

UNIT II: Microcontroller

Introduction to microcontrollers and microprocessors, Different microcontrollers, Arduino: Types, UNO Architecture, ADC, DAC, Data acquisition

Microprocessors are powerful CPUs for general computing (PCs), requiring external memory/peripherals, while [microcontrollers](#) (MCUs) are "computers on a chip," integrating CPU, RAM, ROM, and I/O for specific, cost-effective embedded tasks (appliances, IoT), using internal buses for compactness; common MCU types include 8051, PIC, AVR, and [ARM-based](#) families, differing in complexity, power, and architecture (Harvard vs. Von Neumann).

Microprocessor (MPU)

- **Definition:** A single chip containing the Central Processing Unit (CPU) for arithmetic and logic operations.
- **Key Feature:** Needs external RAM, ROM, I/O, and peripherals to function as a complete system.
- **Application:** General-purpose computing (desktops, servers).
- **Architecture:** Often uses the Von Neumann model, with shared memory for data/instructions.
- **Characteristics:** High speed, complex, expensive, high power consumption.

Microcontroller (MCU)

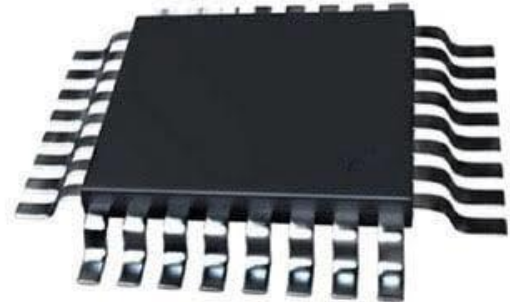
- **Definition:** A complete system-on-a-chip (SoC) integrating CPU, memory (RAM, ROM), and I/O ports on one IC.
- **Key Feature:** Self-contained, requiring few or no external components.
- **Application:** Embedded systems (washing machines, remote controls, IoT devices).

- **Architecture:** Often based on the Harvard architecture, with separate buses for data and instructions.
- **Characteristics:** Lower power, lower cost, compact, designed for specific control tasks.



Microprocessor

VS



Microcontroller

Different Microcontrollers

- **8-bit & 16-bit MCUs:** Older, simpler, cost-effective (e.g., [Intel 8051](#), [PIC16/PIC18](#), [Motorola 68HC12](#)), suitable for basic tasks.
- **AVR Family:** Popular for hobbyists (Arduino) and embedded systems, known for ease of use and low power.
- **[ARM Cortex-M Series](#):** High-performance, energy-efficient MCUs (e.g., STM32, LPC) used in complex embedded systems, IoT, and automotive.
- **[PIC Microcontrollers](#) (Microchip):** Widely used, versatile family (PIC10, PIC24, PIC32).
- **[ESP32/ESP8266](#):** Popular for IoT due to integrated Wi-Fi/Bluetooth.
- **[Raspberry Pi Pico](#) (RP2040):** Modern, dual-core ARM Cortex-M0+ MCU for general-purpose applications.

Key Differences Summary

- **Integration:** Microcontroller has everything on-chip; Microprocessor needs external parts.
- **Purpose:** MPU for general computing; MCU for dedicated control.
- **Cost/Power:** MPU is high-cost/power; MCU is low-cost/power.

