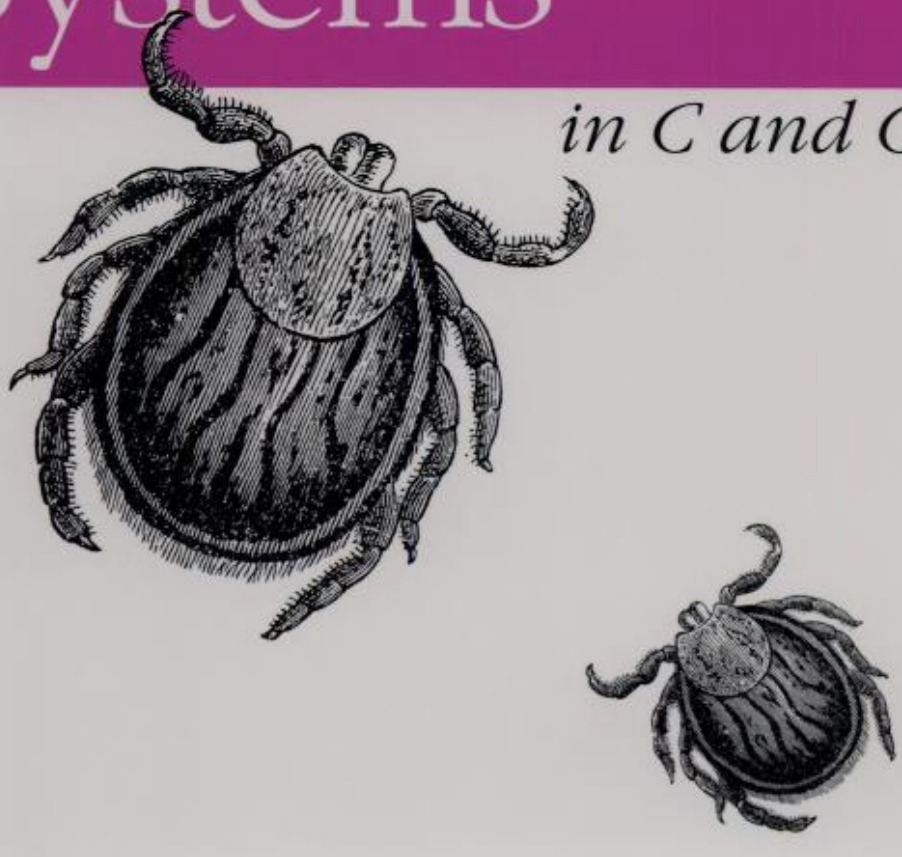
Thinking Inside the Box

Programming Embedded Systems

in C and C++



O'REILLY®

Michael Barr

Programming Embedded Systems in C and C++
by Michael Barr

Published by O'Reilly & Associates, Inc., 101 Morris Street, Sebastopol, CA 95472.

Editor: Andy Oram

Production Editor: Melanie Wang

Printing History:

January 1999: First Edition.

ISBN: 1-56592-354-5 [1/01]
[M]

evolutionary path. The most obvious example is Intel's 80x86 family, which spans from the original 8086 to the Pentium II—and beyond. In fact, the 80x86 family has been so successful that it has spawned an entire industry of imitators.

As it is used in this book, the term *processor* refers to any of three types of devices known as microprocessors, microcontrollers, and digital signal processors. The name microprocessor is usually reserved for a chip that contains a powerful CPU that has not been designed with any particular computation in mind. These chips are usually the foundation of personal computers and high-end workstations. The most common microprocessors are members of Motorola's 68k—found in older Macintosh computers—and the ubiquitous 80x86 families.

A microcontroller is very much like a microprocessor, except that it has been designed specifically for use in embedded systems. Microcontrollers typically include a CPU, memory (a small amount of RAM, ROM, or both), and other peripherals in the same integrated circuit. If you purchase all of these items on a single chip, it is possible to reduce the cost of an embedded system substantially. Among the most popular microcontrollers are the 8051 and its many imitators and Motorola's 68HCxx series. It is also common to find microcontroller versions of popular microprocessors. For example, Intel's 386EX is a microcontroller version of the very successful 80386 microprocessor.

The final type of processor is a digital signal processor, or DSP. The CPU within a DSP is specially designed to perform discrete-time signal processing calculations—like those required for audio and video communications—extremely fast. Because DSPs can perform these types of calculations much faster than other processors, they offer a powerful, low-cost microprocessor alternative for designers of modems and other telecommunications and multimedia equipment. Two of the most common DSP families are the TMS320Cxx and 5600x series from TI and Motorola, respectively.

Intel's 80188EB Processor

The processor on the Arcom board is an Intel 80188EB—a microcontroller version of the 80186. In addition to the CPU, the 80188EB contains an interrupt control unit, two programmable I/O ports, three timer/counters, two serial ports, a DRAM controller, and a chip-select unit. These extra hardware devices are located within the same chip and are referred to as on-chip peripherals. The CPU is able to communicate with and control the on-chip peripherals directly, via internal buses.

Although the on-chip peripherals are distinct hardware devices, they act like little extensions of the 80186 CPU. The software can control them by reading and writing a 256-byte block of registers known as the peripheral control block (PCB). You may recall that we encountered this block when we first discussed the memory and I/O maps for the board. By default the PCB is located in the I/O space,