ISSN: 0975-5662, September, 2014 www.ijrct.org

Node Discovery and Localization Protocol for Mobile Underwater Sensor Networks

Swathi Lakum [1]M.Tech, Computer Science Engineering, lakumswathi@gmail.com
Prasad Goranthala[2], Assoc. Professor, Department of CSE , srigvp@gmail.com
Fasi Ahmed Parvez[3], Associate professor and HOD, Department of CSE, parvez40509@gmail.com
BALAJI INSTITUTE OF ENGINEERING AND SCIENCES, Warangal, Telangana, India

Abstract:

In Underwater Wireless Sensor Networks (UWSNs), localization is one of most important technologies since it plays a critical role in many applications. Motivated by widespread adoption of localization, in this paper, we present a Node Discovery and Localization Protocol. The methods and strategies of node discovery start with one seed node (primary seed) in a known position. The primary seed node is capable of determining the relative positions of neighboring nodes, and eventually other nodes in the network, without using eternal data.

1. Introduction:

Time synchronization is an important requirement for many services provided by distributed networks. A lot of time synchronization protocols have been proposed for terrestrial Wireless Sensor Networks (WSNs). However, none of them can be directly applied to Underwater Sensor Networks (UWSNs). A synchronization algorithm for UWSNs must consider additional factors such as long propagation delays from the use of acoustic communication and sensor node mobility. These unique challenges make the accuracy of synchronization procedures for UWSNs even more critical. Time synchronization solutions specifically designed for UWSNs are needed to satisfy these new requirements. This paper proposes Mobi-Sync, a novel time synchronization scheme for mobile underwater sensor networks. Mobi-Sync distinguishes itself from previous approaches for terrestrial WSN by considering spatial correlation among the mobility patterns of neighboring UWSNs nodes. This enables Mobi-Sync to accurately estimate the long dynamic propagation delays. Motivated by the advances in acoustic modem technology and the growing number of applications that call for ad hoc deployable autonomous underwater systems (floating sensors, crawlers, vehicles), we address the problem of network initialization upon deployment. A neighbor discovery protocol is proposed, whose goal is to establish communication links over a large area, with a finite power budget that mandates multi-hopping to provide full coverage. The protocol uses random access to eliminate the need for scheduling (i.e., enable system operation without a global clock reference) and power control to ensure that full connectivity is provided using shortest links (i.e., to conserve batteries and prolong the system's lifetime). Transmit power allocation takes into account the acoustic propagation loss, while additional large-scale variation in the average received power is modeled via log-normal fading which is confirmed by experimental observations. System performance is assessed through simulation, by measuring the energy consumption, time to completion, and reliability in the presence of fading. Fading is shown to have a degrading effect on the system reliability, and protocol adjustments are proposed to recover the performance

ISSN: 0975-5662, September, 2014 www.ijrct.org

under the constraint on maximum power. The key features of the protocol are simplicity of implementation and efficient use of powerIn Underwater Wireless Sensor Networks (UWSNs), localization is one of most important technologies since it plays a critical role in many applications. Motivated by widespread adoption of localization, in this paper, we present a comprehensive survey of localization algorithms. First, we classify localization algorithms into three categories based on sensor nodes' mobility: stationary localization algorithms, mobile localization algorithms and hybrid localization algorithms. Moreover, we compare the localization algorithms in detail and analyze future research directions of localization algorithms in UWSNs.

2.0 Existing System:

The majority of the earth's surface is covered by water. Wireless information transmission through the water is one of the enabling technologies for the development of future observations on systems and sensor networks. Traditional monitoring systems are expensive and complicated. These equipments utilizes the individual and disconnected equipments to collect data from their surrounding environments [2,3]. The emergence of UWSNs provides new opportunities to explore the ocean. In UWSNs, conventional large, expensive, individual ocean monitoring equipments are replaced by relatively small and less expensive underwater sensor nodes that are able to communicate with each other via acoustic signals. Many technologies for UWSNs have been researched, e.g., medium access control (MAC) and secure routing protocols, localization technologies and time synchronization schemes. Localization is one of the most important technologies since it plays a critical role in many applications. Generally, there are three kinds of sensor nodes in UWSNs: anchor nodes, unknown nodes and reference nodes. Unknown nodes are responsible for sensing environment data. Anchor nodes are responsible for localizing unknown nodes. They can acquire their position in advance using GPS systems
or artificial arrangement. Reference nodes consist of localized unknown nodes and initial anchor nodes. Localization process of an unknown node can be described as how the node determines its position by limited communication with several anchor nodes or reference nodes using some specific localization technologies. Although various localization algorithms have been proposed for terrestrial WSNs, they are not suitable for UWSNs [4,5]. The major difference between UWSNs and terrestrial WSNs is the different communication signals. Radio signal propagates at long distances through sea water only at extra low frequencies between 30 Hz and 300 Hz. Low-frequency radio signal requires long antennae and high transmission power. Relatively, acoustic signal attenuates less and travels further. Thus, acoustic signal is more suitable for UWSNs [6]. Acoustic communication channel has its unique characteristics. Hence, the existing localization algorithms or terrestrial WSNs cannot be applied to UWSNs. Currently, many localization algorithms have been proposed for UWSNs. Researchers in [2,3] classify these localization algorithms into two categories: distributed and centralized localization algorithms, based on where the location of an unknown node is determined. In distributed localization algorithms, each underwater unknown node collects localization information and then runs a location estimation algorithm individually. In centralized localization algorithms, the location of each unknown node is estimated by a base station or a sink node. The problem of time synchronization is

a critical service in any sensor network. Nearly all UWSN applications depend on time synchronization service. For example, data mining requires global time information, TDMA, one of the most commonly used Medium Access Control (MAC) protocols, often requires nodes to be synchronized.

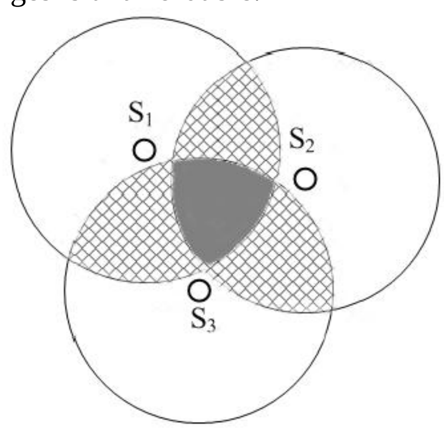
3.0 Proposed System

Distributed Localization Algorithms

In this section, seven distributed localization schemes are summarized: (1) Node Discovery and Localization Protocol (NDLP), (2) Large-Scale Hierarchical Localization (LSHL) approach, (3) Reactive Localization Algorithm (RLA), (4) Underwater Positioning Scheme (UPS), (5) Underwater Sensor Positioning (USP), (6) Localization Scheme for Large Scale underwater networks (LSLS) and (7) Ray Bending based Localization (RBL).

3.1 Node Discovery and Localization Protocol (NDLP)

In [8,9], the authors proposed a Node Discovery and Localization Protocol (NDLP) to manage sub-sea localization. As shown in Figure 4, NDLP starts with one seed node (primary seed *S*1) with known position. The primary seed node is capable of determining the relative positions of neighboring nodes. A second seed node, *S*2 is then chosen by *S*1. *S*2 is the most distant node within the communication range of *S*1. The advantage of choosing the farthest node as the second seed node is that a larger area can be covered more quickly. A third seed node *S*3 is chosen from those nodes that lie in both communication ranges of *S*1 and *S*2, and has the maximum summation distance from *S*1 and *S*2. Each node in the overlapping region is able to calculate the relative location using a simple triangulation technique. The nodes in the cross-hatched region can only obtain two distance measures from seed nodes. In order to localize the nodes in the cross-hatched region, a fourth seed node is selected based on four algorithms, Farthest/Farthest Algorithm, Farthest/Nearest Algorithm, Nearest/Farthest Algorithm and Nearest/Nearest Algorithm. NDLP is an anchor-free and GPS-less algorithm. Large scale of unknown nodes can be localized by continuously selecting seed nodes. However, NDLP has some serious problems. First, the node discovery phase needs much communication overhead. Each node participates in massage exchange to select seed nodes. Hence, energy consumption of node discovery is high. Second, the seed node's selection process takes long time, hence localization time is long. Moreover, unknown nodes' relative coordinates calculated based on the seed nodes' positions are not accurate. In some areas, if nodes are much sparsely deployed or become sparser due to some movements, then it is possible that very few or even no node can be selected as seed node. It is shown that NDLP is not suitable for sparse and mobile UWSNs. Furthermore, in mobile UWSNs, repeating the node discovery each time the topology changes is unaffordable.



The Node Discovery and Localization Protocol.

4. Conclusion

This paper presents Mobi-Sync, a time synchronization scheme for mobile UWSNs. Mobi-Sync is the first time synchronization algorithm to utilize the spatial correlation characteristics of underwater objects, improving the synchronization accuracy as well as the energy efficiency. The simulation results show that this new approach achieves higher accuracy with a lower message overhead.

5. References

1. Localization Algorithms of Underwater Wireless Sensor Networks: A Survey Guangjie Han 1,2,⋆, Jinfang Jiang 1,2, Lei Shu 3, Yongjun Xu 4 and FengWang 5
2. A node discovery protocol for ad hoc underwater acoustic networks Ashish Patil and Milica Stojanovic* Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/wcm.2206
3. Underwater sensor networks: applications, advances and challenges BY JOHN HEIDEMANN1,*,MILICA TOJANOVIC2 AND MICHELE ZORZI3 *Phil. Trans. R. Soc. A* (2012) **370**, 158–175 doi:10.1098/rsta.2011.0214
4. Akyildiz, I.F.; Pompili, D.; Melodia, T. Underwater acoustic sensor networks: Research challenges.Ad Hoc Netw. 2005, 3, 257-279.
5. Erol-Kantarciz, M.; Mouftah, H.T.; Oktug, S. Localization techniques for underwater acoustic sensor networks. IEEE Commun. Mag. 2010, 48, 152-158.
6. Erol-Kantarciz, M.; Mouftah, H. T.; Oktug, S. A survey of architectures and localization techniques for underwater acoustic sensor networks. IEEE Commun. Surv. & Tutor. 2011, 13, 487-502.
7. Li, X.; Xu, Y.; Ren, F. Wireless Sensor Network Technology; Beijing Institute of Technology Press: Beijing, China, 2007; pp. 191-218.
8. I.F. Akyildiz, D. Pompili, and T. Melodia, “Underwater Acoustic Sensor Networks: Research Challenges,” Ad Hoc Networks, vol. 3, no. 3, pp. 257-279, Mar. 2005.
9. J.-H. Cui, J. Kong, M. Gerla, and S. Zhou, “Challenges: Building Scalable Mobile Underwater Wireless Sensor Networks for Aquatic Applications,” IEEE Network, vol. 20, no. 3, pp. 12-18, May/June 2006.
10. J. Heidemann, Y. Li, A. Syed, J. Wills, and W. Ye, “Research Challenges and Applications for Underwater Sensor Networking,” Proc. IEEE Wireless Comm. and Networking Conf. (WCNC), 2006.
11. J. Partan, J. Kurose, and B.N. Levine, “A Survey of Practical Issues in Underwater Networks,” Proc. ACM Int’l Workshop UnderWater Networks (WUWNet), pp. 17-24,http://prisms.cs.umass.edu/brian/pubs/partan.wuwnet2006.pdf, Sept. 2006.
12. J.-H., C.Z. Zhou, and S. Le, “An OFDM Based MAC Protocol for Underwater Acoustic Networks,” Proc. ACM Int’l Workshop UnderWater Networks (WUWNet), Sept. 2010.

Swathi Lakum studying M.Tech (COMPUTER SCEINCE AND ENGINEERING) in BALAJI INSTITUTE OF ENGINEERING AND SCIENCES, NARSAMPET. Area of interest is DATAMINING, NETWORK SECURITY.

ISSN: 0975-5662, September, 2014 www.ijrct.org

Vishnu Prasad Goranthala completed M.Tech Computer Science and Engineering from JNTU,Hyderabad,Master of Computer Applications from Osmania University ,BSc from KaKathiya University Warangal, Currently working as an Associate Prof, at Balaji Institute of Engineering & Sciences, Narsampet, Warangal., and has 10+ years of experience in Academic. His research areas include Databases, Programming Languages and Information Security, Cryptography, Network Security.

Fasi Ahmed Parvez working as Associate professor and HOD BALAJI INSTITUTE OF ENGINEERING SCIENCES-NARSAMPET, with 12+ years of Experience. Completed M.Tech from JNTU Hyderabad in2010. SUBJECT INTERESTS are programming languages, database management system and data ware house & data mining.