Introduction To Embedded System Chapter 1

Embedded System Design

UCS704

Introduction

- Embedded System
  - Electronic system
  - Perform one or limited set of functions
  - Use hardware and software
  - Not counted as PC
  - "Special Purpose" computing unit
  - Software is burned into the ROM (we can call it as firmware)
  - Example: Automobile Electronics

Application Domain of Embedded System

- Consumer Electronics
- Household Appliances
- Automobile Controls
- Handheld Devices
- Medical Equipments
- Banking
- Computer Peripherals
- Networking
- Factories
- Aviation
- Robotics
- Toys

Features and General Characteristics of Embedded System

- One or small set of functions
- Low-power dissipation
- Limited memory and peripherals
- not alterable by user
- Generally part of large system
- Need to be highly reliable
- Need to operate with time constraint

PC is not considered as Embedded System, why?

- Large application set
- Power is not a constraint
- Large amount of memory available of various forms (RAM, ROM and Secondary storage)
- Can be accessed by input devices (mouse, keyboard...)
- Reliability and Time criticality is subject to where it is employed.

Modal of an Embedded System

- Consists of
  - Processor
  - Sensors
  - Actuators
  - Memory

Modal of an Embedded System
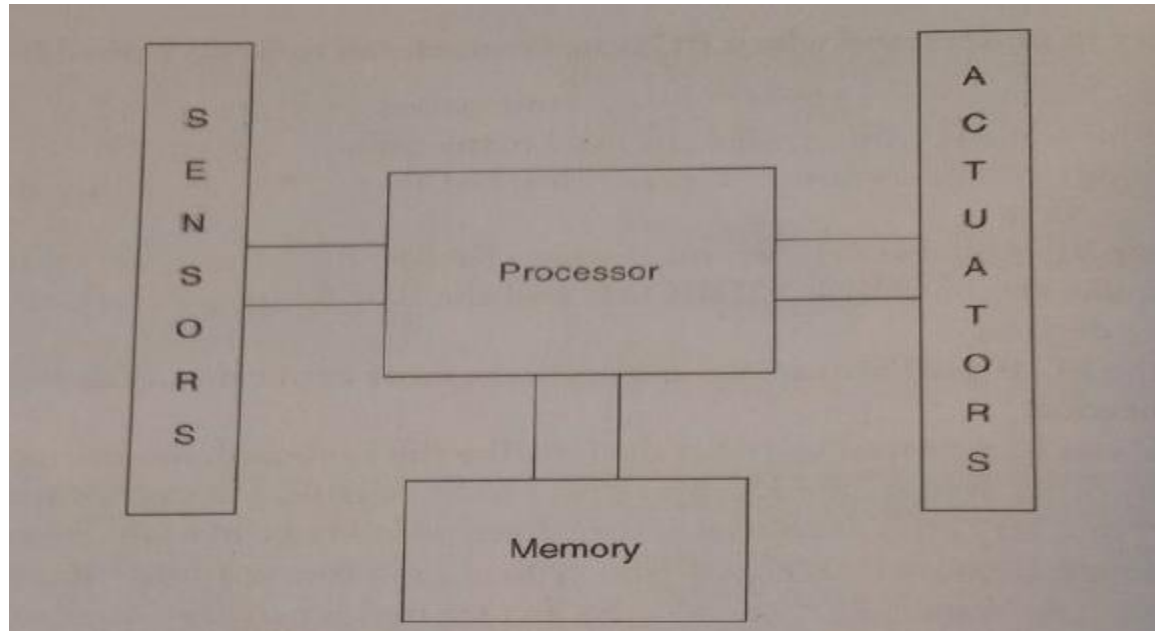
Microprocessor vs Microcontroller

- Embedded System requires computational engine.
- Types of processor units
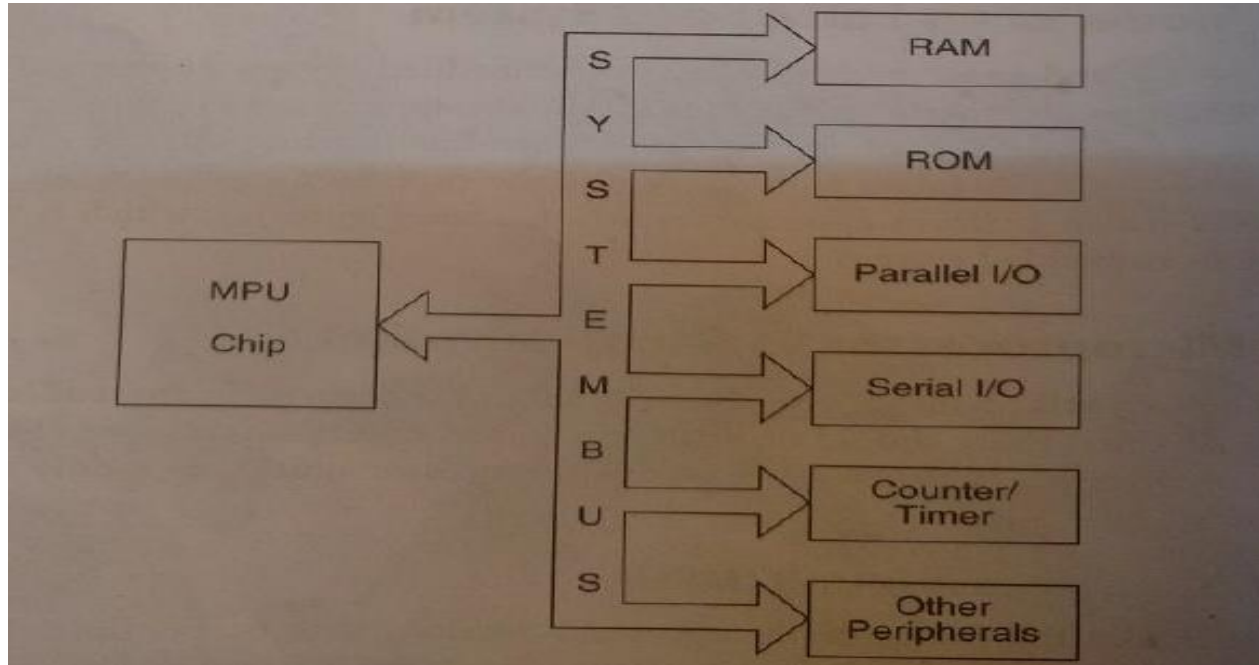 - Microprocessor Unit
  - Microcontroller Unit

Microprocessor vs Microcontroller

Microprocessor Unit (MPU)

- Processor like 8085, 8086 or any Pentium processor
- Does not have pins to interface with external world.
  - Require external chips as peripheral controllers
  - Example: parallel port IC to connect LCD
- Emphasis on "computational power" rather than interfacing capabilities

Microprocessor vs Microcontroller

Microprocessor Unit (MPU)

Microprocessor vs Microcontroller

Microcontroller Unit (MCU)

- Processing unit along with timers, parallel ports, serial ports, RAM, ROM (on the same chip)
- Program code is burned into internal ROM
- Application code is run with the help of internal RAM
- Can be considered as Self contained single chip computer i.e. "System on Chip (SoC)"

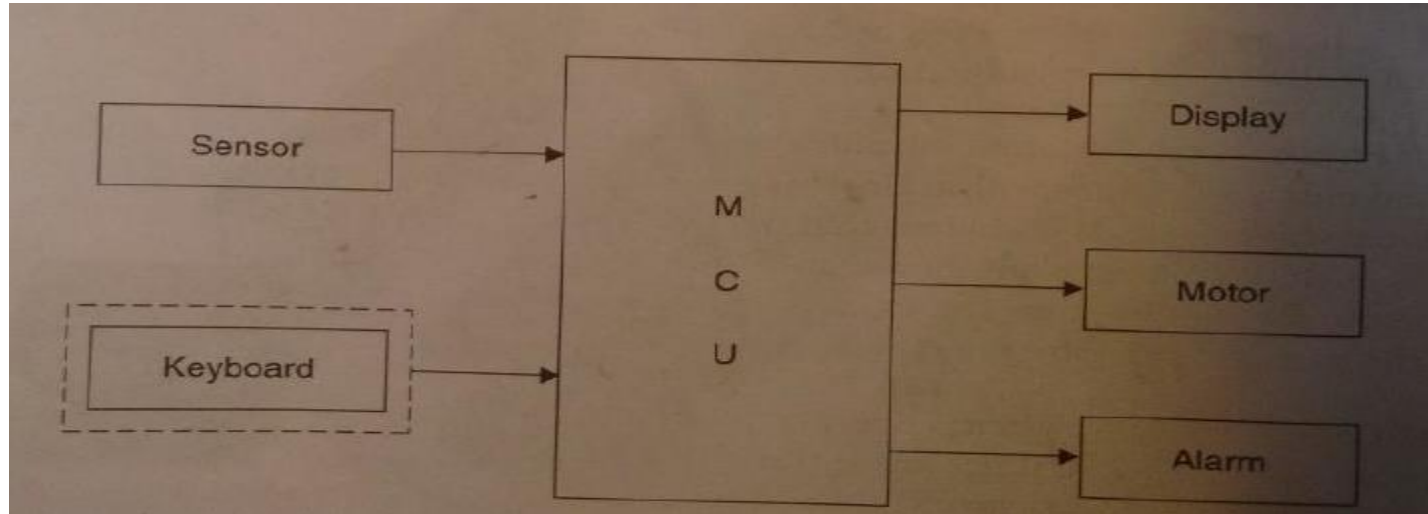# Microprocessor vs Microcontroller

Microcontroller Unit (MCU)
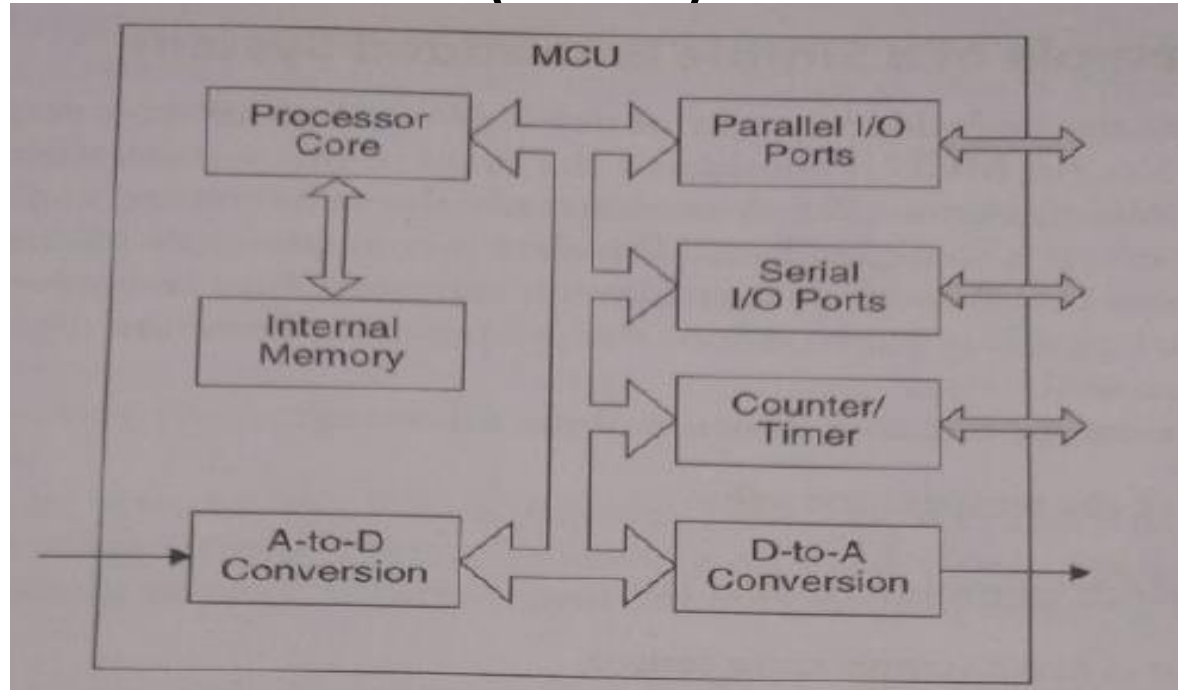
Simple Embedded System

Temperature Monitor/ Controller

- Sensor reads the temperature (Analog form)
- ADC inside the MCU coverts to digital form
- Processing (Compare to reference point)
- Action (Display /alarm) is performed

Simple Embedded System

Temperature Monitor/ Controller

Merits of an Embedded System

- Low-power dissipation
- Small physical size
- Small code size
- High speed of respoonse

Classification of MCUs

- 4 bits MCUs
  - Used in simple toys and to switch inputs
- 8 bits MCUs: 8051, PIC
  - For moderately complex operations
- 16 bits MCUs: 8096, 80196, PIC, MSP 430 (Texas Instruments)
- 32 bits MCUs: ARM
  - Used in Image and video processing

Devices as Embedded System

- Application Specific Integrated Circuits (ASIC)
  - Integrate complex functional blocks
  - Designed from basics
- Field Programmable Gate Arrays (FPGA)
  - Programmable, Reconfigurable
- DSP Processors
  - Designed for signal processing and math operations

Challenges in the field of Embedded System

- The three P's of innovation
  - Price
  - Performance
  - Power

Current Trends

- Multi-core processors
- Embedded and Real Time Operating Systems
- Newer areas of deployment of embedded system
  - Entertainment, Healthcare, Automotive, Communications