IGI PUBLISHING
701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.igi-global.com

ITB15280

This paper appears in the publication, **Advances in Ubiquitous Computing: Future Paradigms and Directions** edited by S. Mostefaoui, Z. Maamar, and G. Giaglis © 2008, IGI Global

Chapter IV

Device Localization in Ubiquitous Computing Environments

Rui Huang, The University of Texas at Arlington, USA

Gergely V. Záruba, The University of Texas at Arlington, USA

Sajal Das, The University of Texas at Arlington, USA

Abstract

In this chapter, we will study the localization problem in ubiquitous computing environments. In general, localization refers to the problem of obtaining (semi-) accurate physical location of the devices in a dynamic environment in which only a small subset of the devices know their exact location. Using localization techniques, other devices can indirectly derive their own location by means of some measurement data such as distance and angle to their neighbors. Localization is now regarded as an enabling technology for ubiquitous computing environments because it can substantially increase the performance of other fundamental tasks such as routing, energy conservation, and network security. Localization is also a difficult problem because it is computationally intractable. Furthermore, it has to be implemented in a highly dynamic and distributed environment in which measurement data is often subject to noise. In this chapter, we will give an overview of localization in terms of its common applications, its hardware capacities, its algorithms, and its computational complexity.

Introduction

In a ubiquitous computing environment, devices are often connected to one another on the fly to form an infrastructure-less network that is frequently referred to as a mobile ad hoc network (MANET). Since MANET serves as an abstract model that can be seen as a superset of diverse sub-areas such as sensor networks, mesh networks or an enabler for pervasive computing, it has attracted significant research interests in the past several years. A major advantage of MANETs over regular wired or wireless networks is their infrastructure-less nature, as MANETs can potentially be deployed more rapidly and less expensively than infrastructure-based networks. However, the lack of an underlying explicit infrastructure also becomes a major disadvantage in adapting MANETs to a wider array of applications, since existing network algorithms and protocols are often not "plug-in" solutions for such dynamic networks. New algorithms need to be designed for fundamental network tasks such as addressing, topology discovery, and routing.

Location discovery is emerging as one of the more important tasks as it has been observed that (semi-) accurate location information can greatly improve the performance of other MANET tasks such as routing, energy conservation, or maintaining network security. For instance, algorithms such as location aided routing (LAR) (Ko, 2000), GRID (Liao, 2001), and GOAFR+ (Kuhn, 2003) rely on location information to provide more stable routes during unicast route discovery. The availability of location information is also required for geocast (multicast based on geographic information (Jiang, 2002)) algorithms such as location-based multicast (LBM) (Ko, 1999), GeoGRID (Liao, 2000) and position-based multicast (PBM) (Mauve, 2003). To minimize power consumption, the geographical adaptive fidelity(GAF) algorithm (Xu, 2001) uses location information to effectively modify the network density by turning off certain nodes at particular instances. Furthermore, in (Hu, 2003), the authors have shown that wormhole attacks can be effectively prevented when location information is available. As more algorithms are being proposed to exploit location information of devices in ubiquitous networks, it is clear that obtaining such information efficiently and accurately becomes of great importance.

A direct way of obtaining location information is to install global positioning system (GPS) receivers on devices. However, this is currently impractical as GPS receivers are still relatively expensive, power-hungry, and require clear line of sight (i.e., making indoor usage impossible) to several earth-bound satellites. In ubiquitous environments (e.g., sensor networks), devices are imagined as small as possible and operating on a very restricted power source, thus, it may not be feasible to install GPS receivers onto all sensor nodes. *Localization* in MANET refers to the problem of finding the locations of those non-GPS enabled nodes based on limited information such as the locations of some known *beacons* (also referred to as *anchors*) and measurements such as *ranges* or *angles* among the neighbors. In this chapter, we

Related Content

Falling Behind: A Case Study in Uncritical Assessment
Jonathan G.M. Pratt (2009). *Risk Assessment and Management in Pervasive Computing: Operational, Legal, Ethical, and Financial Perspectives (pp. 102-133).*
www.irma-international.org/chapter/falling-behind-case-study-uncritical/28452

Model-Driven Development for Pervasive Information Systems
José Eduardo Fernandes, Ricardo J. Machadoand João Álvaro Carvalho (2010). *Ubiquitous and Pervasive Computing: Concepts, Methodologies, Tools, and Applications (pp. 408-438).*
www.irma-international.org/chapter/model-driven-development-pervasive-information/37799

An Investigation of User Behaviour Consistency for Context-Aware Information Retrieval Systems
Adam Grzywaczewski, Rahat Iqbal, Anne Jamesand John Halloran (2009). *International Journal of Advanced Pervasive and Ubiquitous Computing (pp. 69-90).*
www.irma-international.org/article/investigation-user-behaviour-consistency-context/41705

Real Impact of the Blockchain in Securing a ToIP Network
Sekoude Jehovah-nis Pedrie Sonon, Tahirou Djara, Matine Abdoul Ousmaneand Abdou-Aziz Sobabe (2023). *International Journal of Security and Privacy in Pervasive Computing (pp. 1-22).*
www.irma-international.org/article/real-impact-of-the-blockchain-in-securing-a-toip-network/324165

Design and Research of Web-Based Assistant Teaching System
Yanna Wang, Xinyue Zhouand Jie Zhang (2012). *International Journal of Advanced Pervasive and Ubiquitous Computing (pp. 19-22).*
www.irma-international.org/article/design-and-research-of-web-based-assistant-teaching-system/79907