International Journal of Advanced Science and Research
ISSN: 2455-4227; Impact Factor: RJIF 5.12
Received: 28-07-2020; Accepted: 13-08-2020; Published: 29-08-2020
www.allsciencejournal.com
Volume 5; Issue 3; 2020; Page No. 31-35

Design and development of liveliness proficient sensual data assemblage by portable sinks consuming cluster created resorts bulge

S Ravichandran[1], S Karthika[2]
[1] Professor, Computer Science Department, Annai Fathima College of Arts & Science, Madurai, Tamil Nadu, India
[2] Assistant Professor, Computer Science Department, Annai Fathima College of Arts & Science, Madurai, Tamil Nadu, India

Abstract
In Wireless Sensor Networks (WSN) applications include a lot of disconnected urban zones secured by sensor Nodes (SNs) observing ecological parameters. Single-bounce move of information from SNs that exist in the MS's range or substantial contribution of system fringe hubs in information recovery, handling, buffering, and conveying assignments. These hubs risk quick vitality depletion bringing about loss of system availability and diminished system lifetime. Proposed framework targets limiting the general system overhead and vitality use related with the multi-hop information recovery measure while likewise guaranteeing adjusted vitality utilization among SNs and delayed system lifetime. This is accomplished through structure bunch structures comprised of part hubs that course their deliberate information to their relegated Centre head (CH). CHs perform information separating upon crude information abusing potential spatial-worldly information repetition and forward the sifted data to fitting end hubs with adequate leftover vitality, situated in closeness to the MS's direction. This methodology constructs a grouping structure on head of the sensor arrange. That way, high information collection proportions are conceivable since information from the hubs of a similar group for the most part are unequivocally related and subsequently total at each bunch head extensively diminishes the information sent to RNs. This thus prompts a lot of lower vitality utilization in the WSN and furthermore substantially less information are cradled at RNs, diminishing so the likelihood of cushion floods at a RN.

Keywords: multi-hop, WSN, sensor node (SN), RN, mobile sink (MS), beacon message

1. Introduction
An explanation of vitality going through in WSNs relates with conveying the sensor readings from the sensor hubs (SNs) to distant sinks. These readings are commonly handed-off utilizing specially appointed multi-hop courses in the WSN. A reaction of this methodology is that the SNs found near the sink are intensely used to transfer information from all system hubs; consequently, their vitality is expended quicker, prompting a no uniform consumption of vitality in the WSN [2]. This outcomes in arrange detachments and restricted system lifetime. System lifetime can be expanded if the vitality spent in handing-off information can be spared. Late exploration work has demonstrated the appropriateness of portable components (submarines, vehicles, versatile robots, and so forth.) for the recovery of tangible information from smart dust bits [3] in examination with multi-hop moves to a concentrated component. A versatile sink (MS) traveling through the system sending locale can gather information from the static SNs over a solitary jump radio connection when drawing nearer inside the radio scope of the SNs or with restricted bounce moves if the SNs are found further. This stays away from long-jump handing-off and lessens the vitality utilization at SNs close to the base station, drawing out the system lifetime. A huge class of checking applications include a lot of urban regions (e.g., urban stops or building obstructs) that should be observed concerning natural boundaries (e.g., temperature, dampness, contamination, light power), reconnaissance, fire identification, and so forth. In these situations, individual checked zones are commonly secured by confined "sensor islands," which makes information recovery fairly testing since portable hubs can't travel through however just methodology the fringe of the system arrangement locale. In such cases, various delegate hubs situated in the fringe of the sensor field can be utilized as "rendezvous" focuses wherein tactile information from neighbor hubs might be gathered lastly conveyed to a MS when the last methodologies inside radio range.

In this unique situation, the detail of the suitable number and areas of meeting hubs (RNs) is urgent. The quantity of RNs ought to be proportional (neither little nor very large) to the organization thickness of SNs. In this, we explore the utilization of MSs for proficient information assortment from "sensor islands" spread all through urban conditions. We contend that the ideal transporters of such MSs are open surface transportation vehicles (e.g., transports) that consistently follow a predefined direction with an intermittent timetable that may go along the border of the secluded sensor fields. Our proposed convention called vitality use related with the information recovery measure while likewise guaranteeing adjusted vitality utilization among SNs and delayed system lifetime. This is accomplished through structure group structures comprised of part hubs that course their deliberate information to their relegated bunch head (CH). The CHs perform information sifting upon the crude information misusing potential spatial-worldly information repetition and forward the separated data to their allotted RNs, regularly situated in vicinity to the MS's direction. We additionally present a

refined technique for selecting fitting hubs as RNs considering the sending example and thickness of sensor hubs. Last, we propose strategies for building versatile inter cluster overlay charts and procedures for decently disseminating tangible information among RNs and conveying information to MSs in nonintersecting time windows. The rest of this paper is sorted out as follows: Section 2 audits related work in the field. Area 3 subtleties the structure standards for DSR convention and examines its usage and execution stage. Segment 4 talks about reenactment results and Section 5 finishes up our work.

2. Related Work

Various methodologies abusing sink portability for information assortment in WSNs have been proposed as of late [3]. The MS(s) may visit every SN and accumulate its information (single-jump correspondence), or may visit just a few areas of the WSN and SNs send their information to MS through multi-hop correspondence. Evidently, since in the main arrangement just single hop correspondence is required, vitality utilization is limited, be that as it may, to the detriment of high information conveyance delay. In the subsequent arrangement, this deferral is low however the vitality utilization due to multi-hop correspondence is fairly high. Furthermore, SNs ought to continually be kept refreshed about the MS's present area along these lines making significant steering overhead. An answer in the middle of is to have SNs send first their information to a specific number of hubs (RNs) which cradle the got information and send them to MS when MS is inside their transmission extend or when they get an inquiry from MS requesting the cushioned information [1]. In the subsequent methodology, the MS doesn't really go close to the RNs and the information put away at every RN are sent to MS by switching the course of the got inquiry parcel. Our proposed convention is a meeting based arrangement and targets applications that include observing of disconnected urban regions (e.g., urban parks, building squares, or enormous common offices) as for ecological boundaries, observation, fire identification, and so on. In such conditions, MSs might be mounted upon city transports that consistently follow a predefined direction with an intermittent timetable. The utilization of such existing foundation eliminates the ridiculous necessity for utilizing devoted portable, controllable stages to convey MSs.

We likewise follow the primary methodology of the meeting based arrangements and the proposed convention chooses RNs that are in nearness with the MS direction. In this unique circumstance, the works introduced in [20] is generally applicable to the examination portrayed thus as they are rendezvous-based arrangements which both expect MS. In, a MS is utilized to gather information from gatherings of SNs. During a preparation period, all the WSN edge hubs situated inside the scope of MS courses are delegated as RNs and assemble ways interfacing them with the rest of sensor hubs. Those ways are utilized by distant hubs to advance their tactile information to RNs; the last support tangible information and convey them to the MS when it re approaches in go. The development of versatile robots is controllable which is unrealistic in reasonable urban rush hour gridlock conditions. In particular, no system is utilized to designate appropriate hubs as RNs while chosen RNs are regularly connected with lopsided quantities of SNs. In [20], rendezvous-based arrangements are introduced for variable just as fixed MS directions. The proposed strategy expect full conglomeration. Evidently, this isn't generally conceivable and along these lines it is somewhat a solid suspicion. The arrangement introduced for fixed MS track looks to decide a section of the MS track shorter than a specific bound with the end goal that the all-out expense of the trees interfacing source hubs with RNs is limited. Note that in both the instances of variable and fixed tracks, information on organize geography is essential and the entire calculation is performed halfway at the BS. Aside from, various different meeting based arrangements that expect variable MS direction have been proposed. These works decide the MS direction in such manner that specific advancement measures (e.g., least vitality utilization for moving the information to RNs) are met while complying with specific limitations.

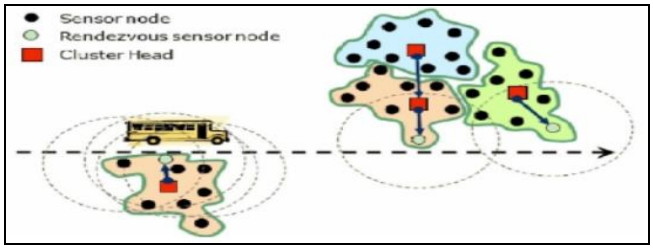

Fig 1: Rendezvous sensor nodes, cluster structures, and data forwarding paths

Besides, the activity of RNs is very much planned and the perfect measure of information is dispersed to every RN as per the contact time and information conveyance pace of every RN. Above all, on the off chance that that a RN runs out of vitality, it is immediately supplanted by other accessible RNs and subsequently the information transmission to MS isn't upset as in different meeting based plans. Likewise, as opposed to different plans which utilize a level system design, our methodology fabricates a bunching structure on head of the sensor organize. That way, high information total proportions are conceivable since information from the hubs of a similar bunch normally are firmly connected [4] and along these lines accumulation at each group head impressively lessens the information sent to RNs. This thusly prompts a lot of lower vitality utilization in the WSN and furthermore considerably less information are cushioned at RNs, diminishing so the likelihood of support flood at a RN.

3. Implementation

3.1 The Dynamic Sequence Routing Protocol

In the proposed convention, MSs are mounted upon open transports circling inside urban situations on fixed directions and close occasional timetable. In particular, sinks movement isn't controllable and their courses don't adjust upon explicit WSN organizations. Our lone supposition that will be that sensors are conveyed in urban territories in vicinity to open transportation vehicle courses. Additionally, a satisfactory number of hubs are enlisted as RNs as a reasonable tradeoff between a modest number which brings about their fast vitality consumption and a huge number which brings about diminished information throughput. At last, SNs are assembled in discrete bunches. Crude tangible information are separated inside individual bunches misusing their inborn spatial-fleeting excess. In this manner, the overhead of multi-hop information transferring (inter

clustering traffic) to the edge RNs is limited (see Fig. 1). Given that the correspondence cost is a few significant degrees higher than the calculation cost, in-bunch information collection can accomplish noteworthy vitality reserve funds.

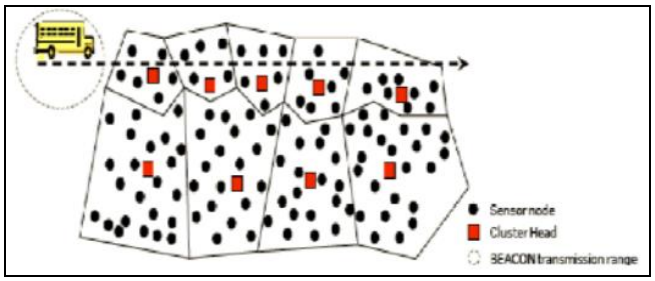

Fig 2: Unequal Cluster Formation

The fundamental supposition in this model is that hubs which are nearer than a specific separation (transmission go R) can consistently impart. In any case, by and by a message sent by a hub is gotten by the beneficiary with just certain likelihood regardless of whether the separation of the two hubs is littler than the transmission go. In Society Digital, we will portray how our convention can be adjusted with the goal that it can even now chip away at the head of a more reasonable physical layer. The initial three stages include the arrangement stage while the last two involve the consistent stage. The arrangement stage finishes in a solitary MS trip and during this excursion, the MS occasionally communicates BEACON messages which are utilized by SNs for deciding various boundaries significant for the convention activity. In the consistent stage, information from SNs are regularly accumulated to RNs and afterward sent to MS. During the consistent stage, reselection of RNs or potentially neighborhood re bunching is acted in the event of vitality fatigue of some basic hubs. In particular, these activities happen out of sight without upsetting the convention's typical activity.

3.1.1 Phase 1: Clustering

The huge scope arrangement of WSNs and the requirement for information accumulation require proficient association of the system geography to adjust the heap and dragging out the system lifetime. Bunching has demonstrated to be a powerful methodology for arranging the system in the above setting. Other than accomplishing vitality effectiveness, grouping additionally diminishes channel dispute and parcel impacts, bringing about improved system throughput under high burden [4]. Our bunching calculation acquires thoughts from the calculation of Chen *et al.* [5] to construct a group structure of inconsistent bunches. The grouping calculation in [5] develops a multi estimated bunch structure, where the size of each group diminishes as the separation of its bunch head from the base station increments. We somewhat alter the methodology of [5] to fabricate groups of two unique sizes relying upon the separation of the CHs from the MS's direction. In particular, SNs situated close to the MS direction are gathered in little measured bunches while SNs found farther away are assembled in groups of bigger size (Fig. 2). The CHs close to the MS direction are normally troubled with substantial hand-off traffic originating from different pieces of the system. By keeping up the groups of these CHs little, CHs close to the MS direction are moderately alleviated from intra bunch preparing and correspondence undertakings and accordingly they can bear to burn through more effort for handing-off inter cluster traffic to RNs. During an instatement stage, the MS moves along its fixed direction broadcasting occasionally a BEACON sign to all SNs at a fixed force level. All hubs close to the MS direction get the BEACON message and accordingly they realize that the groups in their locale will be little measured. At that point, these hubs flood the BEACON message to the remainder of the system. A definite portrayal of the bunching calculation (Algorithm CH_ELECTION) which is executed just after the MS finishes its first outing, can be accessible in the online supplemental material.

3.1.2 Phase 2: RNs Selection

RNs ensure availability of sensor islands with MSs; consequently, their determination to a great extent decides arrange lifetime. RNs exist in the scope of voyaging sinks and their area relies upon the situation of the CH and the sensor field concerning the sinks direction. Reasonable RNs are those that stay inside the MS's range for generally lengthy timespan, in moderately short good ways from the sink's direction and have adequate vitality supplies. In reasonable organizations, the quantity of assigned RNs presents a fascinating compromise: Countless RNs infers that the last will seek the remote channel conflict when the versatile robot shows up in go, accordingly bringing about low information throughput and incessant blackouts. Few RNs infers that every RN is related with a huge gathering of sensors. Henceforth, RNs will be intensely utilized during information transfers, their vitality will be expended quickly and they will probably encounter support floods. To direct the quantity of RNs and forestall either their fast vitality consumption or potential information misfortunes, we propose a basic choice model whereby a lot of bunch individuals (in region to the MS's direction) from each group is enlisted as RNs. RN's job might be exchanged among bunch individuals when the vitality level of a hub as of now filling in as RN dips under a pre indicated edge. As referenced before, MSs follow a fixed direction. Each CH u gets RN_C and _ Messages from all the up-and-comer RNs of its group, and afterward it continues to the determination of the suitable RNs to construct the set Ru of the last RNs related with it. After the execution of this calculation, it is ensured that RNs situated inside a similar group won't contend with one another in the information conveyance stage and each will begin conveying its information after the past closures. Consequently, the remote channel is all the more proficiently utilized, the quantity of parcel crashes is decreased and information throughput is amplified. Likewise, the work of different RNs, at every possible opportunity, infers lower interest for information buffering space and reasonable circulation of the vitality use related with information conveyance.

3.1.3 Phase 3: CHs Attachment to RNs

Note that few out of every odd CH u has a nonempty Ru set related with it. CHs situated a long way from the MS directions don't include any RNs inside transmission go. A significant condition for building inter cluster overlay diagrams is that CHs with no connected RNs, join themselves to a CH u with nonempty Ru set to deliver their bunches' information to u. The portrayal of the inter cluster overlay diagram building strategy can be found, accessible

in the online supplemental material. It is noticed that our methodology regularly requires a solitary MS outing to gather (through the receipt of BEACON messages) the data expected to execute the arrangement stage. Bunching (stage #1) begins upon the finishing of the principal MS trip. The RNs' choice cycle (stage #2) initiates quickly subsequently (the data required for the execution of this stage, i.e., the quantity of reference points, their receipt time, and sign quality is additionally gathered during the main MS trip). CHs connection to RNs stage #3) follows straightaway. Every one of these stages total in sensibly brief timeframe, commonly inside the time span between two progressive transport trips. When the arrangement stage settles, tactile information gathered at CHs from their connected group individuals are sent toward the RNs following an inter cluster overlay diagram (see Fig. 1). The chose transmission extend among CHs may differ to guarantee a specific level of network and to control interference.

3.1.4 Phase 4: Data Aggregation and Forwarding to the RNs

The consistent period of DSR convention begins with the intermittent account of natural information from sensor hubs with a Tr period. The information amassed at singular source hubs are sent to nearby CHs (intra cluster correspondence) with a Tc period (commonly, Tc is a several of Tr). CHs perform information preparing to eliminate spatial-worldly information excess, which is probably going to exist since bunch individuals are found greatest two bounces away. CHs then forward sifted information toward distant CH they are connected to. Close by the inter cluster way, a second-level of information sifting may apply. After arriving at the end CH u, sifted information are sent to u's neighborhood RNs in a pipeline style. For the situation that various RNs exist in that group, information are not similarly circulated among them. Rather, the CH favors the information conveyance by the most appropriate RNs, i.e., those with most elevated skill esteem (Compval). Information conveyance among RNs ought to guarantee that every RN will have the option to oblige its doled out information, i.e., to convey all its cradled information and not experience a blackout. Subsequently, CH u sorts the RNs in its Ru set in Compval diminishing request and conveys to every RN hub vi 2 Ru the most extreme measure of information Di it can oblige, less a "blackout anticipation remittance" sum O. The Di esteem is determined considering the RN's information rate ri and the length li of the time span [vi.T first, vi.T last] that vi stays inside the MS's range. The cycle is rehashed for every vi 2 Ru until all information accessible at u are conveyed among its RNs. The calculation executed by each CH u for conveying information to the RNs appended to it.

3.1.5 Phase 5: Communication between RNs and Mobile Sinks

The last period of Mobile Cluster convention includes the conveyance of information cushioned to RNs to MSs. Information conveyance happens along an irregularly accessible connection; consequently, a key prerequisite is to decide when the availability between a RN and the MS is accessible. Correspondence should begin when the association is accessible and stop when the association does not exist anymore, with the goal that the RN doesn't keep on communicating information when the MS is done accepting it. To address this issue, we utilize an affirmation based convention between RNs and MSs. The MS, in all resulting way crossings after the arrangement stage, occasionally communicates a POLL packet, reporting its essence and requesting information as it continues along the way. The POLL is sent at fixed stretches Tpoll (typically equivalent to Tbeacon). This POLL bundle is utilized by RNs to recognize when the MS is inside network territory. The RN accepting the POLL will begin communicating information bundles to the MS. The MS recognizes each got information parcel to the RN so the RN understands that the association is dynamic and the information were dependably conveyed. The recognized information parcel would then be able to be cleared from the RN's reserve. More insights concerning the correspondence convention among RNs and MS can be found in Appendix C, accessible in the online supplemental material. It ought to be accentuated the enrolment of explicit hubs as RNs is liable to change during the consistent stage. In this manner, if the vitality flexibly of a RN falls under an edge, it might demand the neighborhood CH to draw in another hub as RN to additionally expand the system's lifetime without influencing the current bunched framework. To empower RNs replacement, the CH surveys the competitor RNs of the arrangement stage (barring the resigning RN) to be educated about their present lingering vitality status and afterward chooses the new RN list following the strategy depicted in Section. In specific, new modern techniques are proposed for selecting proper hubs as RNs, building versatile inter cluster overlay diagrams, reasonably appropriating tangible information among RNs and conveying these information to the MS in nonintersecting time windows (Phase 2 through Phase 5).

4. Performance Evaluation

As examined in the Section 2, various meeting based methodologies have been proposed which either expect a fixed MS direction or confirm that direction as indicated by some vitality related advancement models. As DSR accept that MS proceeds onward a fixed direction, a reasonable correlation of this convention with different proposition should just think about the proficiency of steering structures for moving information from SNs to RNs. In the reproduction tests, we contrast our strategy and the arrangements proposed in which additionally accept fixed MS trajectory.2 in these tests, first, the three conventions are thought about as far as the system lifetime, the normal leftover vitality just as the difference of this vitality over the system. At that point, the conventions are looked at regarding the general number of blackouts, i.e., the quantity of information bundles stored in RNs, yet, not conveyed to the MS because of cradle floods, parcel impacts or the development of the MS away of the RNs' transmission go. At long last, the third gathering of tests concerns the all-out created traffic just as the system throughput of these conventions, i.e., the parcels conveyed to the MS over those sent from the RNs. Next, we present the outcomes for the most delegate execution measurements, in particular the quantity of blackouts, the system lifetime and the normal remaining vitality. The specific boundary esteems utilized in our reenactments can be found in accessible in the online supplemental material. In a similar addendum, we give further avocation to our philosophy in the tests and we additionally examine the outcomes for the rest of the presentation measurements. It outlines the yield screen

captures of our test system. The dabbed dark line, in all subfigures, speaks to the MS's direction. The RNs in are signified as "CHs" following the documentation utilized in. DSR displays the best presentation in all situations due to the more refined determination of RNs; RN shave adequate opportunity to convey their information and endure low number of impacts since they are very much isolated spatially.

5. Conclusion

The network objective is tended to by utilizing MSs to gather information from confined urban sensor islands and furthermore through dragging out the lifetime of chose fringe RNs which exist in the scope of passing MSs and used to reserve and convey tactile information got from far off source hubs. Expanded information throughput is guaranteed by controlling the quantity of RNs for permitting adequate chance to convey their supported information and forestalling information misfortunes. In contrast to different methodologies, Mobile Cluster moves the preparing and information transmission trouble away from the crucial fringe hubs (RNs) and empowers adjusted vitality utilization over the WSN through structure group structures that abuse the high excess of information gathered from neighbor hubs and limit inter cluster information overhead. The presentation addition of Mobile Cluster over elective methodologies has been approved by broad reenactment tests.

6. Acknowledgments

The authors are thankful to S. Nesamony, E. Melachrinoudis and A. Ramanoorthy for providing the necessary facilities for the preparation of the paper. Also thanks to IJASR Journal staffs to publish this paper.

9. References

1. Stojmenovic I, Nayak A, Kuruvila J. “Design Guidelines for Routing Protocols in Ad Hoc and Sensor Networks with a Realistic Physical Layer,” IEEE Comm. Magazine. 2017; 43(3):101-106.
2. Nesamony S, Vairamuthu M, Orlowska M. “On Optimal Route of a Calibrating Mobile Sink in a Wireless Sensor Networks,” Proc. Fourth Int’l Conf. Networked Sensing Systems (INSS), 2016, pp. 61-64.
3. Mamalis B, Gavalas D, Konstantopoulos C, Pantziou G. “Clustering in Wireless Sensor Networks,” RFID and Sensor Networks: Architectures, Protocols, Security and Integrations, Y. Zhang, L.T. Yang, J. Chen, eds., pp. 324-353, CRC Press, 2018.
4. Basagni S, Carosi A, Melachrinoudis E, Petrioli C, Wang ZM. “Controlled Sink Mobility for Prolonging Wireless Sensor Networks Lifetime,” ACM Wireless Networks. 2018; 14(6):831-858.
5. Vincze Z, Vass D, Vida R, Vidacs A, Telcs A. “Adaptive Sink Mobility in Event-Driven Densely Deployed Wireless Sensor Networks,” Ad Hoc and Sensor Wireless Networks. 2017; 3(2/3):255-284.
6. Demirbas M, Soysal O, Tosun A. “Data Salmon: A Greedy Mobile Basestation Protocol for Efficient Data Collection in Wireless Sensor Networks,” Proc. Int’l Conf. Distributed Computing in Sensor Systems (DCOSS ’07), 2018, 267-280.
7. Somasundara A, Ramanoorthy A, Srivastana M. “Mobile Element Scheduling with Dynamic Deadlines,” IEEE Trans. Mobile Computing. 2018; 6(4):395-410.
8. Ma M, Yang Y. “SenCar: An Energy-Efficient Data Gathering Mechanism for Large-Scale Multihop Sensor Networks,” IEEE Trans. Parallel and Distributed Systems. 2017; 18(10):1476-1488.
9. Puccinelli D, Haenggi M. “Reliable Data Delivery in Large- Scale Low-Power Sensor Networks,” ACM Trans. Sensor Networks. 2017; 6(4):1-28.
10. Somasundara AA, Kansal A, Jea DD, Estrin D, Srivastava MB. “Controllably Mobile Infrastructure for Low Energy Embedded Networks,” IEEE Trans. Mobile Computing. 2016; 5(8):958-973.
11. Rao J, Biswas S. “Joint Routing and Navigation Protocols for Data Harvesting in Sensor Networks,” Proc. Fifth IEEE Int’l Conf. Mobile Ad Hoc and Sensor Systems (MASS), 2016, 143-152.
12. Rao J, Biswas S. “Network- Assisted Sink Navigation for Distributed Data Gathering: Stability and Delay-energy Trade- Offs,” Computer Comm, 2016; 33:160-175.
13. Chatzigiannakis I, Kinalis A, Nikolitseas S. “Efficient Data Propagation Strategies in Wireless Sensor Networks Using a Single Mobile Sink,” Computer Comm, 2017; 31:896-914.
14. Sugihara R, Gupta R. “Improving the Data Delivery Latency in Sensor Networks with Controlled Mobility,” Proc. Fourth IEEE Int’l Conf. Distributed Computing in Sensor Systems (DCOSS), 2018, 386-399.
15. Shah R, Roy S, Jain S, Brunette W. “Data MULEs: Modeling and Analysis of a Three-Tier Architecture for Sparse Sensor Networks,” Ad Hoc Networks. 2018; 1(2/3):215-233.
16. Hamida E, Chelius G. “Strategies for Data Dissemination to Mobile Sinks in Wireless Sensor Networks,” IEEE Wireless Comm. 2017; 15(6):31-37.
17. Olariu S, Stojmenovic I. “Design Guidelines for Maximizing Lifetime and Avoiding Energy Holes in Sensor Networks with Uniform Distribution and Uniform Reporting,” Proc. IEEE INFOCOM, 2017.
18. Soro S, Heinzelman WB. “Prolonging the Lifetime of Wireless Sensor Networks via Unequal Clustering,” Proc. 19th IEEE Int’l Parallel and Distributed Processing Symp, 2018.
19. Chen G, Li C, Ye M, Wu J. “An Unequal Cluster-Based Routing Protocol in Wireless Sensor Networks,” Wireless Networks, 2017; 15:193-207.
20. Li X, Nayak A, Stojmenovic I. “Sink Mobility in Wireless Sensor Networks,” Wireless Sensor and Actuator Networks, A. Nayak, I. Stojmenovic, eds., Wiley, 2016.