Book Reviews

Embedded systems and the kitchen sink

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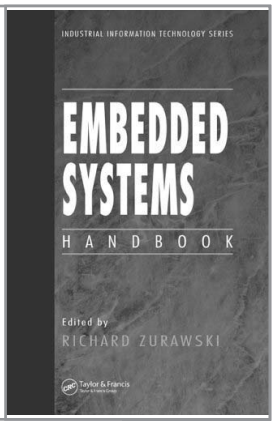
Reviewed in this issue

Embedded Systems Handbook, edited by Richard Zurawski (CRC Press, 2005, ISBN 0-84-932824-1, 1160 pp., $139.95).



Are embedded systems small systems based on Intel 8051 microcontrollers attached to wireless sensors? Are they complex networks of 32-bit processors connected through high-bandwidth interconnects? Are they board-level constructs with many discrete components together on one board? Are they backplane systems with multiple standard boards working together to get the job done? Are they SoCs with multiple processors and peripherals tucked away inside one piece of packaging? Are they deployed in circumstances where a fault can literally mean life or death? Are they deployed in casual circumstances where a fault is quietly and safely ignored? Are they interrupt-driven systems responding to frequent and unpredictable events from the outside world? Are they predictable computation systems handling regular data delivery and processing? The answer to all of these questions is yes.

Are embedded systems a weighty topic? At 4 pounds, 13 ounces, 46 chapters, and 1,160 pages, Richard Zurawski's *Embedded Systems Handbook* suggests that the answer here is also yes. But on a more serious note, there is no denying that *ESH* is a large book; truly, the breadth and depth of the topic requires such a tome to adequately cover it. The challenge for the editor of such a book is clear: Can the editorial focus be both broad and consistent enough to cover the topic well? Exploring that question requires exploring the structure and content of *ESH*.

ESH has six sections, covering everything from basic theory and background to different types of computation platforms, interconnects, and target application domains. Many of the sections have dramatically different quantities of content. For example, the Networked Embedded Systems section contains only two chapters. The first chapter defines networked embedded systems and a semantic framework for discussing them. It goes on to cover common trade-offs in the design of networked embedded systems and tools useful in crafting such systems. The second chapter of the section delves into the evaluation and use of middleware abstraction layers to ease the creation of networked embedded systems.

In contrast to Networked Embedded Systems, the Embedded Systems section contains 17 chapters divided into seven subsections. It covers topics ranging from the basics of real-time operating systems to more modern design methodologies, such as the Unified Modeling Language.

Though of dramatically different lengths, these two sections share commonalities that illustrate one of the many strengths of *ESH*. Each section of *ESH* lays out both the core principles and fundamental wisdom of the section topic, as well as discussing areas of recent innovation. The book takes you from the accepted and the well-understood to the recent and the novel—providing both a solid grounding in the topic and an understanding of the current state of the art.

Other sections in *ESH* cover SoC design, the testing of embedded-core-based ICs, sensor networks, and embedded applications.

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SoC design offers increased integration with lower power and part count, and higher performance for end solutions. Because of these advantages, it has been appearing in embedded products, and *ESH* does a reasonable job of explaining the issues surrounding SoC design as they apply to embedded systems. The chapters in the System-on-Chip Design section cover such topics as application-specific microprocessors and instruction set design, on-chip network design, and various methodologies and design approaches to streamlining the SoC design process.

The embedded systems and EDA disciplines stand cheek by jowl: EDA provides the platforms upon which designers construct embedded systems. The Testing of Embedded-Core-Based Integrated Circuits is the section in *ESH* perhaps furthest from embedded systems and closest to EDA. Whereas the System-on-Chip Design section predominantly focuses on issues existing at the architectural level—and therefore of great relevance to the embedded-systems designer—this short section seems more generically targeted at the testing challenges facing the silicon industry today. It is unclear why the book includes this particular topic when the challenges of testing silicon have their own practitioners and craft. Regardless, the ideas that these two chapters present make a compelling case that the use of processors on SoCs will be key to solving the problem of silicon testing—and perhaps the point is to show that it is a new application area for embedded systems.

The rise of low-power wireless networking creates a whole new class of applications for embedded systems and a whole new set of problems as these wireless networks communicate between remote battery-driven sensors and consumers of sensor data. Although these remote sensors have many of the challenges of traditional embedded systems, they also bring many new challenges. *ESH*'s Sensor Networks section directly addresses this new embedded venue, starting with discussions of the coming trend and a catalog of the challenges and possible solutions, and then moving into specific issues unique to this new application space.

The book closes with the Embedded Applications section, covering an eclectic group of applications for embedded systems. It covers the traditional automotive and industrial applications as well as the newer topic of intelligent sensors. The industrial chapters focus almost exclusively on the use of embedded Web servers, whereas the automotive chapters discuss topics ranging from the embedded landscape inside a car to methods and techniques for automotive design and verification.

ZURAWSKI HAS DONE A GOOD JOB given the scope of the topic *ESH* addresses. The book broadly covers embedded systems and also delves deeply into specific new areas of interest. Although some readers might disagree with the book's editorial focus and selection here and there, *ESH* will indisputably be valuable to many different readers. A reader new to embedded systems but grounded in software and computer architecture would have a broad and solid understanding of embedded systems after finishing the book. A seasoned embedded-systems technologist will gain an understanding of new application areas and new ways of addressing old problems more efficiently. *ESH* is a valuable tool offering something to almost everyone in the field. ■

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