Spider Web Based Effective Localization Algorithm for WSN

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Abstract

Localization, as a crucial service for sensor networks, is an energy-demanding process for both indoor and outdoor scenarios. GPS based localization schemes are infeasible in remote, indoor areas and it is not a cost-effective solution for large-scale networks. Single mobile-beacon architecture is recently considered to localize sensor networks with the aim of removing numerous GPS-equipped nodes. The critical issue for the mobile beacon-assisted localization is to preserve the consumed power to increase the lifetime. Different path planning schemes have been proposed for localization. In this work , the performance of conventional path planning schemes is evaluated and propose a new spider web based path planning strategy analyzed based on three parameters such as location error ratio, energy consumption, and number of references. NS-2 is used as a simulation tool to evaluate existing and proposed system performance in terms of energy consumption ,delay and localization accuracy .

I. INTRODUCTION

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. Sensor in wireless network receives input information, store the information, compute and forward the data to other devices. For example, a thermocouple converts temperature to an output voltage which can be read by a voltmeter. A Wireless Sensor Network (WSN) [1][2] consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance and is now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation and traffic control [3]. Since most applications depend on a successful localization [4], i.e. to compute their positions in some fixed coordinate system, it is of great importance to design efficient localization algorithms. Localization [5] means to determine location of nodes in a network. With the support of some infrastructure, a node can determine its location in the network by extracting information received from the infrastructure; also, by making a node to send signals periodically, the infrastructure can calculate the location of the nodes. For example, GPS [6] is a typical localization system. There are 24 satellites positioned at the altitude of 20200 km and distributed in 6 orbital planes. These satellites share the high accurate atomic clocks and they know exactly their coordinates. A GPS receiver can receive signals from at least 4 satellites if the receiver is not hidden from the line of sight. By matching the code pattern in the signal, a receiver can calculate the time shift and know the distance away from that satellite by multiply the time shift to the speed of light. After that, the GPS receiver can figure out its coordinate based on some localization algorithm.

II. PARAMETERS FOR LOCALIZATION

For the different ways of estimating location information, we have to name parameters to distinguish the similarities and differences between different approaches. In this section we present the most typical parameters to classify different techniques. Accuracy: Accuracy is very important in the localization of wireless sensor network. Higher accuracy is typically required in military installations, such as sensor network deployed for intrusion detection. However, for commercial networks which may use localization to send advertisements from neighboring shops, the required accuracy may not be lower. Cost: Cost is a very challenging issue in the localization of wireless sensor network. There are very few algorithms which give low cost but those algorithms don’t give the high rate of accuracy. Power: Power is necessary for computation purpose. Power play a major role in wireless sensor network as each sensor device has limited power. Power supplied by battery. Static Nodes: All static sensor nodes are homogeneous in nature. This means that, all the nodes have identical sensing ability, computational ability, and the ability to communicate. We also assume that, the initial battery powers of the nodes are identical at deployment. Mobile Nodes: It is assumed that a few number of GPS enabled mobile nodes are part of the sensor network. These nodes are homogeneous in nature. But, are assumed to have more battery power as compared to the static nodes and do not drain out completely during the localization process. The communication range of mobile sensor nodes are assumed not to change drastically during the entire localization algorithm runtime and also not to change significantly within the reception of four beacon messages by a particular static node.

III.LOCALIZATION TECHNIQUES IN WSNS

There are different kinds of localization approaches and accuracy requirements. Localization can be roughly divided into two categories: range-based and range-free. Range-based approach uses absolute distance estimate or angle estimate, meaning that a node in a network can measure the distances from itself to the beacons. [7, 8, 9, 10, 11, 12] are some examples of range-based localization techniques In contrast, range-free approach [13,14] means that it is impossible for a node to measure the direct distances from itself to beacons. Only through connectivity and proximity, a node can estimate its regions or areas where it stays. Range-based approach is precise while range-free method is often inaccurate. Range-based localization can also divided into another two categories. One is distance estimation by one-hop; another is by multi-hop, meaning that a node in the network can not directly communicate with beacons. Localization in WSN is a multi-hop approach because a node may not communicate directly with beacons. Only through multi-hop routing, can a node send or receive messages to or from beacons. Existing location discovery approaches [15] basically consists of two basic phases: (1) distance or angle estimation and (2) distance and angle combining. The most popular methods for estimating the distance between two nodes are described below: Received Signal Strength Indicator (RSSI), Time based methods (ToA, TDoA), Angle-of-Arrival (AoA, DoA), Triangulation and Maximum Likelihood (ML) estimation.

Received Signal Strength Indicator (RSSI): The RSSI technique is based on the fact that the radio signal attenuates exponentially with the increase of distance. According to the receiving power, the distance can be evaluated by translating the power loss with theoretical model. RSSI has also been employed for range estimation in [16, 17, 18].

Time based methods(ToA, TDoA): ToA and TDoA techniques [19, 20, 21] evaluate the distance by translating the propagation time between two nodes with known signal propagation speed. Angle-of-

Arrival (AoA): AoA is also called DoA [22, 23] (Direction of Arrival) techniques measure the position by geometric relationships with the angle where signals are received. ToA, TDoA and AoA techniques can typically achieve better accuracy than RSSI techniques, because radio signal amplitude is affected by environmental factors [24].

Triangulation: Triangulation method is used when the direction of the node instead of the distance is estimated, as in AoA systems. The node positions are calculated in this case by using the trigonometry laws of sines and cosines. Maximum Likelihood (ML) estimation: ML estimation estimates the position of a node by minimizing the differences between the measured distances and estimated distances.

Guojun Dai et al propose LISTEN, a noninteractive localization approach. Using LISTEN, every camera sensor node only needs to silently listen to the beacon signals from a mobile beacon node and capture a few images until determining its own location.

Jen-Feng Huang ; Guey-Yun Chang ; Gen-Huey Chenused a historical beacons (i.e., anchor nodes' announcements delivered in previous time slots) and received signal strength (RSS) to derive three constraints. By the aid of the three constraints, ntroduce a low-communication-cost range-free localization algorithm (only one-hop beacon broadcasting is required). According to the theoretical analysis and simulation results, our three constraints can indeed improve the accuracy

Jaehyun Park et al proposes a beacon color code scheduling algorithm for the localization of multiple robots in a multiblock workspace. With the development of intelligent robotics and ubiquitous technology, service robots are applicable for use in wide areas, such as airports and train stations, where multiple indoor GPS systems are required for the localization of the mobile robots

Upadhyaya et al identify a class of distance-based localization algorithms that can always guarantee a bounded localization error. Finally, we outline three novel distance-based localization algorithms that belong to this class of bounded error localization algorithms

MarjanMoradi et al KumbesanSandrasegaran ; Reza Farahbakhsh proposed scheme takes the advantage of deterministic path traveled by the single beacon to efficiently adjust the transmission power. Based on the extensive results, the proposed power control scheme could successfully improve the beacon and sensors energy consumption about 25.37% and 34.09%, respectively

N. Bulusu et al present a novel scheme for node localization in a delay-tolerant sensor network (DTN). In a DTN, sensor devices are often organized in network clusters that may be mutually disconnected.

Some mobile robots may be used to collect data from the network clusters. The key idea in our scheme is to use this robot to perform location estimation for the sensor nodes it passes based on the signal strength of the radio messages received from them.

Igor Škrjanc et al presented an efficient indoor localization algorithm based on the confidence-interval fuzzy model . The width of the confidence interval is essential within the proposed fingerprinting method for calculating weights, which are then taken into account while searching for the K nearest neighbors in the database of fingerprints.

Wenbo Zhang et al proposed a path-planning algorithm combining a Localization algorithm with a Mobile Anchor node based on Trilateration (LMAT) and SCAN algorithm (SLMAT) SLMAT ensures that each unknown node is covered by a regular triangle formed by beacons. Furthermore, the number of corners along the planned path is reduced to save the energy of the mobile anchor node

OnurGungor et al considers secret key generation by a pair of mobile nodes utilizing observations of their relative locations in the presence of a mobile eavesdropper. the legitimate node pair makes noisy observations of the relative locations of each other. Based on these observations, the nodes generate secret key bits via information reconciliation, data compression, and privacy amplification

IV. PROPOSED SYSTEM

we consider the structural similarities between the spider-webs and localization segments and try to create a spider web-like model for localization to obtain the paths. The spider-web is constructed by the spokes and hypotenuses. Spokes begin from the web center and form the framework of the structure. Hypotenuses are the concentric circles around the web center. The lines formed by road intersections with same layer are regarded as the hypotenuses. The road segments connecting the adjacent layer intersections can be regarded as the spokes

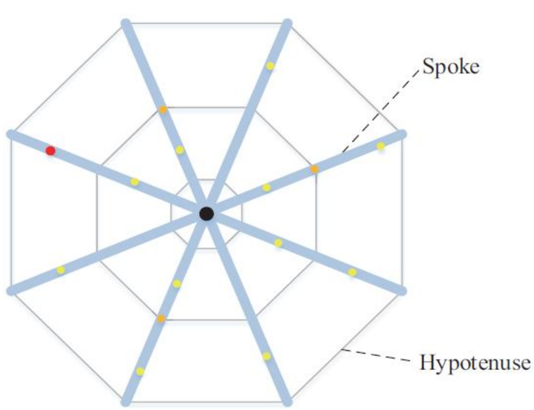

Fig. Spider web-like model

We select the source intersection based on the distance between the source vehicle and the candidate intersection, as well as the angle formed by the candidate intersection,. Each candidate intersection has a grade, and the candidate with the highest grade is selected as the first node of path intersection.

The grade expression is as Eq. (1):

$$G(i) = \lambda(1 - \frac{d(i)}{L}) + (1 - \lambda)D(i)$$

Where L is the length of path , d(i) isthe distance between the intersection .direction parameter expressed by Eq. 2

$$D(i) = \begin{cases} 0 & (\alpha > \frac{\pi}{2}) \\ 1 & (\alpha < \frac{\pi}{2}) or (\alpha = \frac{\pi}{2} \& Dir = 1) \end{cases}$$

In Eq. (2), _ is the angle formed by the mobile beacon ,Inwhichthe NODE is as the vertex, the node intersection are as the end points. Dir is thevehicle movement direction. If the vehicle is moving towardsintersectioni, then Dir = 1, otherwise Dir = 0.Without loss of generality, we assume that I1 and I2 are thetwo neighbor intersections of A, _I1AI2 is the angle betweenthe lines which connect A, I1 and A, I2. _D1AD2 is the anglebetween the lines connecting A with D1, D2 in Fig. AI1
and AI2 are defined as the spokes. The condition _I1AI2 and_D1AD2 should satisfy Eq. (3).

$$\theta_{D_1AD_2} \leq \theta_{I_1AI_2\,min}$$

Note that when _D1AD2 = 0, there is only one destinationintersection. Besides, if AI1 and AD1 (AI2 and AD2)coincide, only the intersection I1 (I2) is selected as the firstlayerintersection. In that case there is only one first-layerintersection. Otherwise _I1AI2 min should be the minimumangle bigger than _D1AD2 .

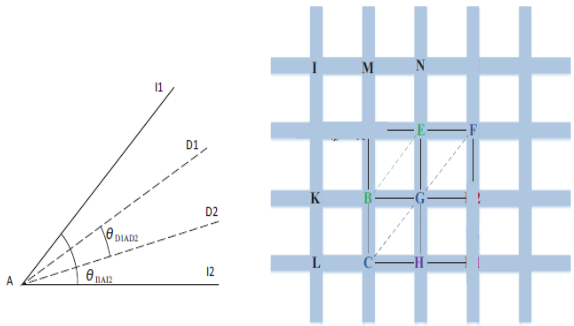

Fig.(a) First-layer intersection (b) Each layer intersection

We can construct the spider web like model, according to which the available paths consisting of intersections can be found

Input: number of nodes
Output: transmission path
1: procedure path discovery
2: create the spider web like model w
3: create the path tree t
4: depth-first search t and get paths
5: send request spiders
6: activate(request clock)
7: if receive confirmed spider when request clock isnot timeout then
8: calculate intersection of node whenreceiveconfirmed spider
9: return the path with the smallest (Tr-Ts)
10: else
11: restart Path Discovery
12: end if
13: end if
14: end procedure

V. RESULTS AND DISCUSSIONS

Screenshots

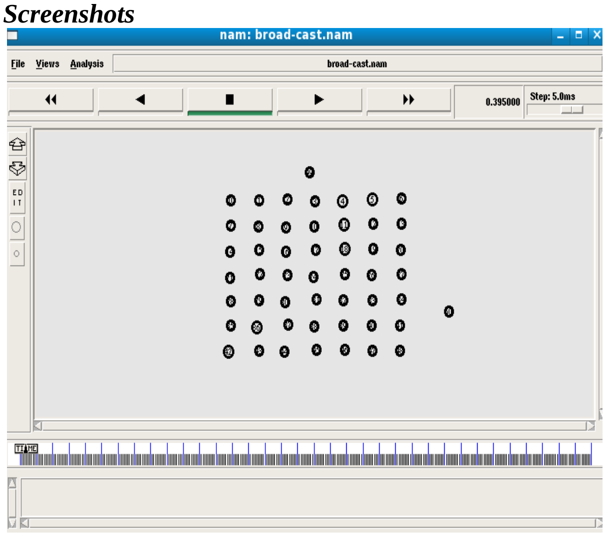

Figure node creation

Above fig shows node creation done by using network simulator .number of node set by TCL language was set to 50

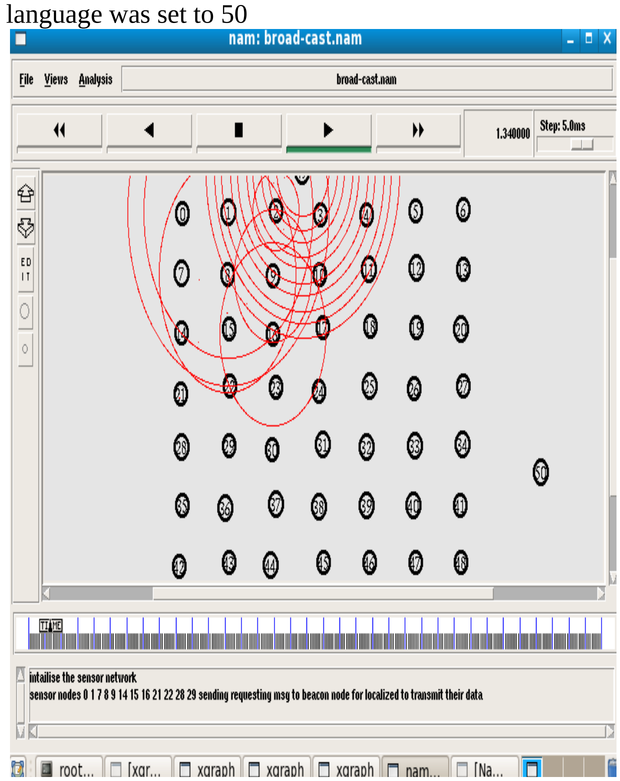

Figure Beacon message sharing

Above figure shows message sharing of beacon node to network nodes for localization ,beacon follow a random way path

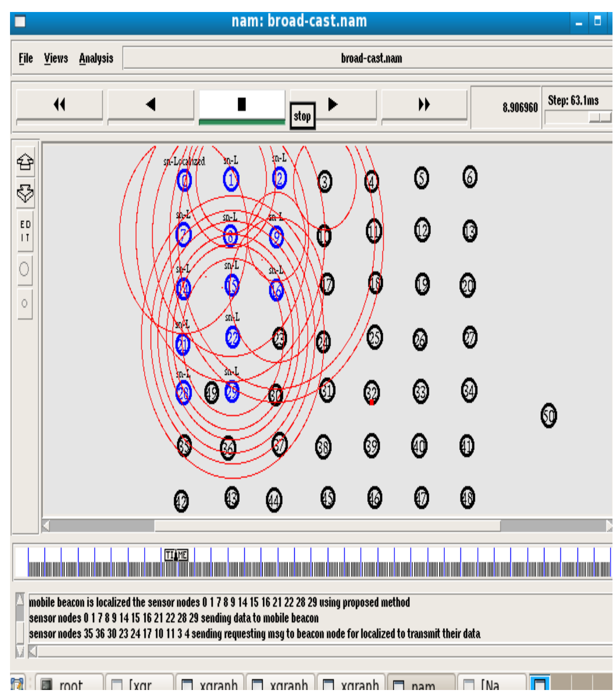

Figure localized nodes

Above figure shows localized nodes of network by mobile beacon using random way point

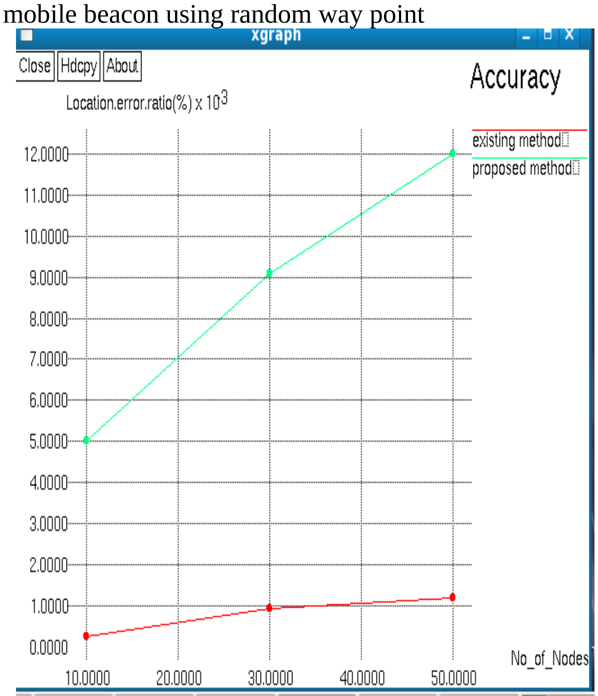

Figure Accuracy analysis

Figure shows localization accuracy for existing random way and proposed web mechanism .from that graph our method increases accuracy when number of node increases

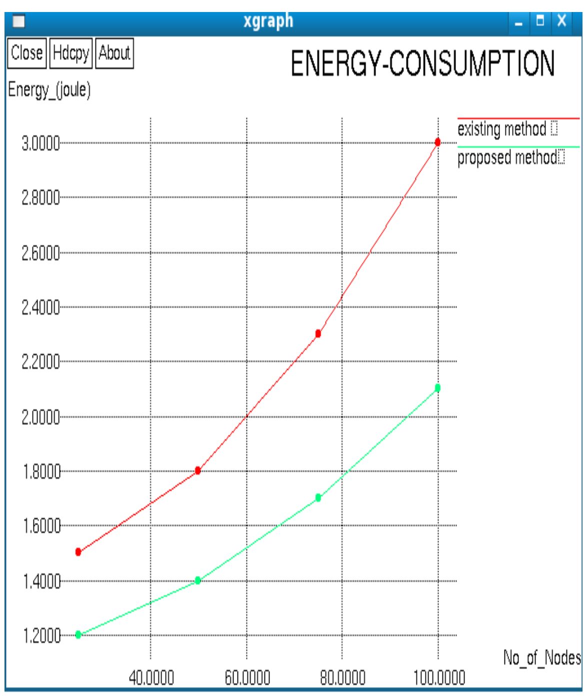

Figure Energy consumption

Figure shows energy analysis for existing random way and proposed web mechanism .from that graph our method reduces energy consumption by following intersection based path

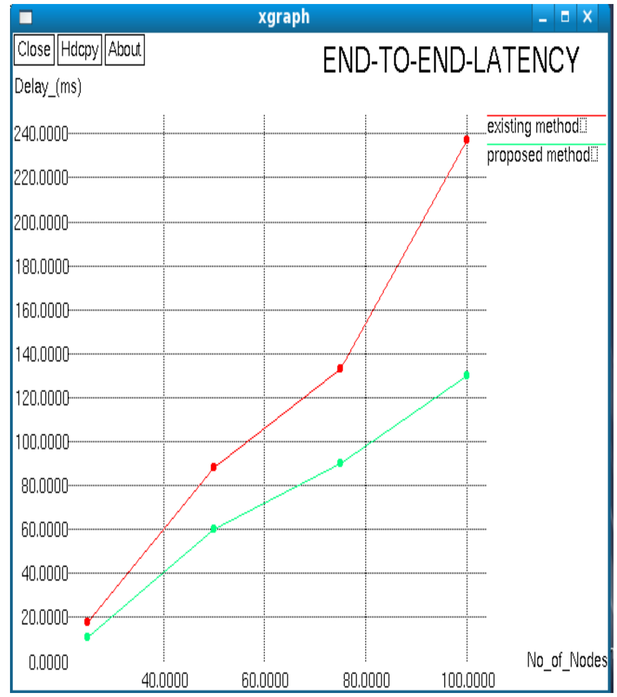

Figure Latency analysis

Figure shows delay analysis for existing random way and proposed web mechanism .from that graph our method reduces delay overhead by following intersection based path

VI. CONCLUSION

To fulfil the real-time constraints, we proposed new path planning, a novel spider web-like mechanism for localization. We create a spider web-like model to restrict the searching area. Simulation results show that our proposed scheme performs better than conventional in terms of average transmission delay, packet delivery ratio. The results prove that spider mechanism can ensure real-time requirements of in the presence of network congestion

Future work

In future dual mobile beacon will used instead of single in order to reduce path overhead and to achieve higher level of accuracy

REFERENCES

[1] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: A survey," Computer Networks J., 38(4), 393–422, 2002.

[2] J. Yick, B. Mukherjee and D. Ghosal, "Wireless sensor network survey," Computer Networks, 52(12), 2292-2330, 2008.

[3] http://en.wikipedia.org/wiki/Wireless sensor network.

[4] K. Muthukrishnan, M. Lijding, and P. Havinga, "Towards smart surroundings: Enabling techniques and technologies for localization,"

in Proc. of the Int. Workshop on location and context awareness, 2005.
[5] C.-F. Huang and Y.C. Tseng,"The Coverage Problem in a Wireless Sensor Network," ACM International Workshop on Wireless Sensor Networks and Applications (WSNA), pp. 115-121,2003. [6] B. H. Wellenhoff, H. Lichtenegger and J. Collins.,Global Positions System: Theory and Practice. Fourth Edition. Springer Verlag, 1997.
[7] L. Doherty, K. S. Pister, and L. E. Ghaoui., Convex optimization methods for sensor node position estimation. In Proceedings of IEEE INFOCOM '01, 2001.
[8] A. Savvides, C. Han, and M. Srivastava. Dynamic fine-grained localization in ad-hoc networks of sensors. In Proceedings of ACM MobiCom '01, pages 166-179, 2001.
[9] A. Savvides, H. Park, and M. Srivastava., The bits and flops of the n-hop multilateration primitive for node localization problems. In Proceedings of ACM WSNA '02, 2002.
[10] A. Nasipuri and K. Li.,A directionality based location discovery scheme for wireless sensor networks. In Proceedings of ACM WSNA '02, 2002.
[11] N. Patwari, A. O. Hero, M. Perkins, N. S. Correal, and R. J. ODea, Relative Location Estimation in Wireless Sensor Networks. IEEE Transactions on Signal Processing, VOL. 51, NO. 8,2003.
[12] D. Liu, P. Ning, and W. Du., Detecting Malicious Beacon Nodes for Secure Location Discovery in Wireless Sensor Networks. 25th IEEE International Conference on Distributed Computing Systems (ICDCS '05), pp. 609-619, 2005.
[13] T. He, C. Huang, B. Blum, J. Stankovic, and T. Abdelzaher, "Range-free localization schemes in large scale sensor networks", In Proceedings of the Ninth Annual International Conference on Mobile Computing and Networking (MobiCom'03), San Diego, CA, USA, pp. 81-95, 2003.
[14] C. Savarese, J. Rabay and K. Langendoen., Robust Positioning Algorithms for Distributed Ad-Hoc Wireless Sensor Networks. USENIX Technical Annual Conference, Monterey, CA, 2002.
[15] G. Mao, B. Fidan and B. D. O. Anderson, "Wireless Sensor Networks Localization Techniques," Computer Networks: The International Journal of Computer and Telecommunications Networking, vol. 51, no. 10, pp. 2529-2553, 2007.
[16] Yuan He ; Yunhao Liu ; XingfaShen ; Lufeng Mo ; Guojun Dai ,Noninteractive Localization of Wireless Camera Sensors with Mobile Beacon, IEEE Transactions on Mobile Computing (Volume: 12 , Issue: 2 , Feb. 2013)
[17]Jen-Feng Huang ; Guey-Yun Chang ; Gen-Huey Chen,A Historical-Beacon-Aided Localization Algorithm for Mobile Sensor Networks, IEEE Transactions on Mobile Computing (Volume: 14 , Issue: 6 , June 1 2015)
[18]Jaehyun Park ; Jangmyung Lee, A Beacon Color Code Scheduling for the Localization of Multiple Robots, IEEE Transactions on Industrial Informatics (Volume: 7 , Issue: 3 , Aug. 2011)
[19] Upadhyaya ; ChunmingQiao ; Jean-Pierre Hubaux Secure Distance-Based Localization in the Presence of Cheating Beacon Nodes, IEEE Transactions on Mobile Computing (Volume: 9 , Issue: 6 , June 2010)
[20]JavadRezazadeh ; MarjanMoradi ; KumbesanSandrasegaran ; Reza Farahbakhsh Transmission Power Adjustment Scheme for Mobile Beacon-Assisted Sensor Localization
[21]MarjanMoradi ; KumbesanSandrasegaran ; Reza Farahbakhsh, Transmission Power Adjustment Scheme for Mobile Beacon-Assisted Sensor Localization
,IEEE Transactions on Industrial Informatics (Early Access)
[22]N. Bulusu ; A.V. Savkin ; S. Jha ,Node localization using mobile robots in delay-tolerant sensor networks, IEEE Transactions on Mobile Computing (Volume: 4 , Issue: 3 , May-June 2005)
[23]Simon Tomažič ; DejanDovžan ; Igor Škrjanc Confidence-Interval-Fuzzy-Model-Based Indoor Localization, IEEE Transactions on Industrial Electronics (Volume: 66 , Issue: 3 , March 2019)
[24]Xuan Yang ; Li Liu ; Mohsen Guizani ; Wenbo Zhang ,A Disaster Management-Oriented Path Planning for Mobile Anchor Node-Based Localization in Wireless Sensor Networks, IEEE Transactions on Emerging Topics in Computing (Early Access)
[26]OnurGungor ; Fangzhou Chen ; Can EmreKoksal Secret Key Generation Via Localization and Mobility, IEEE Transactions on Vehicular Technology (Volume: 64 , Issue: 6 , June 2015)