Improving Localization Algorithms Based on Location Estimation Mobile Anchor Nodes in Wireless Sensor Networks

Priyanka Patel [1], M. Tech. Scholar, Department of EC, SVCST, Bhopal, India; singhpriyanka714@gmail.com

Dharmendra Kumar Singh [2], Asst. Professor, Department of EC; SVCST, Bhopal, India; dharmendra.svcst@gmail.com

ABSTRACT: *A wireless detector network (WSN) consisting of an oversized variety of small sensors are often a good tool for gathering knowledge in various forms of environments. The data collected by every detector is communicated to the base station, which forwards the information to the top user. Cluster is introduced to WSNs as a result of its tested to be a good approach to produce higher knowledge aggregation and measurability for giant WSNs. cluster additionally conserves the restricted energy resources of the detector. A wireless network is any kind of electronic node network that uses wireless data connections to plug network nodes. Wireless networks portable computer networks agency doesn't appear to be connected by cables in spite of the kind. The use of a wireless network permits enterprises to prevent the expensive suggests that of introducing cables into buildings or as associate affiliation between completely different instrumentality locations. The cornerstone of wireless systems is radio waves, associated implementation that occurs at the physical higher level of network structure. Wireless Networks (WSNs) are networks of distributed autonomous devices that might sense or monitor physical or environmental conditions in native space. Wireless Networks (WN) face several challenges and communication failures. Resource potency of target nodes finds additional in wireless networks and demand for nodes position estimation. Wireless networks learning on localization ways for mobile wireless device networks. Wireless network applications that need nodes position estimation. Improve performance localization in wireless networks based mostly on AOAA, RSSA technique and projected advanced localization algorithmic program (PALA). A resource utilized in WN with wireless channels and quick channel, aware WN and find nodes target localization is painted based mostly parameter, RSSA and AOAA sensible issue involving the presence of malicious sensors nodes. The projected advanced localization algorithmic program is an analysis of minimum error as compared to the previous methodology. Time interval analysis averages. The best accuracy with minimum errors and time minimum. The simulation on the mat research lab and gets results show that the projected algorithmic program will estimate the location of the unknown node with fewer anchor nodes and enhance the positioning of nodes in WN. Previous methodology additional error however our projected methodology less error.*

Keywords: Wireless sensor Network, security, localization, mobile sensors, anchor nodes, Localization error, received signal strength, RSSA, AOAA, PALA.

INTRODUCTION

Wireless technologies disagree in a variety of dimensions, most notably in exactly however a lot of information measures they supply and the way apart human action nodes are often. Different necessary variations embrace that maybe the magnetism spectrums they select (including whether or not this has or not a license) and precisely however a lot of power them consume (very necessary to mobile nodes). In this section, we tend to discuss four distinguished wireless technologies: Bluetooth (802.15.1), Wi-Fi (more formally typically referred to as 802.11), Wi-MAX (802.16), and third-generation 3G cellular wireless. In the subsequent sections, we tend to present them as a means ROM shortest vary to longest vary.
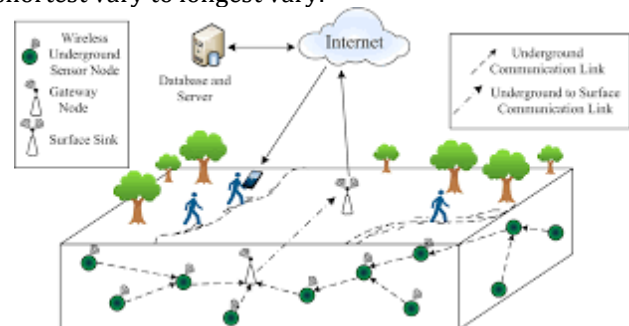

Figure 1: wireless network [1]

One of the foremost historically used wireless links these days square measure typically uneven, i.e., each endpoints square measure typically sorts of nodes. One terminus, generally termed the base-station, commonly has no quality, however, features a wired (or at the best high bandwidth) link to the web or different networks as shown in Figure one. The node within the opposite finish from the link shown as a result of a "client node" will typically be mobile and utilizes its link to the bottom station for those its communication with different nodes.

Issues

Geographic Routing: Geographic routing is a routing principle that relies on geographic position information. It is mainly proposed for wireless networks and based on the idea that the source sends a message to the geographic location of the destination instead of using the network address.

Sensor Holes: A routing hole consists of a region in the sensor network, where either node is not available or the available nodes cannot participate in the actual routing of the data due to various possible reasons. The task of

International Journal of Innovative Research in Technology & Science

Received 1 August 2019, Received in revised form, 29 August 2019, Accepted 10 September 2019, Available online 25 September 2019

identifying holes is especially challenging since typical wireless sensor networks consist of lightweight, low-capability nodes that are unaware of their geographic location.

Coverage Topology: Coverage problem reflects how well an area is monitored or tracked by sensors. The coverage and connectivity problems in sensor networks have received considerable attention in the research community in recent years. This problem can be formulated as a decision problem, whose goal is to determine whether every point in the service area of the sensor network is covered by at least k sensors, where k is a given parameter. [3]

Ad-hoc Networks

An advert hoc network is typically a network that's composed of individual devices human action conjointly directly. the thought of implies spontaneous or impromptu construction as a result of networks typically bypass the gate keeping hardware or central access purpose, for instance, a router. several random networks square measure neighborhood networks wherever computers or different merchandise square measure enabled to send information on to every different instead of addressing a centralized access purpose [3].Ad-hoc networks square measure multi-hop wireless networks that will operate minus the services of the established backbone infrastructure. whereas such networks have obvious applications from the military and disaster relief environments, a lot of fashionable works that contain intended their use even in regular wireless packet information networks have raised their significance. The most objective of this paper ought to be to review the performance with the transmission control protocol transport layer protocol over ad-hoc networks. Thinking about an advert hoc network is generally unfamiliar with end-users with solely seen tiny residential or business networks that use a regular router to send wireless signals to individual computers. However, the unintentional network is going to be used an excellent deal in new types of wireless engineering, though until recently it clad a rather cryptic plan. One example may be a mobile random network involves mobile devices human action directly with one another. A distinct variety of random networks, the conveyance random network, involves inserting communication devices in cars. Each these square measure samples of unintentional networks designed to use an oversized type of individual devices to freely communicate with no type of top-down or hierarchal communication structure [4].

LITERATURE SURVEY

1. Localization in wireless device network may be a hot space of analysis that has been addressed through several planned schemes. Supported the dependency of the various measurements theses proposal schemes square measure classified into 2 major categories: range-based schemes and range-free schemes. However, it's troublesome to classify hybrid schemes that mix different ways supported property info and/or vary menstruation techniques as range-based or range-free schemes. During this paper, we tend to create the classification of any localization schemes straightforward, wherever range based schemes and range-free schemes square measure divided into 2 types: schemes and hybrid schemes. What is more, this classification is planned additionally to assist in scrutiny localization schemes in terms of accuracy. Especially, between the schemes of a similar class either for range-primarily based or for range- frees classes. This comparative analysis conducted the United States of America to conclude that every formula has its typical options and none is the simplest. On the complete, the range based ways square measure either dearly-won concerning hardware price or status to environmental noises and dynamics. In distinction, the range-free way's square measure general and simply plagued by node density. On the opposite hand, a hybrid localization theme provides higher accuracy than any single localization theme. However, it's a lot of complicated and wants a lot of computation time. What is more, the importance of this comparative study depends on giving different authors the chance of utilizing this analysis to spot the localization schemes that most closely fits their explicit drawback. [5]

2. REST:-primarily based net services on a scientific discipline based low power WSN work that allows information access from anyplace. The alert feature has additionally been enforced to give notice users via email or tweets for watching information once they exceed values and events of interest. Paper proposes A protractile and versatile design for group action Wireless device Networks with the Cloud. we've got used REST primarily based net services as AN practical application layer which will be directly integrated into different application domains for remote watching like e-health care services, sensible homes, or maybe conveyance space networks (VAN).To avoid loss of information and network disruption thanks to the failure of the organizer, we tend to embedded intelligence at totally different fine arts layers to accommodate the various necessities of potential application eventualities with minimum plan and cryptography. The analysis results illustrate that the device information is often accessed by the users anyplace and on any mobile device with web access. The results additionally incontestable that it takes a median of 11s for the alert notification email to be machine-generated and delivered to the user on their email account from the Open.Sen.se server. Additionally, exploitation of the sleep mechanism for low power XBee

ZB transceiver modules provided AN energy economical approach to extend the lifespan of device nodes. [6]

3. The Underwater device Network (UWSN) is the main attention-grabbing space thanks to its most useful applications like disaster preventions, distributed military science police work, subsurface exploration, unstable watching, environmental watching and plenty of a lot of. The look of energy economical routing protocol but may be a difficult issue as a result of in underwater atmosphere the batteries of the device nodes cannot be recharged simply. The majority of the researchers have tailored the terrestrial WSN methodologies to beat this drawback however in the underwater atmosphere the terrestrial WSN approach isn't possible thanks to the acoustic communication and water current. This analysis paper focuses on the key limitation of the present energy economical routing protocols. The simulation results with comparative analysis for energy economical routing protocols are bestowed during this analysis article; that helps the analyzers to seek out any research gap within the field of energy economical routing protocols. The main purpose of this text is to elaborate on the operations of the protocol with its designed design, route discovery, route maintenance, information forwarding, and energy consumed by device nodes. The limitation of planned protocols can guide the analysis to any research within the field of routing protocols. This analysis article any focuses on the analytical analysis technique and numerical simulation analysis technique. In the numerical simulation technique, we have a tendency to discover that the ERP2R and R-ERP2R consume less energy as compare to the remainder of the planned routing protocols that shows that these protocols have used the reliable methodology for energy potency. [7]

4. Location-Based clump formula for information Gathering (LCAD) a). Protocol Operation the authors of this analysis paper have recommended that 3D girds network structure for LCAD routing protocol [7]. The dimensions of every gird have been tailored in 3D type measured in meters as 30×40×50. Authors have recommended communication structure in terms of 3 phases: (i) transmission, (ii) information gathering, and (iii) fitting. In the transmission section, the information is collected through clustered head and might be delivered with the assistance of Autonomous Underwater Vehicles (AUVs) to the bottom stations. In the information gathering section the information square measure transferred with the assistance of the device nodes to the clustered heads. The fitting section can choose the correct cluster. The authors any classified the network with 2 key parts that square measure C_NODE and C_HEAD (Cluster Node and Cluster Head). The C_NODE has additional energy power and memory; that is that the qualifier of C_HEAD, and is placed at the middle level

of every gird. The normal device nodes square measure round the C_NODE makes clusters. AUVs can collect the information from C_HEADS rather than normal device nodes. The authors have set the acoustic link around 500m solely. The authors have additionally tailored the number of tiers approach on the highest and lowest level. They settled the very best level tiers approach for dense readying and lowest for the distributed deployment; through this approach, the authors claimed that they're obtaining the general best results. The planned technique resolves the 2 issues: (i) energy dissipation throughout transmission versus distance between sender and receiver and (ii) energy drain thanks to multihop approach from supply to sink node

b) Limitations of LCAD -1. The results of the LCAD square measure measured in terms of terrestrial readying of device nodes; in the real state of affairs, this sort of simulation isn't appropriate for underwater atmosphere and no quite correct energy methodology has been outlined. 2. The behavior of node movement per the readying regions; focuses that node will drop the packets oft and can lose the battery life right away. [8]

5. a) Minimum-Cost clump Protocol (MCCP) Minimum-Cost clump Protocol (MCCP) may be a technique that focuses on node clump drawback in underwater atmosphere [9]. The authors of this analysis paper claimed that MCCP is the ability to boost energy potency and prolong the network lifetime. The MCCP technique focuses the answer of 3 major parameters that are: (i) total energy consumed by cluster members for causing information to cluster head, (ii) residual energy of cluster member and cluster head, and (iii) relative location between cluster head and sink node. The authors have targeted first, the minimum-cost clump formula (MCCA) and second, the minimum-cost clump protocol (MCCP) to resolve the issues. The authors claimed that they need thought-about the node clump drawback as a cluster-centric cost-based improvement drawback [10].

MCCP distributed approach works per the following steps: one. All the nodes square measure cluster-head candidates and cluster member candidates. 2. Cluster-head candidate with neighbor nodes forms a cluster. 3. price of the fashioned cluster is often calculated through price metric parameters. 4. Computed cluster with its price metric and cluster-head node broadcast 2 hop neighbors.

b). Limitations of MCCP
1. The authors have used the energy model as delineated in [9] isn't appropriate for this sort of design. 2. The fundamental quantity of re-clustering can affect on the battery lifetime of normal device nodes.

International Journal of Innovative Research in Technology & Science

Received 1 August 2019, Received in revised form, 29 August 2019, Accepted 10 September 2019, Available online 25 September 2019

ISSN: 2321-1156   *http://www.ijirts.org*   *Volume VII Issue V, September 2019*

6. a) Hierarchical Multipath Routing-LEACH

HMR-LEACH) HMR-LEACH planned by [11] is that the advancement in terrestrial LEACH protocol. The authors have utilized the HMR-LEACH formula to save lots of energy state of the device nodes throughout the trail mechanism. Authors claimed that HMR-LEACH formula reduces the only path to energy depletion phenomena, and so extends the network lifetime. HMR-LEACH uses second readying of device nodes with covering space of 100m×100m with dynamic readying of the device nodes. The authors have thought-about a similar energy state of all the device nodes with distinctive ID variety and additionally thought-about the nodes organization per the position calculation with respects to the node movement. HMR-LEACH thought-about the static base station with unlimited battery power. It additionally thought-about the adjustment of the node transmission power per the bi-directional property and communication distance. HMR-LEACH additionally thought-about the multi-hop mechanism for those nodes that square measure off from the bottom station; through this mechanism the energy state of the way nodes square measure maintained. As for routing algorithms, the authors planned HMR-LEACH for the development of the nodes cluster mechanism. The authors have divided the HMR-LEACH formula into 2 phases: (i) Multipath institution method, and (ii) path choice method. The authors have used the color-coded communication model for the transmission of controlled packets from the sink node to the bottom stations by formation adjacent clusters and non-adjacent clusters.

b) Limitations of HRM-LEACH

1. HRM-LEACH formation of clusters is simply a hypothesis in a real state of affairs this sort of formation isn't valid for the underwater atmosphere as a result of the device nodes unceasingly changes their positions.
2. Simulation results square measure supported terrestrial networks and terrestrial network parameters don't seem to be valid for the underwater atmosphere.
3. No localization primarily based formula has been thought-about by authors; even the methodology strictly targeted the localization procedures.
4. Energy economical model is additionally outlined for authors that are barely appropriate for terrestrial network.

7. Reliable Energy-Efficient Routing Protocol supported Physical Distance and Residual Energy (R-ERP2R) R-ERP2R planned by [12]. The authors of R-ERP2R have thought-about the physical distance calculation parameter to calculate the gap between the device nodes and sink nodes and a balanced energy state of the device nodes. The design of R-ERP2R relies on sink nodes that square measure deployed on the water surface and square measure connected through RF communication with the onshore information center; the device nodes square measure deployed within the readying region of the water and square measure connected with the acoustic communication with one another and with sinks nodes. The protocol operation relies on 3 sections: in section one data format phase the device nodes have a responsibility to calculate the physical distance and therefore the Expected Transmission Count (ETX) concerning share the residual energy info among the neighbor nodes. Second refers to the information forwarding section with price calculation among the supply and sinks nodes. The third section refers to the value change and maintenance section; this phase updates sporadically the ETX, residual energy info, and physical distance. The authors have thought-about the calculation of the ETX parameter supported the forward delivery magnitude relation and reverse delivery ratio between the 2 coupled nodes. each node features a responsibility to calculate the ETX, physical distance and residual energy info. Physical distance calculation supported the greeting message and Time of Arrival (ToA) mechanism. once each node is aware of the ETX, physical distance and residual energy; then they're going to forward their information packets towards the sink nodes.

Limitations of R-ERP2R

1. The physical path calculation mechanism isn't clearly outlined. 2. The author's square measure forwarding the information through the hop-by-hop mechanism however they need not mentioned in their analysis paper. 3. The majority variety of packets is also born once device nodes are available the void region areas as a result of removal of void regions don't seem to be considered by authors. [12]

8. within the Indian state of affairs, the WSN-based farming solutions have to be compelled to be of terribly low price to be cheap by finish users. However, with the increasing population, the demand of food-grain is additionally rising. Recent reports warn that the expansion in food product production is a smaller amount than the expansion in population (Shanwad et al., 2004). Also, the Asian nation is one amongst the most important exporters of food grains, and thus, researchers (Shanwad et al., 2004; Mondal and Basu, 2009) demand to spice up production by incorporating advanced technologies. Consequently, new and fashionable technologies square measure being thought-about in several agricultural applications to realize the target (Mondal et al., 2004). the present state of development within the Indian state of affairs contains technologies like WSNs, General Packet Radio Service (GPRS), world Positioning System, remote sensing, and Geographical data system (GIS). The current progressive offers WSN-based solutions for irrigation management, crop malady prediction, and farm exactness farming principally.

International Journal of Innovative Research in Technology & Science

Received 1 August 2019, Received in revised form, 29 August 2019, Accepted 10 September 2019, Available online 25 September 2019

ISSN: 2321-1156   *http://www.ijirts.org*   *Volume VII Issue V, September 2019*

Simplified, low cost and ascendible systems square measure in demand, specifically for the LMICs. At a similar time, with the appearance of contemporary technologies, there exists a great deal of scope for innovating new and economical systems. Specifically, low price resolution with options like autonomous operation, low maintenance is in demand. Overall, futurist pre-planning is needed for the success of those applications specifically to beat the issues in the world in addition to LMICs. [13]

MATLAB SOFTWARE

The Performance analysis of MATLAB version 14 (R2008a) i.e. used for this thesis Implementation of data mining provides processor optimized libraries for fast execution and computation and performed on input cancer dataset. It uses its JIT (just in time) compilation technology to provide execution speeds that rival traditional programming languages. It can also further advantage of multi-core and multiprocessor computers, MATLAB provides many multi-threaded linear algebra and numerical function. These functions automatically execute on multiple computational threads in a single MATLAB, to execute faster on multicore computers. In this thesis, all enhanced efficient data retrieve results were performed in MATLAB 14 (R2008b) to get an enhanced result using k-mean and ECABKC.
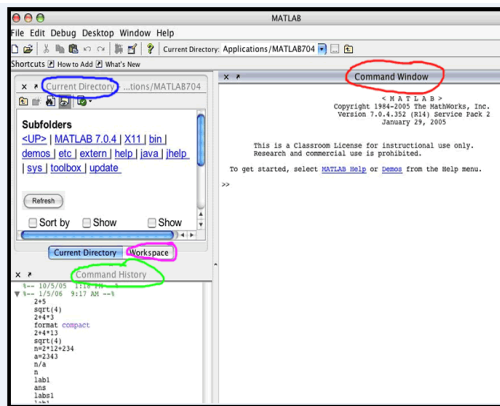

Figure 2 Matlab Main window images

MATLAB is the high-level language and interactive environment used by millions of engineers and scientists worldwide. It lets them explore and visualize ideas and collaborate across different disciplines with signal and image processing, communication and computation of results. MATLAB provides tools to acquire, analyze, and visualize data, enable you to get insight into your data in a division of the time it would take using spreadsheets or traditional programming languages. It can also document and share the results through plots and reports or as published MATLAB code. MATLAB (matrix laboratory) is a multi-paradigm numerical computing situation and 4th generation programming language. It is developed by math work; MATLAB allows matrix strategy, plotting of

function and data, implementation of the algorithm, construction of user interfaces with programs. MATLAB is intended mainly for mathematical computing; an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing capabilities.

It is simulating on mat lab 7.8.0 and for this work, we use Intel 1.4 GHz Machine and operating system window7, window-XP, etc. MATLAB version 14 (R2008a) is a high-level technical computing language and interactive environment for algorithm development, data visualization, records analysis, and numeric computation Mat lab is a software program that allows you to do data manipulation and visualization, calculations, math, and programming. It can be used to do very simple as well as very sophisticated tasks such as Database analysis, visualization, and algorithm development. You can perform efficient data retrieve enhancement. Many functions in the toolbox are multithreaded to take benefit of multicore and multiprocessor computers. An additional package, Simulink, a natural network. The key features of MATLAB, a high-level language.

RESULT ANALYSIS

The evaluation of the proposed work and simulation given figure 1.

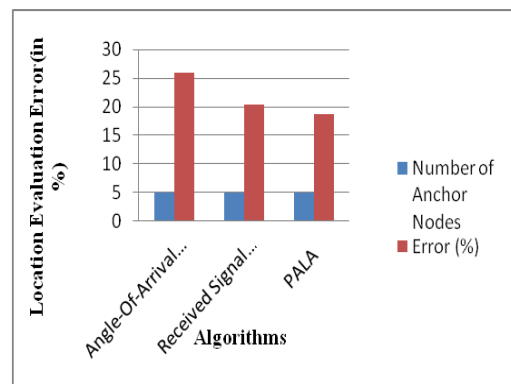| Properties	Value
Width	107m
Height	107 m
Length	107 m
Number of Mobile Anchor Nodes	8,7,5
Distance Approximately	8
Angle Approximately	8
GA Population Size	60
Maximum Iterations	107

Figure 3: Evaluation of Error comparison previous and proposed Approach

(i) Accuracy analysis based Evaluation of Error

Selection algorithms and set anchor nodes 5 and our recommend algorithm PALA gets error estimation

minimum through new algorithm mini error as compare to old algorithm.

(ii) Time analysis based Evaluation of total Processing time

Selection algorithms and set anchor nodes 5 and our recommend algorithm PALA gets time minimum through a new algorithm as compared to the old algorithm.
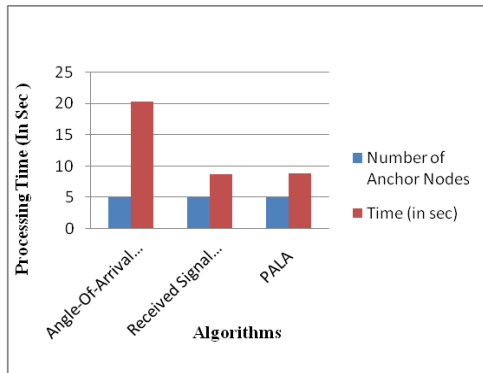

Figure 4 Evaluation of Time comparisons previous and proposed Approach

CONCLUSION

Localization in wireless device network may be a hot-space of analysis that has been addressed through many proposed advanced localization algorithm (PALA).Supported the dependency of the various measurements theses proposed schemes are classified into two major categories: range-based schemes and range-free schemes. It's troublesome to classify hybrid schemes that mix different ways supported property localization algorithms based on range-based schemes. The classification of any localization schemes complicated, wherever range-based schemes and range-free schemes are divided into two parts first part gets more error and second depending on angle and distance, this classification is planned additionally to assist in scrutiny localization schemes in terms of accuracy. Though WSNs are a current position analysis of nodes their square measure already numerous localization schemes, every with a stress on the specific state of affairs and/or application. During this paper, they to analyze and compare the lot of representative localization this comparison was primarily based primarily within the following parameters: network assumptions (deployment, Node density, existence of obstacle, and existence of anchor node, nodes quality and mobile-assisted), localization method (range estimation, vary combination, procedure model and localization coordinates), and style goal (scalability, overhead and accuracy). Among all studied schemes, this comparative analysis conducted the United States of America to conclude that every formula has its typical options and none is the simplest. On the complete, the range-based ways square measure either dearly-won concerning hardware price or status to environmental noises and

dynamics. In distinction, the range-free way's square measure general and simply plagued by node density. On the opposite hand, a hybrid localization theme provides higher accuracy than any single localization theme. However, it's a lot of complicated and wants a lot of computation time. What is more, the importance of this comparative study depends on giving different authors the chance of utilizing this analysis to spot the localization schemes that most closely fits their explicit drawback. As we tend towards notable accuracy is that the most vital key for localization performance. Among the schemes analyzed during this paper, hybrid schemes look promising. However, it still suffers from the time of execution required for the calculation. Improvement algorithms for fast this point are perspective creating this theme an efficient resolution for the localization in wireless device networks. What is more, the event of a recent combination between the vary menstruation techniques and/ or between vary menstruation techniques and property ways for various applications extremely intended the study during this direction. Optimized localization algorithm to locate the most reliable solution of the location of the sensor node using a few anchor nodes. WSN localization algorithm is used to estimate the location with the measured.PALA evaluation minimum error as compared to the previous method. Processing time analysis averages.the best accuracy with minimum errors and time minimum. The simulation on the mat lab and gets results displays that the proposed algorithm can estimate the placement of the unknown node with fewer anchor nodes and enhances the positioning of nodes in WSN.

REFERENCES

[1]. Tamoghna Ojha, Sudip Misra, Narendra Singh Raghuwanshi," Wireless device networks for agriculture: The progressive in apply and future challenges", ELSEVIER Computers and physics in Agriculture 118 (2015) 66–84.

[2]. A Comparative Study of Wireless Sensor Networks and Their Routing Protocols, Debnath Bhattacharyya, Tai-hoon Kim, and Subhajit Pal, Sensors 2010, 10, 10506-10523; DOI:10.3390 /s101210506 www.mdpi.com/journal/sensors.

[3]. Indu, Sunita Dixit," Wireless Sensor Networks: Issues & Challenges", International Journal of Computer Science and Mobile Computing, IJCSMC, Vol. 3, Issue. 6, June 2014, pg.681 – 685

[4]. Ad Hoc Networks Technologies and Protocols, Edited by Peasant Mohapatra University of California, Davis, Srikanth V. Krishnamurthy University of California, Riverside ©2005 Springer Science + Business Media, Inc.

[5]. Asma Mesmoudi, Mohammed Feham, Nabila Labraoui," Wireless Sensor Networks Localization Algorithms: A Comprehensive Survey."

International Journal of Computer Networks & Communications, Vol.5, No.6, November 2013.

[6]. Rajeev Piyare and Seong Ro Lee," Towards Internet of Things (IOTs): Integration Of Wireless Sensor Network To Cloud Services For Data Collection And Sharing", International Journal of Computer Networks & Communications, Vol.5, No.5, September 2013.

[7]. Mukhtiar Ahmed, Mazleena Salleh, M. Ibrahim Channa, Mohd Foad Rohani," Energy Efficient Routing Protocols for UWSN", TELKOMNIKA, Vol.15, No.1, March 2017, pp. 212~219.

[8]. K Anupama, a Sasidharan, S Vadlamani. A location-based clustering algorithm for data gathering in 3D underwater wireless sensor networks. In Telecommunications, 2008. IST 2008. International Symposium on. 2008: 343-348.

[9]. P Wang, C Li, J Zheng. Distributed minimum-cost clustering protocol for underwater sensor networks (UWSNs). In Communications, 2007. ICC'07. IEEE International Conference on. 2007: 3510-3515.

[10]. EM Sozer, M Stojanovic, JG Proakis. Underwater acoustic networks. Oceanic Engineering, IEEE Journal. 2000; 25: 72-83.

[11]. G Liu, C Wei. A new multipath routing protocol based on a cluster for underwater acoustic sensor networks. In Multimedia Technology (ICMT), 2011 International Conference on. 2011: 91-94.

[12]. A Wahid, S Lee, D Kim. A reliable and energy-efficient routing protocol for underwater wireless sensor networks. International Journal of Communication Systems. 2014; 27: 2048-2062.

[13]. Tamoghna Ojha, Sudip Misra, Narendra Singh Raghuwanshi," Wireless sensor networks for agriculture: The state-of-the-art in practice and future challenges", ELSEVIER Computers and Electronics in Agriculture 118 (2015) 66–84.

[14]. S. Lee, E. Kim, C. Kim, and K. Kim, "Localization with a mobile beacon based on geometric constraints in wireless sensor networks," IEEE Trans. Wireless Communication, vol. 8, no. 12, pp. 5801–5805, Dec. 2009.

[15]. S. Misra, S. K. Dhurandher, M. S. Obaidat, N. Nangia, N. Bhardwaj, P. Goyal, and S. Aggarwal, "Node stability-based location updating in mobile Ad-Hoc networks," IEEE Syst. J., vol. 2, no. 2, pp. 237–247,2008.

[16]. T. S. Rappaport, Wireless Communications: Principles and Practice.Englewood Cliffs, NJ: Prentice-Hall, 1996.

[17]. Weile Zhang; Qinye Yin; Hongyang Chen; Feifei Gao; Ansari, N., "Distributed Angle Estimation for Localization in Wireless Sensor Networks," in Wireless Communications, IEEE Transactions on, vol.12, no.2, pp.527-537, 2013.

[18]. Malajner, M.; Gleich, D.; Planinsic, P., "Angle of Arrival Measurement Using Multiple Static Monopole Antennas," in Sensors Journal, IEEE, vol.15, no.6, pp.3328-3337, 2015.

[19]. Quanrui Wei; Dexing Zhong; Jiuqiang Han, "Improved localization method based on multi-hop distance unbiased estimation," in Communications, IET, vol.8, no.16, pp.2797-2804, 11 6 2014.

[20]. Maddumabandara, A.; Leung, H.; Minxiang Liu, "Experimental Evaluation of Indoor Localization Using Wireless Sensor Networks," in Sensors Journal, IEEE, vol.15, no.9, pp.5228-5237, Sept. 2015.