Preface

About this Book

Over the past decade, there has been a prolific increase in the research, development and commercialisation of Wireless Sensor Networks (WSNs) and their associated technologies (see Figure 1). This rise has been a result of a number of contributing factors, including continued miniaturisation (leading towards an era of truly 'pervasive' and 'invisible' computing); low-power circuits, devices and computation (for example, the ultra-low-power sleep states now found in microcontrollers); and efficient short-range communication (such as ZigBee and Bluetooth). The dramatic rise in WSN activity, fuelled by the prospect of a new computing paradigm, has resulted in the topic being researched (and taught) in the electronics and computer science departments of Universities around the world.
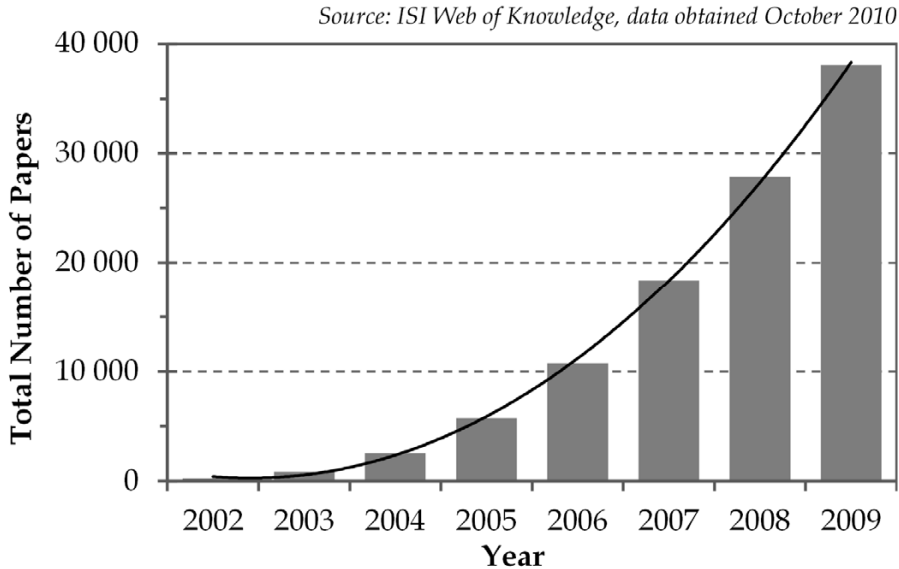

Figure 1. The increase in research into WSNs, shown by the total number of published papers (as catalogued on the ISI Web of Knowledge) matching the topic (sensor network*).

While enabling technologies such as low-power circuitry have permitted the conception and growth of WSNs (for example a microcontroller's ultra-low-power sleep states enable a vast reduction in the average power consumption obtained through duty cycled operation, a technique which underpins the operation of most implementations), the principal reason for the explosion of research is, in my opinion, due to the volume of WSN applications that can be conceived and realised. To name a few, they have found use in healthcare, defence and security, environmental monitoring, process control, structural health monitoring, condition monitoring, building automation, multimedia provision and advertising. However, as a result of the broad array of pertinent applications, WSN researchers have also realised the application specificity of the domain; it is incredibly difficult, if not impossible, to find an application-independent solution to most WSN problems (be it a routing algorithm, MAC protocol, energy harvesting architecture, or data processing algorithm). Hence, research into WSNs dictates the adoption of an application-centric design process.

Research into WSN applications not only concerns the technical issues and system integration strategies of deployment, but also the communication and processing of data, alongside the analysis, understanding and modelling of the application parameters that are of interest. As such, this book is not intended to be a comprehensive review of all WSN applications and deployments to date. Instead, it is a collection of state-of-the-art research papers discussing current applications and deployment experiences, but also the communication and data processing technologies that are fundamental in further developing solutions to applications. Whilst a common foundation is retained through all chapters, this book contains a broad array of often differing interpretations, configurations and limitations of WSNs. I believe that these aid to highlight the rich diversity and sheer scale of this ever-changing research area.

Organisation

The chapters of this book have been categorised into three distinct sections: applications and case studies (section A), communication and networking technologies (section B), and information and data processing technologies (section C). These are described below:

Applications and Case Studies: The first chapter of this section serves as an introduction to the book, providing a concise overview of WSNs, discussing their history, platforms and architectures, research challenges, and application. The remainder of the section discusses current applications and their implementation, from experiences of monitoring agricultural processes to the different methods by which accidental falls of the elderly can be detected and classified.

Communication and Networking Technologies: Alongside the predominant theme of this book, this section contains a collection of state-of-the-art technical papers on application-specific communication and networking problems. These include modelling wireless propagation through water, routing strategies for hybrid radio frequency/fibre optic WSNs, through to an overview of radio transceiver design.

Information and Data Processing Technologies: The final section of this book provides an insight into current research on information and data processing, including data fusion, target tracking, fault tolerance and multimedia provision in WSNs.

The readership of this book is intended to be postgraduate/postdoctoral researchers, and professional engineers. Some of the chapters may also be of interest to master's level students that are undertaking modules that are particularly relevant to this field.

Dr. Geoff V Merret and Dr. Yen Kheng Tan (Editor-in-Chief)