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KEY=SOFTWARE - MICHAEL EVA

Embedded Systems Hardware for Software Engineers

[McGraw Hill Professional](#) **A PRACTICAL GUIDE TO HARDWARE FUNDAMENTALS** Embedded Systems Hardware for Software Engineers describes the electrical and electronic circuits that are used in embedded systems, their functions, and how they can be interfaced to other devices. Basic computer architecture topics, memory, address decoding techniques, ROM, RAM, DRAM, DDR, cache memory, and memory hierarchy are discussed. The book covers key architectural features of widely used microcontrollers and microprocessors, including Microchip's PIC32, ATMEL's AVR32, and Freescale's MC68000. Interfacing to an embedded system is then described. Data acquisition system level design considerations and a design example are presented with real-world parameters and characteristics. Serial interfaces such as RS-232, RS-485, PC, and USB are addressed and printed circuit boards and high-speed signal propagation over transmission lines are covered with a minimum of math. A brief survey of logic families of integrated circuits and programmable logic devices is also contained in this in-depth resource. **COVERAGE INCLUDES:** Architecture examples Memory Memory address decoding Read-only memory and other related devices Input and output ports Analog-to-digital and digital-to-analog converters Interfacing to external devices Transmission lines Logic families of integrated circuits and their signaling characteristics The printed circuit board Programmable logic devices Test equipment: oscilloscopes and logic analyzers

Programming Embedded Systems

With C and GNU Development Tools

"[O'Reilly Media, Inc.](#)" Authored by two of the leading authorities in the field, this guide offers readers the knowledge and skills needed to achieve proficiency with embedded software.

Embedded Systems – A Hardware-Software Co-Design Approach

Unleash the Power of Arduino!

[Springer Nature](#) This textbook introduces the concept of embedded systems with exercises using Arduino Uno. It is intended for advanced undergraduate and graduate students in computer science, computer engineering, and electrical engineering programs. It contains a balanced discussion on both hardware and software related to embedded systems, with a focus on co-design aspects. Embedded systems have applications in Internet-of-Things (IoT), wearables, self-driving cars, smart devices, cyberphysical systems, drones, and robotics. The hardware chapter discusses various microcontrollers (including popular microcontroller hardware examples), sensors, amplifiers, filters, actuators, wired and wireless communication topologies, schematic and PCB designs, and much more. The software chapter describes OS-less programming, bitmath, polling, interrupt, timer, sleep modes, direct memory access, shared memory, mutex, and smart algorithms, with lots of C-code examples for Arduino Uno. Other topics discussed are prototyping, testing, verification, reliability, optimization, and regulations. Appropriate for courses on embedded systems, microcontrollers, and instrumentation, this textbook teaches budding embedded system programmers practical skills with fun projects to prepare them for industry products. Introduces embedded systems for wearables, Internet-of-Things (IoT), robotics, and other smart devices; Offers a balanced focus on both hardware and software co-design of embedded systems; Includes exercises, tutorials, and assignments.

Making Embedded Systems

Design Patterns for Great Software

"[O'Reilly Media, Inc.](#)" Interested in developing embedded systems? Since they don't tolerate inefficiency, these systems require a disciplined approach to programming. This easy-to-read guide helps you cultivate a host of good development practices, based on classic software design patterns and new patterns unique to embedded programming. Learn how to build system architecture for processors, not operating systems, and discover specific techniques for dealing with hardware difficulties and manufacturing requirements. Written by an expert who's created embedded systems ranging from urban surveillance and DNA scanners to children's toys, this book is ideal for intermediate and experienced programmers, no matter what platform you use. Optimize your system to reduce cost and increase performance Develop an architecture that makes your software robust in resource-constrained environments Explore sensors, motors, and other I/O devices Do more with less: reduce RAM consumption, code space, processor cycles, and power consumption Learn how to update embedded code directly in the processor Discover how to implement complex mathematics on small processors Understand what interviewers look for when you apply for an embedded systems job "Making Embedded Systems is the book for a C programmer who wants to enter the fun (and lucrative) world of embedded systems. It's very well written—entertaining, even—and filled with clear illustrations." —Jack Ganssle, author and embedded system expert.

Software Engineering for Embedded Systems

Methods, Practical Techniques, and Applications

[Newnes](#) This Expert Guide gives you the techniques and technologies in software engineering to optimally design and implement your embedded system. Written by experts with a solutions focus, this encyclopedic reference gives you an indispensable aid to tackling the day-to-day problems when using software engineering methods to develop your embedded systems. With this book you will learn: The principles of good architecture for an embedded system Design practices to help make your embedded project successful Details on principles that are often a part of embedded systems, including digital signal processing, safety-critical principles, and development processes Techniques for setting up a performance engineering strategy for your embedded system software How to develop user interfaces for embedded systems Strategies for testing and deploying your embedded system, and ensuring quality development processes Practical techniques for optimizing embedded software for performance, memory, and power Advanced guidelines for developing multicore software for embedded systems How to develop embedded software for networking, storage, and automotive segments How to manage the embedded development process Includes contributions from: Frank Schirrmeyer, Shelly Gretlein, Bruce Douglass, Erich Styger, Gary Stringham, Jean Labrosse, Jim Trudeau, Mike Brogioli, Mark Pitchford, Catalin Dan Udma, Markus Levy, Pete Wilson, Whit Waldo, Inga Harris, Xinxin Yang, Srinivasa Addepalli, Andrew McKay, Mark Kraeling and Robert Oshana. Road map of key problems/issues and references to their solution in the text Review of core methods in the context of how to apply them Examples demonstrating timeless implementation details Short and to-the-point case studies show how key ideas can be implemented, the rationale for choices made, and design guidelines and trade-offs

Embedded Systems Architecture

A Comprehensive Guide for Engineers and Programmers

[Newnes](#) Embedded Systems Architecture is a practical and technical guide to understanding the components that make up an embedded system's architecture. This book is perfect for those starting out as technical professionals such as engineers, programmers and designers of embedded systems; and also for students of computer science, computer engineering and electrical engineering. It gives a much-needed 'big picture' for recently graduated engineers grappling with understanding the design of real-world systems for the first time, and provides professionals with a systems-level picture of the key elements that can go into an embedded design, providing a firm foundation on which to build their skills. Real-world approach to the fundamentals, as well as the design and architecture process, makes this book a popular reference for the daunted or the inexperienced: if in doubt, the answer is in here! Fully updated with new coverage of FPGAs, testing, middleware and the latest programming techniques in C, plus complete source code and sample code, reference designs and tools online make this the complete package Visit the companion web site at <http://booksite.elsevier.com/9780123821966/> for source code, design examples, data sheets and more A true introductory book, provides a comprehensive get up and running reference for those new to the field, and updating skills: assumes no prior knowledge beyond undergrad level electrical engineering Addresses the needs of practicing engineers, enabling it to get to the point more directly, and cover more ground. Covers hardware, software and middleware in a single volume Includes a library of design examples and design tools, plus a complete set of source code and embedded systems design tutorial materials from companion website

Embedded Systems Design with 8051 Microcontrollers

Hardware and Software

[CRC Press](#) A presentation of developments in microcontroller technology, providing lucid instructions on its many and varied applications. It focuses on the popular eight-bit microcontroller, the 8051, and the 83C552. The text outlines a systematic methodology for small-scale, control-dominated embedded systems, and is accompanied by a disk of all the example problems included in the book.

An Embedded Software Primer

[Addison-Wesley Professional](#) Simon introduces the broad range of applications for embedded software and then reviews each major issue facing developers, offering practical solutions, techniques, and good habits that apply no matter which processor, real-time operating systems, methodology, or application is used.

Real-Time Embedded Systems

Design Principles and Engineering Practices

[Newnes](#) This book integrates new ideas and topics from real time systems, embedded systems, and software engineering to give a complete picture of the whole process of developing software for real-time embedded applications. You will not only gain a thorough understanding of concepts related to microprocessors, interrupts, and system boot process, appreciating the importance of real-time modeling and scheduling, but you will also learn software engineering practices such as model documentation, model analysis, design patterns, and standard conformance. This book is split into four parts to help you learn the key concept of embedded systems; Part one introduces the development process, and includes two chapters on microprocessors and interrupts---fundamental topics for software engineers; Part two is dedicated to modeling techniques for real-time systems; Part three looks at the design of software architectures and Part four covers software implementations, with a focus on POSIX-compliant operating systems. With this book you will learn: The pros and cons of different architectures for embedded systems POSIX real-time extensions, and how to develop POSIX-compliant real time applications How to use real-time UML to document system designs with timing constraints The challenges and concepts related to cross-development Multitasking design and inter-task communication techniques (shared memory objects, message queues, pipes, signals) How to use kernel objects (e.g. Semaphores, Mutex, Condition variables) to address resource sharing issues in RTOS applications The philosophy underpinning the notion of "resource manager" and how to implement a virtual file system using a resource manager The key principles of real-time scheduling and several key algorithms Coverage of the latest UML standard (UML 2.4) Over 20 design patterns which represent the best practices for reuse in a wide range of real-time embedded systems Example codes which have been tested in QNX---a real-time operating system widely adopted in industry

Embedded Systems: World Class Designs

[Newnes](#) Famed author Jack Ganssle has selected the very best embedded systems design material from the Newnes portfolio. The result is a book covering the gamut of embedded design, from hardware to software to integrated embedded systems, with a strong pragmatic emphasis.

Hardware-Software Co-Design of Embedded Systems

The POLIS Approach

[Springer Science & Business Media](#) Embedded systems are informally defined as a collection of programmable parts surrounded by ASICs and other standard components, that interact continuously with an environment through sensors and actuators. The programmable parts include micro-controllers and Digital Signal Processors (DSPs). Embedded systems are often used in life-critical situations, where reliability and safety are more important criteria than performance. Today, embedded systems are designed with an ad hoc approach that is heavily based on earlier experience with similar products and on manual design. Use of higher-level languages such as C helps structure the design somewhat, but with increasing complexity it is not sufficient. Formal verification and automatic synthesis of implementations are the surest ways to guarantee safety. Thus, the POLIS system which is a co-design environment for embedded systems is based on a formal model of computation. POLIS was initiated in 1988 as a research project at the University of California at Berkeley and, over the years, grew into a full design methodology with a software system supporting it. Hardware-Software Co-Design of Embedded Systems: The POLIS Approach is intended to give a complete overview of the POLIS system including its formal and algorithmic aspects. Hardware-Software Co-Design of Embedded Systems: The POLIS Approach will be of interest to embedded system designers (automotive electronics, consumer electronics and telecommunications), micro-controller designers, CAD developers and students.

Embedded System Design

A Unified Hardware / Software Introduction

[John Wiley & Sons](#) This book introduces a modern approach to embedded system design, presenting software design and hardware design in a unified manner. It covers trends and challenges, introduces the design and use of single-purpose processors ("hardware") and general-purpose processors ("software"), describes memories and buses, illustrates hardware/software tradeoffs using a digital camera example, and discusses advanced computation models, controls systems, chip technologies, and modern design tools. For courses found in EE, CS and other engineering departments.

Design Patterns for Embedded Systems in C

An Embedded Software Engineering Toolkit

[Elsevier](#) A recent survey stated that 52% of embedded projects are late by 4-5 months. This book can help get those projects in on-time with design patterns. The author carefully takes into account the special concerns found in designing and developing embedded applications specifically concurrency, communication, speed, and memory usage. Patterns are given in UML (Unified Modeling Language) with examples including ANSI C for direct and practical application to C code. A basic C knowledge is a prerequisite for the book while UML notation and terminology is included. General C programming books do not include discussion of the constraints found within embedded system design. The practical examples give the reader an understanding of the use of UML and OO (Object Oriented) designs in a resource-limited environment. Also included are two chapters on state machines. The beauty of this book is that it can help you today. . Design Patterns within these pages are immediately applicable to your project Addresses embedded system design concerns such as concurrency, communication, and memory usage Examples contain ANSI C for ease of use with C programming code

Embedded Systems

Hardware, Design and Implementation

[John Wiley & Sons](#) Covers the significant embedded computing technologies—highlighting their applications in wireless communication and computing power An embedded system is a computer system designed for specific control functions within a larger system—often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Presented in three parts, Embedded Systems: Hardware, Design, and Implementation provides readers with an immersive introduction to this rapidly growing segment of the computer industry. Acknowledging the fact that embedded systems control many of today's most common devices such as smart phones, PC tablets, as well as hardware embedded in cars, TVs, and even refrigerators and heating systems, the book starts with a basic introduction to embedded computing systems. It hones in on system-on-a-chip (SoC), multiprocessor system-on-chip (MPSoC), and network-on-chip (NoC). It then covers on-chip integration of software and custom hardware accelerators, as well as fabric flexibility, custom architectures, and the multiple I/O standards that facilitate PCB integration. Next, it focuses on the technologies associated with embedded computing systems, going over the basics of field-programmable gate array (FPGA), digital signal processing (DSP) and application-specific integrated circuit (ASIC) technology, architectural support for on-chip integration of custom accelerators with processors, and O/S support for these systems. Finally, it offers full details on architecture, testability, and computer-aided design (CAD) support for embedded systems, softprocessors, heterogeneous resources, and on-chip storage before concluding with coverage of software support—in particular, O/S Linux. Embedded Systems: Hardware, Design, and Implementation is an ideal book for design engineers looking to optimize and reduce the size and cost of embedded system products and increase their reliability and performance.

Hardware-Software Co-Synthesis of Distributed Embedded Systems

Springer Science & Business Media Embedded computer systems use both off-the-shelf microprocessors and application-specific integrated circuits (ASICs) to implement specialized system functions. Examples include the electronic systems inside laser printers, cellular phones, microwave ovens, and an automobile anti-lock brake controller. Embedded computing is unique because it is a co-design problem - the hardware engine and application software architecture must be designed simultaneously. Hardware-Software Co-Synthesis of Distributed Embedded Systems proposes new techniques such as fixed-point iterations, phase adjustment, and separation analysis to efficiently estimate tight bounds on the delay required for a set of multi-rate processes preemptively scheduled on a real-time reactive distributed system. Based on the delay bounds, a gradient-search co-synthesis algorithm with new techniques such as sensitivity analysis, priority prediction, and idle-processing elements elimination are developed to select the number and types of processing elements in a distributed engine, and determine the allocation and scheduling of processes to processing elements. New communication modeling is also presented to analyze communication delay under interaction of computation and communication, allocate interprocessor communication links, and schedule communication. Hardware-Software Co-Synthesis of Distributed Embedded Systems is the first book to describe techniques for the design of distributed embedded systems, which have arbitrary hardware and software topologies. The book will be of interest to: academic researchers for personal libraries and advanced-topics courses in co-design as well as industrial designers who are building high-performance, real-time embedded systems with multiple processors.

Embedded System Design

Embedded Systems Foundations of Cyber-Physical Systems

Springer Science & Business Media Until the late 1980s, information processing was associated with large mainframe computers and huge tape drives. During the 1990s, this trend shifted toward information processing with personal computers, or PCs. The trend toward miniaturization continues and in the future the majority of information processing systems will be small mobile computers, many of which will be embedded into larger products and interfaced to the physical environment. Hence, these kinds of systems are called embedded systems. Embedded systems together with their physical environment are called cyber-physical systems. Examples include systems such as transportation and fabrication equipment. It is expected that the total market volume of embedded systems will be significantly larger than that of traditional information processing systems such as PCs and mainframes. Embedded systems share a number of common characteristics. For example, they must be dependable, efficient, meet real-time constraints and require customized user interfaces (instead of generic keyboard and mouse interfaces). Therefore, it makes sense to consider common principles of embedded system design. Embedded System Design starts with an introduction into the area and a survey of specification models and languages for embedded and cyber-physical systems. It provides a brief overview of hardware devices used for such systems and presents the essentials of system software for embedded systems, like real-time operating systems. The book also discusses evaluation and validation techniques for embedded systems. Furthermore, the book presents an overview of techniques for mapping applications to execution platforms. Due to the importance of resource efficiency, the book also contains a selected set of optimization techniques for embedded systems, including special compilation techniques. The book closes with a brief survey on testing. Embedded System Design can be used as a text book for courses on embedded systems and as a source which provides pointers to relevant material in the area for PhD students and teachers. It assumes a basic knowledge of information processing hardware and software. Courseware related to this book is available at <http://ls12-www.cs.tu-dortmund.de/~marwedel>.

Building Embedded Systems

Programmable Hardware

Apress Develop the software and hardware you never think about. We're talking about the nitty-gritty behind the buttons on your microwave, inside your thermostat, inside the keyboard used to type this description, and even running the monitor on which you are reading it now. Such stuff is termed embedded systems, and this book shows how to design and develop embedded systems at a professional level. Because yes, many people quietly make a successful career doing just that. Building embedded systems can be both fun and intimidating. Putting together an embedded system requires skill sets from multiple engineering disciplines, from software and hardware in particular. Building Embedded Systems is a book about helping you do things in the right way from the beginning of your first project: Programmers who know software will learn what they need to know about hardware. Engineers with hardware knowledge likewise will learn about the software side. Whatever your background is, Building Embedded Systems is the perfect book to fill in any knowledge gaps and get you started in a career programming for everyday devices. Author Changyi Gu brings more than fifteen years of experience in working his way up the ladder in the field of embedded systems. He brings knowledge of numerous approaches to embedded systems design, including the System on Programmable Chips (SOPC) approach that is currently growing to dominate the field. His knowledge and experience make Building Embedded Systems an excellent book for anyone wanting to enter the field, or even just to do some embedded programming as a side project. What You Will Learn Program embedded systems at the hardware level Learn current industry practices in firmware development Develop practical knowledge of embedded hardware options Create tight integration between software and hardware Practice a work flow leading to successful outcomes Build from transistor level to the system level Make sound choices between performance and cost Who This Book Is For Embedded-system engineers and intermediate electronics enthusiasts who are seeking tighter integration between software and hardware. Those who favor the System on a Programmable Chip (SOPC) approach will in particular benefit from this book. Students in both Electrical Engineering and Computer Science can also benefit from this book and the real-life industry practice it provides.

Designing Embedded Hardware

Create New Computers and Devices

"O'Reilly Media, Inc." Embedded computer systems literally surround us: they're in our cell phones, PDAs, cars, TVs, refrigerators, heating systems, and more. In fact, embedded systems are one of the most rapidly growing segments of the computer industry today. Along with the growing list of devices for which embedded computer systems are appropriate, interest is growing among programmers, hobbyists, and engineers of all types in how to design and build devices of their own. Furthermore, the knowledge offered by this book into the fundamentals of these computer systems can benefit anyone who has to evaluate and apply the systems. The second edition of Designing Embedded Hardware has been updated to include information on the latest generation of processors and microcontrollers, including the new MAXQ processor. If you're new to this and don't know what a MAXQ is, don't worry--the book spells out the basics of embedded design for beginners while providing material useful for advanced systems designers. Designing Embedded Hardware steers a course between those books dedicated to writing code for particular microprocessors, and those that stress the philosophy of embedded system design without providing any practical information. Having designed 40 embedded computer systems of his own, author John Catsoulis brings a wealth of real-world experience to show readers how to design and create entirely new embedded devices and computerized gadgets, as well as how to customize and extend off-the-shelf systems. Loaded with real examples, this book also provides a roadmap to the pitfalls and traps to avoid. Designing Embedded Hardware includes: The theory and practice of embedded systems Understanding schematics and data sheets Powering an embedded system Producing and debugging an embedded system Processors such as the PIC, Atmel AVR, and Motorola 68000-series Digital Signal Processing (DSP) architectures Protocols (SPI and I2C) used to add peripherals RS-232C, RS-422, infrared communication, and USB CAN and Ethernet networking Pulse Width Monitoring and motor control If you want to build your own embedded system, or tweak an existing one, this invaluable book gives you the understanding and practical skills you need.

Architecting High-Performance Embedded Systems

Design and build high-performance real-time digital systems based on FPGAs and custom circuits

Packt Publishing Ltd Explore the complete process of developing systems based on field-programmable gate arrays (FPGAs), including the design of electronic circuits and the construction and debugging of prototype embedded devices Key Features Learn the basics of embedded systems and real-time operating systems Understand how FPGAs implement processing algorithms in hardware Design, construct, and debug custom digital systems from scratch using KiCad Book Description Modern digital devices used in homes, cars, and wearables contain highly sophisticated computing capabilities composed of embedded systems that generate, receive, and process digital data streams at rates up to multiple gigabits per second. This book will show you how to use Field Programmable Gate Arrays (FPGAs) and high-speed digital circuit design to create your own cutting-edge digital systems. Architecting High-Performance Embedded Systems takes you through the fundamental concepts of embedded systems, including real-time operation and the Internet of Things (IoT), and the architecture and capabilities of the latest generation of FPGAs. Using powerful free tools for FPGA design and electronic circuit design, you'll learn how to design, build, test, and debug high-performance FPGA-based IoT devices. The book will also help you get up to speed with embedded system design, circuit design, hardware construction, firmware development, and debugging to produce a high-performance embedded device - a network-based digital oscilloscope. You'll explore techniques such as designing four-layer printed circuit boards with high-speed differential signal pairs and assembling the board using surface-mount components. By the end of the book, you'll have a solid understanding of the concepts underlying embedded systems and FPGAs and will be able to design and construct your own sophisticated digital devices. What you will

learn Understand the fundamentals of real-time embedded systems and sensors Discover the capabilities of FPGAs and how to use FPGA development tools Learn the principles of digital circuit design and PCB layout with KiCad Construct high-speed circuit board prototypes at low cost Design and develop high-performance algorithms for FPGAs Develop robust, reliable, and efficient firmware in C Thoroughly test and debug embedded device hardware and firmware Who this book is for This book is for software developers, IoT engineers, and anyone who wants to understand the process of developing high-performance embedded systems. You'll also find this book useful if you want to learn about the fundamentals of FPGA development and all aspects of firmware development in C and C++. Familiarity with the C language, digital circuits, and electronic soldering is necessary to get started.

Embedded Hardware: Know It All

Newnes The Newnes Know It All Series takes the best of what our authors have written to create hard-working desk references that will be an engineer's first port of call for key information, design techniques and rules of thumb. Guaranteed not to gather dust on a shelf! Circuit design using microcontrollers is both a science and an art. This book covers it all. It details all of the essential theory and facts to help an engineer design a robust embedded system. Processors, memory, and the hot topic of interconnects (I/O) are completely covered. Our authors bring a wealth of experience and ideas; this is a must-own book for any embedded designer. *A 360 degree view from best-selling authors including Jack Ganssle, Tammy Noergard, and Fred Eady *Key facts, techniques, and applications fully detailed *The ultimate hard-working desk reference: all the essential information, techniques, and tricks of the trade in one volume

Software Engineering for Embedded Systems

Chapter 16. Software Development Tools for Embedded Systems

Elsevier Inc. Chapters This chapter focuses on the software development tools for embedded systems, especially on the debugging and investigation tools. The chapter starts by presenting the capabilities of a source code debugger - a tool that allows the developer to see what is inside his program at the current execution point or at the moment when the program crashed. The debugger features are described using as an example one of the most popular and widely used debuggers, GDB - GNU Debugger, provided by Free Software Foundation. In order to cover all the requirements of an embedded system, the chapter presents in the following how to design a debug agent that fits into our special target requirements starting from a simple debug routine and evolving to a fully featured debugger. It also presents the typical use cases and the key points of the design like context switching, position-independent executables, debug event handling and multi-core. It then presents the benefits of using the JTAG, an external device used to connect the debugger directly to the target, allowing the debugger to have full control of the target and its resources. Toward the end the chapter presents other tools that may help in the debugging process, like integrated development tools based on free open-source software (Eclipse, GDB), instrumented code and analysis tools.

Programming Embedded Systems in C and C++

"O'Reilly Media, Inc." An introduction to embedding systems for C and C++ programmers encompasses such topics as testing memory devices, writing and erasing Flash memory, verifying nonvolatile memory contents, and much more. Original. (Intermediate).

Introduction to Embedded Systems, Second Edition

A Cyber-Physical Systems Approach

MIT Press An introduction to the engineering principles of embedded systems, with a focus on modeling, design, and analysis of cyber-physical systems. The most visible use of computers and software is processing information for human consumption. The vast majority of computers in use, however, are much less visible. They run the engine, brakes, seatbelts, airbag, and audio system in your car. They digitally encode your voice and construct a radio signal to send it from your cell phone to a base station. They command robots on a factory floor, power generation in a power plant, processes in a chemical plant, and traffic lights in a city. These less visible computers are called embedded systems, and the software they run is called embedded software. The principal challenges in designing and analyzing embedded systems stem from their interaction with physical processes. This book takes a cyber-physical approach to embedded systems, introducing the engineering concepts underlying embedded systems as a technology and as a subject of study. The focus is on modeling, design, and analysis of cyber-physical systems, which integrate computation, networking, and physical processes. The second edition offers two new chapters, several new exercises, and other improvements. The book can be used as a textbook at the advanced undergraduate or introductory graduate level and as a professional reference for practicing engineers and computer scientists. Readers should have some familiarity with machine structures, computer programming, basic discrete mathematics and algorithms, and signals and systems.

Testing Complex and Embedded Systems

CRC Press Many enterprises regard system-level testing as the final piece of the development effort, rather than as a tool that should be integrated throughout the development process. As a consequence, test teams often execute critical test plans just before product launch, resulting in much of the corrective work being performed in a rush and at the last minute. Presenting combinatorial approaches for improving test coverage, Testing Complex and Embedded Systems details techniques to help you streamline testing and identify problems before they occur—including turbocharged testing using Six Sigma and exploratory testing methods. Rather than present the continuum of testing for particular products or design attributes, the text focuses on boundary conditions. Examining systems and software testing, it explains how to use simulation and emulation to complement testing. Details how to manage multiple test hardware and software deliveries Examines the contradictory perspectives of testing—including ordered/ random, structured /unstructured, bench/field, and repeatable/non repeatable Covers essential planning activities prior to testing, how to scope the work, and how to reach a successful conclusion Explains how to determine when testing is complete Where you find organizations that are successful at product development, you are likely to find groups that practice disciplined, strategic, and thorough testing. Tapping into the authors' decades of experience managing test groups in the automotive industry, this book provides the understanding to help ensure your organization joins the likes of these groups.

ARM System Developer's Guide

Designing and Optimizing System Software

Elsevier Over the last ten years, the ARM architecture has become one of the most pervasive architectures in the world, with more than 2 billion ARM-based processors embedded in products ranging from cell phones to automotive braking systems. A world-wide community of ARM developers in semiconductor and product design companies includes software developers, system designers and hardware engineers. To date no book has directly addressed their need to develop the system and software for an ARM-based system. This text fills that gap. This book provides a comprehensive description of the operation of the ARM core from a developer's perspective with a clear emphasis on software. It demonstrates not only how to write efficient ARM software in C and assembly but also how to optimize code. Example code throughout the book can be integrated into commercial products or used as templates to enable quick creation of productive software. The book covers both the ARM and Thumb instruction sets, covers Intel's XScale Processors, outlines distinctions among the versions of the ARM architecture, demonstrates how to implement DSP algorithms, explains exception and interrupt handling, describes the cache technologies that surround the ARM cores as well as the most efficient memory management techniques. A final chapter looks forward to the future of the ARM architecture considering ARMv6, the latest change to the instruction set, which has been designed to improve the DSP and media processing capabilities of the architecture. * No other book describes the ARM core from a system and software perspective. * Author team combines extensive ARM software engineering experience with an in-depth knowledge of ARM developer needs. * Practical, executable code is fully explained in the book and available on the publisher's Website. * Includes a simple embedded operating system.

Formal Development of a Network-Centric RTOS

Software Engineering for Reliable Embedded Systems

Springer Science & Business Media Many systems, devices and appliances used routinely in everyday life, ranging from cell phones to cars, contain significant amounts of software that is not directly visible to the user and is therefore called "embedded". For coordinating the various software components and allowing them to communicate with each other, support software is needed, called an operating system (OS). Because embedded software must function in real time (RT), a RTOS is needed. This book describes a formally developed, network-centric Real-Time Operating System, OpenComRTOS. One of the first in its kind, OpenComRTOS was originally developed to verify the usefulness of formal methods in the context of embedded software engineering. Using the formal methods described in this book produces results that are more reliable while delivering higher performance. The result is a unique real-time concurrent programming system that supports heterogeneous systems with just 5 Kbytes/node. It is compatible with safety related engineering standards, such as IEC61508.

Designing Embedded Hardware

"O'Reilly Media, Inc." Intelligent readers who want to build their own embedded computer systems-- installed in everything from cell phones to cars to handheld organizers to refrigerators-- will find this book to be the most in-depth, practical, and up-to-date guide on the market. Designing Embedded Hardware carefully steers between the practical and philosophical aspects, so developers can both create their own devices and gadgets and customize and extend off-the-shelf systems. There are hundreds of books to choose from if you need to learn programming, but only a few are available if you want to learn to create hardware. Designing Embedded Hardware provides software and hardware engineers with no prior experience in embedded systems with the necessary conceptual and design building blocks to understand the architectures of embedded systems. Written to provide the depth of coverage and real-world examples developers need, Designing Embedded Hardware also provides a road-map to the pitfalls and traps to avoid in designing embedded systems. Designing Embedded Hardware covers such essential topics as: The principles of developing computer hardware Core hardware designs Assembly language concepts Parallel I/O Analog-digital conversion Timers (internal and external) UART Serial Peripheral Interface Inter-Integrated Circuit Bus Controller Area Network (CAN) Data Converter Interface (DCI) Low-power operation This invaluable and eminently useful book gives you the practical tools and skills to develop, build, and program your own application-specific computers.

Building Embedded Linux Systems

"O'Reilly Media, Inc." Linux® is being adopted by an increasing number of embedded systems developers, who have been won over by its sophisticated scheduling and networking, its cost-free license, its open development model, and the support offered by rich and powerful programming tools. While there is a great deal of hype surrounding the use of Linux in embedded systems, there is not a lot of practical information. Building Embedded Linux Systems is the first in-depth, hard-core guide to putting together an embedded system based on the Linux kernel. This indispensable book features arcane and previously undocumented procedures for: Building your own GNU development toolchain Using an efficient embedded development framework Selecting, configuring, building, and installing a target-specific kernel Creating a complete target root filesystem Setting up, manipulating, and using solid-state storage devices Installing and configuring a bootloader for the target Cross-compiling a slew of utilities and packages Debugging your embedded system using a plethora of tools and techniques Details are provided for various target architectures and hardware configurations, including a thorough review of Linux's support for embedded hardware. All explanations rely on the use of open source and free software packages. By presenting how to build the operating system components from pristine sources and how to find more documentation or help, this book greatly simplifies the task of keeping complete control over one's embedded operating system, whether it be for technical or sound financial reasons. Author Karim Yaghmour, a well-known designer and speaker who is responsible for the Linux Trace Toolkit, starts by discussing the strengths and weaknesses of Linux as an embedded operating system. Licensing issues are included, followed by a discussion of the basics of building embedded Linux systems. The configuration, setup, and use of over forty different open source and free software packages commonly used in embedded Linux systems are also covered. uClibc, BusyBox, U-Boot, OpenSSH, tftpd, ftp, strace, and gdb are among the packages discussed.

Embedded Systems Design with Platform FPGAs

Principles and Practices

Morgan Kaufmann Embedded Systems Design with Platform FPGAs introduces professional engineers and students alike to system development using Platform FPGAs. The focus is on embedded systems but it also serves as a general guide to building custom computing systems. The text describes the fundamental technology in terms of hardware, software, and a set of principles to guide the development of Platform FPGA systems. The goal is to show how to systematically and creatively apply these principles to the construction of application-specific embedded system architectures. There is a strong focus on using free and open source software to increase productivity. Each chapter is organized into two parts. The white pages describe concepts, principles, and general knowledge. The gray pages provide a technical rendition of the main issues of the chapter and show the concepts applied in practice. This includes step-by-step details for a specific development board and tool chain so that the reader can carry out the same steps on their own. Rather than try to demonstrate the concepts on a broad set of tools and boards, the text uses a single set of tools (Xilinx Platform Studio, Linux, and GNU) throughout and uses a single developer board (Xilinx ML-510) for the examples. Explains how to use the Platform FPGA to meet complex design requirements and improve product performance Presents both fundamental concepts together with pragmatic, step-by-step instructions for building a system on a Platform FPGA Includes detailed case studies, extended real-world examples, and lab exercises

Open-Source Robotics and Process Control Cookbook

Designing and Building Robust, Dependable Real-time Systems

Newnes With recent powerful developments in processor and sensor technology, robotics and the closely related field of process control systems are experiencing rapid growth and attracting many new hardware and software engineers. There is particular interest in using open source tools for these applications, with many companies, universities and laboratories desiring to build sophisticated systems without having to purchase an expensive real-time operating system (RTOS). Practical, authoritative information on this subject is scattered and difficult to find. In this comprehensive guide, experienced embedded engineer and author Lewin Edwards demonstrates efficient and low-cost open source design techniques, covering end-to-end robotic/process control systems using Linux as the development platform (and also as the embedded operating system), with extensive information on free compilers and other tools. Specifically the book targets development of real-time physical system controls using Atmel AVR microcontrollers communicating with Linux-based PCs for overmonitoring. It also covers open-source tools for other controllers, including MSP430, PIC and 8051. Code examples are given to provide concrete illustrations of tasks described in the text. The accompanying CD-ROM contains all the code used in the design examples as well as useful open-source tools for robotics and process control system design. The book includes: * schematics, PCB layouts and firmware source code for various sensors and servo/stepper/propulsion motor controllers, with theory of operation text. * discussion of navigation mathematics (GPS) and example code and circuits. * discussion of 3D attitude sensing using MEMS accelerometers. * techniques for designing reliable systems, including watchdogs, avoidance of race conditions, and identifying when it's time to offload functionality onto slave processors * documented sourcecode (with theory-of-operation) for sample overmonitoring applications, both for testing the sensor/controller modules and for complete process monitoring. (To take a trivial example, documenting how to build a system that monitors four thermal sensors with onscreen thermometers, logs the temperature over time, and emails a supervisor's pager if any of the temperatures go out of range.) * a brief introduction to machine vision, including simple ways to capture images, differentiating the image for edge detection, and simple shape recognition. *The first-ever book on using open source technology for robotics design! *Immensely valuable source code and design tools provided on the CD-ROM *Covers hot topics such as GPS navigation, 3-D sensing, and machine vision, all using a Linux platform!

Beginning BBC micro:bit

A Practical Introduction to micro:bit Development

Apress Learn essential concepts and techniques to build simple-to-advanced projects and overcome common programming challenges in micro:bit development. Beginning BBC micro:bit will take you through the complete features and capabilities of the micro:bit controller, enabling you to program and build your own projects. The uses are endless for the micro:bit and this books will help get you started on building your next project with this popular and easy-to-use microcontroller. You'll use online Python Editor and Mu Editor to build your own applications. Reviewed by the micro:bit developer team, this comprehensive guide also provides clean code examples to help you learn the key concepts behind the micro:bit API. What You'll Learn Work with the various kits and accessories Master the micro:bit development platform with easy to follow examples and clean code Build your own micro:bit applications using an online Python editor and Mu editor Use the on-board LED matrix, built-in buttons, I/O pins, accelerometer, and compass Learn how to connect and communicate with devices through I2C, SPI, and UART Build applications with music and speech libraries Use Local Persistent File System to store and manipulate files Build applications based on wired and radio networks Use micro:bit and micro:bit Blue apps Who This Book Is For Beginners, those already experienced with electronics, and hobbyists at all levels looking to get started with a new microcontroller.

Embedded Software Development with ECos

Prentice Hall Professional How to build low-cost, royalty-free embedded solutions with eCos, covers eCos architecture, installation, configuration, coding, debugging, bootstrapping, porting, and more, includes open source tools on CD-ROM for a complete embedded software development environment with eCos as the core.

Patterns in the Machine

A Software Engineering Guide to Embedded Development

Apress Discover how to apply software engineering patterns to develop more robust firmware faster than traditional embedded development approaches. In the authors' experience, traditional embedded software projects tend towards monolithic applications that are optimized for their target hardware platforms. This leads to software that is fragile in terms of extensibility and difficult to test without fully integrated software and hardware. Patterns in the Machine focuses on creating loosely coupled implementations that embrace both change and testability. This book illustrates how implementing continuous integration, automated unit testing, platform-independent code, and other best practices that are not typically implemented in the embedded systems world is not just feasible but also practical for today's embedded projects. After reading this book, you will have a better idea of how to structure your embedded software projects. You will recognize that while writing unit tests, creating simulators, and implementing continuous integration requires time and effort up front, you will be amply rewarded at the end of the project in terms of quality, adaptability, and maintainability of your code. What You Will Learn Incorporate automated unit testing into an embedded project Design and build functional simulators for an embedded project Write production-quality software when hardware is not available Use the Data Model architectural pattern to create a highly decoupled design and implementation Understand the importance of defining the software architecture before implementation starts and how to do it Discover why documentation is essential for an embedded project Use finite state machines in embedded projects Who This Book Is For Mid-level or higher embedded systems (firmware) developers, technical leads, software architects, and development managers.

Embedded Systems Dictionary

CRC Press This technical dictionary defines the 2,500 most-used words in the embedded systems field, with over 4,500 entries and cross-references. Designed to serve both the technical and non-technical audience, this book defines advanced terms in two steps. The fi

Demystifying Embedded Systems Middleware

Elsevier When asked, "What is the biggest factor influencing processor choice for new projects?" engineers overwhelmingly agree that the robustness of the processors' attendant software is the key linchpin of the decision. Not speed, not price, but available software. Because software has become the driving factor in the development of embedded systems, middleware, the "glue" allowing hardware and software to work together effectively, has taken on a role of pivotal importance. However, middleware is perhaps the most mysterious of all the aspects of an embedded system, even to expert designers! Available information is scattered and mostly proprietary, not to mention largely outdated, and obfuscated by a sea of acronyms. This practical technical guide to embedded middleware implementation offers a coherent framework that guides readers through all the key concepts necessary to gain a clear understanding of this broad and diverse topic. Big picture theoretical discussion is integrated with down-to-earth advice on successful real-world use via step-by-step examples of each type of middleware implementation. Hundreds of diagrams help the reader to visualize the complexities of the wide variety of embedded middleware that exists in the industry today. Technically detailed case studies help to bring it all together, providing valuable insight into the typical engineering situations readers are likely to encounter. Expert author Tammy Noergaard keeps explanations as simple and readable as possible, eschewing jargon and carefully defining acronyms. The start of each chapter includes a 'setting the stage' section, so readers can take a step back and understand the context and applications of the information being provided. Core middleware, such as networking protocols, file systems, virtual machines, and databases; more complex middleware that builds upon generic pieces, such as MOM, ORB, and RPC; and integrated middleware software packages, such as embedded JVMs, .NET, and CORBA packages are all demystified. A free companion CD-ROM includes all the open-source code utilized by the author in examples, so that readers can obtain hands-on programming experience without making any further purchase. * The only complete guide to middleware, one of the most important AND most widely misunderstood aspects of embedded systems - hundreds of devices, from digital TVs to smart phones, can't function without it! * Offers thorough middleware coverage, including basic theory and core middleware, as well as complex implementations and integrated packages * Detailed case studies, real-world examples, hundreds of diagrams, and a free CD-ROM provide context and aid understanding of embedded middleware

Embedded FreeBSD Cookbook

Elsevier The FreeBSD operating system has become a popular OS choice for embedded systems due to its small size and the fact that it is free to users. However, detailed information on using FreeBSD is difficult to find. Author Paul Cevoli, an experienced embedded systems engineer, answers that need in this cookbook aimed at making life easier for engineers working with FreeBSD. Topics covered in the book include core operating system components, processes, process scheduling, virtual memory, device drivers and debugging, as these are the core features necessary for embedded system developers. Each chapter discusses basic components of FreeBSD, device drivers, Unix kernel, and C and GNU development tools, and provides the reader with the information needed to accomplish the stated task, along with sample source code. Provides numerous examples of system software with source code and debugging techniques that can provide starting points for your own designs Covers core operating system components, processes and process scheduling, system booting, virtual memory, device drivers, debugging, and much more

Making Embedded Systems

Design Patterns for Great Software

"O'Reilly Media, Inc." Eager to develop embedded systems? These systems don't tolerate inefficiency, so you may need a more disciplined approach to programming. This easy-to-read book helps you cultivate a host of good development practices, based on classic software design patterns as well as new patterns unique to embedded programming. You not only learn system architecture, but also specific techniques for dealing with system constraints and manufacturing requirements. Written by an expert who's created embedded systems ranging from urban surveillance and DNA scanners to children's toys, Making Embedded Systems is ideal for intermediate and experienced programmers, no matter what platform you use. Develop an architecture that makes your software robust and maintainable Understand how to make your code smaller, your processor seem faster, and your system use less power Learn how to explore sensors, motors, communications, and other I/O devices Explore tasks that are complicated on embedded systems, such as updating the software and using fixed point math to implement complex algorithms

Patterns for Time-triggered Embedded Systems

Building Reliable Applications with the 8051 Family of Microcontrollers

Addison-Wesley Longman CD-ROM contains: Source code in 'C' for patterns and examples -- Evaluation version of the industry-standard Keil 'C' compiler and hardware simulator.

Extreme C

Taking you to the limit in Concurrency, OOP, and the most advanced capabilities of C

Packt Publishing Ltd Push the limits of what C - and you - can do, with this high-intensity guide to the most advanced capabilities of C Key FeaturesMake the most of C's low-level control, flexibility, and high performanceA comprehensive guide to C's most powerful and challenging featuresA thought-provoking guide packed with hands-on exercises and examplesBook Description There's a lot more to C than knowing the language syntax. The industry looks for developers with a rigorous, scientific understanding of the principles and practices. Extreme C will teach you to use C's advanced low-level power to write effective, efficient systems. This intensive, practical guide will help you become an expert C programmer. Building on your existing C knowledge, you will master preprocessor directives, macros, conditional compilation, pointers, and much more. You will gain new insight into algorithm design, functions, and structures. You will discover how C helps you squeeze maximum performance out of critical, resource-constrained applications. C still plays a critical role in 21st-century programming, remaining the core language for precision engineering, aviations, space research, and more. This book shows how C works with Unix, how to implement OO principles in C, and fully covers multi-processing. In Extreme C, Amini encourages you to think, question, apply, and experiment for yourself. The book is essential for anybody who wants to take their C to the next level. What you will learnBuild advanced C knowledge on strong foundations, rooted in first principlesUnderstand memory structures and compilation pipeline and how they work, and how to make most out of themApply object-oriented design principles to your procedural C codeWrite low-level code that's close to the hardware and squeezes maximum performance out of a computer systemMaster concurrency, multithreading, multi-processing, and integration with other languagesUnit Testing and debugging, build systems, and inter-process communication for C programmingWho this book is for Extreme C is for C programmers who want to dig deep into the language and its capabilities. It will help you make the most of the low-level control C gives you.

Embedded Systems Architecture

Explore architectural concepts, pragmatic design patterns, and best practices to produce robust systems

[Packt Publishing Ltd](#) Learn to design and develop safe and reliable embedded systems **Key Features** Identify and overcome challenges in embedded environments Understand the steps required to increase the security of IoT solutions Build safety-critical and memory-safe parallel and distributed embedded systems **Book Description** Embedded systems are self-contained devices with a dedicated purpose. We come across a variety of fields of applications for embedded systems in industries such as automotive, telecommunications, healthcare and consumer electronics, just to name a few. Embedded Systems Architecture begins with a bird's eye view of embedded development and how it differs from the other systems that you may be familiar with. You will first be guided to set up an optimal development environment, then move on to software tools and methodologies to improve the work flow. You will explore the boot-up mechanisms and the memory management strategies typical of a real-time embedded system. Through the analysis of the programming interface of the reference microcontroller, you'll look at the implementation of the features and the device drivers. Next, you'll learn about the techniques used to reduce power consumption. Then you will be introduced to the technologies, protocols and security aspects related to integrating the system into IoT solutions. By the end of the book, you will have explored various aspects of embedded architecture, including task synchronization in a multi-threading environment, and the safety models adopted by modern real-time operating systems. **What you will learn** Participate in the design and definition phase of an embedded product Get to grips with writing code for ARM Cortex-M microcontrollers Build an embedded development lab and optimize the workflow Write memory-safe code Understand the architecture behind the communication interfaces Understand the design and development patterns for connected and distributed devices in the IoT Master multitask parallel execution patterns and real-time operating systems **Who this book is for** If you're a software developer or designer wanting to learn about embedded programming, this is the book for you. You'll also find this book useful if you're a less experienced embedded programmer willing to expand your knowledge.