Embedded System Classification and Features

Classification of Embedded System

1. **Small Scale** Embedded Systems: 8-16 bit microcontroller, little h/w and s/w complexities and involve board level design.

   Usually, 'C' is used for developing these systems. The software has to fit within the memory available in the system.

Contt..

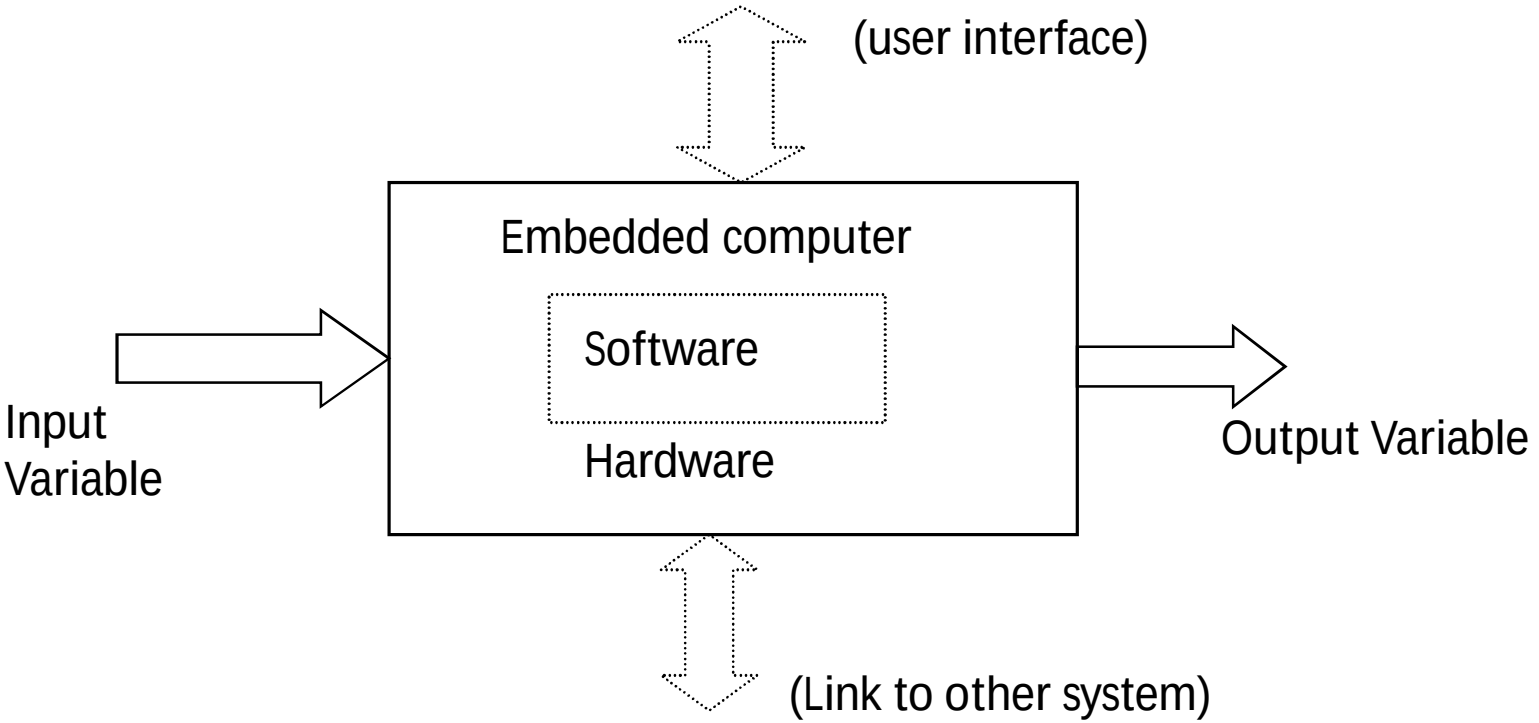
2. **Medium Scale** Embedded Systems:
   - 16 or 32 bit Microcontroller.DSP or RISC
   - H/W and S/W complexities
3. **Sophisticated** Embedded Systems:
   - Enormous h/w and s/w complexities.
   - may need scalable processors, configurable processors.

Features of the Embedded System

1. Constituents of the embedded computer: h/w and s/w
2. Timeliness: The controller must be able to respond fast enough to keep its operation within a safe region.
3. System interconnection
4. Reliability

The essence of the embedded system

- ESD



Where are Embedded Systems used?

- **Signal processing systems**
  - Real-time video, DVD players, Medical equipment.
- **Distributed control**
  - Network routers, switches, firewalls, mass transit systems, Elevators
- **"Small" systems**
  - Mobile phones, pagers, home appliances, toys, smartcards, MP3 players, PDAs, digital cameras, sensors, pc keyboard & mouse
- **Modern cars**: Up to 100 or more processors
  - Engine control unit
  - ABS systems (Anti Lock Brake systems)
  - Emissions control
  - Diagnostics and Security systems
  - Accessories (doors, windows etc)

Why do we need to learn Microprocessors/controllers?

- The microprocessor is the core of computer systems.
- Nowadays many communication, digital entertainment, portable devices, are controlled by them.
- A designer should know what types of components he needs, ways to reduce production costs and product reliable.

Different aspects of a microprocessor/controller

- **Hardware** :Interface to the real world

- **Software** :order how to deal with inputs

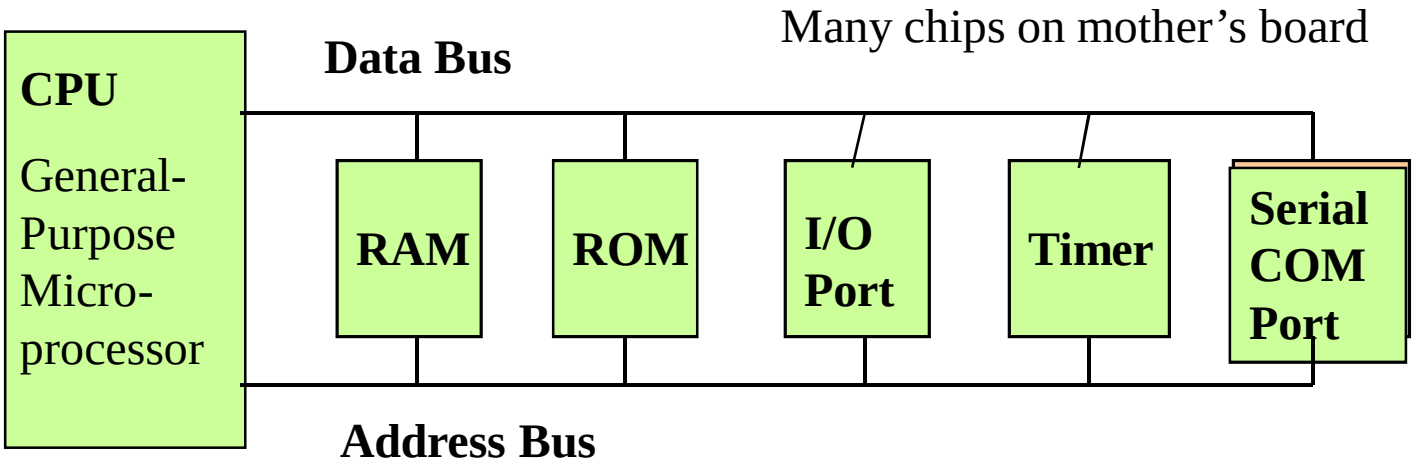
Tools for a microprocessor/controller

- **CPU**: Central Processing Unit
- **I/O**: Input /Output
- **Bus**: Address bus & Data bus
- **Memory**: RAM & ROM
- **Timer**
- **Interrupt**
- **Serial Port**
- **Parallel Port**

Microprocessors:

General-purpose microprocessor

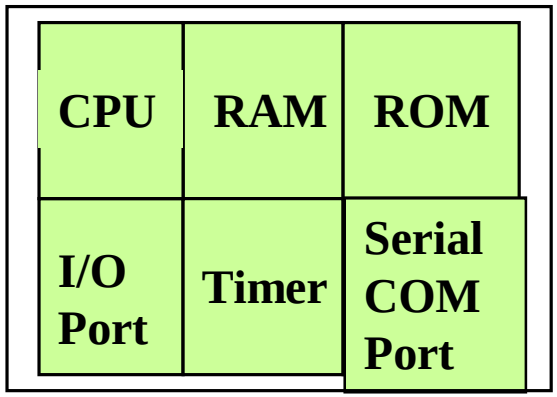
- CPU for Computers
- No RAM, ROM, I/O on CPU chip itself
- Example：Intel’s x86, Motorola’s 680x0



General-Purpose Microprocessor System

Microcontroller :

- A smaller computer
- On-chip RAM, ROM, I/O ports...
- Example：Motorola’s 6811, Intel’s 8051, Zilog’s Z8 and PIC 16X



A single chip

Microcontroller

Microcontrollers

- **A Microcontroller is essentially a small and selfsufficient**
- **computer on a chip, used to control devices**
- **It has all the memory and I/O it needs on board**
- **Is not expandable – no external bus interface**

Characteristics of a Microcontroller

- **Low cost, on the order of $1**
- **Low speed, on the order of 10 KHz – 20 MHz**
- **Low Power, extremely low power in sleep mode**
- **Small architecture, usually an 8-bit architecture**
- **Small memory size, but usually enough for the type of application it is intended for. Onboard Flash.**
- **Limited I/O, but again, enough for the type of application**

Microprocessors

- **A Microprocessor is fundamentally a collection of**
- **on/off switches laid out over silicon in order to perform**
- **Computations**

Characteristics of a Microprocessor

- **High cost, anywhere between $20 - $200 or more!**
- **High speed, on the order of 100 MHz – 4 GHz**
- **High Power consumption, lots of heat**
- **Large architecture, 32-bit, and recently 64-bit architecture**
- **Large memory size, onboard flash and cache, with an external bus interface for greater memory usage**
- **Lots of I/O and peripherals, though Microprocessors tend to be short on General purpose I/O**

Microprocessor vs. Microcontroller

Microprocessor

- CPU is stand-alone, RAM, ROM, I/O, timer are separate
- designer can decide on the amount of ROM, RAM and I/O ports.
- Different Ics for memory and I/O.
- Single memory map in which data & code will lie.
- expansive
- versatility
- general-purpose

Microcontroller

- CPU, RAM, ROM, I/O and timer are all on a single chip
- fix amount of on-chip ROM, RAM, I/O ports
- Memory and I/O are inbuilt.
- Separate data and code memory.
- for applications in which cost, power and space are critical
- single-purpose.
- Compared to up, more numbers of pins are multifunctioned.