Microprocessor Theory
and Applications with
68000/68020 and Pentium

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To my wife, Kusum; my son, Tito; and my brother, Elan
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Microprocessors play an important role in the design of digital systems. They are found in a wide range of applications, such as process control and communication systems.

This book is written to present the fundamental concepts of assembly language programming and system design concepts associated with typical microprocessors, such as the Motorola 68000/68020 and Intel Pentium. The 68000 is a 16-bit microprocessor that continues to be popular. Since the 68000 uses linear memory and contains 32-bit general-purpose registers, it is an excellent educational tool for acquiring an understanding of both hardware and software aspects of typical microprocessors.

Conventional microprocessors such as the 68000 complete fetch, decode and execute cycles of an instruction in sequence. Typical 32-bit microprocessors such as the 68020 and Pentium use pipelining, in which instruction fetch and execute cycles are overlapped. This speeds up the instruction execution time of 32-bit microprocessors. Pipelining was used for many years in mainframe and minicomputer CPUs. In addition, other mainframe features, such as memory management and floating-point and cache memory, are implemented in 32-bit microprocessors. Hence, brief coverage of these topics is provided in the first part of the book.

The book is self-contained and includes a number of basic topics. A basic digital logic background is assumed. Characteristics and principles common to typical microprocessors are emphasized and basic microcomputer interfacing techniques are demonstrated via examples using the simplest possible devices, such as switches, LEDs, A/D converters, the hexadecimal keyboard, and seven-segment displays.

The book has evolved from classroom notes developed for three microprocessor courses taught at the Electrical and Computer Engineering Department, California State Poly University, Pomona for the last several years: ECE 343 (Microprocessor I), ECE 432 (Microprocessor II), and ECE 561 (Advanced Microprocessors).

The text is divided into 12 chapters. In Chapter 1, we provide a review of terminology, number systems, evolution of microprocessors, system design concepts and typical microprocessor applications.

Chapters 2 through 12 form the nucleus of the book. Chapter 2 covers typical microcomputer architectures for both 16-bit (conventional) and 32-bit microprocessors. The concepts of pipelining, superscalar processors and RISC vs. CISC are included.