# Microcontrollers & Applications

Lecture 0.2: Basic Terminology

Microprocessor versus Microcontroller

Parameter	Microprocessor	Microcontroller
Definition	The heart of a computer system.	The heart of an embedded system.
What is it?	A microprocessor is a processor where the memory and I/O component are connected externally.	A microcontroller is a controlling device wherein the memory and I/O output component are present internally.
Circuit complexity	The circuit is complex due to external connection.	Microcontrollers are present on chip memory. The circuit is less complex.
Memory and I/O	The memory and I/O components are to be connected externally.	The memory and I/O components are available.
Compact system	Microprocessors can't be used in compact system.	Microcontrollers can be used with a compact system.
Efficiency	Microprocessors are not efficient.	Microcontrollers are efficient.
Zero status flag	Microprocessors have a zero status flag.	Microcontroller doesn't have a zero status flag.
Number of registers	Microprocessors have less number of registers.	Microcontrollers have more number of registers.

Microprocessors (Central Processing Unit, CPU)
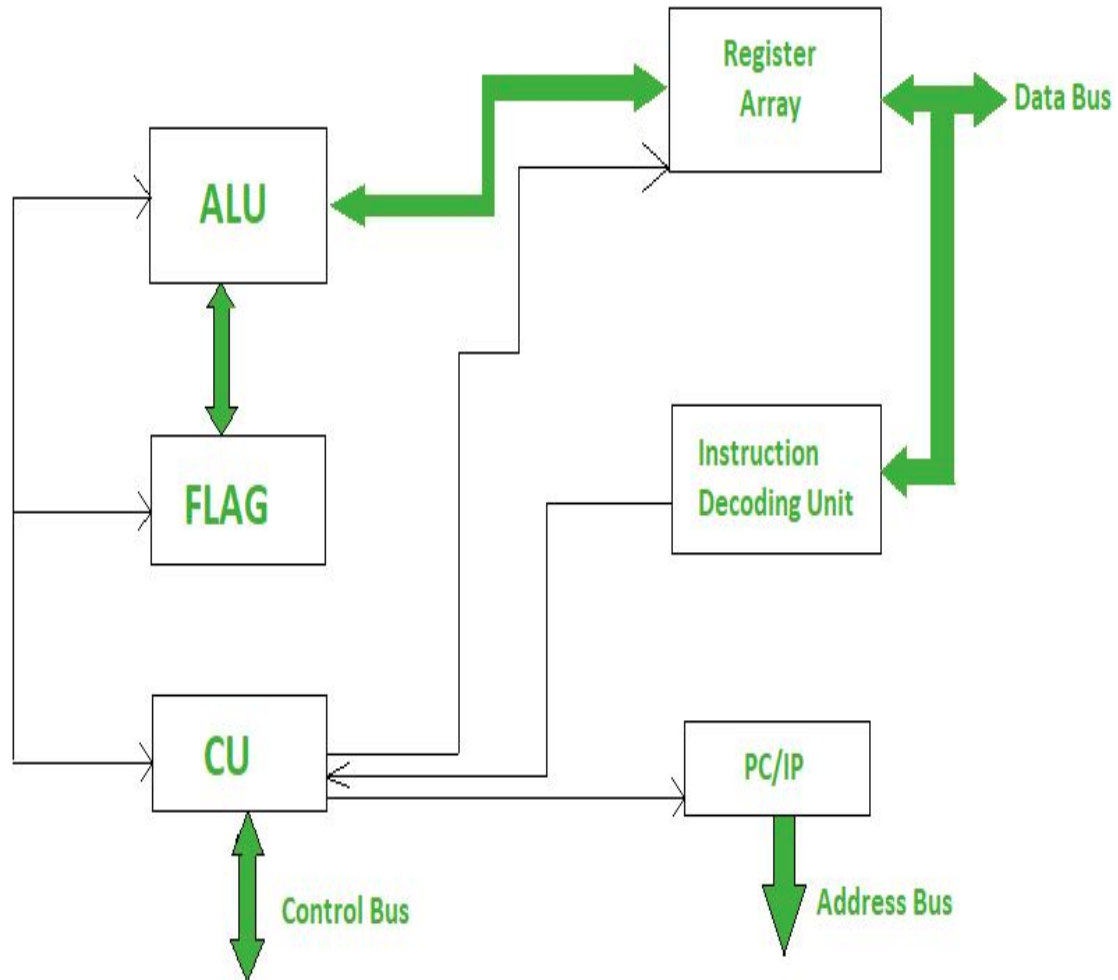
- A Microprocessor takes a bunch of instructions in machine language and executes them, telling the processor what it has to do. Microprocessor performs three basic things while executing the instruction:

  - It performs some basic operations like addition, subtraction, multiplication, division, and some logical operations using its Arithmetic and Logical Unit (ALU). New Microprocessors also perform operations on floating-point numbers also.

  - Data in microprocessors can move from one location to another.

  - It has a Program Counter (PC) register that stores the address of the next instruction based on the value of the PC, Microprocessor jumps from one location to another and takes decisions.

Microcontrollers

RAM
CLOCK
ADC
CPU
ROM
I/O
DAC
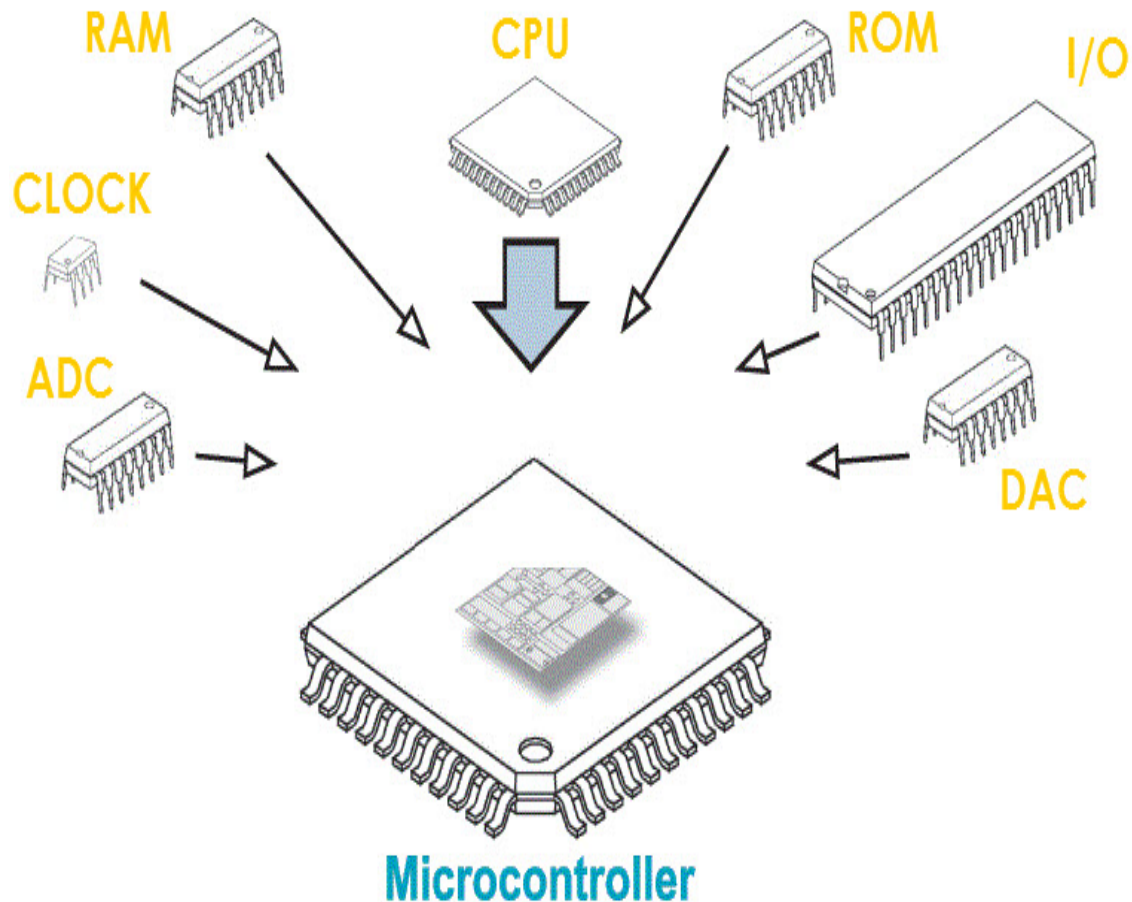
Microcontroller

- A microcontroller is an electronic system which consists of a processing element, a small memory (RAM, ROM, EPROM), I/O ports, etc. on a single chip. Therefore, a microcontroller is a tiny resemblance of a microcomputer. It is a quite small and low–cost electronic device which is used in several electronic appliances as the main functioning device.

- In electronic systems such washing machines, air conditioners, refrigerators, etc., microcontrollers are used to automate the operation of the device based on user's instructions. Hence, a microcontroller is the backbone of all embedded systems like microwave oven, washing machine, smart refrigerators, etc.

Microcontroller Components

- **Central Processing Unit (CPU)** is the brain of the Microcontroller. It consists of an Arithmetic Logic Unit (ALU) and a Control Unit (CU). A CPU reads, decodes and executes instructions to perform Arithmetic, Logic and Data Transfer operations.

- **Core** means CPU and some CPU-specific hardware components. For example, two-core microcontroller means that it has two separate CPU and related components internally.

- **Program Memory** contains the program i.e. the instructions to be executed by the CPU. It is a Read Only Memory (ROM). When the electricity is down, it protects its contents.

- **Data Memory** is required to store temporary data while executing the instructions. It is a Random Access Memory (RAM). When the electricity is down, it losts its contents.

- **Input/Output (IO) Interface** provides connection between the microcontroller and the external world. Button, Switch, Keypad, LED, etc.

- **Timers/Counters** provide the operations of Time Delays and counting external events.

- **Serial Port (UART)** is to communicate with other devices via single or only a few wires.

- **Interrupts** handle unusual ordinary or critical events when they occur. They may be external or internal, hardware or software related.

- **ADC (Analog to Digital Converter)** converts Analog signals to Digital Signals.

- **DAC (Digital to Analog Converter)** converts Digital signals to Analog Signals.

Microcontroller Advantages & Disadvantages

- A Microcontroller is a true device that fits the computer-on-a-chip idea.

- No need for any external interfacing of basic components like Memory, I/O Ports, etc.

- Microcontrollers doesn't require complex operating systems as all the instructions must be written and stored in the memory. (RTOS is an exception).

- All the Input/Output Ports are programmable.

- Integration of all the essential components reduces the cost, design time and area of the product (or application).

- Microcontrollers are not known for their computation power.

- The amount of memory limits the instructions that a microcontroller can execute.

- No Operating System and hence, all the instruction must be written.

Thanks for listening ☺

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