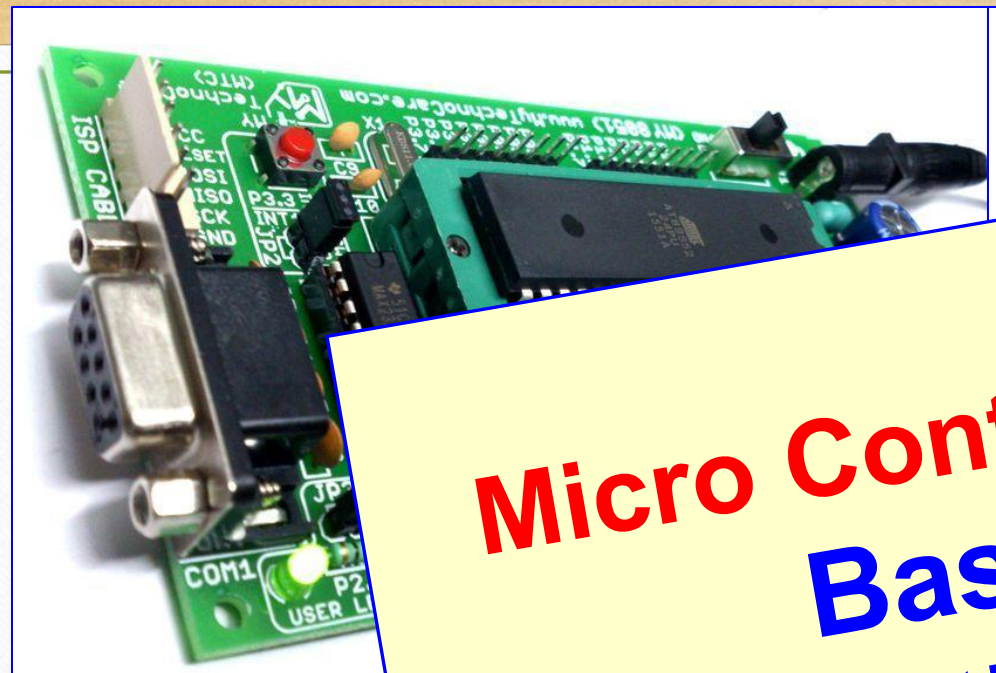
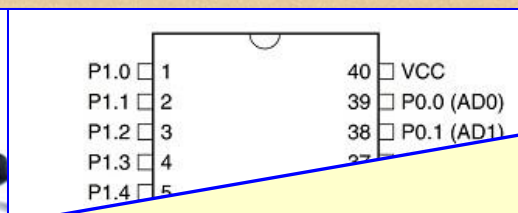
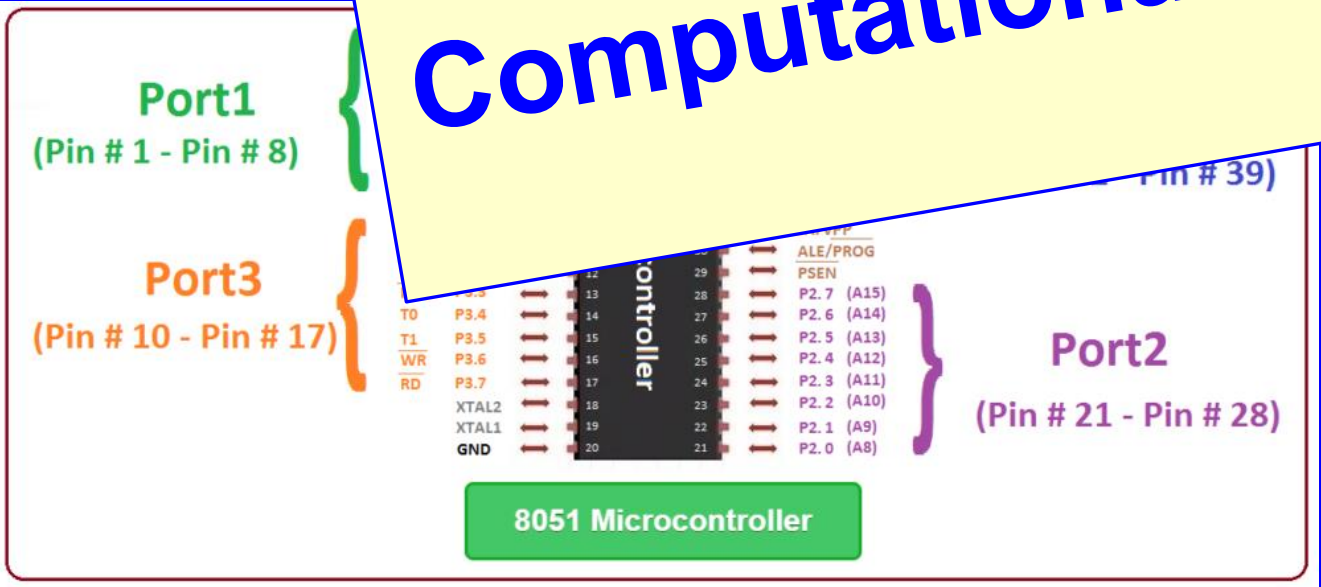
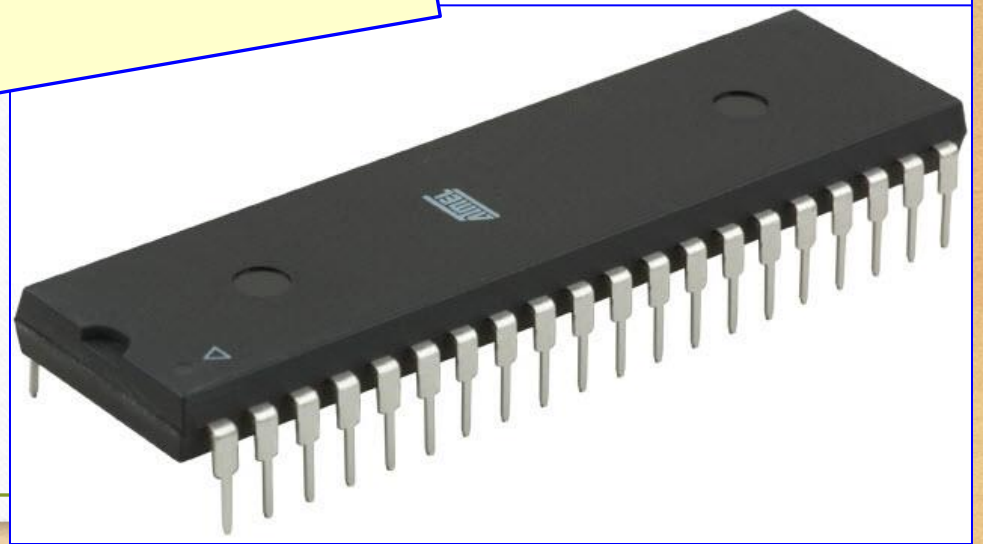




Micro Controllers – 2.1
Basics of
Computational Devices





To Compute = To Count, To Calculate

Essential Features of a computing device –

1) Input data i.e. information
2) Processing units i.e. brain
3) Output i.e. answer

Additional Features –

1) Storage of the data and output
2) To retrieve the data and output when required
3) Print / Display / Transfer the output
4) Make changes in the process

Role of Flip-flops

- **Storage** and **Retrieval** of the Data.
- Flip-flop is the basic unit which can do this.
- Thus called as basic building block of memory.
- A flip-flop has two stable states, thus, called as a bistable multivibrator.

- Flip-flops and Latches are used as data storage elements.
- A Flip-flop is a device which can store a single bit (binary digit) of data.
- Many Flip-flops together form the memory of the computing device.

Microprocessor

A **microprocessor** is an electronic device that is used by a computer. It is a central processing unit on a single **integrated circuit chip** containing millions of very small components including **transistors, resistors, and diodes** that work together.

It has **no specific task** given for which it is designed. Thus, it can be programmed as per the need.

- Non-volatile memory (ROM)
- Volatile memory (RAM)
- Clock
- I/O control unit etc.

Microprocessor has only the CPU in it and these features are to be **added from outside**

Microcontroller has the CPU along with these features **embedded inside** in a single chip.

Microprocessor	Microcontroller
As all the memory, I/O are added from outside, size of the circuit is large.	As all the memory, I/O are present internally, size of the circuit is small.
As all the devices are external, each instruction has external operation, thus slower process.	As most of the devices are in-built, most of the operations are internal, thus faster process.
High power consumption	Low power consumption
High cost	Low cost
Non specific, Generalised applications such as Personal Computers	Dedicated applications such as Washing machines, Automobiles, Music systems etc.
Difficulty in writing program	Easier to write program

History of Micro Processors -

Name of Processor	Year of Invention	Clock speed	No. of transistors	Instructions per second
Intel 4004 / 4040	1971	740 KHz	2,300	60,000

History of Micro Processors contd….

NAME	YEAR	TRANSISTORS	DATA WIDTH	CLOCK SPEED
8080	1974	6,000	8 bits	2 MHz
8085	1976	6,500	8 bits	5 MHz
8086	1978	29,000	16 bits	5 MHz
8088	1979	29,000	8 bits	5 MHz
80286	1982	134,000	16 bits	6 MHz
80386	1985	275,000	32 bits	16 MHz
80486	1989	1,200,000	32 bits	25 MHz
PENTIUM	1993	3,100,000	32/64 bits	60 MHz
PENTIUM II	1997	7,500,000	64 bits	233 MHz
PENTIUM III	1999	9,500,000	64 bits	450 MHz
PENTIUM IV	2000	42,000,000	64 bits	1.5 GHz

History of Micro Processors contd….

Name of Processor	Year of Invention	Clock speed	No. of transistors	Instructions per second
Intel Core 2	core2 duo, core2 quad, etc.	1.2 GHz to 3 GHz	291 000 000	64 KB of L1 cache per core 4 MB of L2 cache
Intel i3, i5, i7, i9, i11	2007, 2009, 2010, 2016, 2019	2.2GHz – 3.3GHz, 2.4GHz – 3.6GHz, 2.93GHz – 3.33GHz	1.75 Billion 2.1 Billion	

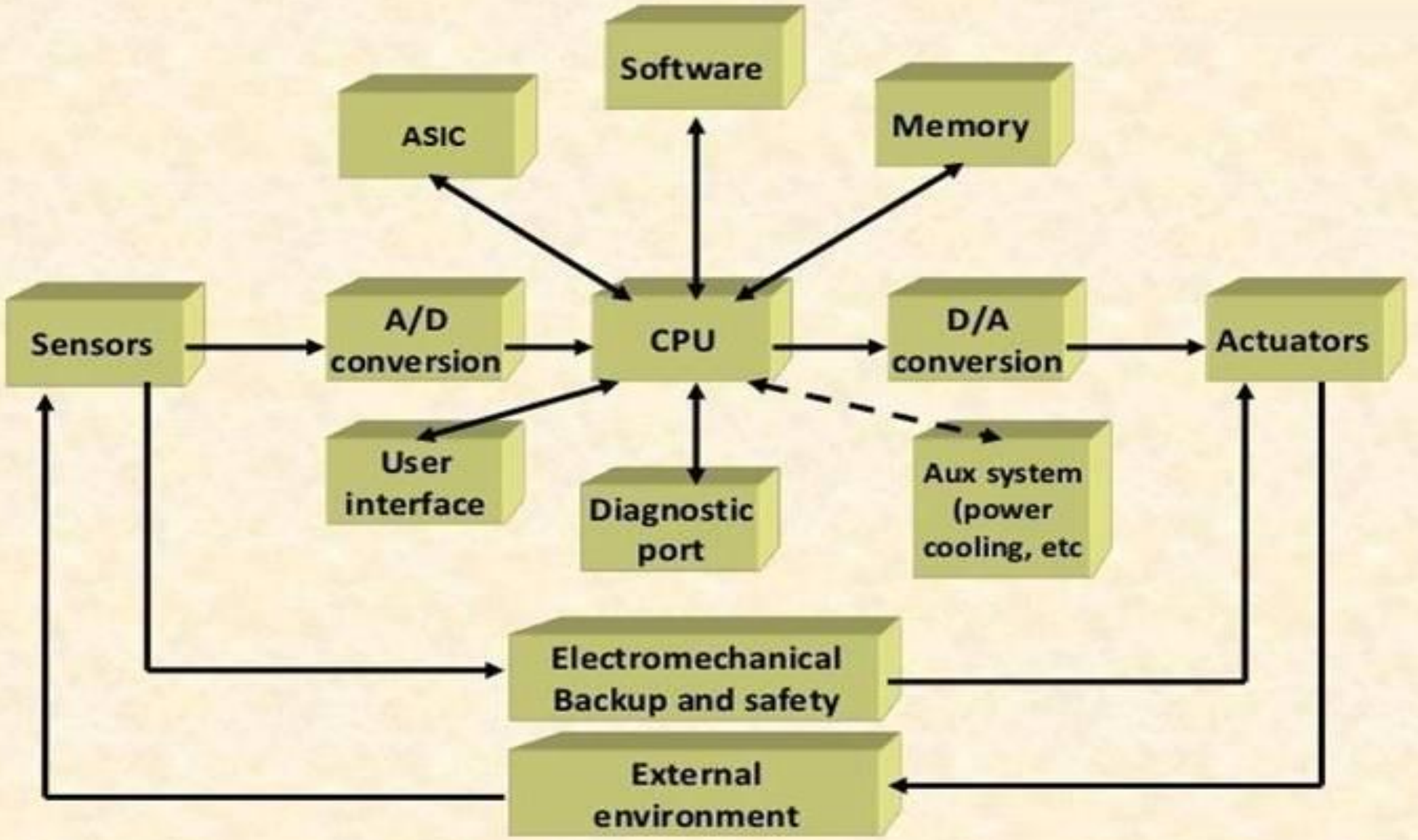
Embedded System Features –

1) Combination of Hardware and Software –
2) There is a specific task given –
3) There is a dialogue between the h/w and s/w –
4) It can be a small part of a bigger system –
5) Specific program instructions are written in the ROM called as firmware, thus can not be used in any other system –
6) Examples – Washing machines, Mobile phones, Microwave ovens, Automobiles, Video devices, Video games, Music systems, Cameras, Medical instruments, Defence weapons …..

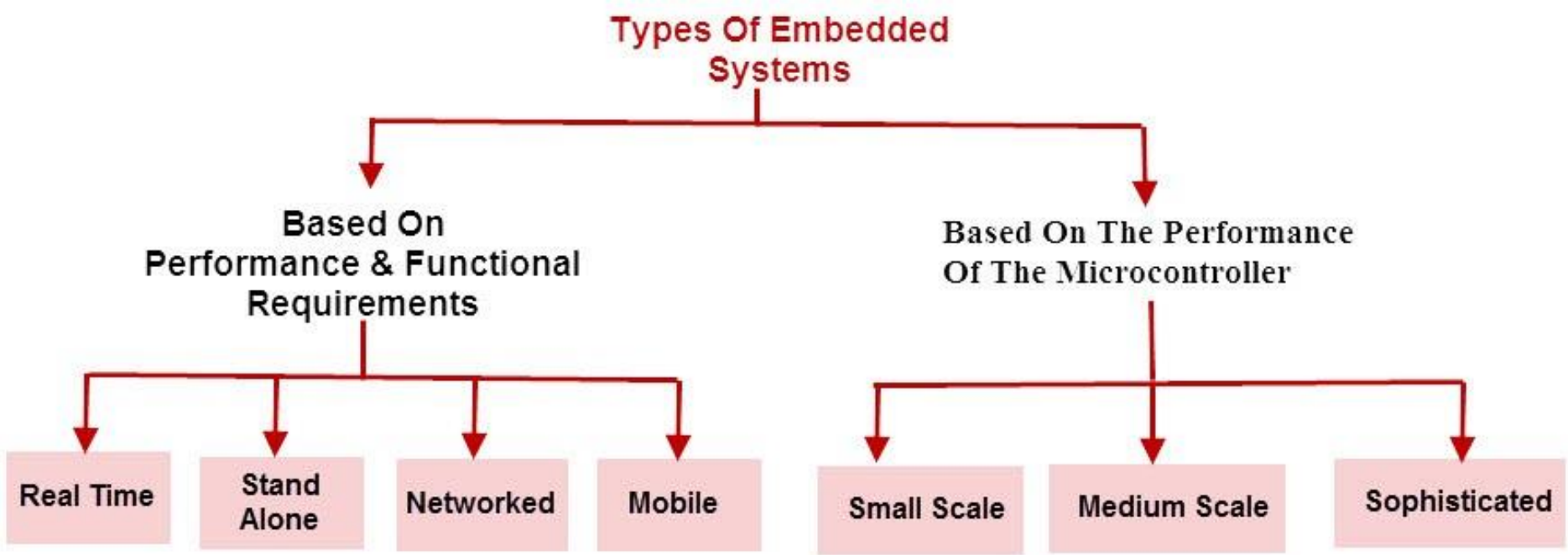
Embedded System Features contd….

7) Requires less power –
8) Highly stable system –
9) Highly reliable –
10) Highly efficient –
11) Minimal user interface –
12) Time specific –
13) Task specific –
14) Mass produced thus cheap –
15) A little development in the system will make earlier version obsolete –
16) User friendly –

Block Diagram of a generalised Embedded System



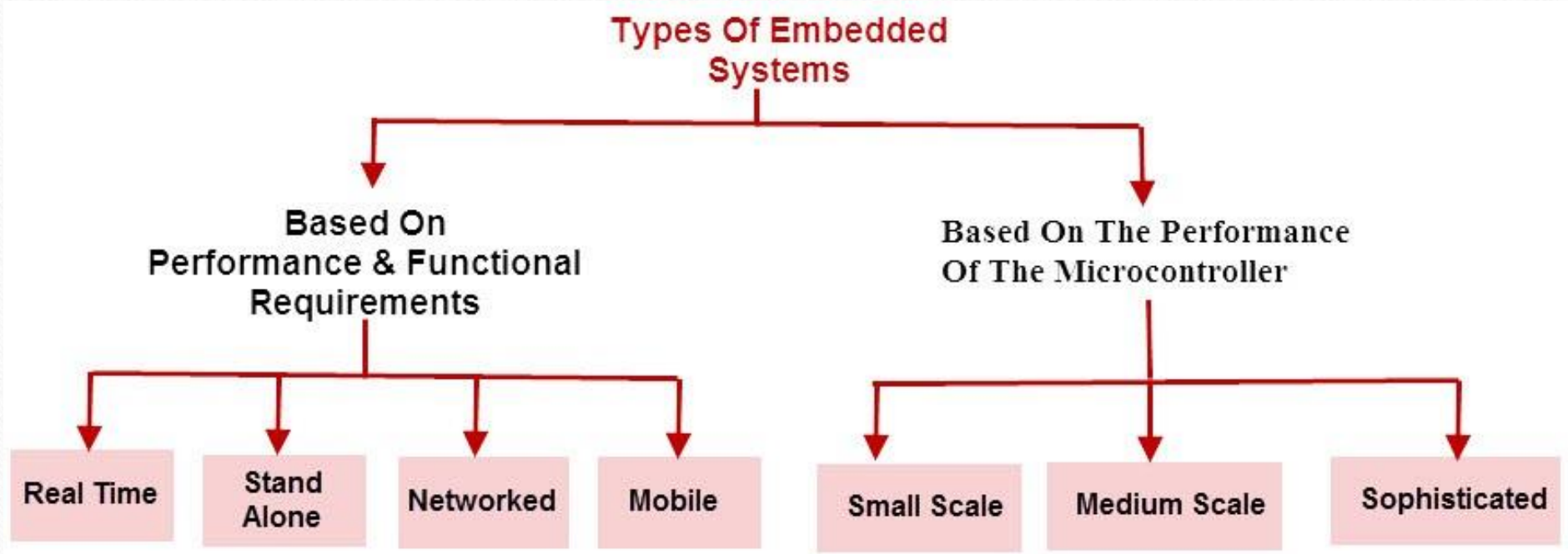
Classification of Embedded Systems –



Small scale embedded system – Uses an 8 bit microcontroller, very few hardware components and a small power source.

Medium scale embedded systems – Uses a 16 bit or 32 bit microcontroller, h/w and s/w are complicated. Uses RTOS, Simulator, Debugger and some special purpose tools for the design. e.g. Home appliances, security systems etc.

Classification of Embedded Systems contd….



Sophisticated embedded system – Uses huge h/w and s/w and is very complex. Costly systems. Used for high end applications. Many subsystems are required to be designed to build the complete system. Dedicated special purpose Development tools are required.

e.g. Washing machines, Mobile phones, Automobiles, Medical instruments, Defence weapons etc.

Classification of Embedded Systems contd….

Stand alone embedded systems – Least complicated type of embedded system. Do not require support from any computer. Works of its own independently. i/p can be analog or digital. e.g. Calculator, Digital wrist watch etc.

Real time embedded systems – These are functions of time. Work in definite time interval. Further types are **Soft time E.S.** (Microwave oven, Washing machine) and **Hard time E.S.** (Missiles, Robotics, Space operations)

Networked embedded systems – Connected to a network like LAN, WAN, Internet etc. e.g. ATM, Card swipe machine, Home security system etc.

Mobile embedded systems – Portable E.S. like Cell phones, Digital Data devices etc.