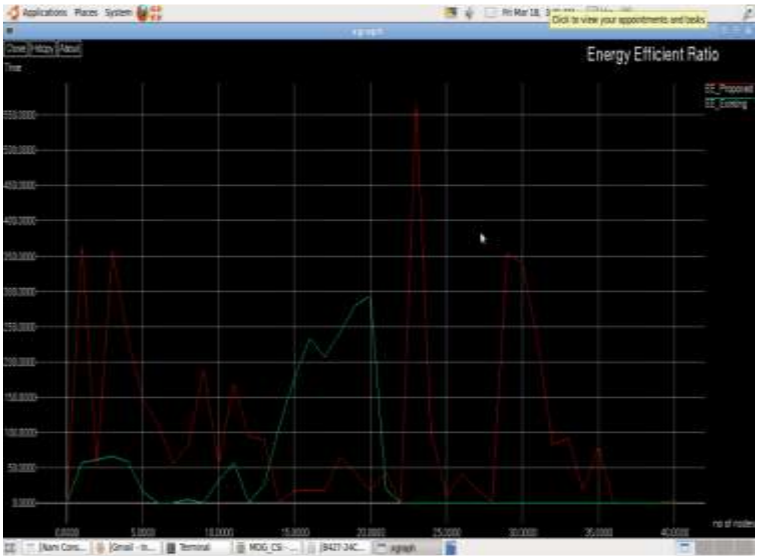
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 4, April 2017



Energy Efficiency Ratio

Bellow graph shows the comparison of existing and proposed scheme in terms of energy efficiency. In this figure, the performance of proposed scheme is good and high energy level as compared to existing scheme.



V. CONCLUSION

LBC framework for mobile data collection in a WSN. It consists of sensor layer, cluster head layer and Base station layer. It employs distributed load balanced clustering for sensor self-organization, adopts collaborative inter-cluster communication for energy-efficient transmissions among CHGs, uses dual data uploading for fast data collection, and optimizes mobile collector mobility to fully enjoy the benefits of MIMO.

Our performance study demonstrates the effectiveness of the proposed framework. The results show that LBC can greatly reduce energy consumptions by alleviating routing burdens on nodes and balancing workload among cluster heads, which achieves 20 percent less data collection time compared to SISO mobile data gathering and over 60 percent energy saving on cluster heads. We have also justified the energy overhead and explored the results with different numbers of cluster heads in the framework.

Finally, we would like to point out that there are some interesting problems that may be studied in our future work. The first problem is how to find polling points and compatible pairs for each cluster. A discretization scheme should be 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

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 4, April 2017

to schedule MIMO uploading from multiple clusters. An algorithm that adapts to the current MIMO-based transmission scheduling algorithms should be studied in future.

REFERENCES

[1] B. Krishnamachari, Networking Wireless Sensors. Cambridge, U.K.: Cambridge Univ. Press, Dec. 2005.
[2] R. Shorey, A. Ananda, M. C. Chan, and W. T. Ooi, Mobile, Wireless, Sensor Networks. Piscataway, NJ, USA: IEEE Press, Mar. 2006.
[3] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, “A survey on sensor networks,” IEEE Commun. Mag., vol. 40, no. 8,pp. 102–114, Aug. 2002.
[4] W. C. Cheng, C. Chou, L. Golubchik, S. Khuller, and Y. C. Wan, “A coordinated data collection approach: Design, evaluation, and comparison,” IEEE J. Sel. Areas Commun., vol. 22, no. 10, pp. 2004– 2018, Dec. 2004.
[5] K. Xu, H. Hassanein, G. Takahara, and Q. Wang, “Relay node deployment strategies in heterogeneous wireless sensor networks,” IEEE Trans. Mobile Comput., vol. 9, no. 2, pp. 145–159,Feb. 2010.
[6] O. Gnawali, R. Fonseca, K. Jamieson, D. Moss, and P. Levis, “Collection tree protocol,” in Proc. 7th ACM Conf. Embedded Netw. Sensor Syst., 2009, pp. 1–14.
[7] E. Lee, S. Park, F. Yu, and S.-H. Kim, “Data gathering mechanism with local sink in geographic routing for wireless sensor networks,” IEEE Trans. Consum.Electron., vol. 56, no. 3, pp. 1433– 1441, Aug. 2010.
[8] Y. Wu, Z. Mao, S. Fahmy, and N. Shroff, “Constructing maximum-lifetime data-gathering forests in sensor networks,” IEEE/ ACM Trans. Netw., vol. 18, no. 5, pp. 1571–1584, Oct. 2010.
[9] X. Tang and J. Xu, “Adaptive data collection strategies for lifetime-constrained wireless sensor networks,” IEEE Trans. Parallel Distrib. Syst., vol. 19, no. 6, pp. 721–7314, Jun. 2008.
[10] W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, “An application-specific protocol architecture for wireless microsensor networks,” IEEE Trans. Wireless Commun., vol. 1, no. 4, pp. 660– 660, Oct. 2002.
[11] O. Younis and S. Fahmy, “Distributed clustering in ad-hoc sensor networks: A hybrid, energy-efficient approach,” in IEEE Conf. Comput. Commun., pp. 366–379, 2004.
[12] D. Gong, Y. Yang, and Z. Pan, “Energy-efficient clustering in lossy wireless sensor networks,” J. Parallel Distrib. Comput., vol. 73, no. 9, pp. 1323–1336, Sep. 2013.