Software Engineering For Embedded Systems Chapter 11 Optimizing Embedded Software For Performance

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Software Engineering for Embedded Systems Newnes
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.
Embedded Systems – A Hardware-Software Co-Design Approach Elsevier Inc. Chapters
Multicore software development is growing in importance and applicability in many areas of embedded systems from automotive to networking, to wireless base stations. This chapter is a summary of key sections of the recently released Multicore Programming Practices (MPP) from the Multicore Association (MCA). The MPP standardized “best practices” guide is written specifically for engineers and engineering managers of companies considering or implementing a development project involving multicore processors and favoring use of existing multicore technology. There is an important need to better understand how today’s C/C++ code may be written to be “multicore ready”, and this was accomplished under the influence of the MPP working group. The guide will enable you to (a) produce higher-performing software; (b) reduce the bug rate due to multicore software issues; (c) develop portable multicore code which can be targeted at multiple platforms; (d) reduce the multicore programming learning curve and speed up development time; and (e) tie into the current structure and roadmap of the Multicore Association’s API infrastructure.
Chapter 13. Optimizing Embedded Software for Power Elsevier Inc. Chapters
Build complex embedded systems faster and with lower costs by: * Knowing when and how much simulation testing is appropriate * Applying engineering methods to simulation design and development * Using the best tools available to develop simulations. * Va
With C and GNU Development Tools Elsevier Inc. Chapters
An embedded system is a computer system designed for a specific function within a larger system, and often has one or more real-time computing constraints. It is embedded as part of a larger device which can include hardware and mechanical parts. This is in stark contrast to a general-purpose computer, which is designed to be flexible and meet a wide range of end-user needs. The methods, techniques, and tools for developing software systems that were successfully applied to general purpose computing are not as readily applicable to embedded computing. Software systems running on networks of mobile, embedded devices must exhibit properties that are not always required of more traditional systems such as near-optimal performance, robustness, distribution, dynamism, and mobility. This chapter will examine the key properties of software systems in the embedded, resource-constrained, mobile, and highly distributed world. The applicability of mainstream software engineering methods is assessed and techniques (e.g., software design, component-based development, software architecture, system integration and test) are also discussed in the context of this domain. This chapter will overview embedded and real-time systems.
Build Better Embedded Systems Faster Elsevier Inc. Chapters
Embedded Software Development With C offers both an effectual reference for professionals and researchers, and a valuable learning tool for students by laying the groundwork for a solid foundation in the hardware and software aspects of embedded systems development. Key features include a resource for the fundamentals of embedded systems design and development with an emphasis on software, an exploration of the 8051 microcontroller as it pertains to embedded systems, comprehensive tutorial materials for instructors to provide students with labs of varying lengths and levels of difficulty, and supporting website including all sample codes, software tools and links to additional online references.
Software Engineering for Embedded Systems Elsevier Inc. Chapters
Creating a model for your embedded system provides a time- and cost-effective approach to the development of simple or incredibly complex dynamic control systems, all based on a single model maintained in a tightly integrated software suite. Using modern modeling software tools you can design and perform initial validation in off-line simulation. These models then form the basis for all subsequent development stages. Creating models for your embedded design provides numerous advantages over the traditional design approach. Using this approach – combined with hardware prototyping – you reduce the risk of mistakes and shorten the development cycle by performing verification and validation testing throughout the development instead of only during the final testing stage. Design evaluations and predictions can be made much more quickly and reliably with a system model as a basis. This iterative approach results in improved designs, in terms of both performance and reliability. The cost of resources is reduced, because of reusability of models between design teams, design stages, and various projects and the reduced dependency on physical prototypes. Development errors and overhead can be reduced through the use of automatic code-generation techniques. These advantages translate to more accurate and robust control designs, shorter time to market, and reduced design cost.
Programming Embedded Systems Elsevier Inc. Chapters
Offering comprehensive coverage of the convergence of real-time embedded systems scheduling, resource access control, software design and development, and high-level system modeling, analysis and verification Following an introductory overview, Dr. Wang delves into the specifics of hardware components, including processors, memory, I/O devices and architectures, communication structures, peripherals, and characteristics of real-time operating systems. Later chapters are dedicated to real-time task scheduling algorithms and resource access control policies, as well as priority-inversion control and deadlock avoidance. Concurrent system programming and POSIX programming for real-time systems are covered, as are finite state machines and Time Petri nets. Of special interest to software engineers will be the chapter devoted to model checking, in which the author discusses temporal logic and the NuSMV model checking tool, as well as a chapter treating real-time software design with UML. The final portion of the book explores practical issues of software reliability, aging, rejuvenation, security, safety, and power management. In

addition, the book: Explains real-time embedded software modeling and design with finite state machines, Petri nets, and UML, and real-time constraints verification with the model checking tool, NuSMV Features real-world examples in finite state machines, model checking, real-time system design with UML, and more Covers embedded computer programing, designing for reliability, and designing for safety Explains how to make engineering trade-offs of power use and performance Investigates practical issues concerning software reliability, aging, rejuvenation, security, and power management Real-Time Embedded Systems is a valuable resource for those responsible for real-time and embedded software design, development, and management. It is also an excellent textbook for graduate courses in computer engineering, computer science, information technology, and software engineering on embedded and real-time software systems, and for undergraduate computer and software engineering courses.

Chapter 24. Embedded Software for Networking Applications Elsevier Inc. Chapters

One of the most important considerations in the product life-cycle of an embedded project is to understand and optimize the power consumption of the device. Power consumption is highly visible for hand-held devices which require battery power to be able to guarantee certain minimum usage/idle times between recharging. Other main embedded applications, such as medical equipment, test, measurement, media, and wireless base stations, are very sensitive to power as well – due to the need to manage the heat dissipation of increasingly powerful processors, power supply cost, and energy consumption cost – so the fact is that power consumption cannot be overlooked. The responsibility for setting and keeping power requirements often falls on the shoulders of hardware designers, but the software programmer has the ability to provide a large contribution to power optimization. Often, the impact that the software engineer has on the power consumption of a device is overlooked or underestimated. The goal of this chapter is to discuss how software can be used to optimize power consumption, starting with the basics of what power consumption consists of, how to properly measure power consumption, and then moving on to techniques for minimizing power consumption in software at the algorithmic level, hardware level, and data-flow level. This will include demonstrations of the various techniques and explanations of both how and why certain methods are effective at reducing power so the reader can take and apply this work to their application immediately.

Software Engineering for Embedded Systems "O'Reilly Media, Inc."

This chapter provides information to successfully organize and manage any embedded software project or program. It introduces quality systems, the OSI model of architecting software into stacks, several software development models and ways in which teams may be organized, and overviews communications. Managing the constraints of scope, schedule, costs including resources, quality, and customer satisfaction fully addresses all the work and activities of any project or program. The natural progression of software development from its concept through its life-cycle until release is discussed. Tools are presented for successful planning and execution of resource management, risk management, problem solving, and the traceability of work extending from requirements to respective engineering responses to testing against those software specifications.

A Comprehensive Guide for Engineers and Programmers Mcgraw-hill

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.

Hardware-Software Co-Design of Embedded Systems Elsevier Inc. Chapters

When planning the development of modern embedded systems, hardware and software cannot be considered independently. Over the last two decades chip and system complexity has seen an enormous amount of growth, while more and more system functionality has moved from dedicated hardware implementation into software executing on general-purposed embedded processors. By 2010 the development effort for software had outgrown the development efforts for hardware, and the complexity trend continues in favor of software. Traditional design techniques such as independent hardware and software design are being challenged due to heterogeneous models and applications being integrated to create a complex system on chip. Using proper techniques of hardware-software codesign, designers consider the trade-offs in the way hardware and software components of a system work together to exhibit a specified behavior, given a set of performance goals and technology. This chapter will cover these topics.

Software Engineering for Embedded Systems Elsevier Inc. Chapters

In this chapter, we cover the aspects of developing safety-critical software. The first part of the chapter covers project planning, and the crucial steps that are needed to scope the effort and getting started. It offers insights into managing safety-critical requirements and how to meet them during the development. Key strategies for project management are also provided. The second part of the chapter goes through an analysis of faults, failures, and hazards. It includes a description of risk analysis. The next part of the chapter covers a few safety-critical architectures that could be used for an embedded system. The final part of the chapter covers software implementation guidelines for safety-critical software development.

Chapter 1. Software Engineering of Embedded and Real-Time Systems Cambridge University Press

Code optimization is a critical step in the development process as it directly impacts the ability of the system to do its intended job. Code that executes faster means more channels, more work performed and competitive advantage. Code that executes in less memory enables more application features to fit into the cell phone. Code that executes with less overall power consumption increases battery life or reduces money spent on powering a base station. This chapter is intended to help programmers write the most efficient code possible, whether that is measured in processor cycles, memory, or power. It starts with an introduction to using the tool chain, covers the importance of knowing the embedded architecture before optimization, then moves on to cover a wide range of optimization techniques. Techniques are presented which are valid on all programmable architectures – C-language optimization techniques and general loop transformations. Real-world examples are presented throughout.

Chapter 8. Embedded Operating Systems Elsevier Inc. Chapters

Embedded systems often have one or more real-time requirements. The complexity of modern embedded software systems requires a systematic approach for achieving these performance targets. An ad hoc process can lead to missed deadlines, poorly performing systems and cancelled projects. There is a maturity required to define, manage, and deliver on multiple real-time performance requirements. Software performance engineering (SPE) is a discipline within the broader systems engineering area that can improve the maturity of the performance engineering process. SPE is a systematic, quantitative approach to constructing software systems that meet performance objectives. SPE is a software-oriented approach; it focuses on architecture, design, and implementation choices. It focuses on the activities, techniques, and deliverables that are applied at every phase of the embedded software development life-cycle, especially responsiveness and scalability, to ensure software is being architected and implemented to meet the performance-related requirements of the system.

Chapter 18. Safety-Critical Software Development Elsevier Inc. Chapters

Agile software development is a set of software development techniques based on iterative development. Requirements and software systems evolve through collaboration between self-organizing, cross-functional teams. Agile development supports adaptive planning, evolutionary development and delivery, and a time-boxed iterative approach. The goal of agile is rapid and flexible response to change. Agile is a conceptual framework which promotes interactions throughout the development cycle. Applying agile to embedded software projects introduces some unique challenges, such as more difficulty effectively testing evolving software features, because the corresponding hardware may not be available in time, less freedom to make changes, due to the fact that the corresponding hardware change may have an unacceptably high cost, and less ability for “learn as you go” approaches, considering the hardware construction may demand a more upfront style of planning and design. This chapter will introduce agile software development and show how to apply these techniques to an embedded system.

Software Engineering for Embedded Systems Elsevier Inc. Chapters

Optimization metrics for compiled code are not always measured in resulting execution clock cycles on the target architecture. Consider a modern cellular telephone or wireless device which may download executables over a wireless network connection or backhaul infrastructure. In such cases, it is often advantageous for the compiler to reduce the size of the compiled code which must be downloaded to the wireless device. By reducing the size of the code needed to be downloaded, savings are achieved in terms of bandwidth required for each wireless point of download. Optimization metrics such as the memory system performance of compiled code are other metrics which are often important to developers. These are metrics correlated to the dynamic run-time behavior of not only the compiled code on the target processor, but also the underlying memory system, caches, DRAM and buses, etc. By efficiently arranging the data within the application or, more specifically, the order in which data and corresponding data structures are accessed by the application dynamically at run-time, significant performance improvements can be gained at the memory-system level. In addition, vectorizing compilers can also improve performance due to spatial locality of data when SIMD instruction sets are present and varying memory-system alignment conditions are met.

Chapter 20. Managing Embedded Software Development CRC Press

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.

Software Engineering for Embedded Systems Springer Science & Business Media

Software Engineering for Embedded Systems: Methods, Practical Techniques, and Applications, Second Edition provides the techniques and technologies in software engineering to optimally design and implement an embedded system. Written by experts with a solution focus, this encyclopedic reference gives an indispensable aid on how to tackle the day-to-day problems encountered when using software engineering methods to develop embedded systems. New sections cover peripheral programming, Internet of things, security and cryptography, networking and packet processing, and hands on labs. Users will learn about the principles of good architecture for an embedded system, design practices, details on principles, and much more. Provides a roadmap of key problems/issues and references to their solution in the text Reviews core methods and how to apply them Contains examples that demonstrate timeless implementation details Users case studies to show how key ideas can be implemented, the rationale for choices made, and design guidelines and trade-offs

Software Engineering for Embedded Systems "O'Reilly Media, Inc."

This chapter provides some guidelines that are commonly used in embedded software development. It starts with principles of programming, including readability, testability, and maintainability. The chapter then proceeds with discussing how to start an embedded software project, including considerations for hardware, file organization, and development guidelines. The focus then shifts to programming guidelines that are important to any software development project, which includes the importance of a syntax coding standard. The chapter concludes with descriptions of variables and definitions and how they are typically used in an embedded software project.

Chapter 15. Embedded Software Quality, Integration and Testing Techniques 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 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