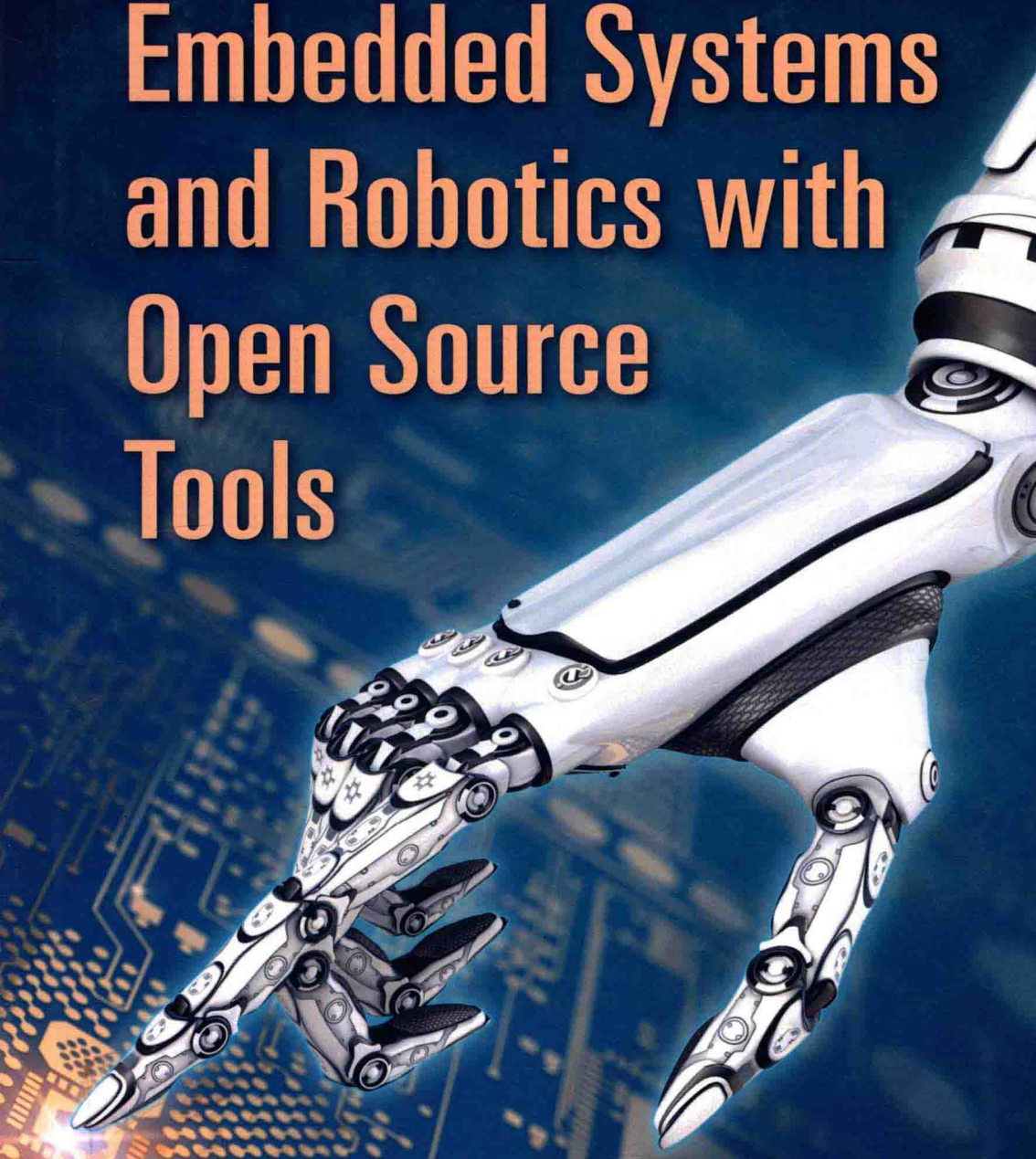
Embedded Systems and Robotics with Open Source Tools



Nilanjan Dey
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CRC Press
Taylor & Francis Group

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CRC Press
Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **Informa** business

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

Printed on acid-free paper
Version Date: 20151116

International Standard Book Number-13: 978-1-4987-3438-7 (Hardback)

Library of Congress Cataloging-in-Publication Data

Names: Dey, Nilanjan, 1984- author. | Mukherjee, Amartya.
Title: Embedded systems and robotics with open source tools / Nilanjan Dey and Amartya Mukherjee.
Description: Boca Raton : CRC Press, 2016. | Includes bibliographical references and index.
Identifiers: LCCN 2015042967 | ISBN 9781498734387
Subjects: LCSH: Autonomous robots. | Embedded computer systems--Programming. | Open source software.
Classification: LCC TJ211.495 .D485 2016 | DDC 006.2/2--dc23
LC record available at http://lccn.loc.gov/2015042967

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Embedded Systems and Robotics with Open Source Tools

In loving memory of the

late Mihir Kumar Mukherjee

When the tools of production are available to everyone, everyone becomes a producer.

—**Chris Anderson**

Preface

In the world of computer science, software and hardware are deeply interrelated. A computer system is a combination of the functions of several electronic devices that act collaboratively with the help of software systems. Nowadays, the computer system is not limited to a desktop PC, laptop, palmtop, or a workstation server. The definition of a computer has been changed by the smart phone revolution. Starting from a basic video-gaming device to a more sophisticated unmanned aerial vehicle, everywhere we realize the presence of high-performance embedded computing.

This era is also well known for the open-source revolution. Technological enhancements have been achieved through both open-source software and hardware platforms. One of the very popular tools today is the rapid prototyping environment, which consists of a combination of hardware and software suites. With the help of high-performance microprocessors, microcontroller, and highly optimized algorithms, one can develop smarter embedded applications.

This book aims to present some cutting-edge open-source software and hardware technology and the practical applications of such smarter systems that take the technology to the next level. The chapters are designed in a way to help readers who are not familiar with advanced computing technologies easily understand and learn as they read deeper into the book. The book includes eight high-end, real-time projects for evaluation of the rapid prototype development skill. These projects are properly verified and tested so that one can easily deploy them soon after learning. The book will serve as a guide to undergraduate and postgraduate engineering students, researchers, and hobbyists in the field.

Nilanjan Dey

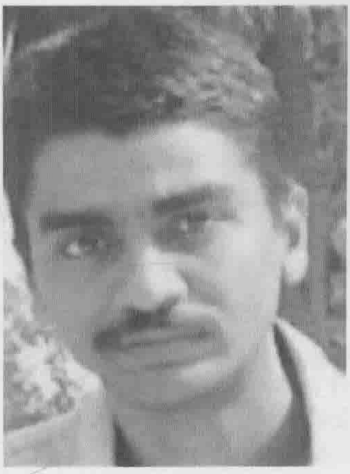
Amartya Mukherjee

Acknowledgments

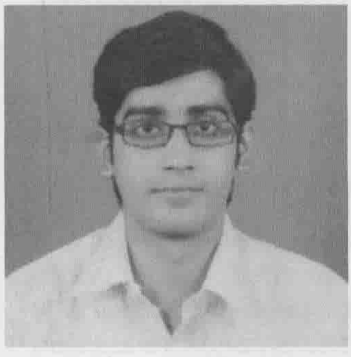
This book itself is an acknowledgment to the technical and innovative competence of many individuals who have contributed to this domain. First, we thank our colleagues and coresearcher(s), especially Sayan Chakrabarty, Souvik Chatterjee, and Soumya Kanti Bhattacharaya, for their technical support in all regards. We thank Dr. Amira S. Ashour, vice-chairperson, Department of Computer Science, College of Computers and Information Technology, Taif University, Taif, Kingdom of Saudi Arabia, for extending her expertise in upgrading the literary quality of this book. We also thank Eshita Mazumder Mukherjee for her support in writing the book and our students Anant Kumar, Manish Kumar, and Masoom Haider.

Finally, we thank our parents, wives, and children for their continuous support.

Authors



Nilanjan Dey is an assistant professor in the Department of Information Technology, Techno India College of Technology, Rajarhat, Kolkata, India. He holds an honorary position of visiting scientist at Global Biomedical Technologies Inc., California, and research scientist at the Laboratory of Applied Mathematical Modeling in Human Physiology, Territorial Organization of Scientific and Engineering Unions, Bulgaria. He is the editor in chief of the *International Journal of Rough Sets and Data Analysis*, IGI Global, US; managing editor of the *International Journal of Image Mining* (IJIM), Inderscience; regional editor (Asia) of the *International Journal of Intelligent Engineering Informatics* (IJIEI), Inderscience; and associate editor of the *International Journal of Service Science, Management, Engineering, and Technology*, IGI Global. His research interests include medical imaging, soft computing, data mining, machine learning, rough set, mathematical modeling and computer simulation, modeling of biomedical systems, robotics and systems, information hiding, security, computer-aided diagnosis, and atherosclerosis. He has published 8 books and 160 international conferences and journal papers. He is a life member of the Institution of Engineers, Universal Association of Computer and Electronics Engineers, Internet Society as a Global Member (ISOC), etc. Detailed information on Nilanjan Dey can be obtained from https://sites.google.com/site/nilanjandeyprofile/.



Amartya Mukherjee, MTech, is an assistant professor at the Institute of Engineering and Management, Salt Lake, Kolkata, India. He holds a bachelor's degree in computer science and engineering from West Bengal University of Technology and a master's degree in computer science and engineering from the National Institute of Technology, Durgapur, West Bengal, India. His primary research interest is in embedded application development, including mobile ad hoc networking, aerial robotics, and Internet of Things. He has written several papers in the field of wireless networking and embedded systems.

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Introduction

1.1 Embedded Systems and Robotics

Embedded systems and robotics are the most interrelated terms in this cutting-edge technological era. The revolution of smartphone, smart real-time operating system (RTOS), and system-on-chip technology provides a new dimension to the embedded hardware. In the past, the embedded system was a bit complicated to manage and a huge chunk of assembly-level code was to be written to program the whole system. But as things keep changing quite drastically, nowadays embedded systems act as a platform in the development of software/firmware, thus reducing the development time. The architecture of the system also keeps changing day by day so as to increase processing power and to decrease energy consumption. The enhancement of the RTOS-like Android gives another new dimension to embedded systems. On the contrary, robotics has evolved to higher-dimensional applications. In earlier years, robots were only used in industrial and scientific research, but today robotics has reached a new dimension, thanks to open-source hardware; starting from military to medical applications or maybe for entertainment or as a hobby, the concept of robotics has been widely spread. Robotics experts claim that by 2022 they will produce a robotic maid that will cost less than $100,000.

1.2 Fundamental Goal of Embedded Systems

The growth of embedded systems depends on innovative engineers with exposure to robotic technology. Loosely defined, an embedded system, which is a computer system that is intended to be a general-purpose computer, is a programmable device that drives some specific set to the system. It might be connected with one or more number of sensors and actuators. The main task of the embedded system is to acquire data from the sensor. The system should be smart enough to process and analyze the data using its