SUBJECT NAME: Computer organisation and Microprocessor Architecture
SUBJECT CODE: 303105210

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What is Microprocessor?

- A *microprocessor* is a programmable electronics chip that has computing and decision making capabilities similar to central processing unit of a computer.
- It is clock driven IC
- It is Si type of semiconductor chip which contain no. of transistors.
- It is register array based device.
- Microprocessor is used as multipurpose

Technology Used: The semiconductor manufacturing technologies used for chips are:

- Transistor-Transistor Logic (TTL)
- Emitter Coupled Logic (ECL)
- Complementary Metal-Oxide Semiconductor (CMOS)

Classification of Microprocessors:

Based on size of data bus:

- 4-bit microprocessor
- 8-bit microprocessor
- 16-bit microprocessor
- 32-bit microprocessor

Based on architecture:

- Reduced Instruction Set Computer (RISC) processors
- Complex Instruction Set Computer (CISC) processors

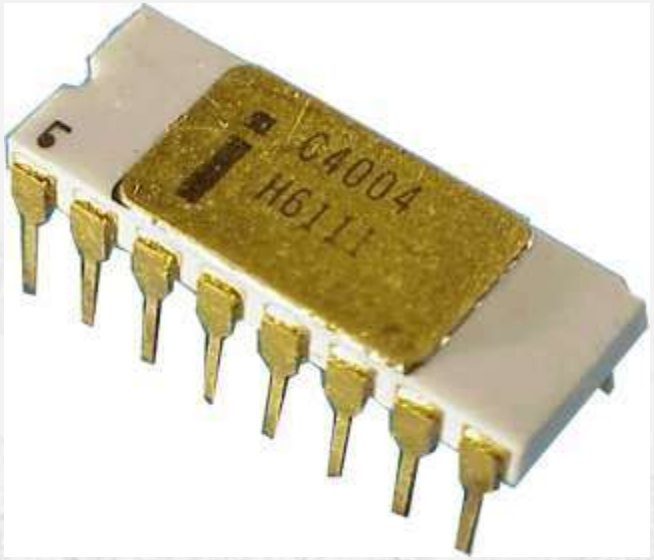
Based on application:

- ✓ General-purpose microprocessor- used in general computer system and can be used by programmer for any application. Examples, 8085 to Intel Pentium.
- ✓ Microcontroller- microprocessor with built-in memory and ports and can be programmed for any generic control application. Example, 8051.
- ✓ Special-purpose processors- designed to handle special functions required for an application. Examples, digital signal processors and application-specific integrated circuit (ASIC) chips.

History of Microprocessors:

4-BIT MICROPROCESSORS

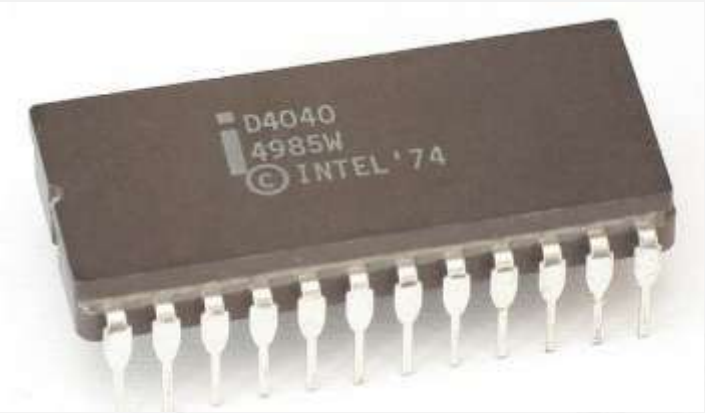
INTEL 4004



- Introduced in 1971.
- It was the first microprocessor by Intel.
- It was a 4-bit µP.
- Its clock speed was 740KHz.
- It had 2,300 transistors.
- It could execute around 60,000 instructions per second.

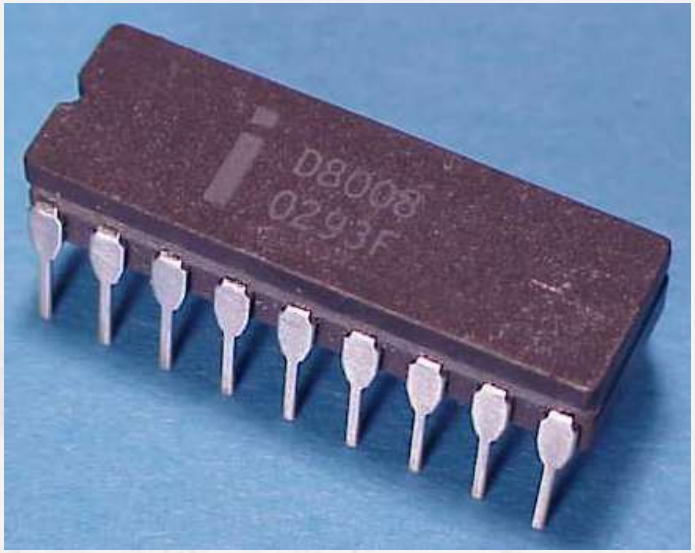
INTEL 4040

- Introduced in 1974.
- It was also 4-bit µP.



8-BIT MICROPROCESSORS

INTEL 8008



- Introduced in 1972.
- It was first 8-bit µP.
- Its clock speed was 500 KHz.
- Could execute 50,000 instructions per second.

INTEL 8080

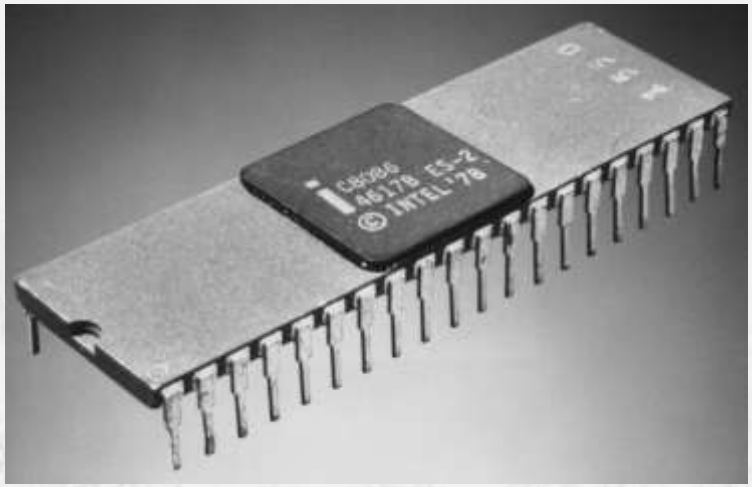
- Introduced in 1974.
- It was also 8-bit µP.
- Its clock speed was 2 MHz.
- It had 6,000 transistors.
- Was 10 times faster than 8008.
- Could execute 5,00,000 instructions per second.

INTEL 8085

- Introduced in 1976.
- It was also 8-bit µP.
- Its clock speed was 3 MHz.
- Its data bus is 8-bit and address bus is 16-bit.
- It had 6,500 transistors.
- Could execute 7,69,230 instructions per second.
- It could access 64 KB of memory.
- It had 246 instructions.

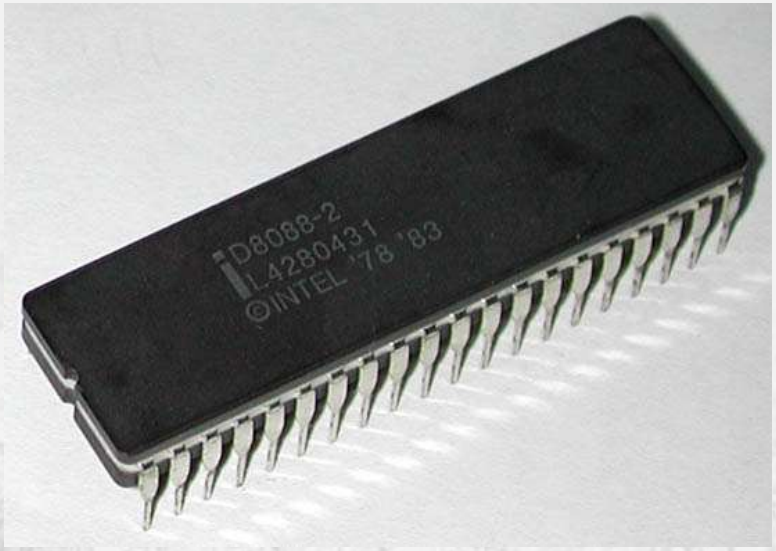
16-BIT MICROPROCESSORS

INTEL 8086



- Introduced in 1978.
- It was first 16-bit µP.
- Its clock speed is 4.77 MHz, 8 MHz and 10 MHz, depending on the version.
- Its data bus is 16-bit and address bus is 20-bit.
- It had 29,000 transistors.
- Could execute 2.5 million instructions per second.
- It could access 1 MB of memory.
- It had 22,000 instructions.
- It had ***Multiply*** and ***Divide*** instructions.

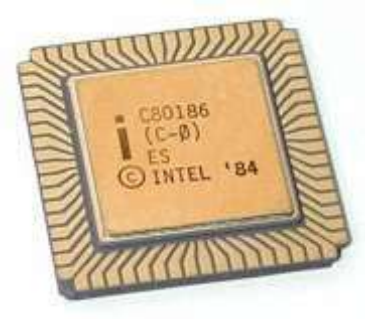
INTEL 8088

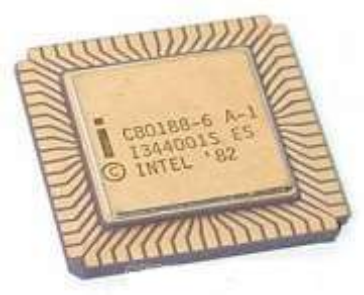


- Introduced in 1979.
- It was also 16-bit µP.
- It was created as a cheaper version of Intel's 8086.
- It was a 16-bit processor with an 8-bit external bus.

INTEL 80186 & 80188

- Introduced in 1982.
- They were 16-bit µPs.
- Clock speed was 6 MHz.





INTEL 80286

- Introduced in 1982.
  - It was 16-bit µP.
- Its clock speed was 8 MHz.

32-BIT MICROPROCESSORS

INTEL 80386

- Introduced in 1986.
  - It was first 32-bit µP.
- Its data bus is 32-bit and address bus is 32-bit.
- It could address 4 GB of memory.

INTEL 80486

- Introduced in 1989.
  - It was also 32-bit µP.
- It had 1.2 million transistors.
- Its clock speed varied from 16 MHz to 100 MHz depending upon the various versions.

INTEL PENTIUM

- Introduced in 1993.
  - It was also 32-bit µP.
- It was originally named 80586.
- Its clock speed was 66 MHz.

Intel Pentium Pro

- Introduced in 1995.
- It was also 32-bit µP.

Intel Pentium II

- Introduced in 1997.
- It was also 32-bit µP.

Intel Pentium II Xeon

- Introduced in 1998.
  - It was also 32-bit µP.

Intel Pentium III

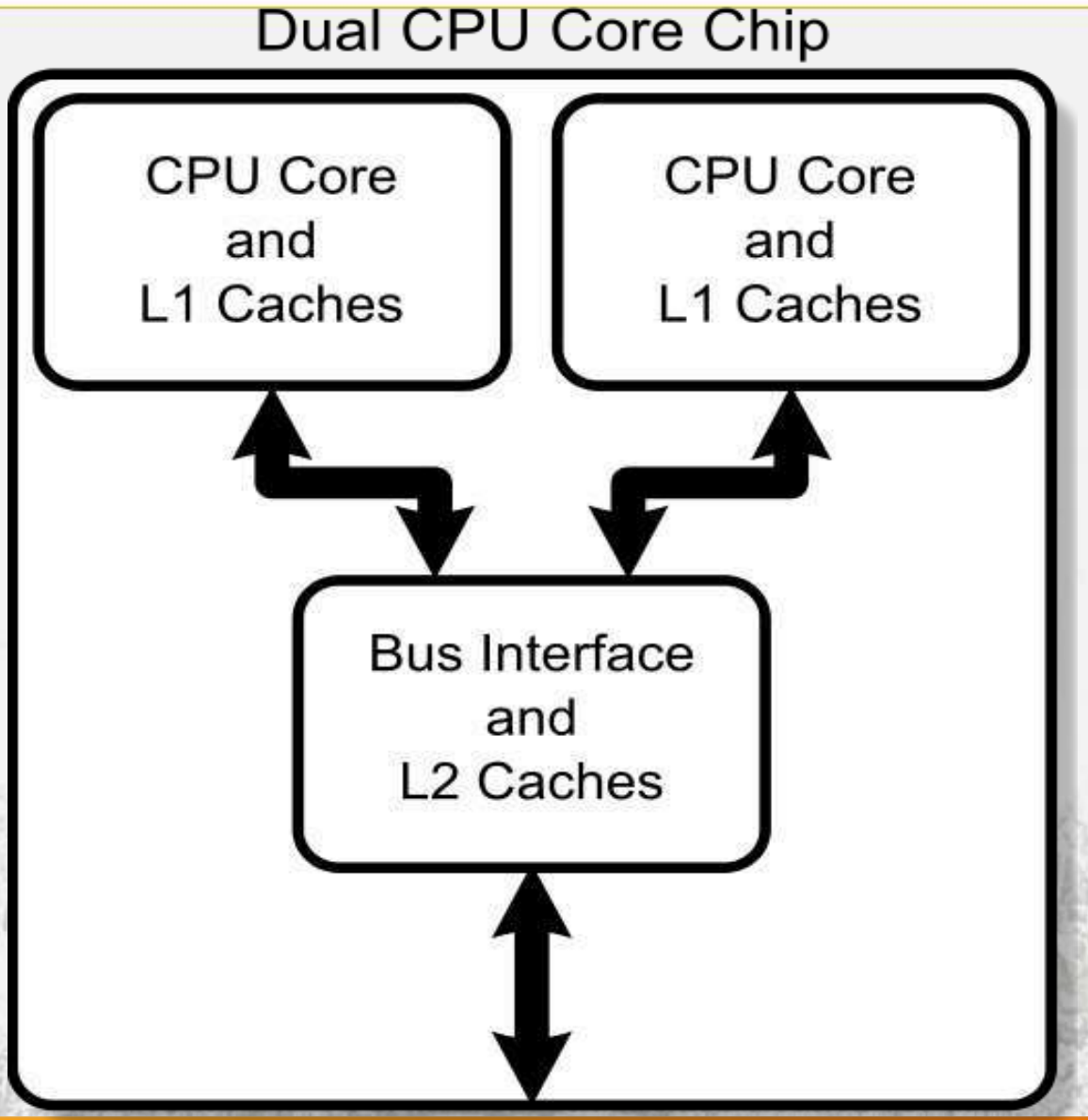
- Introduced in 1999.
- It was also 32-bit µP.

Intel Pentium IV

- Introduced in 2000.
- It was also 32-bit µP.

INTEL DUAL CORE

- Introduced in 2006.
- It is 32-bit or 64-bit µP.
- It has two cores.
- Both the cores have there own internal bus and L1 cache, but share the external bus and L2 cache


Dual CPU Core Chip
CPU Core and L1 Caches
CPU Core and L1 Caches
Bus Interface and L2 Caches

Advantages of Dual cores

Better performance

Multitasking

Energy efficiency

64-BIT MICROPROCESSORS

INTEL CORE 2

- Introduced in 2006.
  - It is a 64-bit µP.

Intel Core i7

- Introduced in 2008.
- It is a 64-bit µP.

Intel Core i5

- Introduced in 2009.
- It is a 64-bit µP.

Intel Core i3

- Introduced in 2010.
- It is a 64-bit µP.

Intel	Year	Speed of operation	Bitwise	Memory
4004	1971	750 K Hertz	4 bit	1 Kilobyte
8085	1976	3.07 Megahz	8 bit	64 Kb
8086	1982	5-10 MHz	16 bit	1 Megabyte
80286, 80386	1985	6-12 MHz, 20-33 MHz	16 bit	16 Mb
80486	1988	25-100 MHz	32 bit	4 gigabyte
pentium1	1993	60-200 MHz	32 bit	4 gb
pentium2	1997	230-400 MHz	32 bit	4-64 GB
pentium 3, 4	2000	upto 1.3 gHz, upto 1.3-1.5 gHz	32 bit	4-64 GB
Itanium	2001	upto 3 GHz	64 bit	4-128 GB

Formal structure of Microprocessors:

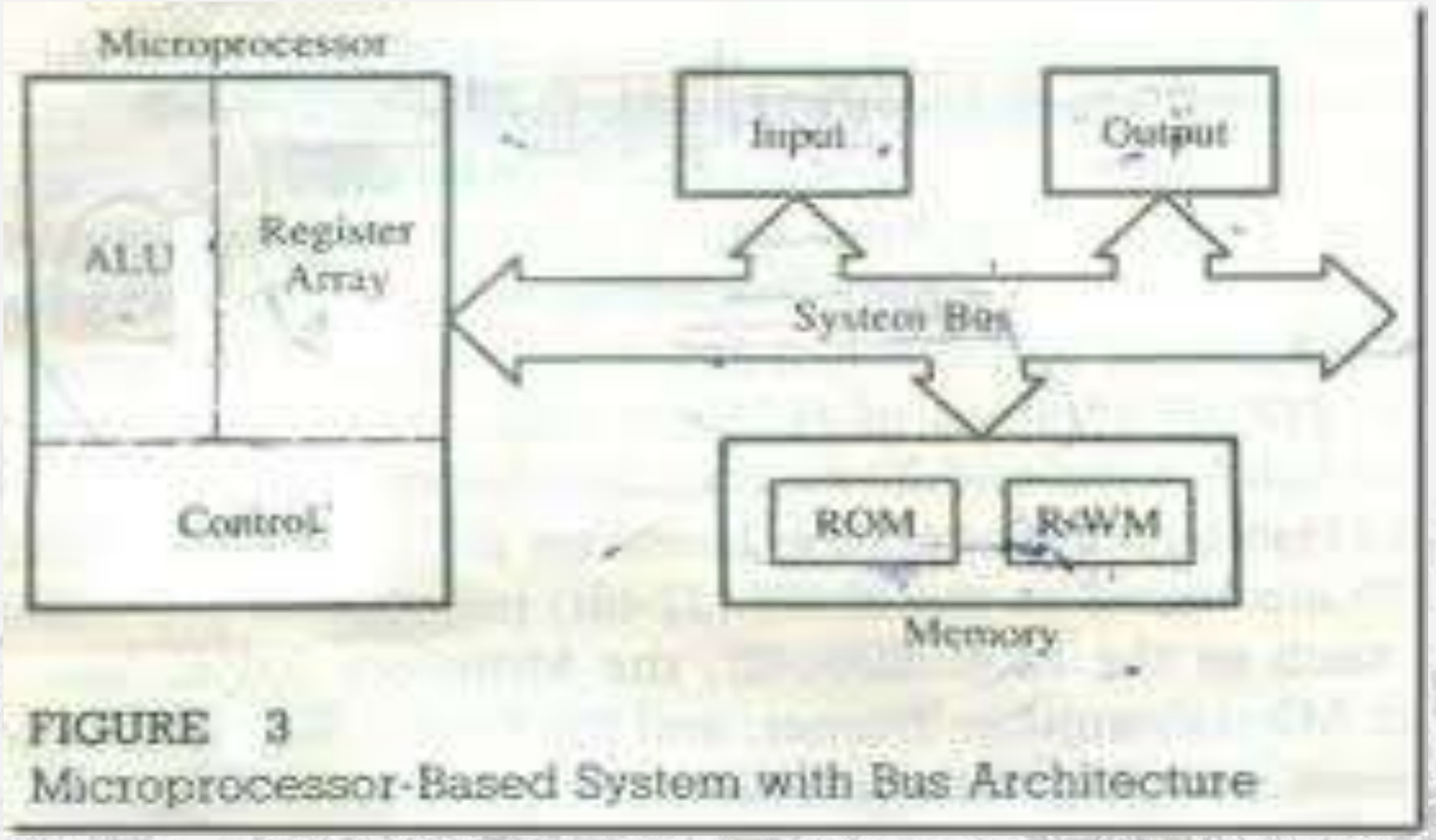


FIGURE 3
Microprocessor-Based System with Bus Architecture

- **Bit**: A bit is a single binary digit.
- **Word**: A word refers to the basic data size or bit size that can be processed by the arithmetic and logic unit of the processor. A 16-bit binary number is called a word in a 16-bit processor.
- **Bus**: A bus is a group of wires/lines that carry similar information.
- **System Bus**: The system bus is a group of wires/lines used for communication between the microprocessor and peripherals.
- **Memory Word**: The number of bits that can be stored in a register or memory element is called a memory word.
- **Address Bus**: It carries the address, which is a unique binary pattern used to identify a memory location or an I/O port. For example, an eight bit address bus has eight lines and thus it can address 28 = 256 different locations. The locations in hexadecimal format can be written as 00H – FFH.
- **Data Bus**: The data bus is used to transfer data between memory and processor or between I/O device and processor. For example, an 8-bit processor will generally have an 8-bit data bus and a 16-bit processor will have 16-bit data bus.
- **Control Bus**: The control bus carry control signals, which consists of signals for selection of memory or I/O device from the given address, direction of data transfer and synchronization of data transfer in case of slow devices.

Language of Microprocessors:

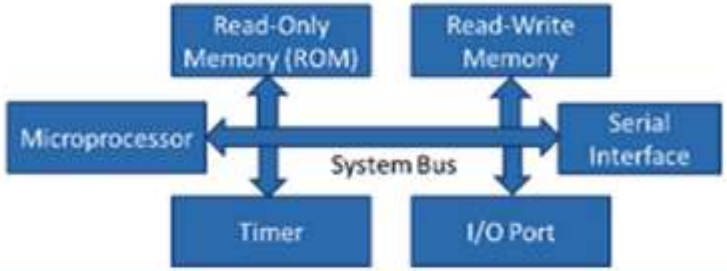
Each microprocessor has a set of instructions, a list which is provided by the microprocessor manufacturer. The instruction set of a microprocessor is provided in two forms: *binary machine code and mnemonics*.

Microprocessor communicates and operates in binary numbers 0 and 1. The set of instructions in the form of binary patterns is called a *machine language*

and it is difficult for us to understand. Therefore, the binary patterns are given abbreviated names, called mnemonics, which forms the *assembly language*.

The conversion of assembly-level language into binary machine-level language is done by using an application called *assembler.*

Microprocessors Vs Microcontroller:

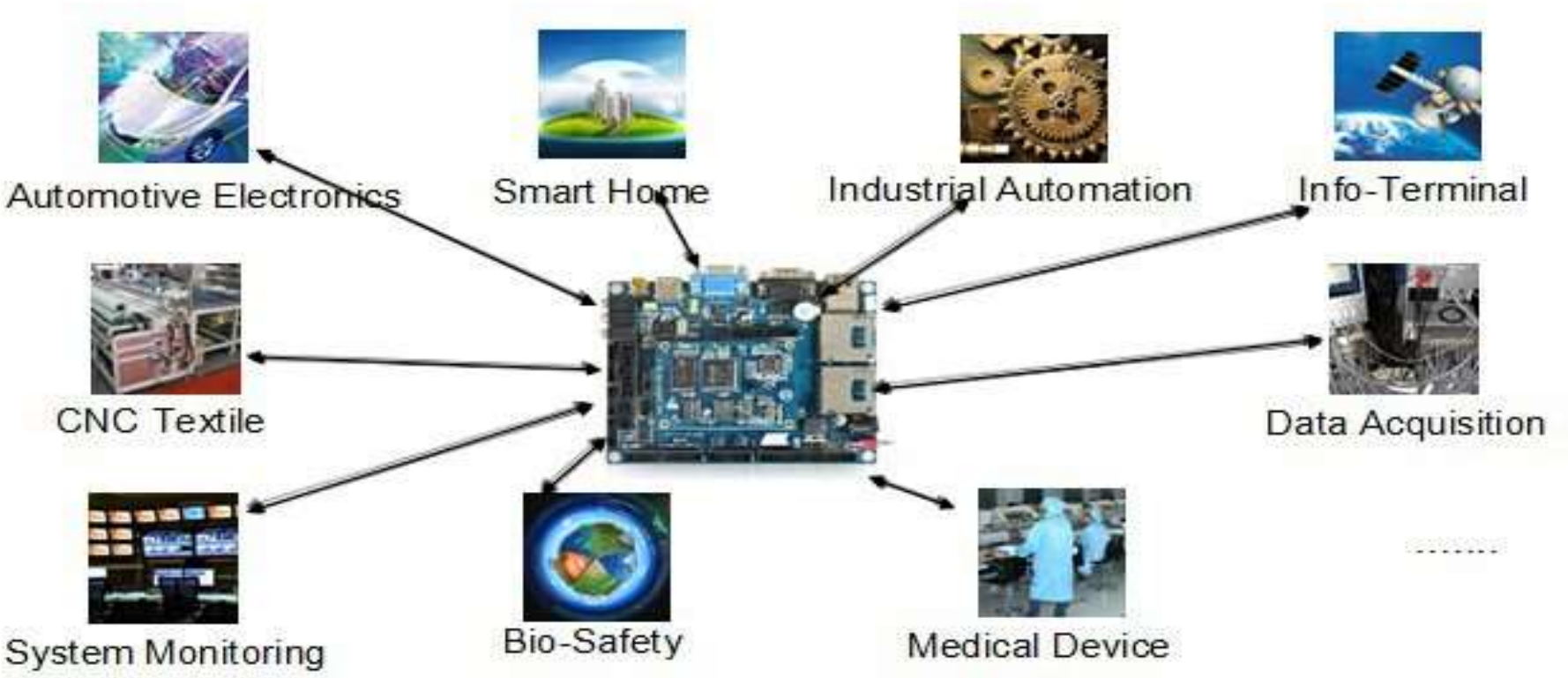
Microprocessor	Micro Controller
	
Microprocessor is heart of Computer system.	Micro Controller is a heart of embedded system.
It is just a processor. Memory and I/O components have to be connected externally	Micro controller has external processor along with internal memory and i/O components
Since memory and I/O has to be connected externally, the circuit becomes large.	Since memory and I/O are present internally, the circuit is small.
Cannot be used in compact systems and hence inefficient	Can be used in compact systems and hence it is an efficient technique
Cost of the entire system increases	Cost of the entire system is low
Due to external components, the entire power consumption is high. Hence it is not suitable to used with devices running on stored power like batteries.	Since external components are low, total power consumption is less and can be used with devices running on stored power like batteries.

Microprocessors Vs Microcontroller:

Most of the microprocessors do not have power saving features.	Most of the micro controllers have power saving modes like idle mode and power saving mode. This helps to reduce power consumption even further.
Since memory and I/O components are all external, each instruction will need external operation, hence it is relatively slower.	Since components are internal, most of the operations are internal instruction, hence speed is fast.
Microprocessor have less number of registers, hence more operations are memory based.	Micro controller have more number of registers, hence the programs are easier to write.
Microprocessors are based on von Neumann model/architecture where program and data are stored in same memory module	Micro controllers are based on Harvard architecture where program memory and Data memory are separate
Mainly used in personal computers	Used mainly in washing machine, MP3 players

Application - <<Microprocessor>>

Focus Area / Application:



Hangzhou Qiyang ------Classical Application Case:

Marine Navigator And Monitoring System; Centralized Meter Reading Terminal; On-line Data Acquisition Terminal;Human Machine Interface (HMI), etc.


Embedded Networking with RTCS
Server
Embedded Device
PDA
Broadband Modem
Internet
Printer
PC
Router


Networking
Automation
Thin clients
Bar code readers
VoIP
Instrumentation
WiFi access points
E-retail shelves
Docking stations
Imaging

THANK YOU