Building Wireless Sensor Networks With Zigbee Xbee Arduino And Processing

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Wireless Sensor Networks presents the latest practical solutions to the design issues presented in wireless-sensor-network-based systems. Novel features of the text, distributed throughout, include workable solutions, demonstration systems and case studies of the design and application of wireless sensor networks (WSNs) based on the first-hand research and development experience of the author, and the chapters on real applications: building fire safety protection; smart home automation; and logistics resource management. Case studies and applications illustrate the practical perspectives of: sensor node design; embedded software design; routing algorithms; sink node positioning; co-existence with other wireless systems; data fusion; security; indoor location tracking; integrating with radio-frequency identification; and Internet of things. Wireless Sensor Networks brings together multiple strands of research in the design of WSNs, mainly from software engineering, electronic engineering, and wireless communication perspectives, into an over-arching examination of the subject, benefiting students, field engineers, system developers and IT professionals. The contents have been well used as the teaching material of a course taught at postgraduate level in several universities making it suitable as an advanced text book and a reference book for final-year undergraduate and postgraduate students.

Wireless sensor networks have become quite pervasive in the last few years. As their technology has matured, they have transformed from an academic research area to a viable means of solving practical engineering problems. This dynamic field has several vendors who can provide the necessary software and hardware infrastructure in order to get up and running quickly. While it is relatively easy to get up and running with a 'laboratory' setup, it is a completely different story when it comes to deploying a real world wireless sensor network. Any real world deployment, whether it is outdoors or indoors, has its own unique challenges as the scale of the deployment increases. We have observed these challenges, especially involving indoor deployments while working on several research
projects in our lab. Our previous projects required a large and distributed deployment of an indoor wireless sensor network. Those ad hoc deployments were done manually, making us realize the need for management primitives to do things more efficiently. The solution as proposed in this thesis, is a set of technology agnostic management primitives that help in overall management of wireless sensor networks. We used ZigBee as it is quite popular for smart building applications. Leveraging our management primitives we built features to address these challenges of administering a wireless sensor network in a building. We have used these primitives to deploy a small scale sensor network comprising of 100 nodes, which we then used to demonstrate their benefits as well as evaluate our deployment.

This book provides a collection of high-quality research works that address broad challenges in both theoretical and applied aspects of dynamic wireless sensor networks (WSNs) for intelligent and smart applications in a variety of environments. It presents the most central concepts associated with Dynamic Wireless Sensor Networks applications, and discusses issues surrounding Wireless Sensor Network Structures for complex and mobile-based applications. The book subsequently discusses several topics related to energy management in dynamic WSNs, and reviews the steps involved in building a secure and trusted data transmission model using the WSN applications of intelligent environments. Lastly, it discusses the applications of WSNs in live data systems such as SCADA systems. Readers will discover a collection of high-quality research works that address broad challenges in both theoretical and applied aspects of WSNs for intelligent real-life applications. In addition, the book presents original research on the application of a dynamic WSN to solve the problem of energy consumption in a secure WSN during the process of data aggregation and transmission. Written by respected experts in the field, the book will stimulate further efforts in the application of the intelligent WSNs model, helping to solve the problem of data processing in a limited resource WSN-based environment.
Get ready to create distributed sensor systems and intelligent interactive devices using the ZigBee wireless networking protocol and Series 2 XBee radios. By the time you're halfway through this fast-paced, hands-on guide, you'll have built a series of useful projects, including a complete ZigBee wireless network that delivers remotely sensed data. Radio networking is creating revolutions in volcano monitoring, performance art, clean energy, and consumer electronics. As you follow the examples in each chapter, you'll learn how to tackle inspiring projects of your own. This practical guide is ideal for inventors, hackers, crafters, students, hobbyists, and scientists.

Investigate an assortment of practical and intriguing project ideas Prep your ZigBee toolbox with an extensive shopping list of parts and programs Create a simple, working ZigBee network with XBee radios in less than two hours -- for under $100 Use the Arduino open source electronics prototyping platform to build a series of increasingly complex projects Get familiar with XBee's API mode for creating sensor networks Build fully scalable sensing and actuation systems with inexpensive components Learn about power management, source routing, and other XBee technical nuances Make gateways that connect with neighboring networks, including the Internet

Building Wireless Sensor Networks: Theoretical and Practical Perspectives presents the state of the art of wireless sensor networks (WSNs) from fundamental concepts to cutting-edge technologies. Focusing on WSN topics ideal for undergraduate and postgraduate curricula, this book: Provides essential knowledge of the contemporary theory and practice of wireless sensor networking Describes WSN architectures, protocols, and operating systems Details the routing and data aggregation algorithms Addresses WSN security and energy efficiency Includes sample programs for experimentation The book offers overarching coverage of this exciting field, filling a critical gap in the existing literature.

Wireless Sensor Networks: Evolutionary Algorithms for Optimizing Performance provides an integrative overview of bio-inspired algorithms and their applications in the area of Wireless Sensor Networks (WSN). Along with the usage of the
WSN, the number of risks and challenges occurs while deploying any WSN. Therefore, to defeat these challenges some of the bio-inspired algorithms are applied and discussed in this book. Discussion includes a broad, integrated perspective on various challenges and issues in WSN and also impact of bio-inspired algorithms on the lifetime of the WSN. It creates interdisciplinary theory, concepts, definitions, models and findings involved in WSN and Bio-inspired algorithms making it an essential guide and reference. It includes various WSN examples making the book accessible to a broader interdisciplinary readership. The book offers comprehensive coverage of the most essential topics, including: Evolutionary algorithms Swarm intelligence Hybrid algorithms Energy efficiency in WSN Load balancing of gateways Localization Clustering and routing Designing fitness functions according to the issues in WSN. The book explains about practices of shuffled complex evolution algorithm, shuffled frog leaping algorithm, particle swarm optimization and dolphin swarm optimization to defeat various challenges in WSN. The author elucidates how we must transform our thinking, illuminating the benefits and opportunities offered by bio-inspired approaches to innovation and learning in the area of WSN. This book serves as a reference book for scientific investigators who shows an interest in evolutionary computation and swarm intelligence as well as issues and challenges in WSN.

Leverage the powerful Arduino and XBee platforms to monitor and control your surroundings About This Book Build your own low-power, wireless network using ready-made Arduino and XBee hardware Create a complex project using the Arduino prototyping platform A guide that explains the concepts and builds upon them with the help of examples to form projects Who This Book Is For This book is targeted at embedded system developers and hobbyists who have some working knowledge of Arduino and who wish to extend their projects using wireless connectivity. What You Will Learn Interact with XBee boards using the XCTU program on Windows, OS X, or Linux Make your Arduino boards communicate wirelessly, using XBee modules in the advanced API mode Centrally collect and store measured sensor data, in the cloud or your own database Connect the
coordinator Arduino to the Internet and send data to web services Control your environment automatically, based on sensor input from your network Interact with off-the-shelf ZigBee Home Automation devices Make your devices battery-powered and let them sleep to get months or even years of battery life In Detail Arduino has been established as the de facto standard microcontroller programming platform, being used for one-off do-it-yourself projects as well as prototypes for actual products. By providing a myriad of libraries, the Arduino community has made it very easy to interact with pretty much any piece of hardware out there. XBee offers a great range of low-power wireless solutions that are easy to work with, by taking all of the complexity of wireless (mesh) networking out of your hands and letting you focus on what to send without worrying about the how. Building wireless sensor networks is cost-effective as well as efficient as it will be done with Arduino support. The book starts with a brief introduction to various wireless protocols, concepts, and the XBee hardware that enables their use. Then the book expands to explain the Arduino boards to you, letting them read and send sensor data, collect that data centrally, and then even control your home from the Internet. Moving further more advanced topics such as interacting through the standard Zigbee Home Automation protocol, or making your application power-efficient are covered. By the end of the book, you will have all the tools needed to build complete, real-world solutions. Style and approach A hands-on guide, featuring a single home automation project that can be built as described or with endless variations. Every step is illustrated with complete examples and screenshots, allowing you to build the examples swiftly.

This book presents a comprehensive overview of wireless sensor networks (WSNs) with an emphasis on security, coverage, and localization. It offers a structural treatment of WSN building blocks including hardware and protocol architectures and also provides a systems-level view of how WSNs operate. These building blocks will allow readers to program specialized applications and conduct research in advanced topics. A brief introductory chapter covers common
applications and communication protocols for WSNs. Next, the authors review basic mathematical models such as Voronoi diagrams and Delaunay triangulations. Sensor principles, hardware structure, and medium access protocols are examined. Security challenges ranging from defense strategies to network robustness are explored, along with quality of service measures. Finally, this book discusses recent developments and future directions in WSN platforms. Each chapter concludes with classroom-tested exercises that reinforce key concepts. This book is suitable for researchers and for practitioners in industry. Advanced-level students in electrical engineering and computer science will also find the content helpful as a textbook or reference.

Low Power Wide Area Network (LPWAN) steht als Oberbegriff f

Building Wireless Sensor Networks: Application to Routing and Data Diffusion discusses challenges involved in securing routing in wireless sensor networks with new hybrid topologies. An analysis of the security of real time data diffusion—a protocol for routing in wireless sensor networks—is provided, along with various possible attacks and possible countermeasures. Different applications are introduced, and new topologies are developed. Topics include audio video bridging (AVB) switched Ethernet, which uses the representation of a network of wireless sensors by a grayscale image to construct routing protocols, thereby minimizing energy consumption and data sharing in vehicular ad-hoc networks. Existing wireless networks aim to provide communication services between vehicles by enabling the vehicular networks to support wide range applications. New topologies are proposed first, based on the graphiton models, then the wireless sensor networks (WSN) based on the IEEE 802.15.4 standard (ZigBee sensors, and finally the Pancake graphs as an alternative to the Hypercube for interconnecting processors in parallel computer networks. Presents an analysis and protocol for routing in wireless sensor networks Presents ways to prevent attacks against this protocol Introduces different applications Develops new topologies
Wireless sensor networks are an emerging technology with a wide range of applications in military and civilian domains. The book begins by detailing the basic principles and concepts of wireless sensor networks, including information gathering, energy management and the structure of sensory nodes. It proceeds to examine advanced topics, covering localisation, topology, security and evaluation of wireless sensor networks, highlighting international research being carried out in this area. Finally, it features numerous examples of applications of this technology to a range of domains, such as wireless, multimedia, underwater and underground wireless sensor networks. The concise but clear presentation of the important principles, techniques and applications of wireless sensor networks makes this guide an excellent introduction for anyone new to the subject, as well as an ideal reference for practitioners and researchers.

During the last one and a half decades, wireless sensor networks have witnessed significant growth and tremendous development in both academia and industry. “The Art of Wireless Sensor Networks: Volume 1: Fundamentals” focuses on the fundamentals concepts in the design, analysis, and implementation of wireless sensor networks. It covers the various layers of the lifecycle of this type of network from the physical layer up to the application layer. Its rationale is that the first volume covers contemporary design issues, tools, and protocols for radio-based two-dimensional terrestrial sensor networks. All the book chapters in this volume include up-to-date research work spanning various classic facets of the physical properties and functional behavior of wireless sensor networks, including physical layer, medium access control, data routing, topology management, mobility management, localization, task management, data management, data gathering, security, middleware, sensor technology, standards, and operating systems. This book will be an excellent source of information for both senior undergraduate and graduate students majoring in computer science, computer engineering, electrical engineering, or any related discipline. In addition, computer scientists, researchers, and practitioners in both academia and industry will find this book useful and
Infrastructure for Homeland Security Environments Wireless Sensor Networks helps readers discover the emerging field of low-cost standards-based sensors that promise a high order of spatial and temporal resolution and accuracy in an ever-increasing universe of applications. It shares the latest advances in science and engineering paving the way towards a large plethora of new applications in such areas as infrastructure protection and security, healthcare, energy, food safety, RFID, ZigBee, and processing. Unlike other books on wireless sensor networks that focus on limited topics in the field, this book is a broad introduction that covers all the major technology, standards, and application topics. It contains everything readers need to know to enter this burgeoning field, including current applications and promising research and development; communication and networking protocols; middleware architecture for wireless sensor networks; and security and management. The straightforward and engaging writing style of this book makes even complex concepts and processes easy to follow and understand. In addition, it offers several features that help readers grasp the material and then apply their knowledge in designing their own wireless sensor network systems: * Examples illustrate how concepts are applied to the development and application of wireless sensor networks * Detailed case studies set forth all the steps of design and implementation needed to solve real-world problems * Chapter conclusions that serve as an excellent review by stressing the chapter's key concepts * References in each chapter guide readers to in-depth discussions of individual topics This book is ideal for networking designers and engineers who want to fully exploit this new technology and for government employees who are concerned about homeland security. With its examples, it is appropriate for use as a coursebook for upper-level undergraduates and graduate students.

Building Wireless Sensor Networks: Theoretical and Practical Perspectives presents the state of the art of wireless sensor networks (WSNs) from fundamental concepts to cutting-edge
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technologies. Focusing on WSN topics ideal for undergraduate and postgraduate curricula, this book: Provides essential knowledge of the contemporary theory and practice of wireless sensor networking Describes WSN architectures, protocols, and operating systems Details the routing and data aggregation algorithms Addresses WSN security and energy efficiency Includes sample programs for experimentation The book offers overarching coverage of this exciting field, filling a critical gap in the existing literature.

This edited book presents the results of the 5th Workshop on Real-world Wireless Sensor Networks (REALWSN). The purpose of this workshop was to bring together researchers and practitioners working in the area of sensor networks, with focus on real-world experiments or deployments of wireless sensor networks. Included were, nonetheless, emerging forms of sensing such as those that leverage smart phones, Internet of Things, RFIDs, and robots. Indeed, when working with real-world experiments or deployments, many new or unforeseen issues may arise: the network environment may be composed of a variety of different technologies, leading to very heterogeneous network structures; software development for large scale networks poses new types of problems; the performance of prototype networks may differ significantly from the deployed system; whereas actual sensor network deployments may need a complex combination of autonomous and manual configuration. Furthermore, results obtained through simulation are typically not directly applicable to operational networks; it is therefore imperative for the community to produce results from experimental research. The workshop collected the state of the art in emerging and current research trends dealing with Real-world Wireless Sensor Networks, with the aim of representing a stepping stone for future research in this field.

This book explores five fundamental mechanisms to build secure Wireless Sensor Networks (WSNs). It presents security issues related to a single node which deals with the authentication and communication confidentiality with other nodes. It also focuses on network security, providing solutions
for the node capture attack and the clone attack. It examines a number of areas and problems to which WSNs are applied continuously, including: supporting rescue operations, building surveillance, fire prevention, battlefield monitoring and more. However, known and unknown threats still affect WSNs and in many applications of this new technology the security of the network is a fundamental issue for confidentiality, integrity, authenticity and availability. The last section of the book addresses security for a common WSN service. Case studies are provided throughout. Secure Wireless Sensor Networks: Threats and Solutions targets advanced-level students and researchers in computer science and electrical engineering as a secondary text book. Professionals working in the wireless sensor networks field will also find this book useful as a reference.

RedBearLab CC3200 is a development kit to build programs with WiFi module TI CC3200. This book helps you to get started with RedBearLab CC3200 using Energia. The following is highlight topics: * Preparing Development Environment * Hello World - RedBearLab CC3200 * Sketch Programming * Updating RedBearLab CC3200 Firmware * Network Programming (TCP/IP and UDP/IP) * Building Wireless Access Point (AP) Network * Building Wireless Sensor Network

This is a practical book how to implement a simple Wireless Sensor Networks (WSN) with ESP32 over LoRa network. The following is a list of highlight topics in this book. * Preparing Development Environment * Set up ESP32 LoRa * Sending and Receiving Data over ESP32 LoRa * Handling LoRa Receiver Interrupt * Broadcast Messages over LoRa Network * Building WSN Application Based ESP32 LoRa

In this book, the authors describe the fundamental concepts and practical aspects of wireless sensor networks. The book provides a comprehensive view to this rapidly evolving field, including its many novel applications, ranging from protecting civil infrastructure to pervasive health monitoring. Using detailed examples and illustrations, this book provides an
inside track on the current state of the technology. The book is divided into three parts. In Part I, several node architectures, applications and operating systems are discussed. In Part II, the basic architectural frameworks, including the key building blocks required for constructing large-scale, energy-efficient sensor networks are presented. In Part III, the challenges and approaches pertaining to local and global management strategies are presented - this includes topics on power management, sensor node localization, time synchronization, and security. At the end of each chapter, the authors provide practical exercises to help students strengthen their grip on the subject. There are more than 200 exercises altogether. Key Features: Offers a comprehensive introduction to the theoretical and practical concepts pertaining to wireless sensor networks Explains the constraints and challenges of wireless sensor network design; and discusses the most promising solutions Provides an in-depth treatment of the most critical technologies for sensor network communications, power management, security, and programming Reviews the latest research results in sensor network design, and demonstrates how the individual components fit together to build complex sensing systems for a variety of application scenarios Includes an accompanying website containing solutions to exercises (http://www.wiley.com/go/dargie_fundamentals) This book serves as an introductory text to the field of wireless sensor networks at both graduate and advanced undergraduate level, but it will also appeal to researchers and practitioners wishing to learn about sensor network technologies and their application areas, including environmental monitoring, protection of civil infrastructure, health care, precision agriculture, traffic control, and homeland security.

Because they provide practical machine-to-machine communication at a very low cost, the popularity of wireless sensor networks is expected to skyrocket in the next few years, duplicating the recent explosion of wireless LANs. Wireless Sensor Networks: Architectures and Protocols describes how to build these networks, from the layers of the
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Learn all you need to know about wireless sensor networks! Protocols and Architectures for Wireless Sensor Networks provides a thorough description of the nuts and bolts of wireless sensor networks. The authors give an overview of the state-of-the-art, putting all the individual solutions into perspective with one and other. Numerous practical examples, case studies and illustrations demonstrate the theory, techniques and results presented. The clear chapter structure, listing learning objectives, outline and summarizing key points, help guide the reader expertly through the material. Protocols and Architectures for Wireless Sensor Networks: Covers architecture and communications protocols in detail with practical implementation examples and case studies. Provides an understanding of mutual relationships and dependencies between different protocols and architectural decisions. Offers an in-depth investigation of relevant protocol mechanisms. Shows which protocols are suitable for which tasks within a wireless sensor network and in which circumstances they perform efficiently. Features an extensive website with the bibliography, PowerPoint slides, additional exercises and worked solutions. This text provides academic researchers, graduate students in computer science, computer engineering, and electrical engineering, as well as practitioners in industry and research engineers with an understanding of the specific design challenges and solutions for wireless sensor networks. Check out www.wiley.com/go/wsn for accompanying course material! “I am deeply impressed by the book of Karl & Willig. It is by far the most complete source for wireless sensor networks. The book covers almost all topics related to sensor networks, gives an amazing number of references, and, thus, is the perfect source for students, teachers, and researchers. Throughout the book the reader will find high quality text, figures, formulas, comparisons etc. - all you need for a sound basis to start sensor network research.” Prof. Jochen Schiller, Institute of Computer Science, Freie Universität Berlin

Beginning Sensor Networks with Arduino and Raspberry Pi teaches you how to build sensor networks with Arduino,
Raspberry Pi, and XBee radio modules, and even shows you how to turn your Raspberry Pi into a MySQL database server to store your sensor data! First you'll learn about the different types of sensors and sensor networks, including how to build a simple XBee network. Then you'll walk through building an Arduino-based temperature sensor and data collector, followed by building a Raspberry Pi-based sensor node. Next you'll learn different ways to store sensor data, including writing to an SD card, sending data to the cloud, and setting up a Raspberry Pi MySQL server to host your data. You even learn how to connect to and interact with a MySQL database server directly from an Arduino! Finally you'll learn how to put it all together by connecting your Arduino sensor node to your new Raspberry Pi database server. If you want to see how well Arduino and Raspberry Pi can get along, especially to create a sensor network, then Beginning Sensor Networks with Arduino and Raspberry Pi is just the book you need.

Using wireless sensor networks as part of pervasive computing scenarios is a difficult problem. It involves providing functionality and node behavior required by pervasive computing applications given the very limited capabilities and the constraints of wireless sensor nodes. The goal of this work is to investigate the problem of integrating wireless sensor nodes and wireless sensor networks in pervasive computing scenarios and to develop solutions that facilitate such an integration. Based on an analysis of both research areas, of their specific properties and requirements as well as the similarities and differences of the two fields, we identify and discuss a set of five fundamental problem areas that complicate the integration of sensor networks and pervasive computing: communication, network setup and configuration, user experience, security and flexibility and adaptability. In the main part of this work, we then introduce a total of six solution approaches that deal with different aspects of the identified problem areas.

This book presents the state of the art technologies and solutions to tackle the critical challenges faced by the building and development of the WSN and ecological monitoring system
but also potential impact on society at social, medical and technological level. This book is dedicated to Sensing systems for Sensors, Wireless Sensor Networks and Ecological Monitoring. The book aims at Master and PhD degree students, researchers, practitioners, especially WSN engineers involved with ecological monitoring. The book will provide an opportunity of a dedicated and a deep approach in order to improve their knowledge in this specific field.

This book focuses on the suitable methods to solve optimization problems in wireless network system utilizing digital sensors like Wireless Sensor Network. This kind of system has been emerging as the cornerstone technology for all new smart devices and its direct application in many fields in life.

For all the interest that wireless sensor networks have created over the past decade, there are few examples to show that they are truly delivering on this promise and anticipation. What is missing? Deviating from the usual focus on routing and energy efficiency, Building Sensor Networks: From Design to Applications attempts to stitch together the path from conceptual development of applications, on one end, to actual complete applications at the other. With this change in perspective, the book examines important facets of wireless sensor networks (WSNs) that are not often discussed in the literature. From Design Practices to the Networking Protocols that Glue Applications Together Organized into three sections, the book presents insights from international experts representing both industry and academia. The first section, on design practices, explores alternative ways to approach the tasks of developing a suitable WSN solution to an application and assisting that development in a manner that is not necessarily tied to a particular application. The second section, on networking protocols, illustrates the impact of the intermediaries—the "glue" of putting applications together. Chapters look at ways to address traffic, delays in network clustering, and the coexistence of a WSN with other systems on a frequency band. The final section of the book delves into experiences with applications in chemical sensing, defense, global trade and security, and ecosystem monitoring. Although
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these applications may fail the purist definition of an ideal WSN, they offer valuable lessons for the future development and deployment of WSNs. Challenge Your Thinking about Designing WSN Applications Emphasizing the need to build applications, the contributors present examples of what applications of WSNs could look like and identify the constraints. Throughout, the book challenges and illuminates your thinking about how to tame the complexity of designing a WSN application. It is essential reading for anyone interested in future wireless technologies.

Explore how to develop and implement wireless server networks (WSN) using Contiki-NG, branded as the operating system for the IoT. The book explains Contiki-NG’s advantages in sensing, communication, and energy optimization and enables you to begin solving problems in automation with WSN. Practical Contiki-NG is a guide to getting started with Contiki-NG programming featuring projects that demonstrate a variety of applications. This book takes a practical and content-driven approach to the latest technologies, including Raspberry Pi, IoT and cloud servers. Readers will go through step-by-step guides and sample scenarios such as sensing, actuating, connectivity, building middleware, and utilizing IoT and cloud-based technologies. If you're looking to go from zero to hero in using Contiki-NG to build Wireless Sensor Network (WSN) applications then this is the book for you. What You’ll Learn Prepare and set up Contiki-NG development Review the basics of the Contiki-NG platform to build Wireless Sensor Networks (WSN) Develop your own Contiki-NG program Perform sensing and actuating on the Contiki-NG platform Implement a middleware for Contiki-NG motes Build a simple IoT program using the Contiki-NG environment Who This Book Is For Developers, students, researchers and anyone who has an interest in Wireless Sensor Network (WSN).