

## Lecture Note\_1: Microcontroller

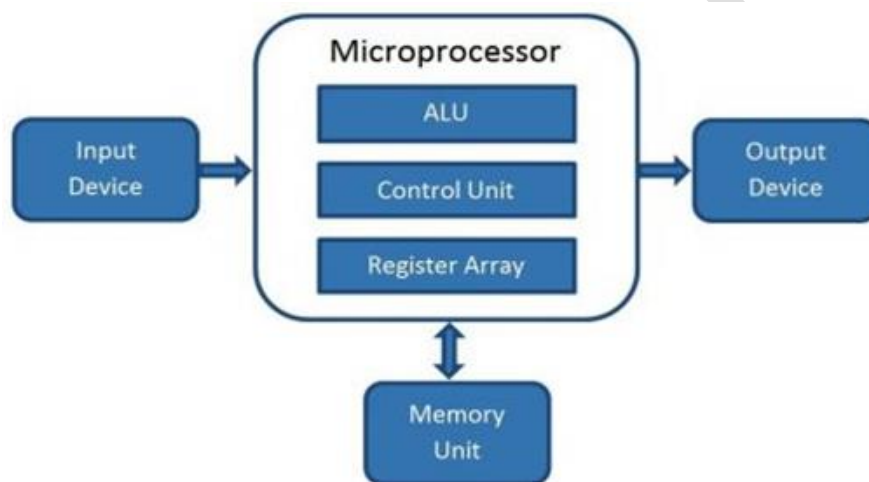
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### Q: What is microprocessor?

Microprocessor is multipurpose, clock driven register based electronics device that reads from memory, accept binary data as input (i/p), process on that data and provide the results (o/p).

- Physical component of this system is known as hardware
- Set of instruction is called program or software



Why Microcontroller?

Example of Microcontroller application: TV Remote



For small application minimum size of memories, I/Os must be used. To reduce the size and cost microcontrollers are used.  $\mu c$  is on-chip true computer optimize for specific application. "Complete system without external components"

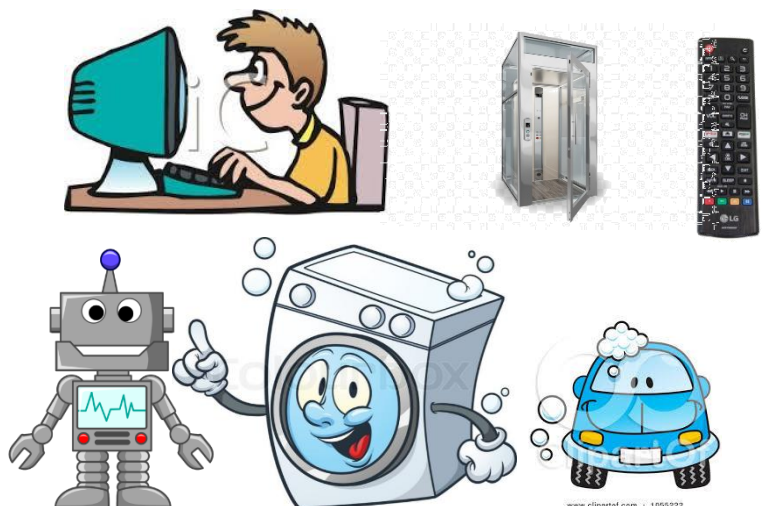
**Embedded system:**  $\mu p$  or  $\mu c$  is the part of final product and is not available for reprogramming to the end user is called embedded system.

**Difference between Microprocessor ( $\mu p$ ) and Microcontroller ( $\mu c$ ) OR Compare microprocessor with microcontroller.**

Microprocessor ( $\mu p$ )	Microcontroller ( $\mu c$ )
$\mu p$ chip depend on other chip for many function	single chip everything in built $\mu c = \text{ALU} + \text{RAM} + \text{ROM} + \text{I/O} + \text{Timer} + \text{Interrupt} + \dots \text{etc}$
Use to processing information	Use to control I/O device
It has few bit manipulation instruction	Many bit manipulation instruction
Less no of multi function pin	More number of multifunction pin
Have large memory space and more data space	Less memory and data space
flexible	Less flexible
More hardware	Less hardware
Access time less	Access time is high
Expensive	Cheap
General purpose and Versatile (Designer can decide an amount of RAM & ROM)	Use for Embedded application
Generally not real time	'Real time' Time taken by the system to perform the task can be predicted accurately

**Application of Microcontroller:**

- Embedded Application
- Telecommunication.
- Office product.
- Home appliances.
- Automotive application.
- Industrial Automation.
- Drives, Display, Touch Xbee, RFID etc..



### Write a short note on 8051 family.

In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051. This microcontroller had 128 bytes of RAM, 4K bytes of on-chip ROM, two timers, one serial port, and four ports (each 8-bits wide) all on a single chip. Because of its popularity and high demand Intel allowed other manufacturers to fabricate and market different variants of 8051 with a condition that all these variants should be code compatible with 8051. This resulted in a lot of variants of 8051 in market, among which 8052 and 8031 are the most popular ones. Therefore, 8052 and 8031 are considered as the family members of 8051.

**8052** – 8052 is the super set of 8051 as it has all the features of 8051 with an extra timer and an extra RAM of 128 bytes. Therefore, 8052 has a total of 256 bytes of RAM and 3 timers in all. Also all the programs written for 8051 will run on 8052 as 8052 is super set of 8051, but its reverse is not true.

**8031** – 8031 is referred to as ROM-less microcontroller chip because it has 0 K bytes of on-chip ROM. For its operation, 8031 requires external ROM which aids it in fetch and execute operations. Apart from this, it shares almost all the features of 8051.

Characteristic	8051	8052	8031
RAM	128 bytes	256 bytes	128 bytes
ROM (on-chip)	4 KB	8 KB	0 KB
Number of Timer	2	3	2
Interrupt Sources	6	8	6
Serial Port	1	1	1
Number of I/O Ports	32	32	32

### Various 8051 Microcontrollers:

**AT89C51/52:** The AT89C51 and AT89C52 are popular derivatives of the 8051 developed by Atmel Corporation. They have additional features such as an on-chip flash memory, an expanded interrupt structure, and a power-down mode. These microcontrollers are also compatible with the 8051 in terms of pinout and instruction set, making it easy to migrate code between them.

**P89V51RD2:** The P89V51RD2 is a derivative of the 8051 developed by NXP Semiconductors. It has additional features such as an on-chip flash memory, an expanded interrupt structure,

and a power-down mode. It also has a dual-data pointer and a programmable counter array. Like the STC89C5x, it is not fully compatible with the 8051 in terms of pinout and instructions 8751 microcontroller

**8751:** This 8751 chip has only 4K bytes of on-chip UV-EPROM. Using this chip for development requires access to a PROM burner, as well as a UV-EPROM eraser to erase the contents of UV-EPROM inside the 8751 chip before you can program it again. Because the on-chip ROM for the 8751 is UV-EPROM, it takes around 20 minutes to erase the 8751 before it can be programmed again. This has led many manufacturers to introduce flash and NV-RAM versions of the 8051, as we will discuss next. There are also various speed versions of the 8751 available from different companies.

**Write a short note on different microcontroller family (PIC, AVR, ARM). OR**

### **8051 and its derivative**

Three prominent microcontroller families are PIC (Peripheral Interface Controller), AVR (Alf and Vegard's RISC Processor), and ARM (Acorn RISC Machine). Each family has its characteristics and is widely used in diverse applications.

#### **PIC (Peripheral Interface Controller):**

**Manufacturer:** Developed by Microchip Technology.

**Architecture:** Harvard architecture.

**Instruction Set:** RISC (Reduced Instruction Set Computing).

**Features:** PIC microcontrollers are known for their low power consumption, ease of use, and a wide range of available peripherals. They are popular in applications like consumer electronics, automotive control systems, and industrial automation.

**Example:** PIC16F873

#### **AVR (Alf and Vegard's RISC Processor):**

**Manufacturer:** Originally developed by Atmel (now a part of Microchip Technology).

**Architecture:** Modified Harvard architecture.

**Instruction Set:** RISC (Reduced Instruction Set Computing).

**Features:** AVR microcontrollers are characterized by their simplicity, efficiency, and a rich set of features. They are often used in applications like robotics, home automation, and educational projects. The Arduino platform, widely used for hobbyist and prototyping projects, is based on AVR microcontrollers.

## ARM (Advanced RISC Machine):

**Manufacturer:** ARM Holdings (now part of NVIDIA).

**Architecture:** Originally developed as a RISC architecture, but ARM processors can be found in both RISC and CISC (Complex Instruction Set Computing) designs.

**Instruction Set:** ARM architecture supports a variable-length instruction set.

**Features:** ARM processors are known for their high performance, scalability, and energy efficiency. They are widely used in a broad range of applications, including mobile devices, automotive systems, embedded systems, and industrial automation. ARM architectures are prevalent in both microcontrollers and microprocessors.

	PIC	AVR	ARM
<b>Bus width</b>	8/16/32-bit	8/32-bit	32-bit mostly also available in 64-bit
<b>Speed</b>	4 Clock/instruction cycle	1 clock/ instruction cycle	1 clock/ instruction cycle
<b>Memory</b>	SRAM, FLASH	Flash, SRAM, EEPROM	Flash, SDRAM, EEPROM
<b>Memory Architecture</b>	Von Neumann architecture	Modified	Modified Harvard architecture
<b>Power Consumption</b>	Low	Low	Low
<b>Families</b>	PIC16, PIC17, PIC18, PIC24, PIC32	Tiny, Atmega, Xmega, special purpose AVR	ARMv4,5,6,7 and series
<b>Manufacturer</b>	Microchip	Atmel	Apple, Nvidia, Qualcomm, Samsung Electronics, and TI etc.
<b>Cost (as compared to features provide)</b>	Average	Average	Low
<b>Popular Microcontrollers</b>	PIC18fXX8, PIC16f88X, PIC32MXX	Atmega8, 16, 32, Arduino Community	LPC2148, ARM Cortex-M0 to ARM Cortex-M7, etc.