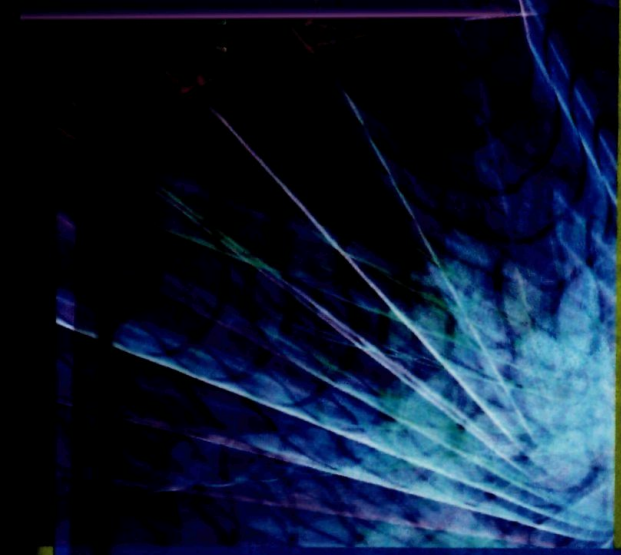

Sudip Misra
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Subhas Chandra M
Editors

Guide to Wireless Sensor Networks

Springer

Guide to Wireless Sensor Networks

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Dedicated to the newborns: Tultuli (Subhas's daughter) and Babai (Sudip's son) and Isaac's grand ma: Maria Happi

Preface

Overview and Goals

Wireless communication technologies are undergoing rapid advancements. The last few years have experienced a steep growth in research in the area of wireless sensor networks (WSNs). In WSNs, communication takes place with the help of spatially distributed autonomous sensor nodes equipped to sense specific information. WSNs, especially the ones that have gained much popularity in the recent years, are, typically, ad hoc in nature and they inherit many characteristics/features of wireless ad hoc networks such as the ability for infrastructure-less setup, minimal or no reliance on network planning, and the ability of the nodes to self-organize and self-configure without the involvement of a centralized network manager, router, access point, or a switch. These features help to set up WSNs fast in situations where there is no existing network setup or in times when setting up a fixed infrastructure network is considered infeasible, for example, in times of emergency or during relief operations. WSNs find a variety of applications in both the military and the civilian population worldwide such as in cases of enemy intrusion in the battlefield, object tracking, habitat monitoring, patient monitoring, fire detection, and so on.

Even though sensor networks have emerged to be attractive and they hold great promises for our future, there are several challenges that need to be addressed. Some of the well-known challenges are attributed to issues relating to coverage and deployment, scalability, quality-of-service, size, computational power, energy efficiency, and security.

This handbook attempts to provide a comprehensive guide on fundamental concepts, new ideas, and results in the area of WSNs. This book has been prepared keeping in mind that it needs to prove itself to be a valuable resource dealing with both the important core and the specialized issues in this area. We have attempted to offer a wide coverage of topics. We hope that it will be a valuable reference for students, instructors, researchers, and industry practitioners. We believe that this is particularly an attractive feature of this book, as the very limited

selection of books available on WSNs we are aware of are written primarily for academicians/researchers. We have attempted to make this book useful for both the academicians and the practitioners alike.

Organization and Features

The book is broadly divided into 27 chapters. Chapter 1 is dedicated to the energy efficiency issues in information processing in WSNs, which is probably and definitely arguably one of the challenges of great concern amongst researchers/practitioners working with sensor networks. Chapters 2 and 3 discuss the issues of topology management and coverage in these networks. Chapters 4–7 relate to the issues of routing, data centricity, and cooperation. Chapters 8 and 9 are dedicated to transport control issues including flow-control and congestion-control issues. As sensor network environments are often characterized by noise and error prone-ness, we have included a separate chapter, Chapter 10, relating to the issue of fault tolerance in these networks. Chapter 11 discusses the self-organizing and self-healing behavior/characteristics desirable of sensor networks. Chapter 12 focuses on the challenges concerning offering quality-of-service guarantees in sensor networks. As sensor nodes are operated by specialized operating systems, we have included a separate chapter, Chapter 13, on this topic. Chapters 14–18 relate to discussions about issues concerning medium access control, scheduling, and resource allocation. Chapters 19–21 concern security issues in sensor networks – this is another set of chapters, which would definitely attract many readers, as successfully enabling security in most types of emerging networks and definitely, sensor networks, is considered very challenging. The last few chapters, Chapters 22–27, are relatively specialized and they cover such topics as multimedia sensor networks, middleware for sensor networks, and biologically inspired communication in sensor networks.

We list below some of the important features of this book, which, we believe, would make this book a valuable resource for our readers:

- Most of the chapters of the book are authored by prominent academicians/researchers/practitioners in WSNs who have been working with these topics for several years and have thorough understanding of the concepts.
- The authors of this book are distributed in a large number of countries and most of them are affiliated with institutions of worldwide repute. This gives this book an international flavor. The readers of this book can get absorbed by perspectives, suggestions, experiences, and issues projected forward by authors from different countries.
- Almost all the chapters in this book have a distinct section providing *directions for future research*, which particularly targets researchers working in these areas. We believe that this section in each chapter should provide insight to the researchers about some of the current research issues.

- The authors of each chapter have also attempted to the extent possible to provide a comprehensive bibliography, which should greatly help the researchers and readers interested further to dig into the topic.
- Almost all chapters of this book have a separate section outlining *thoughts for practitioners*. We believe that this section in every chapter will be particularly useful for industry practitioners working directly with the practical aspects behind enabling these technologies in the field.
- Most of the chapters provide a list of important terminologies and their brief definitions.
- Most of the chapters also provide a set of questions at the end that can help in assessing the understanding of the readers.
- In order to make the book useful for pedagogical purposes, almost all chapters of the book also have a corresponding set of presentation slides. The slides can be obtained as a supplementary resource by contacting the publisher, Springer.

We have made attempts, in all possible way we could, to make the different chapters of the book look as much coherent and synchronized as possible. However, it cannot be denied that as the chapters were written by different authors, it was not fully possible to fully achieve this task. We believe that this is a limitation of most edited books of this sort.

Target Audience

The book is written by primarily targeting the student community. This includes the students of all levels – those getting introduced to these areas, those having an intermediate level of knowledge of the topics, and those who are already knowledgeable about many of the topics. In order to keep up with this goal, we have attempted to design the overall structure and content of the book in such a manner that makes it useful at all learning levels. To aid in the learning process, almost all chapters have a set of questions at the end of the chapter. Also, in order that teachers can use this book for classroom teaching, the book also comes with presentation slides and sample solutions to exercise questions, which are available as supplementary resources.

The secondary audience for this book is the research community, whether they are working in the academia or in the industry. To meet the specific needs to this audience group, most chapters of the book also have a section in which attempts have been made to provide directions for future research.

Finally, we have also taken into consideration the needs to those readers, typically from the industries, who have quest for getting insight into the practical significance of the topics, i.e., how the spectrum of knowledge and ideas are relevant for real-life sensor networks.

Supplementary Resources

As mentioned earlier, the book comes with the following supplementary resources:

- Solution manual, having sample solutions to most questions provided at the end of the chapters
- Presentation slides, which can be used for classroom instruction by teachers

Teachers can contact the publisher, Springer, in order to get access to these resources.

Acknowledgments

We are extremely thankful to the roughly 74 authors of the 27 chapters of this book, who have worked very hard to bring this unique resource forward for help of the student, researcher, and practitioner community. The authors were very much interactive at all stages of preparation of the book from initial development of concept to finalization. We feel it is contextual to mention that as the individual chapters of this book are written by different authors, the responsibility of the contents of each of the chapters lies with the concerned authors.

We are also very much thankful to our colleagues in the Springer publishing and marketing teams, in particular, Mr. Wayne Wheeler and Ms. Catherine Brett, who tirelessly worked with us and guided us in the publication process. Special thanks also go to them for taking special interest in publishing this book, considering the current worldwide market needs for such a book.

Finally, we would like to thank our parents, Prof. J.C. Misra, Mrs. Shorasi Misra, Mr. John Sime, Mrs. Christine Seupa, our wives Satamita, Sulagna, and Clarisse, and our children, Babai, Tultuli, Clyde, Lenny, and Kylian, for the continuous support and encouragement they offered during this project.

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Contents