Linux Rapid Embedded Programming

GNU/Linux Rapid Embedded Programming

An annotated guide to program and develop GNU/Linux Embedded systems quickly Key Features Rapidly design and build powerful prototypes for GNU/Linux Embedded systems Become familiar with the workings of GNU/Linux Embedded systems and how to manage its peripherals Write, monitor, and configure applications quickly and effectively, manage an external micro-controller, and use it as co-processor for real-time tasks Book DescriptionEmbedded computers have become very complex in the last few years and developers need to easily manage them by focusing on how to solve a problem without wasting time in finding supported peripherals or learning how to manage them. The main challenge with experienced embedded programmers and engineers is really how long it takes to turn an idea into reality, and we show you exactly how to do it. This book shows how to interact with external environments through specific peripherals used in the industry. We will use the latest Linux kernel release 4.4.x and Debian/Ubuntu distributions (with embedded distributions like OpenWrt and Yocto). The book will present popular boards in the industry that are user-friendly to base the rest of the projects on - BeagleBone Black, SAMA5D3 Xplained, Wandboard and system-on-chip manufacturers. Readers will be able to take their first steps in programming the embedded platforms, using C, Bash, and Python/PHP languages in order to get access to the external peripherals. More about using and programming device driver and accessing the peripherals will be covered to lay a strong foundation. The readers will learn how to read/write data from/to the external environment by using both C programs or a scripting language (Bash/PHP/Python) and how to configure a device driver for a specific hardware. After finishing this book, the readers will be able to gain a good knowledge level and understanding of writing, configuring, and managing drivers, controlling and monitoring applications with the help of efficient/quick programming and will be able to apply these skills into real-world projects. What you will learn Use embedded systems to implement your projects Access and manage peripherals for embedded systems Program embedded systems using languages such as C, Python, Bash, and PHP Use a complete distribution, such as Debian or Ubuntu, or an embedded one, such as OpenWrt or Yocto Harness device driver capabilities to optimize device communications Access data through several kinds of devices such as GPIO's, serial ports, PWM, ADC, Ethernet, WiFi, audio, video, I2C, SPI, One Wire, USB and CAN Who this book is for This book targets Embedded System developers and GNU/Linux programmers who would like to program Embedded Systems and perform Embedded development. The book focuses on quick and efficient prototype building. Some experience with hardware and Embedded Systems is assumed, as is having done some previous work on GNU/Linux systems. Knowledge of scripting on GNU/Linux is expected as well.

Mastering Embedded Linux Programming

Build, customize, and deploy Linux-based embedded systems with confidence using Yocto, bootloaders, and build tools Key Features Master build systems, toolchains, and kernel integration for embedded Linux Set up custom Linux distros with Yocto and manage board-specific configurations Learn real-world debugging, memory handling, and system performance tuning Book DescriptionIf you’re looking for a book that will demystify embedded Linux, then you’ve come to the right place. Mastering Embedded Linux Programming is a fully comprehensive guide that can serve both as means to learn new things or as a handy reference. The first few chapters of this book will break down the fundamental elements that underpin all embedded Linux projects: the toolchain, the bootloader, the kernel, and the root filesystem. After that, you will learn how to create each of these elements from scratch and automate the process using Buildroot and the Yocto Project. As you progress, the book will show you how to implement an effective storage strategy for flash memory chips and install updates to a device remotely once it’s deployed. You’ll also learn about the key aspects of writing code for embedded Linux, such as how to access hardware from apps, the implications of writing

multi-threaded code, and techniques to manage memory in an efficient way. The final chapters demonstrate how to debug your code, whether it resides in apps or in the Linux kernel itself. You'll also cover the different tracers and profilers that are available for Linux so that you can quickly pinpoint any performance bottlenecks in your system. By the end of this Linux book, you'll be able to create efficient and secure embedded devices using Linux.What you will learn Use Buildroot and the Yocto Project to create embedded Linux systems Troubleshoot BitBake build failures and streamline your Yocto development workflow Update IoT devices securely in the field using Mender or balena Prototype peripheral additions by reading schematics, modifying device trees, soldering breakout boards, and probing pins with a logic analyzer Interact with hardware without having to write kernel device drivers Divide your system up into services supervised by BusyBox runit Debug devices remotely using GDB and measure the performance of systems using tools such as perf, ftrace, eBPF, and Callgrind Who this book is for If you're a systems software engineer or system administrator who wants to learn how to implement Linux on embedded devices, then this book is for you. It's also aimed at embedded systems engineers accustomed to programming for low-power microcontrollers, who can use this book to help make the leap to high-speed systems on chips that can run Linux. Anyone who develops hardware that needs to run Linux will find something useful in this book – but before you get started, you'll need a solid grasp on POSIX standard, C programming, and shell scripting.

Embedded Linux System Design and Development

Based upon the authors' experience in designing and deploying an embedded Linux system with a variety of applications, Embedded Linux System Design and Development contains a full embedded Linux system development roadmap for systems architects and software programmers. Explaining the issues that arise out of the use of Linux in embedded systems, the book facilitates movement to embedded Linux from traditional real-time operating systems, and describes the system design model containing embedded Linux. This book delivers practical solutions for writing, debugging, and profiling applications and drivers in embedded Linux, and for understanding Linux BSP architecture. It enables you to understand: various drivers such as serial, I2C and USB gadgets; uClinux architecture and its programming model; and the embedded Linux graphics subsystem. The text also promotes learning of methods to reduce system boot time, optimize memory and storage, and find memory leaks and corruption in applications. This volume benefits IT managers in planning to choose an embedded Linux distribution and in creating a roadmap for OS transition. It also describes the application of the Linux licensing model in commercial products.

Building Embedded Linux Systems

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, thttpd, tftp, strace, and gdb are among the packages discussed.

Node.js for Embedded Systems

How can we build bridges from the digital world of the Internet to the analog world that surrounds us? By bringing accessibility to embedded components such as sensors and microcontrollers, JavaScript and Node.js might shape the world of physical computing as they did for web browsers. This practical guide shows hardware and software engineers, makers, and web developers how to talk in JavaScript with a variety of hardware platforms. Authors Patrick Mulder and Kelsey Breseman also delve into the basics of microcontrollers, single-board computers, and other hardware components. Use JavaScript to program microcontrollers with Arduino and Espruino Prototype IoT devices with the Tessel 2 development platform Learn about electronic input and output components, including sensors Connect microcontrollers to the Internet with the Particle Photon toolchain Run Node.js on single-board computers such as Raspberry Pi and Intel Edison Talk to embedded devices with Node.js libraries such as Johnny-Five, and remotely control the devices with Bluetooth Use MQTT as a message broker to connect devices across networks Explore ways to use robots as building blocks for shared experiences

Linux Device Driver Development Cookbook

Over 30 recipes to develop custom drivers for your embedded Linux applications Key Features Use kernel facilities to develop powerful drivers Learn core concepts for developing device drivers using a practical approach Program a custom character device to get access to kernel internals Book DescriptionLinux is a unified kernel that is widely used to develop embedded systems. As Linux has turned out to be one of the most popular operating systems worldwide, the interest in developing proprietary device drivers has also increased. Device drivers play a critical role in how the system performs and ensure that the device works in the manner intended. By exploring several examples on the development of character devices, the technique of managing a device tree, and how to use other kernel internals, such as interrupts, kernel timers, and wait queue, you'll be able to add proper management for custom peripherals to your embedded system. You'll begin by installing the Linux kernel and then configuring it. Once you have installed the system, you will learn to use different kernel features and character drivers. You will also cover interrupts in-depth and understand how you can manage them. Later, you will explore the kernel internals required for developing applications. As you approach the concluding chapters, you will learn to implement advanced character drivers and also discover how to write important Linux device drivers. By the end of this book, you will be equipped with the skills you need to write a custom character driver and kernel code according to your requirements.What you will learn Become familiar with the latest kernel releases (4.19/5.x) running on the ESPRESSOBin devkit, an ARM 64-bit machine Download, configure, modify, and build kernel sources Add and remove a device driver or a module from the kernel Understand how to implement character drivers to manage different kinds of computer peripherals Get well-versed with kernel helper functions and objects that can be used to build kernel applications Gain comprehensive insights into managing custom hardware with Linux from both the kernel and user space Who this book is for This book is for anyone who wants to develop their own Linux device drivers for embedded systems. Basic hands-on experience with the Linux operating system and embedded concepts is necessary.

Learning Embedded Android N Programming

Create the perfectly customized system by unleashing the power of Android OS on your embedded device About This Book Understand the system architecture and how the source code is organized Explore the power of Android and customize the build system Build a fully customized Android version as per your requirements Who This Book Is For If you are a Java programmer who wants to customize, build, and deploy your own Android version using embedded programming, then this book is for you. What You Will Learn

Master Android architecture and system design Obtain source code and understand the modular organization Customize and build your first system image for the Android emulator Level up and build your own Android system for a real-world device Use Android as a home automation and entertainment system Tailor your system with optimizations and add-ons Reach for the stars: look at the Internet of Things, entertainment, and domotics In Detail Take a deep dive into the Android build system and its customization with Learning Embedded Android Programming, written to help you master the steep learning curve of working with embedded Android. Start by exploring the basics of Android OS, discover Google's “repo” system, and discover how to retrieve AOSP source code. You'll then find out to set up the build environment and the first AOSP system. Next, learn how to customize the boot sequence with a new animation, and use an Android “kitchen” to “cook” your custom ROM. By the end of the book, you'll be able to build customized Android open source projects by developing your own set of features. Style and approach This step-by-step guide is packed with various real-world examples to help you create a fully customized Android system with the most useful features available.

Real-Time Embedded Components and Systems with Linux and RTOS

This book is intended to provide a senior undergraduate or graduate student in electrical engineering or computer science with a balance of fundamental theory, review of industry practice, and hands-on experience to prepare for a career in the real-time embedded system industries. It is also intended to provide the practicing engineer with the necessary background to apply real-time theory to the design of embedded components and systems. Typical industries include aerospace, medical diagnostic and therapeutic systems, telecommunications, automotive, robotics, industrial process control, media systems, computer gaming, and electronic entertainment, as well as multimedia applications for general-purpose computing. This updated edition adds three new chapters focused on key technology advancements in embedded systems and with wider coverage of real-time architectures. The overall focus remains the RTOS (Real-Time Operating System), but use of Linux for soft real-time, hybrid FPGA (Field Programmable Gate Array) architectures and advancements in multi-core system-on-chip (SoC), as well as software strategies for asymmetric and symmetric multiprocessing (AMP and SMP) relevant to real-time embedded systems, have been added. Companion files are provided with numerous project videos, resources, applications, and figures from the book. Instructors’ resources are available upon adoption. FEATURES: • Provides a comprehensive, up to date, and accessible presentation of embedded systems without sacrificing theoretical foundations • Features the RTOS (Real-Time Operating System), but use of Linux for soft real-time, hybrid FPGA architectures and advancements in multi-core system-on-chip is included • Discusses an overview of RTOS advancements, including AMP and SMP configurations, with a discussion of future directions for RTOS use in multi-core architectures, such as SoC • Detailed applications coverage including robotics, computer vision, and continuous media • Includes a companion disc (4GB) with numerous videos, resources, projects, examples, and figures from the book • Provides several instructors’ resources, including lecture notes, Microsoft PP slides, etc.

Embedded Linux Primer

Program audio and sound for Linux using this practical, how-to guide. You will learn how to use DSPs, sampled audio, MIDI, karaoke, streaming audio, and more. Linux Sound Programming takes you through the layers of complexity involved in programming the Linux sound system. You’ll see the large variety of tools and approaches that apply to almost every aspect of sound. This ranges from audio codecs, to audio players, to audio support both within and outside of the Linux kernel. What You'll Learn Work with sampled audio Handle Digital Signal Processing (DSP) Gain knowledge of MIDI Build a Karaoke-like application Handle streaming audio Who This Book Is For Experienced Linux users and programmers interested in doing multimedia with Linux.

Linux Sound Programming

As the embedded world expands, developers must have a strong grasp of many complex topics in order to make faster, more efficient and more powerful microprocessors to meet the public's growing demand. Embedded Software: The Works covers all the key subjects embedded engineers need to understand in order to succeed, including Design and Development, Programming, Languages including C/C++, and UML, Real Time Operating Systems Considerations, Networking, and much more. New material on Linux, Android, and multi-core gives engineers the up-to-date practical know-how they need in order to succeed. Colin Walls draws upon his experience and insights from working in the industry, and covers the complete cycle of embedded software development: its design, development, management, debugging procedures, licensing, and reuse. For those new to the field, or for experienced engineers looking to expand their skills, Walls provides the reader with detailed tips and techniques, and rigorous explanations of technologies. Key features include: - New chapters on Linux, Android, and multi-core – the cutting edge of embedded software development! - Introductory roadmap guides readers through the book, providing a route through the separate chapters and showing how they are linked About the Author Colin Walls has over twenty-five years experience in the electronics industry, largely dedicated to embedded software. A frequent presenter at conferences and seminars and author of numerous technical articles and two books on embedded software, he is a member of the marketing team of the Mentor Graphics Embedded Software Division. He writes a regular blog on the Mentor website (blogs.mentor.com/colinwalls). - New chapters on Linux, Android, and multi-core – the cutting edge of embedded software development! - Introductory roadmap guides readers through the book, providing a route through the separate chapters and showing how they are linked

Embedded Software

Leverage the power of Linux to develop captivating and powerful embedded Linux projects About This Book Explore the best practices for all embedded product development stages Learn about the compelling features offered by the Yocto Project, such as customization, virtualization, and many more Minimize project costs by using open source tools and programs Who This Book Is For If you are a developer who wants to build embedded systems using Linux, this book is for you. It is the ideal guide for you if you want to become proficient and broaden your knowledge. A basic understanding of C programming and experience with systems programming is needed. Experienced embedded Yocto developers will find new insight into working methodologies and ARM specific development competence. What You Will Learn Use the Yocto Project in the embedded Linux development process Get familiar with and customize the bootloader for a board Discover more about real-time layer, security, virtualization, CGL, and LSB See development workflows for the U-Boot and the Linux kernel, including debugging and optimization Understand the open source licensing requirements and how to comply with them when cohabiting with proprietary programs Optimize your production systems by reducing the size of both the Linux kernel and root filesystems Understand device trees and make changes to accommodate new hardware on your device Design and write multi-threaded applications using POSIX threads Measure real-time latencies and tune the Linux kernel to minimize them In Detail Embedded Linux is a complete Linux distribution employed to operate embedded devices such as smartphones, tablets, PDAs, set-top boxes, and many more. An example of an embedded Linux distribution is Android, developed by Google. This learning path starts with the module Learning Embedded Linux Using the Yocto Project. It introduces embedded Linux software and hardware architecture and presents information about the bootloader. You will go through Linux kernel features and source code and get an overview of the Yocto Project components available. The next module Embedded Linux Projects Using Yocto Project Cookbook takes you through the installation of a professional embedded Yocto setup, then advises you on best practices. Finally, it explains how to quickly get hands-on with the Freescale ARM ecosystem and community layer using the affordable and open source Wandboard embedded board. Moving ahead, the final module Mastering Embedded Linux Programming takes you through the product cycle and gives you an in-depth description of the components and options that are available at each stage. You will see how functions are split between processes and the usage of POSIX threads. By the end of this learning path, your capabilities will be enhanced to create robust and versatile embedded projects. This Learning Path combines some of the best that Packt has to offer in one complete, curated package. It includes content from the following Packt products: Learning Embedded Linux Using the Yocto Project by Alexandru Vaduva

Embedded Linux Projects Using Yocto Project Cookbook by Alex Gonzalez Mastering Embedded Linux Programming by Chris Simmonds Style and approach This comprehensive, step-by-step, pragmatic guide enables you to build custom versions of Linux for new embedded systems with examples that are immediately applicable to your embedded developments. Practical examples provide an easy-to-follow way to learn Yocto project development using the best practices and working methodologies. Coupled with hints and best practices, this will help you understand embedded Linux better.

Linux: Embedded Development

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.

Introduction to Embedded Systems, Second Edition

This is the eBook version of the printed book. If the print book includes a CD-ROM, this content is not included within the eBook version. Advanced Linux Programming is divided into two parts. The first covers generic UNIX system services, but with a particular eye towards Linux specific information. This portion of the book will be of use even to advanced programmers who have worked with other Linux systems since it will cover Linux specific details and differences. For programmers without UNIX experience, it will be even more valuable. The second section covers material that is entirely Linux specific. These are truly advanced topics, and are the techniques that the gurus use to build great applications. While this book will focus mostly on the Application Programming Interface (API) provided by the Linux kernel and the C library, a preliminary introduction to the development tools available will allow all who purchase the book to make immediate use of Linux.

Advanced Linux Programming

Embedded Linux provides the reader the information needed to design, develop, and debug an embedded Linux appliance. It explores why Linux is a great choice for an embedded application and what to look for when choosing hardware.

Embedded Linux Systems with the Yocto Project

The open source nature of Linux has always intrigued embedded engineers, and the latest kernel releases have provided new features enabling more robust functionality for embedded applications. Enhanced real-time performance, easier porting to new architectures, support for microcontrollers and an improved I/O system give embedded engineers even more reasons to love Linux! However, the rapid evolution of the Linux world can result in an eternal search for new information sources that will help embedded

programmers to keep up!This completely updated second edition of noted author Doug Abbott's respected introduction to embedded Linux brings readers up-to-speed on all the latest developments. This practical, hands-on guide covers the many issues of special concern to Linux users in the embedded space, taking into account their specific needs and constraints. You'll find updated information on:•The GNU toolchain•Configuring and building the kernel•BlueCat Linux•Debugging on the target•Kernel Modules•Devices Drivers•Embedded Networking•Real-time programming tips and techniques•The RTAI environment•And much moreThe accompanying CD-ROM contains all the source code from the book's examples, helpful software and other resources to help you get up to speed quickly. This is still the reference you'll reach for again and again!* 100+ pages of new material adds depth and breadth to the 2003 embedded bestseller. * Covers new Linux kernel 2.6 and the recent major OS release, Fedora. * Gives the engineer a guide to working with popular and cost-efficient open-source code.

Embedded Linux

Interested in developing embedded systems? Since they donâ??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 whoâ??s created embedded systems ranging from urban surveillance and DNA scanners to childrenâ??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. Itâ??s very well writtenâ??entertaining, evenâ??and filled with clear illustrations.\" â??Jack Ganssle, author and embedded system expert.

Linux for Embedded and Real-time Applications

Two leading Linux developers show how to choose the best tools for your specific needs and integrate them into a complete development environment that maximizes your effectiveness in any project, no matter how large or complex. Includes research, requirements, coding, debugging, deployment, maintenance and beyond, choosing and implementing editors, compilers, assemblers, debuggers, version control systems, utilities, using Linux Standard Base to deliver applications that run reliably on a wide range of Linux systems, comparing Java development options for Linux platforms, using Linux in cross-platform and embedded development environments.

Making Embedded Systems

Build safety-critical and memory-safe stand-alone and networked embedded systems Key FeaturesKnow how C++ works and compares to other languages used for embedded developmentCreate advanced GUIs for embedded devices to design an attractive and functional UIIntegrate proven strategies into your design for optimum hardware performanceBook Description C++ is a great choice for embedded development, most notably, because it does not add any bloat, extends maintainability, and offers many advantages over different programming languages. Hands-On Embedded Programming with C++17 will show you how C++ can be used to build robust and concurrent systems that leverage the available hardware resources. Starting with a primer on embedded programming and the latest features of C++17, the book takes you through various facets of good programming. You’ll learn how to use the concurrency, memory management, and functional programming features of C++ to build embedded systems. You will understand how to integrate

your systems with external peripherals and efficient ways of working with drivers. This book will also guide you in testing and optimizing code for better performance and implementing useful design patterns. As an additional benefit, you will see how to work with Qt, the popular GUI library used for building embedded systems. By the end of the book, you will have gained the confidence to use C++ for embedded programming. What you will learnChoose the correct type of embedded platform to use for a projectDevelop drivers for OS-based embedded systemsUse concurrency and memory management with various microcontroller units (MCUs)Debug and test cross-platform code with LinuxImplement an infotainment system using a Linux-based single board computerExtend an existing embedded system with a Qt-based GUICommunicate with the FPGA side of a hybrid FPGA/SoC systemWho this book is for If you want to start developing effective embedded programs in C++, then this book is for you. Good knowledge of C++ language constructs is required to understand the topics covered in the book. No knowledge of embedded systems is assumed.

The Linux Development Platform

Industrial machines, automobiles, airplanes, robots, and machines are among the myriad possible hosts of embedded systems. The author researches robotic vehicles and remote operated vehicles (ROVs), especially Underwater Robotic Vehicles (URVs), used for a wide range of applications such as exploring oceans, monitoring environments, and supporting operations in extreme environments.

Hands-On Embedded Programming with C++17

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 Mechatronics System Design for Uncertain Environments

Embedded Android is for Developers wanting to create embedded systems based on Android and for those wanting to port Android to new hardware, or creating a custom development environment. Hackers and moders will also find this an indispensible guide to how Android works.

Programming Embedded Systems

In-depth instruction and practical techniques for building with the BeagleBone embedded Linux platform Exploring BeagleBone is a hands-on guide to bringing gadgets, gizmos, and robots to life using the popular BeagleBone embedded Linux platform. Comprehensive content and deep detail provide more than just a BeagleBone instruction manual—you'll also learn the underlying engineering techniques that will allow you to create your own projects. The book begins with a foundational primer on essential skills, and then gradually moves into communication, control, and advanced applications using C/C++, allowing you to learn at your own pace. In addition, the book's companion website features instructional videos, source code, discussion forums, and more, to ensure that you have everything you need. The BeagleBone's small size, high performance, low cost, and extreme adaptability have made it a favorite development platform, and the Linux software base allows for complex yet flexible functionality. The BeagleBone has applications in smart buildings, robot control, environmental sensing, to name a few; and, expansion boards and peripherals dramatically increase the possibilities. Exploring BeagleBone provides a reader-friendly guide to the device, including a crash course in computer engineering. While following step by step, you can: Get up to speed on embedded Linux, electronics, and programming Master interfacing electronic circuits, buses and modules, with practical examples Explore the Internet-connected BeagleBone and the BeagleBone with a display Apply the BeagleBone to sensing applications, including video and sound Explore the BeagleBone's Programmable Real-Time Controllers Hands-on learning helps ensure that your new skills stay with you, allowing you to design with electronics, modules, or peripherals even beyond the BeagleBone. Insightful guidance and online peer support help you transition from beginner to expert as you master the techniques

presented in Exploring BeagleBone, the practical handbook for the popular computing platform.

Embedded Android

Build reliable real-time embedded systems with FreeRTOS using practical techniques, professional tools, and industry-ready design practices Key Features Get up and running with the fundamentals of RTOS and apply them on STM32 Develop FreeRTOS-based applications with real-world timing and task handling Use advanced debugging and performance analysis tools to optimize applications Book DescriptionA real-time operating system (RTOS) is used to develop systems that respond to events within strict timelines. Real-time embedded systems have applications in various industries, from automotive and aerospace through to laboratory test equipment and consumer electronics. These systems provide consistent and reliable timing and are designed to run without intervention for years. This microcontrollers book starts by introducing you to the concept of RTOS and compares some other alternative methods for achieving real-time performance. Once you've understood the fundamentals, such as tasks, queues, mutexes, and semaphores, you'll learn what to look for when selecting a microcontroller and development environment. By working through examples that use an STM32F7 Nucleo board, the STM32CubeIDE, and SEGGER debug tools, including SEGGER J-Link, Ozone, and SystemView, you'll gain an understanding of preemptive scheduling policies and task communication. The book will then help you develop highly efficient low-level drivers and analyze their real-time performance and CPU utilization. Finally, you'll cover tips for troubleshooting and be able to take your new-found skills to the next level. By the end, you'll have built on your embedded system skills and will be able to create real-time systems using microcontrollers and FreeRTOS.What you will learn Understand when to use an RTOS for a project Explore RTOS concepts such as tasks, mutexes, semaphores, and queues Discover different microcontroller units (MCUs) and choose the best one for your project Evaluate and select the best IDE and middleware stack for your project Use professional-grade tools for analyzing and debugging your application Get FreeRTOS-based applications up and running on an STM32 board Who this book is for This book is for embedded engineers, students, or anyone interested in learning the complete RTOS feature set with embedded devices. A basic understanding of the C programming language and embedded systems or microcontrollers will be helpful.

Exploring BeagleBone

Expand Raspberry Pi capabilities with fundamental engineering principles Exploring Raspberry Pi is the innovators guide to bringing Raspberry Pi to life. This book favors engineering principles over a 'recipe' approach to give you the skills you need to design and build your own projects. You'll understand the fundamental principles in a way that transfers to any type of electronics, electronic modules, or external peripherals, using a \"learning by doing\" approach that caters to both beginners and experts. The book begins with basic Linux and programming skills, and helps you stock your inventory with common parts and supplies. Next, you'll learn how to make parts work together to achieve the goals of your project, no matter what type of components you use. The companion website provides a full repository that structures all of the code and scripts, along with links to video tutorials and supplementary content that takes you deeper into your project. The Raspberry Pi's most famous feature is its adaptability. It can be used for thousands of electronic applications, and using the Linux OS expands the functionality even more. This book helps you get the most from your Raspberry Pi, but it also gives you the fundamental engineering skills you need to incorporate any electronics into any project. Develop the Linux and programming skills you need to build basic applications Build your inventory of parts so you can always \"make it work\" Understand interfacing, controlling, and communicating with almost any component Explore advanced applications with video, audio, real-world interactions, and more Be free to adapt and create with Exploring Raspberry Pi.

Hands-On RTOS with Microcontrollers

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 contraints 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

Exploring Raspberry Pi

Freely available source code, with contributions from thousands of programmers around the world: this is the spirit of the software revolution known as Open Source. Open Source has grabbed the computer industry's attention. Netscape has opened the source code to Mozilla; IBM supports Apache; major database vendors haved ported their products to Linux. As enterprises realize the power of the open-source development model, Open Source is becoming a viable mainstream alternative to commercial software.Now in Open Sources, leaders of Open Source come together for the first time to discuss the new vision of the software industry they have created. The essays in this volume offer insight into how the Open Source movement works, why it succeeds, and where it is going.For programmers who have labored on open-source projects, Open Sources is the new gospel: a powerful vision from the movement's spiritual leaders. For businesses integrating open-source software into their enterprise, Open Sources reveals the mysteries of how open development builds better software, and how businesses can leverage freely available software for a competitive business advantage.The contributors here have been the leaders in the open-source arena: Brian Behlendorf (Apache) Kirk McKusick (Berkeley Unix) Tim O'Reilly (Publisher, O'Reilly & Associates) Bruce Perens (Debian Project, Open Source Initiative) Tom Paquin and Jim Hamerly (mozilla.org, Netscape) Eric Raymond (Open Source Initiative) Richard Stallman (GNU, Free Software Foundation, Emacs) Michael Tiemann (Cygnus Solutions) Linus Torvalds (Linux) Paul Vixie (Bind) Larry Wall (Perl) This book explains why the majority of the Internet's servers use open- source technologies for everything from the operating system to Web serving and email. Key technology products developed with open-source software have overtaken and surpassed the commercial efforts of billion dollar companies like Microsoft and IBM to dominate software markets. Learn the inside story of what led Netscape to decide to release its source code using the open-source mode. Learn how Cygnus Solutions builds the world's best compilers by sharing the source code. Learn why venture capitalists are eagerly watching Red Hat Software, a company that gives its key product -- Linux -- away.For the first time in print, this book presents the story of the open- source phenomenon told by the people who created this movement.Open Sources will bring you into the world of free software and show you the revolution.

Design Patterns for Embedded Systems in C

This is the first edition of 'The Engineering of Reliable Embedded Systems': it is released here largely for historical reasons. (Please consider purchasing 'ERES2' instead.) [The second edition will be available for purchase here from June 2017.]

Open Sources

Device drivers literally drive everything you're interested in--disks, monitors, keyboards, modems--everything outside the computer chip and memory. And writing device drivers is one of the few areas of programming for the Linux operating system that calls for unique, Linux-specific knowledge. For years now, programmers have relied on the classic Linux Device Drivers from O'Reilly to master this critical subject. Now in its third edition, this bestselling guide provides all the information you'll need to write drivers for a

wide range of devices.Over the years the book has helped countless programmers learn: how to support computer peripherals under the Linux operating system how to develop and write software for new hardware under Linux the basics of Linux operation even if they are not expecting to write a driver The new edition of Linux Device Drivers is better than ever. The book covers all the significant changes to Version 2.6 of the Linux kernel, which simplifies many activities, and contains subtle new features that can make a driver both more efficient and more flexible. Readers will find new chapters on important types of drivers not covered previously, such as consoles, USB drivers, and more.Best of all, you don't have to be a kernel hacker to understand and enjoy this book. All you need is an understanding of the C programming language and some background in Unix system calls. And for maximum ease-of-use, the book uses full-featured examples that you can compile and run without special hardware.Today Linux holds fast as the most rapidly growing segment of the computer market and continues to win over enthusiastic adherents in many application areas. With this increasing support, Linux is now absolutely mainstream, and viewed as a solid platform for embedded systems. If you're writing device drivers, you'll want this book. In fact, you'll wonder how drivers are ever written without it.

The Engineering of Reliable Embedded Systems (LPC1769)

Learn how to write high-quality kernel module code, solve common Linux kernel programming issues, and understand the fundamentals of Linux kernel internals Key Features Discover how to write kernel code using the Loadable Kernel Module framework Explore industry-grade techniques to perform efficient memory allocation and data synchronization within the kernel Understand the essentials of key internals topics such as kernel architecture, memory management, CPU scheduling, and kernel synchronization Book DescriptionLinux Kernel Programming is a comprehensive introduction for those new to Linux kernel and module development. This easy-to-follow guide will have you up and running with writing kernel code in next-to-no time. This book uses the latest 5.4 Long-Term Support (LTS) Linux kernel, which will be maintained from November 2019 through to December 2025. By working with the 5.4 LTS kernel throughout the book, you can be confident that your knowledge will continue to be valid for years to come. You'll start the journey by learning how to build the kernel from the source. Next, you'll write your first kernel module using the powerful Loadable Kernel Module (LKM) framework. The following chapters will cover key kernel internals topics including Linux kernel architecture, memory management, and CPU scheduling. During the course of this book, you'll delve into the fairly complex topic of concurrency within the kernel, understand the issues it can cause, and learn how they can be addressed with various locking technologies (mutexes, spinlocks, atomic, and refcount operators). You'll also benefit from more advanced material on cache effects, a primer on lock-free techniques within the kernel, deadlock avoidance (with lockdep), and kernel lock debugging techniques. By the end of this kernel book, you'll have a detailed understanding of the fundamentals of writing Linux kernel module code for real-world projects and products.What you will learn Write high-quality modular kernel code (LKM framework) for 5.x kernels Configure and build a kernel from source Explore the Linux kernel architecture Get to grips with key internals regarding memory management within the kernel Understand and work with various dynamic kernel memory alloc/dealloc APIs Discover key internals aspects regarding CPU scheduling within the kernel Gain an understanding of kernel concurrency issues Find out how to work with key kernel synchronization primitives Who this book is for This book is for Linux programmers beginning to find their way with Linux kernel development. If you're a Linux kernel and driver developer looking to overcome frequent and common kernel development issues, or understand kernel intervals, you'll find plenty of useful information. You'll need a solid foundation of Linux CLI and C programming before you can jump in.

Linux Device Drivers

Develop Linux device drivers from scratch, with hands-on guidance focused on embedded systems, covering key subsystems like I2C, SPI, GPIO, IRQ, and DMA for real-world hardware integration using kernel 4.13 Key Features Develop custom drivers for I2C, SPI, GPIO, RTC, and input devices using modern Linux kernel APIs Learn memory management, IRQ handling, DMA, and the device tree through hands on

examples Explore embedded driver development with platform drivers, regmap, and IIO frameworks Book DescriptionLinux kernel is a complex, portable, modular and widely used piece of software, running on around 80% of servers and embedded systems in more than half of devices throughout the World. Device drivers play a critical role in how well a Linux system performs. As Linux has turned out to be one of the most popular operating systems used, the interest in developing proprietary device drivers is also increasing steadily. This book will initially help you understand the basics of drivers as well as prepare for the long journey through the Linux Kernel. This book then covers drivers development based on various Linux subsystems such as memory management, PWM, RTC, IIO, IRQ management, and so on. The book also offers a practical approach on direct memory access and network device drivers. By the end of this book, you will be comfortable with the concept of device driver development and will be in a position to write any device driver from scratch using the latest kernel version (v4.13 at the time of writing this book).What you will learn Use kernel facilities to develop powerful drivers Develop drivers for widely used I2C and SPI devices and use the regmap API Write and support devicetree from within your drivers Program advanced drivers for network and frame buffer devices Delve into the Linux irqdomain API and write interrupt controller drivers Enhance your skills with regulator and PWM frameworks Develop measurement system drivers with IIO framework Get the best from memory management and the DMA subsystem Access and manage GPIO subsystems and develop GPIO controller drivers Who this book is for This book is ideal for embedded systems developers, engineers, and Linux enthusiasts who want to learn how to write device drivers from scratch. Whether you're new to kernel development or looking to deepen your understanding of subsystems like I2C, SPI, and IRQs, this book provides practical, real-world instructions tailored for working with embedded Linux platforms. Foundational knowledge of C and basic Linux concepts is recommended.

Linux Kernel Programming

The book starts with the basics, explaining how to compile and run your first program. First, each concept is explained to give you a solid understanding of the material. Practical examples are then presented, so you see how to apply the knowledge in real applications.

Linux Device Drivers Development

The MSP430 microcontroller family offers ultra-low power mixed signal, 16-bit architecture that is perfect for wireless low-power industrial and portable medical applications. This book begins with an overview of embedded systems and microcontrollers followed by a comprehensive in-depth look at the MSP430. The coverage included a tour of the microcontroller's architecture and functionality along with a review of the development environment. Start using the MSP430 armed with a complete understanding of the microcontroller and what you need to get the microcontroller up and running! - Details C and assembly language for the MSP430 - Companion Web site contains a development kit - Full coverage is given to the MSP430 instruction set, and sigma-delta analog-digital converters and timers

Beginning Linux?Programming

With a mixture of theory, examples, and well-integrated figures, Embedded Software for the IoT helps the reader understand the details in the technologies behind the devices used in the Internet of Things. It provides an overview of IoT, parameters of designing an embedded system, and good practice concerning code, version control and defect-tracking needed to build and maintain a connected embedded system. After presenting a discussion on the history of the internet and the word wide web the book introduces modern CPUs and operating systems. The author then delves into an in-depth view of core IoT domains including: Wired and wireless networking Digital filters Security in embedded and networked systems Statistical Process Control for Industry 4.0 This book will benefit software developers moving into the embedded realm as well as developers already working with embedded systems.

MSP430 Microcontroller Basics

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.

Embedded Software for the IoT

To thoroughly understand what makes Linux tick and why it's so efficient, you need to delve deep into the heart of the operating system--into the Linux kernel itself. The kernel is Linux--in the case of the Linux operating system, it's the only bit of software to which the term \"Linux\" applies. The kernel handles all the requests or completed I/O operations and determines which programs will share its processing time, and in what order. Responsible for the sophisticated memory management of the whole system, the Linux kernel is the force behind the legendary Linux efficiency. The new edition of Understanding the Linux Kernel takes you on a guided tour through the most significant data structures, many algorithms, and programming tricks used in the kernel. Probing beyond the superficial features, the authors offer valuable insights to people who want to know how things really work inside their machine. Relevant segments of code are dissected and discussed line by line. The book covers more than just the functioning of the code, it explains the theoretical underpinnings for why Linux does things the way it does. The new edition of the book has been updated to cover version 2.4 of the kernel, which is quite different from version 2.2: the virtual memory system is entirely new, support for multiprocessor systems is improved, and whole new classes of hardware devices have been added. The authors explore each new feature in detail. Other topics in the book include: Memory management including file buffering, process swapping, and Direct memory Access (DMA) The Virtual Filesystem and the Second Extended Filesystem Process creation and scheduling Signals, interrupts, and the essential interfaces to device drivers Timing Synchronization in the kernel Interprocess Communication (IPC) Program execution Understanding the Linux Kernel, Second Edition will acquaint you with all the inner workings of Linux, but is more than just an academic exercise. You'll learn what conditions bring out Linux's best performance, and you'll see how it meets the challenge of providing good system response during process scheduling, file access, and memory management in a wide variety of environments. If knowledge is power, then this book will help you make the most of your Linux system.

Embedded Systems: World Class Designs

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

Understanding the Linux Kernel

There are many books on project management and many on embedded systems, but few address the project management of embedded products from concept to production. Project Management of Complex and Embedded Systems: Ensuring Product Integrity and Program Quality uses proven Project Management methods and elements of IEEE embedded software develop

Embedded Linux: Hardware, Software, and Interfacing

Embedded Systems Architecture
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