Australian Journal of Basic and Applied Sciences, 8(17) November 2014, Pages: 552-558

AENSI Journals

Australian Journal of Basic and Applied Sciences

ISSN:1991-8178

Journal home page: www.ajbasweb.com

Distribution of Channels for Communication in Wireless Sensor Networks

[1]P. Jesu Jayarin and [2]G. Sheeba

[1]*Associate Professor, Department of CSE, Jeppiaar Engineering College , Chennai, India.*
[2]*Asst Professor, Department of ECE, NPSBC of Engineering & Tech , Chennai, India.*

ARTICLE INFO

Article history:
Received 25 August 2014
Received in revised form
19 September 2014
Accepted 29 October 2014
Available online 16 November 2014

Keywords:
Channel Allocation, Localization, Quality of Service, Traffic Analysis, Position Evaluation, Mobility.

ABSTRACT

Wireless communication and mobile computing are rapidly growing segments of the communication industry with the potential to provide low-cost, high-quality, and high-speed information exchange between portable devices. In wireless sensor networks the Nodes are mobility enabled, since the communication among nodes fully depend on the distance between nodes and time taken to transmit the data packets. Any routing protocols suggesting the shortest path based route formation is the best concept for fast and safe transmission and it improves the QoS of the WSN in terms of speed and accuracy. A common solution addressing the problem of call dropping in wireless cellular networks is Channel reservation Without locating the nodes and the accurate distance, the shortest path finding is inefficient .A novel Localization approach is introduced to localize the nodes accurately with the help of Beacon Nodes in the network. The simulation results produced better performance than the existing systems.

To Cite This Article: P. Jesu Jayarin and G. Sheeba., Distribution of Channels for Communication in Wireless Sensor Networks. ***Aust. J. Basic & Appl. Sci.,*** *8(17): 552-558, 2014*

INTRODUCTION

A cellular communication system (Barth, D., 2011; Dharma Prakash 2003) is considered where we have a provision for N channels in each cell. A number of channels (Dharma Prakash 2003) among the existing N channels can be reserved for handling the incoming handoff calls in order to prioritize the handoff calls. Prior knowledge of the traffic cell (Dharma Prakash, 2003; Barth, D., 2011; Barcelo, F., 2004; Venkata Krishna, P., 2008; Ying Xiao, Young-Chon Kim, 2009; Guolin Sun, 2005; Li Cong, Weihua Zhuang, 2005) and requirement of call blocking are used to determine the number of channels in the conventional cut of priority scheme or guard channel scheme. Channels do not change during the operation of the system. Non-conformity of cell traffic to the prior knowledge evidently degrades the performance. Hence with the change of network traffic, application of dynamic scheme, adapting the channel value is better. The time of channel reservation for the incoming handoff calls needs to be addressed in order to determine either an optimal or near optimal reservation value channel at any specific time. The sufficient reservation is made at a time that can be utilized in the near future; which will certainly achieve an enhanced performance (Barcelo, F., 2004). If handoff calls do not utilize reservation, resources will be wasted unnecessarily in blocking new calls. User mobility during the call connection causes handoff calls. Hence, there is a need for better reservation scheme depending on the mobility pattern of the user. Several factors such as destination of the user, cellular network layout, network's current traffic condition are largely responsible for determining such mobility patterns. Detailed characterization of the pattern of mobility for every individual user is difficult and is not useful either, as call performance is a resultant collective outcome of total users in the network. Instead, using the statistical property of the mobility (Venkata Krishna, P., 2008) of the users would be more useful. Based on their velocities users can be classified into two groups: high speed (vehicular users) and low speed (pedestrians) users. On an average high speed user's cell dwell time is shorter than that of low speed user. These classifications help us to predict the probability handoff (Ying Xiao, Young-Chon Kim, 2009) of each group and accordingly make reservations.

The propagation of wireless sensor network communication tools has been permitted in the progress of WSN, which comprises a huge number of minor and inexpensive sensors with limited resources, such as calculating, announcement, stowage and energy (Yick, J., 2008). These sensor nodes are talented to sense, measure and gather uncooked data from the background, completes simple computations and then transmit only the requisite and partially administered data to the node answerable for combination (Akyildiz, I.F., 2002).

Corresponding Author: P. Jesu Jayarin, Associate Professor, Department of CSE, Jeppiaar Engineering College , Chennai, India.
E-mail: jjayarin@gmail.com

Wireless sensor network is deployed extensively in areas such as surveillance, health monitoring (Toh, S.H., 2009), human action detection, military (Hussain, M., P. Sup, 2009) and disaster management (Wirawan, N., 2008) and hazardous environments (Werner-Allen, 2006). This kind of applications requires that the position of the nodes must be determined. In most of the scenarios node position information gives a critical situation, such as data centric storage based applications (Ratnasamy, S., 2002). Moreover, the algorithm fulfills several secondary design objectives: self-organizing nature, simplicity, robustness, localized processing and security.

Related Work:

For locating the users have to merge both TDOA [Time Difference of Arrival] + AOA [Angle of Arrival] have to be merged. The home BS [Base Station] for an MS [Mobile Station], renders services to the target MS (to be located). All the adjacent BSs, which contain signals having the signal-to-interference-plus noise ratio (SINR) above a specified threshold at the MS, can be involved in the process of an MS location. The MS receiver through the cross correlates can measure the TDOA (Li Cong, Weihua Zhuang, 2005) between the signals either from home BS or other BSs. Enhanced location accuracy can be achieved by using the AOA (Li Cong, Weihua Zhuang, 2005) measurement in conjunction with TDOA measurement. The prime assumption here is that at any given point of time, forward-link pilot signals can be received by the MS to be located both from its home BS and at least from one adjacent BS.

Localization techniques entirely differ from one another in terms of various features (Wang, J., 2010), like the way of gathering input data, the node state in the sensor nodes and the application node answerable for location estimation. In (Franceshini, F., 2009) the different types of algorithms are categorized. Using a GPS receiver or manual configuration of nodes the location is discovered, and it requires special sensor nodes termed as beacons (Shi, Q., 2010). In another way that without the use of beacon nodes (Moore, D., 2004) the location of each nodes are estimated are with the help of nodes related due to some geometric features. There is an algorithm called incremental algorithm (Liu, L., 2006) which starts with a less number of beacon nodes. Once their location is estimated their points are taken as reference points and they increase the x, y value and find the other nodes location. Another approach, called concurrent approach (Patwari, N., 2005; Ji, X. and H. Zha,) takes pair of nodes and by their communication the nodes to share their measurements and find the location. Fine-grained method (Rahman, M.Z. and Kleeman, 2009) uses accurate information in the position estimation which measure the distance by using beacons RSS or the ToA – [time of arrival] procedure. Coarse-grained approaches (Lim, H. and J.C. Hou, 2005) utilize less information with the help of rough techniques like hop count and measure the distance to beacons. A centralized approach (Capkun, C. and J.P. Hubaux, 2006) needs global knowledge to measure all the existing data with the data provided to the nodes in the distributed network. In example (Zhang, S., 2010) an algorithm is proposed and it needs a triangle shape based beacon placed in a particular location, It assumes if the localization algorithm is independent of global infrastructure and beacon placement, else it would increase the computation cost which is clearly stated in (Tran-Xuan, C., 2009).

Some of the localization algorithms (Jesu Jayarin, P., *et al***.,** 2014; Shi, Q., 2010; Wan, J., 2009; Chai, 2009) contain two important main steps: initialization step, where a node get a rough estimation of its location and the refinement step. There are several algorithms introduced to overcome the problems in the existing approaches which are given in (Jiang, H., 2009). A portion of the sight and sound sensors consolidated with scalar sensors (Hicham Touil, Youssef Fakhri, 2014) to enhance the QOS as far as ongoing interactive media requisitions. These sensors are utilized to make another era of MAC conventions for WMSN focused around Ieee802.11e. Improved Distributed Channel Access convention (Ahmed Abu-Khadrah, 2014) utilized as a part of MAC layer for enhancing QOS in WSN as far as VOIP based correspondence. In (Muthusenthil, B., S. Murugavalli, 2014) the creator rolled out an improvement in system topology to keep up a concentrated MAC for MANET and attempted to evade self-centered hubs in the system. Various algorithms and techniques are analyzed to motivate and to compare the proposed approach’s efficiency. It means that the problems in the existing papers and the methods should be rectified and compared for better performance.

System Model:

The localization method needs the information from node to be shared with the other node. By deploying the information of one node into the other node, the accuracy of the location estimation, reduction of the communication information, and requirement of the computational services are shown in figure-1.

Problem Statement:

In order to improve the QoS, the data transmission should happen among the nodes which are relatively close in distance. Before communicating the routing algorithm should find the route by nodes within the shortest distance. To find the closet nodes, it is necessary get the location of the nodes and the location estimation can be obtained by the proposed approach introduced in this paper.

Proposed System:

The novel localization algorithm for wireless sensor networks with efficient accuracy uses a large number of reference nodes to enhance the accuracy of location estimation. It is so called clever reference-assortment method. It chooses a less possible number of references that could contribute most to high accuracy.

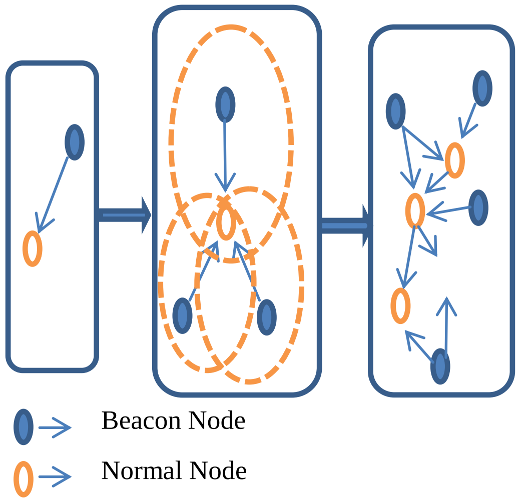

Fig. 1: Localization system Model.

This novel approach has been developed to enhance the accuracy of the location estimation for the nodes. The idea is to select those references that are willing to help the other nodes going to estimate their locations. Based on this method, the node will only select those references that could contribute most to an accurate position estimate, and will eradicate inappropriate references from participating in the final location estimation.

Novel Localization Approach:

Level-1: Initializing the necessities:

- If [state =true] then exist
- Broadcast "LOC_REQ" messages
- Receive "LOC_RES" messages from the neighbor reference [Ri]
- If (C(Ri) < 3) then exist.

Level-2:Initializing the position estimation:

- *Make a subset S_i from the R_i*
- *and measure the distance to the reference in S_i*
- *and apply Mean Square error to check the initial position* $\widehat{z_i^0}$

Level-3:Sophisticated position estimation:

- *For [j=1 to C(S_i))*
- $\widehat{e^d}_{i,j} = \left| \|\widehat{z_i} - \widehat{z_j}\| - \widehat{d_{i,j}} \right|$
- *if (* $\widehat{e^d_{i,j}} > e^d_{max}$ *)then [further == true); break.*
- *if* $[further = true]$
- $for\ (\ j = 1\ to\ C(R_i))$
- $\widehat{e^d}_{i,j} = \left| \|\widehat{z_i} - \widehat{z_j}\| - \widehat{d_{i,j}} \right|$
- $\widehat{e^d_{i,j}} > e^d_{max}$ *) Then [eliminate r_j].*
- *Estimate the refined position* $\widehat{z_i}$ *as shown in 2*
- *else*
- $\widehat{z_i} = \widehat{z_i^0}$

Level-4: Position update:

- $D_{acc} = \sum_{j \in S_i} \left| \|\hat{z}_i - \hat{z}_j\| - \hat{d}_{i,j} \right|$
- $if\ (\ D^k_{acc} < D^{k-1}_{acc})$
- $\hat{z}_i$ *will be accepted*
- $if\ (D_{acc} < T_{acc})then\ (final = true)$

The novel approach contains four main modules where in the first module the nodes collect information from nearby references. In the second module the nodes select a subset of references to estimate the locations. In the third module, the nodes verify the possibilities of improving the current position. In the fourth module the nodes decide if it will accept this location, and if the accepted location can be considered as a final estimation.

Level-1: Initializing the requirements:

In the network for some of the beacons we assign their probability of the accuracy as one 〖Prob〗_acc= 1. Each reference holds the information required to localize the other nodes that are the location or the location estimation and the accuracy probability. Generally a node which broadcasts a location request message and gets the response from the beacon nodes is known as the reference node [Ri] and their ID, location are noted for accuracy calculation.

$Ref_{list}^{i} = \{ID_i, Z_i \; or \; \widehat{Z}_i \, , Prob_{acc}^{i}\}$,

which will be used to find the subset of references S_i.

Level-2: Initial Position Estimation:

The selected subset S ⊆R will contribute to accurate location estimation. The reference node should be the nearest node with low location error produced. The distance error e^d=0 and the total error can then be written as

$$e^l = e^c + \sum_{i \in R} e_i^l$$

When the reference node is selected, the error should be minimum and the node should be nearer to the request node. If, the reference node is the beacon node, it will respond perfectly to its own measurement including the location. From the location of the beacon node the request node can estimate its location by location estimation. The other way is by refined position estimation which is mentioned below.

Level-3: Sophisticated Position estimation:

In the previous level the position estimation is based on the minimum error based REQ and RES method. In this level the distance error is also considered. When a node sends a LOC-REQ for the other nodes and is received by a beacon, it passes the LOC_RES immediately. If the other nodes pass on the response it means, the reference location Z_i and the distance error e_d is calculated and it should be less than the maximum distance error. If the reference node proves a proper response and the error is also minimum it will be included in the subset.

Level-4: Position Update:

In general the node checks the acceptance of the LOC_REQ and the position estimation. Then it applies the termination criterion. To check the acceptance of the estimated position, the node computes the position's degree of accuracy D_acc as follows:

$D_{acc} = \sum_{i \in s_i} \left| \left\| \widehat{Z}_i - Z_j \right\| - \widehat{d_{i,j}} \right|$if the new degree of the accuracy is better than the one from the previous iteration that of $D_{acc}^{i} < D_{acc}^{i-1}$, it will accept the new estimated position, or else it will be rejected.

Simulation Settings:

In order to evaluate the proposed approach and compare it with the other algorithm the networks simulator ns-2 is used. The current version of ns-2 is extended to simulate wireless sensor networks and the localization algorithm is deployed in ns-2 as a new module. The extended ns-2 is user friendly and is easy to use. There is no restriction in the number of nodes and area of the network. According to the distance-measurement we can analyze the error of the accuracy of the proposed algorithm.

In the NS-2 there are some standalone classes are implemented in C++ and will connect the developed localization algorithm based modules as classes. They are compiled classes which are interconnected with the interpreted classes in NS-2. When a location Request is produced, LocReq agent will handle the request messages. Once the response is generated by the reference nodes, Loc_Res agent will take care of the response messages. The LocD agent will discover the location of the nodes, and an important class Poisiton.cpp will estimate the position accurately. Technically, the PT_LocReq is the location request packet and the location response packet. When the packet is transmitted by the response nodes, the nodes information is also attached with the packet. The nodes location is received from the location response packet.

The timer class estimates the time during the run time, at what time the request is generated and at what time it reaches the reference nodes. Then at what time the response is generated and at what time the response reaches the request node. At this particular time the Estimate Timer will call the scheduler and estimate the distance. Using the distance and the response nodes location the Request nodes location is estimated accurately.

RESULTS AND DISCUSSION

The Novel approach introduced in this paper is simulated partially and implemented partially using network simulator-2, the results are given below for pursuing the performance of the approach. There are 8 nodes deployed in the network and 5 nodes are assumed and assigned as beacon nodes and the remaining 3 nodes are normal sensor nodes. While running the application the node 0 estimates its location and it is changed. Means with the help of the reference nodes the node 0 estimates its location. After the node 0's location is estimated the node 2 is estimates its position with the help of beacon node as well as the node 0.Nodes 1 is estimates its location with the help of the other reference nodes that is one that knows its location already and are very near to node 1.The estimated location of the normal nodes is displayed in the trace file by Location Discovery class in the NS-2.

Table 1: Node Location Estimation.

N -t 1.415216 -n 5 -e 0.499387 N -t 1.415216 -n 6 -e 0.499387 L 1.981563 0 0.499387 5 0.300368 45.036380 45.145711 L 2.405284 2 0.499387 4 0.731138 29.734486 20.251282 N -t 3.223998 -n 7 -e 0.499364 N -t 3.223998 -n 4 -e 0.499364							
The above lines are the traced information in NS-2, which shows column wise data to represent the information collected whether it is a normal node or location estimated, The second column mention the time, the third column the location estimated node, then the distance among the requested node and response node followed by the response node number, and finally the location X, Y values.							
Location / Reference	Req-time	Req-Node	Energy	Reference Node	Error	X	Y
L	1.981563	0	0.499387	5	0.300368	45.0	45.0
L	2.405284	2	0.499387	4	0.731138	29.98	20.051282
L	4.154194	1	0.499175	3	1.076115	14.951535	69.902704

The above Table-1 shows the request nodes are 0, 1 and 2, and they estimate their location with the help of the nodes 3, 4 and 5. Generally from the 8 nodes, 0 to 2 are normal nodes that don't know their location and the nodes 3 to 7 are the beacon nodes that know their location. The node 0's location is [45.03, 45.14], node 1's location is [29.73, 20.25] and the node 2's location is [14.55, 69.70] respectively which are estimated very clearly. This output is very accurate and is displayed in the trace file.Node 0, 1, and 2's Original Location shown in the NAM window, which accurately matches with the Traced file information simulated in NS-2.The traced location and the original node location in the NAM window are accurately matched with one another.

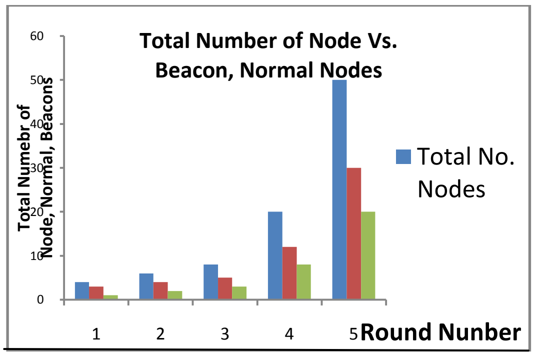

Fig. 2: Number of Node vs. Request and Beacon Nodes.

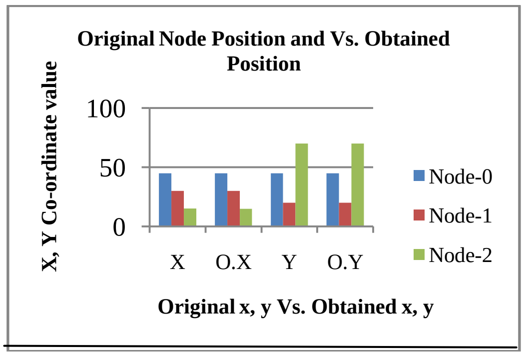

Fig. 3: Original X, Y Coordinate Value Vs. obtained Coordinate Value.

From the above figure, it is depicted that the number of Nodes 4, 6, 8, 20 and 50 are deployed in the Network, where 3, 4, 5, 12, and 30 are the beacon nodes assumed and the remaining 1, 2, 3, 8 and 20 are the number of nodes assumed as request nodes in the network respectively. The partial number of nodes is requests and obtains its position with the help of the beacon nodes if and only the ratios of the nodes are categorized in this manner. It also depends on the distance between the nodes in the network.

It is very clear that the node location in the NAM window and the traced action with the help of the beacon nodes is very accurate. The node 0, 1, and 2 location's x, y values in the NAM window are obtained in equal. Hence the proposed approach is accurate. The projected system was implemented and assessed using a marketable network simulator. This assessment of the proposed algorithm's recital confirmed that it is superior to other localization algorithms evaluated; using fewer references in the literature survey, the proposed algorithm provides better results in terms of location finding, accuracy in estimation, robustness and energy efficiency. From the results, it is confirmed that a location estimation and localization technique uses less reference nodes than the existing system where it reduces the computation time complexity and increases the speed.

The below Figure 4 shows the failure rate of the call arrivals per hour, per cell when one of the base station fails. Distributed channel allocation algorithms have gained more attention because of their high reliability and scalability the simulation results of base station with failure.

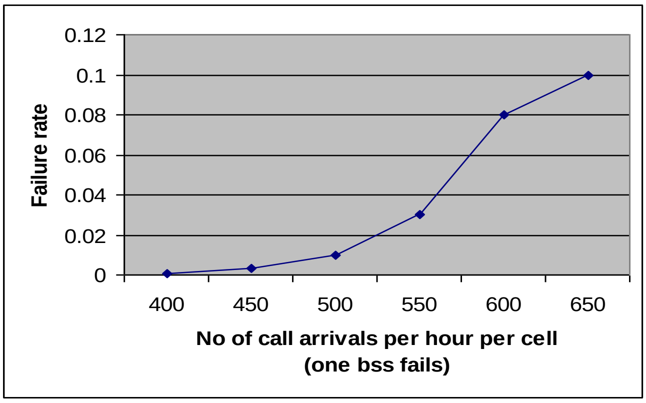

Fig. 4: Failure Rate When One Base Station Fails.

Conclusion:

The Novel localization approach relies on using less number of reference nodes and with the help of the compiler based scheduler and it estimates the time based distance with the location of the beacon nodes. Since beacon nodes are self-organized nodes, the location generated by the beacon nodes are accurate. To investigate the proposed approach the nodes are deployed in many ways in the network and it is concluded that this Novel Localization approach is more efficient and accurate from the Figure-2 and Figure-3. The limitation of this approach is it can estimate the locations only with the help of beacons.

REFERENCES

Ahmed Abu-Khadrah, Zahriladha Zakaria, Mohd Azlishah Othman, 2014. ”New Technique to Enhance Quality of Service Support for Real Time Applications in EDCA Protocol”, Copyright © 2014 Praise Worthy Prize.

Akyildiz, I.F., W. Su, Y. Sankarasubramaniam and E. Cayirci, 2002. “ A survey on sensor networks”, IEEE communication Magazine, 40(8): 102-114.

Barcelo, F., 2004. "Performance analysis of handoff resource allocation strategies through the state-dependent rejection scheme", Wireless *Communications, IEEE Transactions on,* 3(3): 900-909.

Barth, D., S. Bellahsene, L. Kloul, 2011. "Mobility Prediction Using Mobile User Profiles," Modeling, Analysis & Simulation of Computer and Telecommunication Systems (MASCOTS), 2011 IEEE 19th International Symposium on, 286-294.

Capkun, C. and J.P. Hubaux, 2006. “Secure positioning in Wireless networks,” IEEE Journal on Selected Areas in Communications, 24(2): 221-232.

Chai, 2009. “Efficient Intelligent localization scheme for distributed WSN, “Journal of Computers, 4: 1159-1166.

Dharma Prakash Agarwal and Qing AnZeng, 2003. "Introduction to Wireless and Mobile Systems", *published by Thomson Asia Pvt. Ltd, 2003*. ISBN: 981-243-132-2.

Franceshini, F., M. Galetto, D. Maisano and L. Mastrogiacomo, 2009. “A review of localization algorithms for distributed wireless sensor networks in manufacturing,” International Journal of Computer Integrated Manufacturing, 22(7): 698-716.

Guolin Sun, Jie Chen, Wei Guo, K.J.R. Liu, 2005. "Signal processing techniques in network-aided positioning: a survey of state-of-the-art positioning designs," *Signal Processing Magazine, IEEE*, 22(4): 12- 23.

HichamTouil, Youssef Fakhri, 2014. ”QoS-Aware MAC Protocols Based on the IEEE 802.11e for Wireless Multimedia Sensor Networks”, Copyright © 2014 Praise Worthy Prize.

Hussain, M., P. Sup, 2009. “Khan, and K Sup, “WSN research activities for military application,” in Proceedings of the 11th International Conference on Advanced Communication Technology – ICACT ’09, 15-18 February, Phoenix Park, Korea, 1: 271-274.

Jesu Jayarin, P., *et al*., 2014."A Novel Localization approach for QOS Guaranteed Mobility Based communication in WSN" Copyright © 2014 Praise Worthy Prize.

Ji, X. and H. Zha, " Sensor Positioning in Wireless ad-hoc networks using multi-dimensional scaling, " in Proceedings of the 23rd Annual Joint Conference of the IEEE computer and communications Societies – INFOCOM '04, 07-11 March, Hong-Kong, PR China, 4: 2652-2661.

Jiang, H., R. Cao, and X. Wang, 2009. "Apply modified method of non-linear optimization to improve localization accuracy in WSN," in Proceedings of the 5th International Conference on Wireless Communications, Networking and Mobile Computing – WiCOM '09, 24-26 September, Beijing, China, pp: 1-6.

Li Cong, Weihua Zhuang, 2005. "Nonline-of-sight error mitigation in mobile location," *Wireless Communications, IEEE Transactions on,* 4(2): 560-573.

Lim, H. and J.C. Hou, 2005. "Localization for anisotropic sensor networks," in Proceedings of the 24th Annual Joint Conference of the IEEE Computer and Communications Societies – INFOCOM '05, 13-17 March, Miami, Florida, USA, 1: 138-149.

Liu, L., Y. Zhang and F. Zhao, 2006. "Robust distributed node localization with error management," in Proceedings of the 7th ACM International Symposium on Mobile Ad Hoc Networking and computing, 22-25 May, Florence, Italy, pp: 250-261.

Moore, D., J. Leonard, D. Rus and S. Teller, 2004. "Robust distributed network localization with noisy range measureents," in Proceedings of the 2nd International Conference on Embedded Networked Sensor Systems, 03-05 November, Baltimore, MD, USA, 2004, pp. 50-61.

Muthusenthil, B., S. Murugavalli, 2014. "Location Aided Cluster Based Geographical Routing Protocol for Intermittently Connected MANET", Copyright © 2014 Praise Worthy Prize.

Patwari, N., J.N. Ash, S. Kyperountas, A.O. Hero III, R.L. Moses and N.S. Correal, 2005. "Locating the nodes: cooperative localization in WSN," IEEE signal Process. Mag., 22: 54-69.

Rahman, M.Z. and Kleeman, 2009. "Paired measurement localization: A robust approach for wireless localization, " IEEE Transaction on Mobile Computing, 8(8): 1087-1102.

Ratnasamy, S., B. Karp, L. Yin, F. Yu, D. Estrin, R. Govindan and S. Shenker, 2002. "GHT: A geographic hash table for data-centric storage, " in Proceedings of the 1st ACM International Workshop on Wireless Sensor Networks and Applications – WSNA '02, 28 September, Atlanta, Georgia, USA, pp: 78-79.

Shi, Q., C. He, H. Chen and L. Jiang, 2010. "Distributed WSN localization via sequential greedy optimization algorithm," IEEE Transactions on Signal Processing, 58(6): 3328-3340.

Shi, Q., H. Huo, T. Fang and D. Li, 2010. "A distributed node localization scheme for wireless sensor networks, " Wirelss Personal Communications, 53(1): 15-33.

Toh, S.H., K.H. Do, W.Y. Chung and S.C. Lee, 2009. "Health decision support for biomedical signals monitoring system over a WSN, " in proceedings of the 2nd International Symposium on Electronic Commerce and Security – ISECS '09, 22-24 May-608., Nanchang City, China, 1: 605.

Tran-Xuan, C., V.H. Vu and I. Koo, 2009. "Calibration mechanism for RSS based localization method in WSN," in Proceedings of the 11th International Conference on Advanced Communication Technology – ICACT '09, 15-18 February, Gangwon-Do, South Korea, 1: 560-563.

Venkata Krishna, P., N. Ch., S.N. Iyengar, 2008. "Optimal channel allocation algorithm with efficient channel reservation for cellular networks", *Int. J. Communication Networks and Distributed Systems,* 1(1): 33-51.

Wan, J., N. Yu, R. Feng, Y. Wu and C. Su, 2009. "Localization refinement for WSN," Computer Communications, 32(13-14): 1515-1524.

Wang, J., R.K. Ghosh and S.K. Das, 2010. "A Survey on sensor Localization," Journal of Control and Theory Applications, 8(1):. 2-11.

Werner-Allen, K. Lorincz, M. Ruiz, O. Marcillo, J. Johnson, J. Lees and M. Welsh, 2006. "Deploying a wireless sensor network on an active volcano, " IEEE Internet Computing, 10(2): 18-25.

Wirawan, N., S. Rachman, I. Pramoto and N. Mitra, 2008. "Design of low cost wireless sensor networks-based environmental monitoring system for developing country", in Proceedings of the 14th IEEE Asia-Pacific Conference on Communications – APCC '08, 14-16 October, Tokyo, pp: 1-5.

Yick, J., B. Mukherjee and D. Ghosal, 2008. "Wireless sensor network survey" , computer Networks, 52(12): 2292-2330.

Ying Xiao, Young-Chon Kim, 2009. "Channel Allocation Scheme for Handoff Call Based on Markov Chain with Hysteresis", Information *Science and Engineering (ICISE), 2009 1st International Conference on,* page(s): 2578-2581.

Zhang, S., G. Li, W. Wei and B. Yang, 2010. "A Novel iterative multilateral localization algorithms for WSN," Journal of Networks, 5(1): 112-119.