Preface

The emerging generation of Cyber Physical Objects (CPOs) brings new powers opening novel and revolutionary applications and new areas of innovation. The Cyber Physical Systems (CPS) constituted by the CPOs enable fusion between the physical and virtual worlds realizing the totally and globally connected scenario known as Internet of Things (IoT).

In the past decade, Cyber Physical Systems and consequently Cyber Physical Objects as their basic units and IoT as their reference scenario have become one of the ICT priorities.

The range of potential application domains is broad and embedded hardware and software systems could expand functionalities of household appliances, vehicles, aircraft, medical applications, digital libraries, etc. The interconnection of CPOs, through a virtual environment featured with globally networked services, is opening towards innovative business platforms.

The pervasive "features" of the emerging CPOs perfectly match and embrace the philosophy of the future "Internet of Things" (IoT), as the vision that nearly everything is connected to the Next-Generation Internet. This emerging paradigm is demanding novel methods and revolutionary architectures to respond to innovative applications in several daily scenarios. Methods for engineering CPSs that will be able to respond in real-time to dynamic and complex situations while preserving control reliability, safety, and keeping security and privacy need to be designed ad hoc.

Based on these premises, it is easily arguable that new issues and challenges arising with the IoT paradigm and the definition of CPSs need to be identified and timely addressed.

The main objective of this book is to explore multidisciplinary and recent advances in terms of methods, architectures, and identify novel applications deriving from the CPOs as main building blocks of the Internet of Things paradigm.

The book is structured into eight chapters focused on the above-mentioned topics and providing novel and cutting-edge contributions for the Next-Generation IoT systems. A short introduction to the chapters is provided below.

Chapter "Cyber-Physical Systems: Opportunities, Challenges and (Some) Solutions," by Peter Marwedel and Michael Engel, discusses the integration of information and computation technologies (ICT) with real and physical objects. It motivates the work in the Cyber Physical Systems area by presenting the large set of opportunities resulting from this integration. However, this requires coping with a number of challenges that are also discussed. The chapter comprises solutions demonstrating that it is feasible to address the challenges and find solutions, even though a major amount of additional work is required.

Chapter "Cyber-Physical Objects as Key Elements for a Smart Cyber-City," by Riccardo Petrolo, Valeria Loscri, and Nathalie Mitton, investigates the Cyber Physical Systems and their Cyber Physical Objects as key units, in the context of Smart City concept. It surveys the Smart City vision, providing information on the main requirements, the open challenges, and highlighting the benefits; it also browses the European Commission initiatives for Smart Cities and some pilot projects that are under development.

Chapter "Structuring Communications for Mobile Cyber-Physical Systems," by Luis Almeida, Frederico Santos, and Luis Oliveira, addresses the problem of developing applications for, and controlling, Mobile Cyber Physical Systems composed of a team of mobile autonomous agents. It focuses on the communications and middleware platform on which most cooperative behaviors rely. For such purpose, a platform that allows sharing state among team members, while abstracting away communication, has been developed. The platform relies on a shared memory middleware that extends the traditional Blackboard concept with local data proxies that also include data age information.

Chapter "ANIMO, Framework to Simplify the Real-Time Distributed Communication," by Y. Rodríguez, C. Alejo, I. Alejo, and A. Viguria, presents ANIMO, an IoT communication framework developed for interconnecting multi-systems based on the Data Distribution Service (DDS). ANIMO facilitates the integration of DDS in an application and the interoperability between the different data types of the Cooperating (Cyber Physical) Objects with the great feature of real-time. This chapter explains the complete architecture of the ANIMO framework, its diversity of possibilities, and two principal works where it has been applied.

Chapter "SERAPH: Service Allocation Algorithm for the Execution of Multiple Applications in Heterogeneous Shared Sensor and Actuator Networks," by Claudio Miceli de Farias, Wei Li, Flávia C. Delicato, Luci Pirmez, Paulo Pires, and Albert Y. Zomaya, proposes an adaptive algorithm (called SERAPH) to select and allocate what they call services, for multiple applications in a heterogeneous sensor platform. They regard the applications as a set of primitive services, which each node in a Shared Sensor and Actuator Network is able to exhibit. The authors compare their algorithm with three other approaches in terms of network lifetime, allocations successful rate, and loss rate and delay.

Chapter "A Smart Platform for Large-Scale Cyber-Physical Systems," by Andrea Giordano, Giandomenico Spezzano, and Andrea Vinci, introduces Rainbow, an architecture designed to address Cyber Physical Systems issues.

Rainbow hides heterogeneity by providing a Virtual Object concept, and addresses the distributed nature of Cyber Physical Systems introducing a distributed multi-agent system on top of the physical object. Rainbow aims to get the computation close to the sources of information and tackles the dynamic adaptivity requirements of Cyber Physical Systems by using Swarm Intelligence algorithms.

Chapter "Towards Cyberphysical Digital Libraries: Integrating IoT Smart Objects into Digital Libraries," by Giancarlo Fortino, Anna Rovella, Wilma Russo, and Claudio Savaglio, proposes an approach for the inclusion of Smart Objects into Digital Libraries. The inclusion is based on a metadata model for Smart Objects purposely defined to fully characterize all the Smart Object properties (both physical and cyber) as well as their interactions with other human, digital, and cyber physical actors. The approach has also been exemplified through a case study concerning a smart office environment.

Chapter "Cooperation of Smart Objects and Urban Operators for Smart City Applications," by Simona Citrigno, Sabrina Graziano, and Domenico Saccà, describes a set of software tools and intelligent platforms for collecting, representing, managing, and exploiting data and information gathered from sensors and devices deployed in the territory. Tools and platforms are integrated into a complex smart environment that provides advanced services to citizens and operators for environmental monitoring, urban mobility, and emergency management.

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