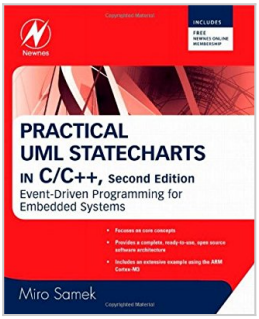

Practical UML Statecharts in C/C++: Event-Driven Programming for Embedded Systems

By Miro Samek

Practical UML Statecharts in C/C++: Event-Driven Programming for Embedded Systems By Miro Samek

Practical UML Statecharts in C/C++ Second Edition bridges the gap between high-level abstract concepts of the Unified Modeling Language (UML) and the actual programming aspects of modern hierarchical state machines (UML statecharts). The book describes a lightweight, open source, active object (actor) framework, called QP that enables direct manual coding UML statecharts and concurrent event-driven applications in C or C++.

This book is presented in two parts. In Part I, you get a practical description of the relevant state machine concepts starting from traditional finite state automata to modern UML state machines followed by state machine coding techniques and state-machine design patterns, all illustrated with executable examples. In Part II, you find a detailed design study of a generic real-time framework indispensable for combining concurrent, event-driven state machines into robust applications. Part II begins with a clear explanation of the key event-driven programming concepts such as inversion of control (”Hollywood Principle”), blocking versus non-blocking code, run-to-completion (RTC) execution semantics, the importance of event queues, dealing with time, and the role of state machines to maintain the context from one event to the next. This background is designed to help software developers in making the transition from the traditional sequential to the modern event-driven programming, which can be one of the trickiest paradigm shifts.

The lightweight QP active object framework goes several steps beyond the traditional real-time operating system (RTOS). In the simplest configuration, QP runs on bare-metal microcontroller completely replacing the RTOS. QP can also work with almost any OS/RTOS to take advantage of the existing device drivers, communication stacks, and other middleware.

The accompanying website to this book (state-machine.com/psicc2) contains complete open source code for QP and the **free QM graphical modeling tool** for QP, ports to popular processors, including ARM Cortex-M, ARM7/9, MSP430, AVR/AVR32, PIC24, RX, etc., as well as QP ports to operating systems, such as Linux, Windows, and Android.

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Editorial Review

Review
"*This book and the free QP download are your entry into the 21st century of embedded systems programming.*"
— **Rob Wehrli** (Knoxville, TN), Amazon.com review

"*It is rare to find an author who is so strong theoretically, while paying such close attention to implementation details like microcontroller resource conservation.*"
-- **Robert Jones** (MI USA), Amazon.com review

"*This book took me from being a C programming novice, to writing 1000s of lines of embedded control systems code, that has been running reliably for several years, with just one bug - my own!*"
— **Haitham Hindi "H.H."** (Palo Alto, CA), Amazon.com review

From the Author
You can't just look at state machines and the event-driven active object framework as a collection of features, because some of the features will make no sense in isolation. You can only use these powerful concepts effectively if you are thinking about incremental, iterative design, not simply coding. And to understand state machines that way, you must understand the problems with programming event-driven systems in general.

This book discusses problems inherent in reactive systems, why they are problems, and how state machines and active object computing model can help. Thus, I begin most chapters with the programming problems the chapter will address. In this way, I hope to move you, a little at a time, to the point where active objects and hierarchical state machines become a much more natural way of solving the problems than the traditional approaches such as deeply nested IFs and ELSEs for coding stateful behavior or using blocking calls, such as semaphores or time delays to signal events in a traditional RTOS.

When you start using the techniques described in this book, your problems will change. You will no longer struggle with 15 levels of convoluted IF-ELSE statements, and you will stop worrying about semaphores or other such low-level RTOS mechanisms. Instead, you'll start thinking at a *higher level of abstraction* about state machines, events, and active objects. After you experience this quantum leap you will find, as I did, that programming can be much **more fun**.

About the Author
Dr. Miro Samek is the founder of Quantum Leaps (state-machine.com), an open source company providing lightweight active object (actor) frameworks for microcontrollers. His practical books about UML state machines and event-driven active object (actor) frameworks for embedded systems are among the most popular on the market. Miro has also published dozens of technical articles, including a column for C/C++ Users Journal, as well as numerous articles for Embedded Systems Design and Dr. Dobb's Journal. He is a regular speaker at the Embedded Systems Conferences, and serves on the editorial review board of the Embedded Systems Design magazine. His extensive industry experience ranges from safety-critical software development at GE Medical Systems through hard real-time embedded software design at two Silicon Valley companies specializing in GPS technologies. Software he wrote continues to power millions of products. Dr.

Samek earned his Ph.D. in nuclear physics at GSI (Darmstadt, Germany).

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