# Microcontrollers

**Microcontroller** is composed of two terms. **Micro** and **Controller**. **Micro** means **very small in size** and **Controller** means which **controls the operation** of all the devices.

**Microcontrollers** are the devices which are very small in size and control operations of all the other devices.

The microcontroller has built-in RAM, ROM, Microprocessor, Input/Output ports, Serial ports, Timers, Interrupts, Clock Circuits.

So we can say that microcontroller is nothing but it is an **on-chip computer**. All the devices of the computer, they are embedded on a single chip, that will be called a microcontroller.

Microcontroller incorporates all features of microprocessors.

Microcontrollers are dedicated devices **embedded** within an application. Example: Engine controller in automobile, Exposure and focus controller in camera, Microwave oven etc.

**CMOS technology** is used in microcontroller.

On-chip peripherals are selected depending on the specifics of the target application.

Since microcontrollers are powerful digital processor, the degree of control and programmability they provide significantly enhances the effectiveness of the application. Used in washing machines, VCD players, Microwave oven, Robotics and in industries.

Development of microcontroller: **Intel** designed the first microcontroller. The first one known as **8051 microcontroller**, developed in 1981. it is an **8-bit microcontroller**. It can read, write, process 8-bit data. If any microcontroller deals with 16-bit then it is called 16-bit microcontroller and so on.

# Types of Microcontrollers:

Microcontrollers are divided into various categories based memory, architecture, bits and instruction sets.

**Based on bits:** 8-bit microcontroller, 16-bit microcontroller, 32-bit microcontroller.

**Based on memory:** External memory, Embedded memory.

**Based on instruction sets:** RISC, CISC.

## Based on bits:

**8-bit microcontroller:** Used to execute arithmetic and logical operations. Example: 8031, 8051. Used for simple application.

**16-bit microcontroller:** Used to perform arithmetic and logical operations where higher accuracy and performance is required. Example: 8096. Used for higher accuracy application.

**32-bit microcontroller:** Used in automatically controlled appliances like automatic operational machines, medical appliances etc. Used for complex application.

## Based on memory:

**External memory microcontroller:** This type of microcontroller is designed in such a way that they do not have a program memory on the chip. In the microcontroller there are two memory. Program memory and Data memory. All the programs are stored in program memory and all data are stored data memory. Example: Intel 8031 microcontroller.

**Embedded memory microcontroller:** This type of microcontroller is designed in such a way that microcontroller has all programs and data, counters, timers, I/O ports on the same chip. Example: 8051 microcontroller.

**Based on instruction set:** Instruction set contains various instructions and these instructions are used to perform the operations by the microcontroller. Operations like arithmetic and logical operations.

**CISC:** Complex instruction set computer. It allows the user to insert a single instruction as an alternative to many simple instructions.

**RISC:** It reduces the operational time by shortening the clock cycle per instruction.

# Comparison between Microprocessors and Microcontrollers:

| Microprocessor | Microcontroller |
|---|---|
| Contains ALU, control unit, different registers and interrupt circuits. | Contains microprocessor, memory, I/O interfacing circuit, peripheral devices, serial ports, timer etc. on single chip. |
| When implemented in a PC, add a keyboard for input, a monitor, a mouse, a printer, etc. | In implementation, may or may not have a keyboard, rather a keypad/switches for input or other types of control, often does not have monitor |
| It has memory instructions to move data between memory and CPU. | It has one or two instructions to move data between memory and CPU. |
| One or two bit handling instructions. | Many bits handling instructions. |
| Access time for memory and I/O devices are more. | Less access time for built-in memory and I/O devices. |

# Comparison between Microprocessors and Microcontrollers:

| Microprocessor | Microcontroller |
|---|---|
| Requires more hardware. | Requires less hardware. |
| More flexible in design, so high designing cost. | Less flexible in design point of view. So less designing cost. |
| Single memory map for data and program code. | Separate memory map for data and program code. |
| Less number of pins are multi functioned. | More number of pins are multi functioned. |
| Used in big applications. | Used to execute a single task within an application. |
| Not so easy to replace. | Easy to replace. |
| Its power consumption is high because it has to control the entire system. | They are built with CMOS technology which require less power to operate. |