CHAPTER 1

THE 8051 MICROCONTROLLERS
Microcontroller vs. General-Purpose Microprocessor

- General-purpose microprocessors have
  - No RAM
  - No ROM
  - No I/O ports

- Microcontrollers have
  - CPU (microprocessor)
  - RAM
  - ROM
  - I/O ports
Microcontroller vs. General-Purpose Microprocessor (cont.)

- Timer
- ADC and other peripherals

Figure 1-1. Microprocessor System Contrasted With Microcontroller System
Microcontroller vs. General-Purpose Microprocessor (cont.)

- General-purpose microprocessors
  - Must add RAM, ROM, I/O ports, and timers externally to make them functional
  - Make the system bulkier and much more expensive
  - Have the advantage of versatility on the amount of RAM, ROM, and I/O ports
Microcontroller vs. General-Purpose Microprocessor (cont.)

- Microcontroller
  - The fixed amount of on-chip ROM, RAM, and number of I/O ports makes them ideal for many applications in which cost and space are critical.
  - In many applications, the space it takes, the power it consumes, and the price per unit are much more critical considerations than the computing power.
Microcontrollers for Embedded Systems

- An embedded product uses a microprocessor (or microcontroller) to do one task and one task only
  - There is only one application software that is typically burned into ROM
- A PC can be used for any number of applications
  - It has RAM memory and an operating system that loads a variety of applications into RAM and lets the CPU run them
Microcontrollers for Embedded Systems (cont.)

- A PC contains or is connected to various embedded products
  - Each one peripheral has a microcontroller inside it that performs only one task

- Home
  - Appliances, telephones, security systems, TVs, video games, cellular phones, camera,

- Office
  - Telephones, computers, fax, laser printer
Very often the terms embedded processor and microcontroller are used interchangeably.

One of the most critical needs of an embedded system is to decrease power consumption and space:
- The trend is to integrate more functions on the CPU chip and let designer decide which features he/she wants to use.
Criteria for Choosing a Microcontroller

- Meeting the computing needs of the task at hand efficiently and cost effectively
  - Speed, Packaging, Power consumption
  - The amount of RAM and ROM on chip
  - The number of I/O pins and the timers on chip
  - How easy to upgrade to higher performance or lower power-consumption versions
  - Cost per unit
Criteria for Choosing a Microcontroller (cont.)

- Availability of software development tools, such as compilers, assemblers, and debuggers
- Wide availability and reliable sources of the microcontroller
  - The 8051 family has the largest number of diversified (multiple source) suppliers
    - Intel (original), Atmel, Philips/Signetics, AMD, Infineon (formerly Siemens), Matra, Dallas Semiconductor/Maxim
8051 Microcontroller

Intel introduced 8051, referred as MCS-51, in 1981

- The 8051 is an 8-bit processor
- The CPU can work on only 8 bits of data at a time

The 8051 had:
- 128 bytes of RAM, 4K bytes of on-chip ROM
- One serial port, four I/O ports (8 bits wide)
- Two timers, 6 interrupt sources
8051 Microcontroller (cont.)

- The 8051 became widely popular after allowing other manufactures to make and market any flavor of the 8051
  - Remaining code-compatible

<table>
<thead>
<tr>
<th>Table 1-3: Features of the 8051</th>
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<tr>
<td>Feature</td>
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<tr>
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<tr>
<td>ROM</td>
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<tr>
<td>RAM</td>
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<tr>
<td>Timer</td>
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<tr>
<td>I/O pins</td>
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<tr>
<td>Serial port</td>
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<tr>
<td>Interrupt sources</td>
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*Note: ROM amount indicates on-chip program space.*
Figure 1-2. Inside the 8051 Microcontroller Block Diagram
**8051 Family**

- The 8051 is a subset of the 8052
- The 8031 is a ROM-less 8051
  - Add external ROM to it
    - You lose two ports,
    - One for the address bus, the other for the data bus
  - Leave only 2 ports for I/O operations

<table>
<thead>
<tr>
<th>Table 1-4: Comparison of 8051 Family Members</th>
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<tbody>
<tr>
<td><strong>Feature</strong></td>
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<td>-------------------------------</td>
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<tr>
<td>ROM (on-chip program space in bytes)</td>
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<tr>
<td>RAM (bytes)</td>
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<tr>
<td>Timers</td>
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<tr>
<td>I/O pins</td>
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<td>Serial port</td>
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