Signals and Communication Technology

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Recent Development in Wireless Sensor and Ad-hoc Networks

Springer

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ISSN 1860-4862
ISBN 978-81-322-2128-9
DOI 10.1007/978-81-322-2129-6

ISSN 1860-4870 (electronic)
ISBN 978-81-322-2129-6 (eBook)

Library of Congress Control Number: 2014952781

Springer New Delhi Heidelberg New York Dordrecht London

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

A WSN may be described as a network of nodes that cooperatively sense and control the environment enabling interaction between persons or computers and the surrounding environment. Recent developments in networking and material science and nanotechnologies are the driving force for the overall development of large-scale wireless sensor networks (WSNs). In addition, these technologies have merged together to enable a new generation of WSNs that differ significantly from traditional wireless networks, which was implemented 5–10 years ago. Like any other advanced technologies, the origin of WSNs can be traced back to military applications. The first wireless network, which has a close resemblance to a recently used WSN, is the Sound Surveillance System (SOSUS) developed by the United States Military in the 1950s. This network used submerged acoustic sensors hydrophones, distributed in the Atlantic and Pacific oceans. The same sensing technology is still existing today and serving for the peaceful applications. Afterward during 1980s, the United States Defense Advanced Research Projects Agency (DARPA) started the Distributed Sensor Network (DSN) program to formally explore the challenges in implementing distributed/wireless sensor networks. Later on, scientific research communities as well as academia join hands to develop the WSN technology. Subsequently, government and universities began using WSNs for various applications, such as air quality monitoring, forest fire detection, natural disaster prevention, weather stations and structural monitoring, power distribution, waste-water treatment, and specialized factory automation, which were basically heavy industrial applications.

Present day state-of-the-art WSN has less deployment and maintenance costs, more rugged, and last longer, and they are now used for various applications at our homes, work places, bringing new sources of information, control, and convenience to our personal and professional lives. Efficient design and implementation of wireless sensor networks has become a hot area of research, due to the vast potential of sensor networks to enable applications that connect the physical world to the virtual world. This volume covers the recent developments in the area of Wireless Sensor and Ad-hoc Network. Potential applications for such large-scale

WSN exist in a various domains, such as health monitoring, home security and surveillance, and personal environmental monitoring, such as temperature and humidity.

In future, micro-fabrication technology shall bring down the cost of sensor nodes resulting in the pervasive use of wireless sensor networks with a large number of nodes. For the smooth deployment of the future WSN, researchers and designers are now engaged in solving the complex trade-offs among many application variables including deployment costs, hardware and software, system reliability, security, and performance. Wireless embedded system designers must also consider these trade-offs and make alternative decisions, such as transducer and battery technology choices, frequency of wireless operation, output power and networking protocols. The complexity of WSN design not only represents one of the most significant barriers to the widespread adoption of WSNs, but also provides an opportunity for hardware and software technology suppliers to add value. Another trade-off is also use of well established, standardized mix of hardware/software solutions for different WSN applications.

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Contents

About the Editors

Prof. Srikanta Patnaik is presently serving as a Professor of Computer Science and Engineering, SOA University, Bhubaneswar, India. He holds Doctor of Philosophy in Engineering from Jadavpur University, India. He has published more than 80 research papers and articles in international journals and magazines of repute. He has supervised 10 research scholars for their Ph.D. degrees. He has completed various funded projects as Principal Investigator from various funding agencies of India. Presently, he is serving as an Editor-in-Chief of two international journals namely, *International Journal of Information and Communication Technology* and *International Journal of Computational Vision and Robotics*, published from Inderscience Publishing House, England and also an Editor-in-Chief of Springer Book Series on Modeling and Optimization in Science and Technology (MOST).

Dr. Xiaolong Li is working as an Associate Professor, Department of Electronics and Computer Engineering Technology, Indiana State University since 2008. He has done his Ph.D. in Electrical and Computer Engineering in 2006 from University of Cincinnati. He did his M.S. in Electronics and Information Engineering from Huazhong University of Science and Technology, China in 2002 and did his B.A. in Electronics and Information Engineering, from the same University of Science and Technology, China in 1999. His major research includes Wireless and Mobile Networks, Wireless Ad Hoc Networks, Wireless Internet, Modeling and Performance Analysis, QoS in Communication Networks, Wireless Mesh Network, Microcontroller-based Applications, Security in Wireless Networks. He has more than 30 International publications in International Journals and conference proceedings of repute. He has also contributed a Book Chapter entitled "Impact of Mobility on the Performance of Mobile Ad Hoc Networks and Performance Analysis of Mobile and Ad Hoc Networks", published by NOVA Publishers. He has association with the Institute of Electrical and Electronic Engineering (IEEE), American Society of Engineering Education (ASEE), Association of Technology, Management, and Applied Engineering (ATMAE) and Epsilon Pi Tau (EPT).

Prof. Yeon-Mo Yang is a Professor in the Department of Electronic Engineering, Kumoh National Institute of Technology, Gumi, Korea. He received the B. Engg. in the field of Electrical and Electronic Engineering from Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea in 1990 and Ph.D. from Gwangju Institute of Science and Technology (GIST), Gwangju, Korea in 2006, in the field of optical networks. From 2005 to 2006, he was a post-doctoral fellow in North Carolina State University (NCSU), Raleigh in Networks Engineering and a short-time visiting scholar at UC Berkeley, Berkeley, CA, in Wireless Sensor Networks. From 2006 to 2008, he was in Daegu-Gyeongbuk Institute of Science and Technology (DGIST) as a senior researcher where he has been a project leader of the developments of wireless sensor networks. His current research interests include wireless sensor networks analysis and implementation both at the physical layer and at the networks layer; dynamic bandwidth allocation schemes in passive optical networks; and realizations of hybrid embedded systems connected to Under Acoustic Sensor Networks, Mechatronics and Information Technology.

Introduction

"Recent Developments in Wireless Sensors and Ad-hoc Networks" is an edited volume in the broad area of WSNs. It covers various chapters like Multi-Channel Wireless Sensor Networks, its Coverage, Connectivity, as well as Deployment. It also covers comparison of performance of various communication protocols and algorithms, such as MANNET, ODMRP, and ADMR Protocols for Ad hoc Multicasting, Location-Based Coordinated Routing Protocol and other Token-based group local mutual exclusion Algorithms.

Chapter 1 entitled "Multi-channel Wireless Sensor Networks" contributed by Amalya Mihnea and Mihaela Cardei, discussed issues and challenges related to multi-channel and multi-radio networks. They have classified the channel assignment schemes into static, semi-dynamic, and dynamic, and also discuss methods proposed in each category. They have presented other related issues such as primary users, network capacity, interference, topology control, and power and traffic aware protocols. They have explained the concept of multi-channel algorithms lucidly for designing additional algorithms for wireless sensor networks.

In Chap. 2 "Coverage, Connectivity and Deployment in Wireless Sensor Networks", Yun Wang et al. have introduced three fundamental problems, i.e., sensing coverage, network connectivity, and sensor placement/deployment in a wireless sensor network (WSN). They have covered the open problems in this area, which includes sensing coverage and connectivity analysis in three-dimensional WSNs, nonuniformly distributed WSNs, and mobile WSNs.

In Chap. 3 "Development of Home Automation System by using ZigbeX and Atmega128 for Wireless Sensor Networks", Nik Khadijah Nik Aznan and Yeon-Mo Yang presented a framework and a test-bed of Home Automation systems by implementing the cost-effective ZigbeX and Atmega128 with TinyOS. They have proposed a house model, which is able to control the lights and curtain depending on the light intensity measured by the photodiode on the ZigbeX.

In Chap. 4 "Efficient Coordination and Routing Protocol for Wireless Sensor and Actor Networks", Biswa Mohan Acharya and S.V. Rao have discussed about the problem of communication and coordination of various sensor nodes and

proposed an efficient model based on geometric structure called Voronoi diagram. They have proposed a new protocol, which is based on clustering (virtual grid) and Voronoi region concept and they have given the simulation results which they claim outperforms in terms of throughput, packet delivery ratio, average delay, and normalized routing overhead.

Chapter 5 entitled "Performance Comparison of BEMRP, MZRP, MCEDAR, ODMRP, DCMP and FGMP to Achieve Group Communication in MANET" by M. Rajeswari et al. presents a comparative performance of six multicast protocols for Mobile Ad hoc Networks—BEMRP, MZRP, MCEDAR, ODMRP, DCMP & FGMP focusing on the effects of changes such as the increasing number of receivers or sources and increasing the number of nodes.

Chapter 6 entitled "Token based Group Local Mutual Exclusion Algorithm in MANETs" by Ashish Khanna et al. proposed a generalization of the group mutual exclusion problem based on the concept of neighborhood, which is named as group local mutual exclusion (GLME). They have also proposed a token-based solution of the group local mutual exclusion. The authors have claimed that their proposed method is the first token-based algorithm to solve group local mutual exclusion problem in MANETs.

In Chap. 7 "A Dual-band Z-shape Stepped Dielectric Resonator Antenna for Millimeter-wave Applications", Ashok Babu Chatla et al. have presented a dual-band z-shape stepped dielectric resonator antenna (DRA) for millimeter wave applications. The authors claimed that their design can be used for inter-satellite service applications, which operate at 65–66 GHz.

In Chap. 8 "OCDMA: Study and Future Aspects", Shilpa Jindal and Neena Gupta, discussed the future trend of OCDMA technique that highlighted on the newly developed three dimensional codes based on optical orthogonal codes and codes from algebra theory and their performance is evaluated on two models Model A and Model B.

In Chap. 9 "Focused Crawling: An Approach for URL Queue Optimization Using Link Score" by Sunita Rawat has presented a case of scaling challenges for traditional crawlers and search engines due to the expansion of the worldwide web and also proposed a method of efficient and focused crawling to enhance the quality of web navigation.

In Chap. 10 "An Optimized Structure Filtered-x Least Mean Square Algorithm for Acoustic Noise Suppression in Wireless Networks", Asutosh Kar and Mahesh Chandra have proposed an improved pseudo-fractional tap-length selection algorithm in context with the FX-LMS algorithm to find out the optimum structure of the acoustic noise canceller, which best balances the complexity and steady state performance.

Last but not least, in Chap. 11 entitled "An Exhaustive Comparison of ODMRP and ADMR Protocols for Ad hoc Multicasting" myself along with my colleague Ajit Nayak have presented a comparative study of two well-known protocols for

wireless multicasting. One of the considered protocols is *On Demand Multicast Routing Protocol* (ODMRP) and the other one is *Adaptive Demand driven Multicast Routing Protocol* (ADMR). ODMRP is a mesh based protocol, whereas ADMR uses a tree-based technology for routing.