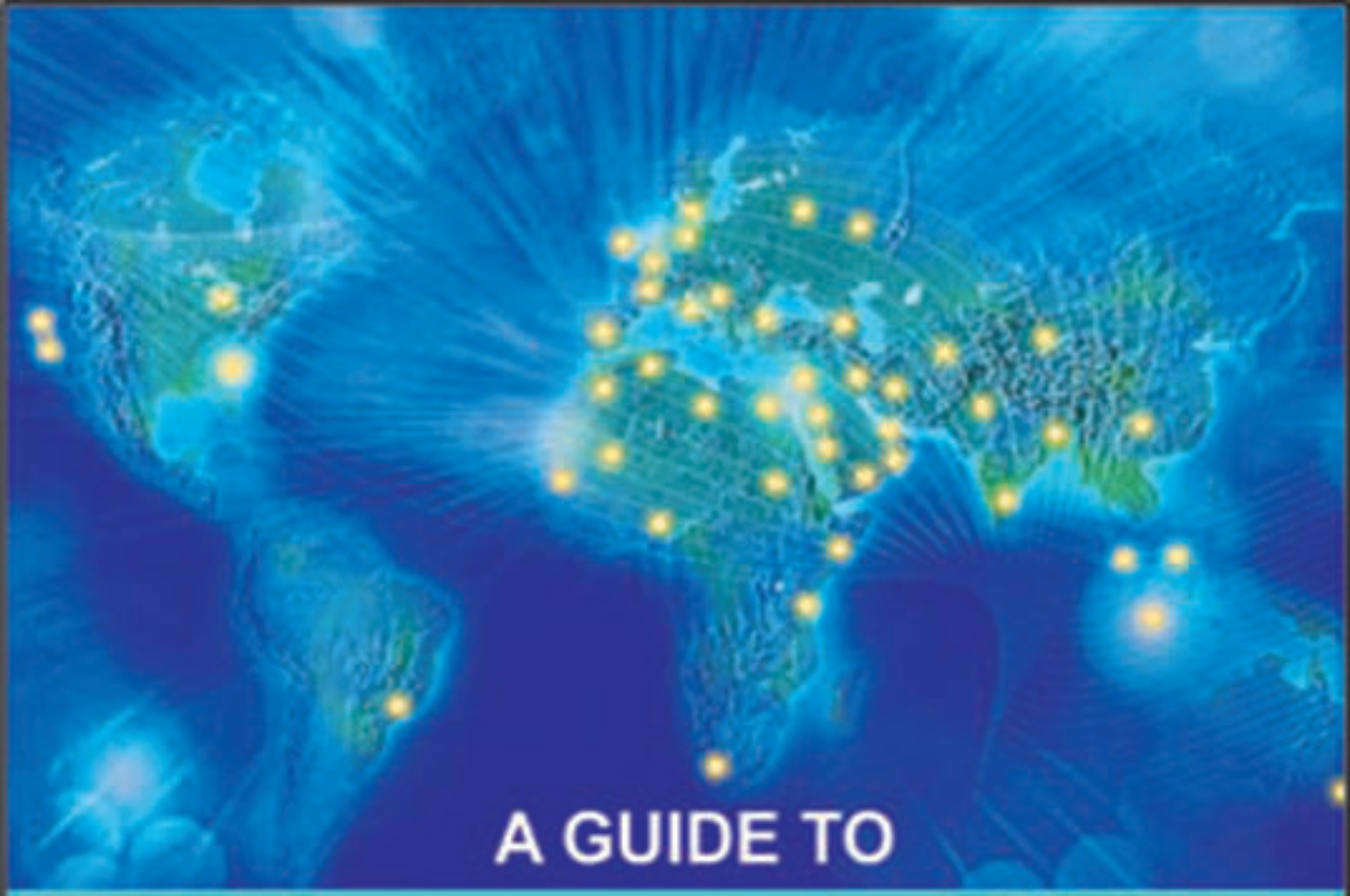
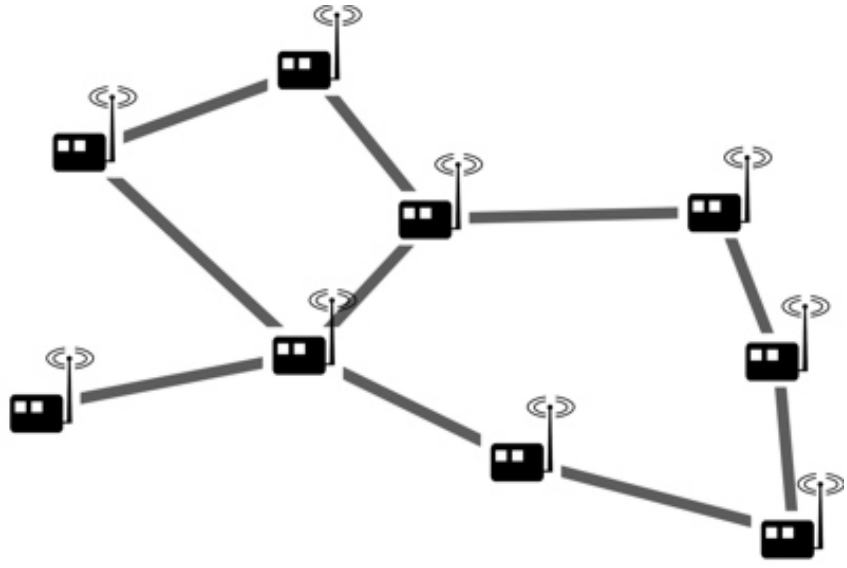


A GUIDE TO

WIRELESS SENSOR NETWORKS

S. SWAPNA KUMAR

A Guide to Wireless Sensor Networks



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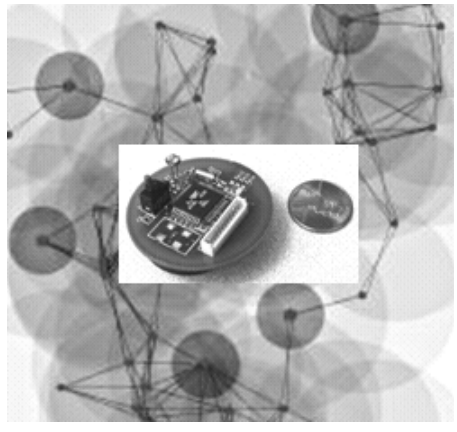

By

S. SWAPNA KUMAR

Professor
Department of Electronics and Communication Engineering
AXIS College of Engineering and Technology,
Thrissur, Kerala.

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Dedicated to

My Father Late K. Surendran, brother Late S. Sudarsh Kumar

and to

My Mother K.S.Omana Kutty, Wife Sona S. Kumar,

Children S. Adarsh Roshan and Ardra S. Kumar

CONTENTS

PREFACE

In the recent years, the wireless sensor networks is a fast emerging and growing study areas that have attracted considerable research attention globally. There has been tremendous development in design and development of application related interfaces with sensor networks. Sensor network find applications in several domains such as medical, industrial, military, home networks, space and so on. Wireless sensor networks have moved from the research domain to the real world implementation with wider range of applications.

Wireless Sensor Networks is the fast emerging revolution in wireless communication. Many research people believe that wireless sensor networks can become as important as the Internet in the near future. Just as the Internet allows access to digital information anywhere, wireless sensor networks will provide remote interaction with the physical world. It is becoming possible thanks to the new Wireless Sensor Networks (WSN) will support ubiquitous computing.

Wireless sensor network key changes is the scalability of network protocols, design of energy efficient protocols, design of data handling, localization techniques, sensor nodes design, development of exciting real time new applications that exploit the prospective of wireless sensor networks. This describes how to build these networks, from the layers of the communication protocol through the design of network nodes. This overview summarizes the multiple protocol study, applications of wireless sensor networks, and discusses network device understanding for the successful performance of these applications.

Author realized that with the rapid changing technology and the research development there is need to bring a comprehensive book that can give the guidelines of the concept of wireless sensor network. The potential audience for this book is intended for the college and universities project practicing, graduate students, research scholars and engineers; those who are interested to survey articles on specific topics without searching in larger text books.

The purpose of this book is to present a collection of excellent chapters from leading researchers on various aspects of wireless sensor networks. The book consists of thirteen chapters that provide a comprehensive coverage that is covers the study on wireless sensor network basic concepts. These chapters describe the various characteristics, features and usage of the sensors. It covers the various areas of research study and the survey made related to sensor and protocol fields. Every effort has been made to make the treatment simple and comprehensives. Throughout the book, the value has been given on fundamental concept through illustrative examples and figures.

The writing style of this book is straightforward and makes 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. The book is written in a very simple and logical way. Every care has been taken to eliminate language and errors. In spite of all precautions and there might crept some misprint due to oversight. So, the author would appreciative if the reader would bring any such error to their notice. Also, any suggestion for improvement will be thankfully acknowledge.

The author takes these opportunities and is in debt to the large number of books and journals that consulted in the preparation of the book.

The author will like to appreciate the sincere effort and contribution made by various reference authors, scientists who design and developed protocols and contributed various concept related to the wireless sensor network.

Finally, author feels that the reader of this book will gains valuable insight into the main stream ideas behind the technology and instigate them to go forth with innovated new ideas and technologies.

Lastly, but not the least, the author heartily thankful to LAXMI PUBLICATIONS (P) LTD. for taking interest and bringing out the well formatted book in time and pricing it moderately for easy reachable to the readers.

—Author

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I am indebted to my parents for their immense blessing throughout my life to achieve the success. This book is dedicated for my Late father and Late brother whom I shall forever cherish memories of their love, affection and guidance. Throughout the period while writing this book my mother, wife, son and daughter motivated, supported, and encouraged me with inspiring words.

I also acknowledge Mr. R. Purushothaman, Mrs. P Rajamma, all relatives, and friends for their constant source of encouragement. Special mention is made for all students of AXIS College of Engineering and Technology who gave me support. My thanks are also due to the publishers, editorial and production teams of the LAXMI PUBLICATIONS (P) LTD, for carefully processing the manuscript.

—Author

0 INTRODUCTION

0.1 OVERVIEW OF WIRELESS SENSOR NETWORKS

Wireless Sensor Networks (WSNs) have been widely considered as one of the most important technologies for the twenty-first century. WSNs development, pervasiveness and research increased tremendously in the last decade. These are daily used in many different fields, such as precision agriculture, environmental and health monitoring, home automation, military applications, object tracking, intrusion detection and surveillance systems. Such networks are based on embedded devices equipped with sensors and radio transceivers, which communicate and collaborate to achieve a common goal. These embedded devices have many characteristics and constraints such as they are low-power, memory-constrained, low-cost and low-size devices.

Those properties, combined with the low cost and size of these devices and the minimal need of human interaction, led to a great success of embedded systems. However, there are many known drawbacks and constraints like limited resources, error-prone wireless medium, environmental conditions variability, and low security and privacy. The strength of wireless sensor networks lies in the ability to deploy large numbers of tiny nodes that assemble and auto configure themselves.

In the past decade, WSNs have received tremendous attention from both academia and industry all over the world. A large amount of research activities have been carried out to explore and solve various design and application issues, and significant advances have been made in the development and deployment of WSNs. It is envisioned that in the near future WSNs will be widely used in various civilian and military fields, and revolutionize the way we live, work, and interact with the physical world.

0.2 FEATURES OF THIS BOOK

The development of the wireless networking in various areas leads to the most important aspects in the design of WSNs, which involves a variety of network architectural and protocol design issues. The application layer protocols for sensor networks remain a largely unexplored region so far. This is because the focus of the research community is towards the lower layers of the OSI stack

rather than towards the higher layers. A new suite of network protocols need to be developed to address the unique characteristics and constraints, in particular, the energy constraint, in sensor networks.

This book focuses on the major basic concepts and wide areas and issues in the design of WSNs, including medium access control, transport protocols, routing and data dissemination, node clustering, node localization, sensor standards, sensor security and harvesting energy.

The aim of this book is to provide a comprehensive and systematic introduction of the fundamental concepts, major issues, and effective solutions in understanding the WSNs from basic level to researchers' motives.

The main features of this book include the following:

- Giving an insight into wireless sensor networks from protocol design perspective.
- Providing a comprehensive and systematic explanation of concepts, major issues, and effective solutions in wireless sensor networking.
- Discussing the methodology and state-of-the-art technologies of various design features in wireless sensor networking.
- Contribution by researchers in the field that is covering the chapters.
- Including a comprehensive up-to-date bibliography.

0.3 ORGANIZATION OF THIS BOOK

This book is organized into 13 chapters that give the comprehensive views of wireless sensor network.

Chapter 1 serves as an introduction to the wireless sensor network (WSN). This chapter includes the basic concept; Ad-Hoc network characteristics, typical network architecture, and IEEE technological background are introduced.

Chapter 2 presents a brief overview of sensors, different types of sensor architectures and introduces a wireless sensor topology and its applications.

Chapters 3 discuss on different layer protocol and, clustering and its related feature. Also discussed, the optimization of layer protocols for WSNs is presented. The major network design objectives and challenges are described.

Chapter 4 is dedicated to medium access control (MAC) in WSNs. The fundamental overview and concepts on MAC protocols for wireless networks are introduced; the major challenges in energy management on MAC design for sensor networks, proposed MAC protocol are discussed.

Chapter 5 focuses on fundamental concepts on routing and the major challenges in routing are discussed. Moreover, a survey of routing design challenges protocols for WSNs is presented.

Chapter 6 is dedicated to data aggregation in WSNs. The concepts of the importance of data aggregation are discussed. The chapter also presents an overview of design areas on data aggregation techniques for WSNs.

Chapter 7 is dedicated to energy efficiency and power control in WSNs. The concepts of power management, the major challenges in WSNs are introduced. The different model on sensor is discussed.

A Guide To Wireless Sensor Networks

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